qooxdoo Documentation

Release 3.0

qooxdoo developers

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CHAPTER

ONE

INTRODUCTION

1.1 About

qooxdoo (pronounced ['kuksdu:]) is a universal JavaScript framework that enables you to create applications for a wide range of platforms. With its object-oriented programming model you build rich, interactive applications (RIAs), native-like apps for mobile devices, traditional web applications or even applications to run outside the browser.

You leverage its integrated tool chain to develop and deploy applications of any scale, while taking advantage of a comprehensive feature set and a state-of-the-art GUI toolkit. qooxdoo is open source under liberal licenses, run by one of the world's leading web hosts 1&1, with a vibrant community.

1.1.1 Framework

The core of qooxdoo is entirely class-based and tries to leverage the features of object-oriented JavaScript. It is largely based on namespaces to allow for easy integration with other libraries and existing user code. Most *modern browsers* are supported (e.g. Firefox, Internet Explorer, Opera, Safari, Chrome). It comes with a comprehensive API reference that is auto-generated from Javadoc-like comments. The fast and complete JavaScript parser not only allows documentation generation but is an integral part of the automatic build process that makes optimizing, compressing, linking and deployment of custom applications very user-friendly. Internationalization and localization of applications for various countries and languages is a core feature and easy to use. *More ...*

1.1.2 GUI Toolkit

Despite being a pure JavaScript framework, qooxdoo is quite on par with GUI toolkits like Qt or SWT when it comes to advanced yet easy to implement user interfaces. It offers a full-blown set of widgets that are hardly distinguishable from elements of native desktop applications. Full built-in support for keyboard navigation, focus and tab handling and drag & drop is provided. Dimensions can be specified as static, auto-sizing, stretching, percentage, weighted flex or min/max, or even as combinations of those. All widgets are based on powerful and flexible layout managers which are a key to many of the advanced layout capabilities. Interface description is done programmatically in JavaScript for maximum performance.

No HTML has to be used and augmented to define the interface. The qooxdoo developer does not even have to know CSS to style the interface. Clean and easy-to-configure themes for appearance, colors, borders, fonts and icons allow for a full-fledged styling.

1.1.3 Communication

While being a client-side and server-agnostic solution, the qooxdoo project includes different communication facilities, and supports low-level XMLHttpRequests (XHR) as well as an RPC API. An abstract transport layer supports queues,

timeouts and implementations via XHR, Iframes and Scripts. Like the rest of qooxdoo it fully supports event-based programming which greatly simplifies asynchronous communication.

1.1.4 More Information (online)

There is more information available about the project on the project's home page.

1.2 Feature Overview

A typical qooxdoo application is created by leveraging the integrated development tools and the client-side programming model based on object-oriented JavaScript. Developers can fully concentrate on creating application without worrying about low-level cross-browser issues.

1.2.1 Runtimes

- qooxdoo supports a wide range of JavaScript environments:
  - desktop browsers (Internet Explorer, Firefox, Opera, Safari, Chrome)
  - mobile browsers (iOS, Android)
  - browserless JS engines (node.js, Rhino, ...)
- No plugins required (neither ActiveX, Java, Flash nor Silverlight needed)
- Non-critical modifications of the native JavaScript objects to allow for easy integration with other libraries and custom code

1.2.2 Object-orientation

- Framework is fully based on classes
- Minimal pollution by global variables due to namespacing
- Besides regular classes, it offers abstract, static or singleton classes
- Constructors and destructors
- Public, protected and private members by naming convention, that can (partly) be enforced during development
- Single inheritance, full polymorphism
- Java-like interfaces
- Ruby-esque mixins
- So-called dynamic properties, a very convenient and powerful way to have optimized setter and getter methods generated from simple configuration

1.2.3 Programming

- Pure JavaScript
- No HTML knowledge required
- No CSS knowledge required

- No DOM knowledge required
- Complete support for event-based programming
- Development of qooxdoo applications fully supported on all platforms, e.g. Windows, Linux, all Unixes, Mac OS X
- Skeletons as pre-configured basis for full-featured custom applications
- Many sample applications and examples
- Designed for high performance
- Aid in developing memory-leak free user applications
- Extensive logging capabilities (e.g. different log appenders, Firebug support)
- Straightforward debugging (e.g. object introspection, benchmarking)
- Browser history management, i.e. browser back/forward button, bookmarks
- Cookies
- Generic JavaScript pretty printer / code formatter for unified code style
- Alternative development platforms offered by third parties

1.2.4 Internationalization

- Built-in internationalization (i18n) and localization (l10n) support
- Supporting all languages and locales, at least of this planet
- Based on the comprehensive Unicode Common Locale Data Repository (CLDR)
- Well-known translation file format (.po)
- Support by professional, free translation tools ("po editors") on all platforms

1.2.5 API reference

- Extended Javadoc-like source code comments
- Full API reference for both framework *and* custom application
- Online and offline API viewer application
- Search functionality

1.2.6 Testing

- Integrated unit testing framework *Test Runner*
- Integrated functional testing framework *Simulator*

1.2.7 Deployment

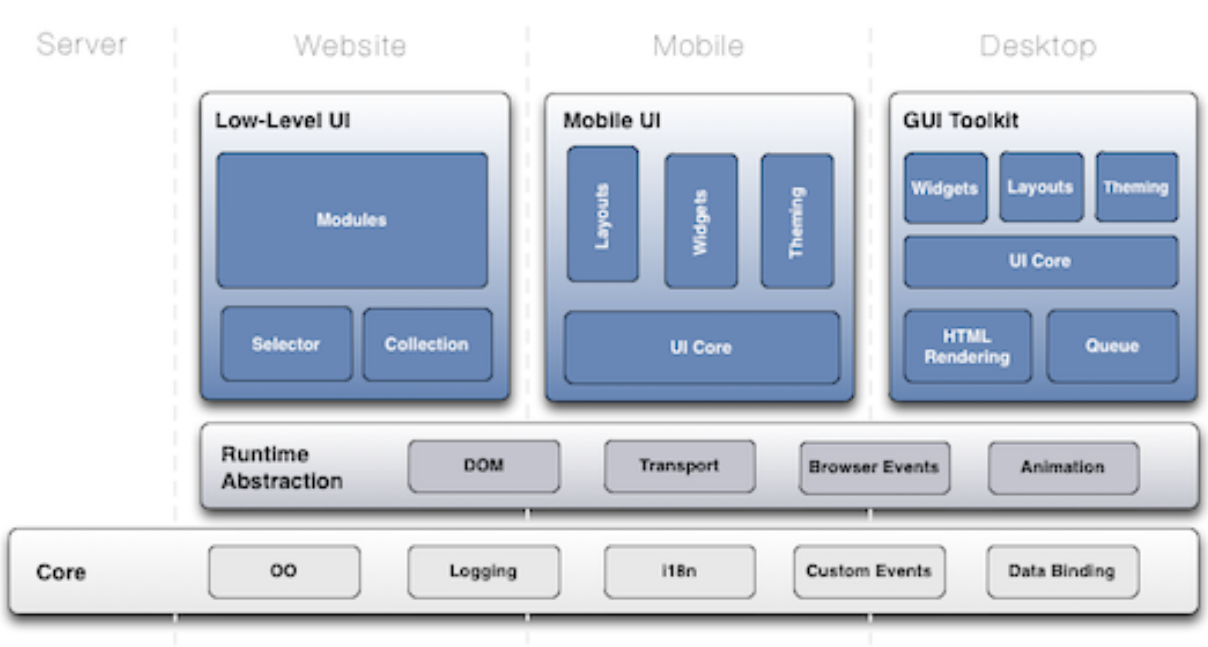
- Generation of a self-contained and easily deployable "build" version
- Complexity of the build process hidden behind user-friendly commands
- JavaScript compression (removal of whitespaces, etc.)
- Automatic dependency resolution of JavaScript classes; no need for manual "require" statements or tweaking a custom build
- Automatic linking of JavaScript classes ("JS linker")
- Copying of required static resources like images or other external files into a self-contained build
- String extraction
- Shortening and obfuscating local variables and/or private members
- Optional browser-specific variant generation for selected feature sets (e.g. Firefox-only build)
- Generation of build versions depending on user-defined variants, which allows for different products from the same code base
- Removal of debug statements within the application code before deployment

1.2.8 Migration

- Support for easy migration of custom applications from one framework release to another
- As painless as technically feasible
- Fully integrated into the regular build system
- All non-ambiguous changes are done automatically for maximum convenience and to avoid manual find/replace errors
- All ambiguous or semantic changes that require some developer decision are put into a comprehensive checklist

1.3 Architectural Overview

The following diagram tries to show the main aspects of qooxdoo and how they are organized in general. Please keep in mind that this diagram does not include all features of qooxdoo. You can see the four main areas for which qooxdoo can be used and what layers are useful in that dedicated scenario.



1.4 Getting Started

This section provides you with resources that help you pick the qooxdoo package for your needs, set it up on your local machine and get started with writing your own code.

1.4.1 qx.Website

qx.Website is a low-level package that you deploy as a single *.js* file, like you would with many other JavaScript libraries. Its contents encompasses DOM and BOM abstractions, cross-browser event handling, a selector engine, and a stripped-down version of the qooxdoo *class system*. It does not include any UI widgets. It is suitable if you basically want to manipulate DOM elements on a page.

qx.Website Requirements

Here are the requirements for developing and deploying with qooxdoo qx.Website. You will usually include the qx.Website library on an HTML page and then write code that utilizes its API.

Browsers

Code written against the qx.Website API will run in all major web browsers, particularly:

	Internet Explorer 6+
	Firefox 2+
	Opera 9+
	Safari 3+
	Chrome 2+

Installation and Setup

Download the qx.Website component from qooxdoo's download page and place it in a suitable URI reachable from your development environment. Then include this URI with a `<script>` tag in the HTML page that you are developing.

```
<html>
<head>
  <script href="<uri_of_qx.Website_download>"/>
  ...
```

That's it, you are ready to start working against the qx.Website API.

Getting Started with qooxdoo qx.Website

It's easy to start using qx.Website. Create an HTML page and `<script>`-include the qx.Website library file, then add code that uses its API. Here is a simple example:

```
<html>
  <head>
    <script href="<uri_to_qx.Website_file>"/>
  </head>
<body>
  <div>
    Hello World!
  </div>
  <script>
    alert(q("div").getHtml());
  </script>
</body>
</html>
```

1.4.2 qx.Desktop

qx.Desktop contains the full scope of qooxdoo classes and infrastructure, like the class system, low-level DOM/BOM layers, a theming system, and a rich set of UI widgets and controls. It is available through the *SDK*. It allows you to create desktop-like, interactive web applications.

qx.Desktop Requirements

Here are the requirements for developing and deploying with qx.Desktop. Applications built with it run in a web browser, so you need at least one of the supported browsers to check your work. During development time you will also need the tools from qooxdoo's SDK to create runnable versions of your application. But these tools are not necessary once you have deployed it.

The cross-browser abstraction of qooxdoo not only benefits the users of your application, it allows also you as a developer to pick your preferred development platform, i.e. combination of browser and operating system, and be confident that the result will run on all other supported platforms.

qx.Desktop does not enforce any specific backend components, any server that is reachable through its I/O layer should be fine. During development, loading your application from the file system should suffice, as long as your application logic doesn't enforce a server connection. Developers should note, though, that with some browsers, such as Chrome and Firefox, there is a known constraint when loading reasonably complex qooxdoo applications (such as the APIviewer or the Demobrowser) via the `file://` protocol. Either consult your browser's documentation (usually

there is a command-line option to change this), or use the HTTP protocol during development. In the latter case be sure to read and understand this FAQ entry.

Browsers

An application comprising of the qooxdoo runtime and custom code written against its API runs across all modern web browsers, unaltered, and with mostly identical look & feel:

	Internet Explorer 8+
	Firefox 3.6+
	Opera 12+
	Safari 4+
	Chrome

SDK

Working with qx.Desktop requires from you that you download and use qooxdoo's SDK. See here for the *SDK's requirements*, and follow its *Installation and Setup* section. This requirement applies to the development phase only, the final app is independent of the SDK.

Getting Started with qooxdoo qx.Desktop

The introduction to *qooxdoo's SDK* covers all you have to know to get going with the qx.Desktop component.

1.4.3 qx.Mobile

qx.Mobile is used to develop applications for mobile platforms, like iOS and Android.It provides specific UI elements and theming capabilities suitable for mobile devices. Like the qx.Desktop component it is available through the *SDK*.

qx.Mobile Requirements

qooxdoo qx.Mobile runs on iOS 2.0+, Android 1.6+ and Windows Mobile devices. Working with qx.Mobile requires access to such a mobile device, with a suitable mobile browser, or a mobile emulator for the respective platform that runs on your desktop PC.

SDK

Working with qx.Mobile requires downloading and using qooxdoo's SDK. See here for the *SDK's requirements*, and follow its *Installation and Setup* section. This requirement applies to the development phase only, the final app is independent of the SDK.

Mobile Browsers

The following mobile browsers are supported:

	Safari Mobile
	Chrome for Android
	Android Native Browser
	Internet Explorer 10 (Windows Phone 8, Windows RT, Windows 8)

Other mobile browsers like Opera Mini might work, but are not officially supported.

Desktop Browsers

As qooxdoo is based on web technologies, you will need a running instance of a browser (Google Chrome, Apple Safari, Mozilla Firefox or Internet Explorer) on your system to run and test the application. An iOS, Android or Windows Phone 8 device is not necessarily required.

The following desktop browsers are supported:

	Apple Safari 5+
	Google Chrome 10+
	Mozilla Firefox 10+
	Internet Explorer 10

Getting Started with qooxdoo qx.Mobile

Working with qx.Mobile requires downloading and using qooxdoo's SDK. See here for the *SDK's requirements*, and follow its *Installation and Setup* section. This requirement applies to the development phase only, the final app is independent of the SDK.

The first step is to create a mobile skeleton, by calling the `create-applicaton.py` script from the command line. Navigate to the qooxdoo folder and execute the following command:

```
./tool/bin/create-application.py --type=mobile --name=helloworld --out=..
```

A new folder "helloworld" will be created next to the qooxdoo folder, containing the mobile skeleton application. Right now the application is pretty useless, until we create the `source` version of it. Navigate to the created folder and call the qooxdoo generator with the following command:

```
./generate.py source
```

After a few seconds the generator has analyzed all class dependencies and created a source version of the application. You can test the application by opening the `source/index.html` file in your Chrome / Safari browser. You should see a page "Page 1" with a button "Next Page". When you click on the button, the next page "Page 2", with a "Back" button in the upper left corner, is displayed.

Congratulations, you have just created your first qooxdoo mobile application!

Now it is your turn. Just open `source/class/helloworld/Application.js` and enhance your cross-platform mobile application.

If you need a more detailed tutorial, please have a look at our mobiletweets tutorial:

qx.Mobile Tweets Client Tutorial

1.4.4 qx.Server

qx.Server is a library suitable for all environments that do not provide a DOM, such as Node.js and Rhino. But you can also use it to program Webworkers. With no dependencies to external APIs (like a global *window* object), you get the infrastructure of qooxdoo's classes, mixins, properties, custom events and data binding.

qx.Server Requirements

qooxdoo qx.Server is a basic component that runs in many different contexts and environments, as it has very little dependencies to the underlying runtime. For use in command-line tools and programs you will need a corresponding JavaScript interpreter like Node.js or Mozilla Rhino. For use in HTML5 Web Workers you will need a browser that supports this technology.

Runtimes

The following runtimes are supported:

- Node.js
- Rhino

Installation

These are the options to get qooxdoo qx.Server.

Manual download Download the qx.Server component from qooxdoo's download page and place it in a suitable path on your machine. Optimized and non-optimized versions are available.

Npm If you are using Node.js, there is an alternative installation using npm, the Node package manager. If you have this installed, issue on your system shell:

```
$ npm install qooxdoo
```

This will install the qooxdoo package into your current folder from where you can include it easily into your applications.

In both cases, to verify the installation use your runtime's loading primitive to include it in a program, e.g. for Node:

```
var qx = require('qooxdoo')
```

SDK You can also use the *SDK* to work with qx.Server. It provides a dedicated *skeleton* which you can utilize. This offers you additional features like dependency detection, optimization, API doc generation, unit testing and generated loaders that work under both Node.js and Rhino. As with all types of qooxdoo skeletons, `create-application.py` is used to create a new custom application:

```
$ qooxdoo-3.0-sdk/tool/bin/create-application.py --name=myapp --type=basic
```

Getting Started with qooxdoo qx.Server

On the basic level, you can just load the qx.Server module into your own program, using your runtime's loading primitives. Here is a simple example for Node.js:

```
var qx = require('qooxdoo');

qx.Class.define("Dog", {
  extend : qx.core.Object,
  members : {
    bark : function() {
      console.log("Ruff!");
    }
  }
});

var dog = new Dog();
dog.bark();
```

1.4.5 Others

- You can find some community made tutorial videos on vimeo.

CHAPTER

TWO

CORE

qooxdoo Core is not a component on its own, but encompasses central features of the qooxdoo class library. The elements described here are available in all qooxdoo components, be it Desktop, Mobile, Website or Server. Among these features are a dedicated class system with custom class properties, data binding and a runtime environment.

We recommend that you at least make your way through the chapters *Introduction to Object Orientation*, *Features of Object Orientation* and *Classes* from the *Object Orientation* section, which provide the foundation for working with qooxdoo's class system. The other chapters can be read when the need arises, and as reference material for the other components' documentation.

2.1 Object Orientation

2.1.1 Introduction to Object Orientation

qooxdoo allows you to easily leverage many key concepts of object-oriented programming without bothering about limited native support in JavaScript.

The main actors of qooxdoo OO are:

- **Classes**
- **Interfaces**
- **Mixins**

When trying to get a grip of the framework code, you should probably understand all those three concepts. As a regular application developer you often get by with ignoring interfaces and mixins when starting and just getting familiar with *classes*.

Classes

A "class" is a central concept in most object-oriented languages, and as a programmer you are certainly familiar with it. qooxdoo supports a "closed form" of class declaration, i.e. the entire declaration is provided within a `qx.Class.define(name, config)` statement, where `name` is the fully-qualified class name, and `config` is a configuration map with various keys (or "sections").

There are several types of classes available, which are specified by the `type` key within the `config` map:

- **regular class**: May contain *class* variables/methods (in a `statics` section) and *instance* variables/methods (in a `members` section). An instance of the class can be created using the `new` keyword, so a constructor needs to be given in `construct`.

- **static class**: Only contains class variables and class methods. Often a helper or utility class. Use `type : "static"`.
- **abstract class**: Does not allow an instance to be created. Typically classes derive from it and provide concrete implementations. `type` is `abstract`.
- **singleton**: Not more than a single instance of the class may exists at any time. A static method `getInstance()` returns the instance. Use `type : "singleton"`.

Interfaces

qooxdoo's interfaces are similar to the ones in Java. Similar to the declaration of class they are created by `qx.Interface.define(name, config)`. They specify an "interface" (typically a set of empty methods), that classes must implement.

Mixins

Mixins are a very practical concept that not all programming languages provide. Unlike interfaces, which require a class to provide concrete implementations to fulfill the interface contract, mixins do include code. This code needs to be generic, if it is "mixed into" different existing classes. Mixins usually cover only a single aspect of functionality and therefore tend to be small. They are declared by `qx.Mixin.define(name, config)`.

Inheritance

Like most programming languages qooxdoo only supports single-inheritance for classes, not multiple-inheritance, i.e. a class can only derive directly from a single super class. This is easily modeled by the `extend` key in the class declaration map.

Since a class may implement/include one or many interfaces/mixins, which themselves can extend others, some advanced forms of multiple-inheritance can still be realized.

qooxdoo OO standalone

If you want to use qooxdoo OO layer standalone, take a look at the *qxoo-build* generator job of the framework.

2.1.2 Features of Object Orientation

Class definition

A class is defined by providing its name as a string:

```
qx.Class.define("my.cool.Class");
```

This example only creates a trivial class `my.cool.Class`. A typical class declaration contains OO features like constructor, instance members, static members, etc. This additional information is provided as a second parameter in form of a map. Since the entire class definition is given in `qx.Class.define()`, it is called a "closed form" of class declaration:

```
qx.Class.define("my.cool.Class", {
  // declare constructor, members, ...
});
```

A regular (non-static) class can simply be instantiated using the `new` keyword:

```
var myClass = new my.cool.Class;
```

Inheritance

In order to derive the current class from another class, the reference to the super class is provided by the key `extend`:

```
qx.Class.define("my.great.SuperClass", {
  // I'm the super class
});

qx.Class.define("my.cool.Class", {
  extend : my.great.SuperClass
});
```

Constructor

The constructor of a regular class is provided as a function declaration in key `construct`:

```
qx.Class.define("my.cool.Class",
{
  extend : my.great.SuperClass,
  construct : function() {
    ...
  }
});
```

Static members

Static members (often called "class" members) are also part of the class definition and declared in a map to the `statics` key. Static *methods* are given by providing a function declaration, while all other values declare static *attributes*. Typically they are given in uppercase to distinguish them from instance members:

```
qx.Class.define("my.cool.Class",
{
  statics :
  {
    FOO : VALUE,
    BAR : function() { ... }
  }
});
```

Static members, both methods and attributes, can be accessed by using the fully-qualified class name:

```
my.cool.Class.FOO = 3.141;
my.cool.Class.BAR();
```

Note: You can use static members as constants, but the value can be changed in the run time!!

Instance Members

Similar to static members, instance members are also part of the class definition. For them the `members` key is used:

```
qx.Class.define("my.cool.Class",
{
  members:
  {
    foo : VALUE,
    bar : function() { ... }
  }
});
```

The instance members can be accessed by using an actual instance of a class:

```
var myClass1 = new my.cool.Class;
myClass1.foo = 3.141;
myClass1.bar();
```

Accessing Static Members

Generic form. Requires no updates if class name changes. This code can optionally be optimized for performance in build versions.

```
qx.Class.define("my.cool.Class",
{
  statics : {
    PI : 3.141
  },
  members : {
    circumference : function(radius) {
      return 2 * this.self(arguments).PI * radius;
    }
  }
});
```

Note: For `this.self` to be available, the class must have as a direct or indirect base class `qx.core.Object`.

Note: Static members aren't inherited. For calling a superclass static method, use `this.superclass`, like in this example:

```
qx.Class.define('A', {
  statics: {
     f: function() {}
  }
});

qx.Class.define('B'), {
  extend: A,
  members: {
     e: function() {
        this.superclass.self(arguments).f();
     }
  }
});
```

Static functions can access other static functions directly through the `this` keyword.

Calling the Superclass Constructor

Generic form. Requires no updates if super class (name) changes. This code can optionally be optimized for performance in build versions.

```
qx.Class.define("my.cool.Class",
{
  extend : my.great.SuperClass,
  construct : function(x) {
    this.base(arguments, x);
  }
});
```

Calling the Overridden Superclass Method

Generic form without using `prototype`. Requires no updates if super class (name) changes. This code can optionally be optimized for performance in build versions.

```
qx.Class.define("my.cool.Class",
{
  extend : my.great.SuperClass,
  ...
  members : {
    foo : function(x) {
      this.base(arguments, x);
    }
  }
});
```

Destructor

As a logical match to any existing constructor given by the key `construct`, a destructor is explicitly given by the `destruct` key:

```
qx.Class.define("my.cool.Class",
{
  extend : my.great.SuperClass,
  construct : function() {
    ...
  }
  destruct : function() {
    ...
  }
});
```

Properties

qooxdoo comes with a very powerful feature called dynamic *properties*. A concise declaration of an `age` property may look like the following:

```
qx.Class.define(
...
properties : {
  age: { init: 10, check: "Integer" }
```

```
}
...
```

This declaration generates not only a corresponding accessor method `getAge()` and a mutator method `setAge()`, but would allow for many more *features*.

Interfaces

A leading uppercase `I` is used as a naming convention for *interfaces*.

```
qx.Interface.define("my.cool.IInterface");
```

Mixins

Leading uppercase `M` as a naming convention. A *mixin* can have all the things a class can have, like properties, constructor, destructor and members.

```
qx.Mixin.define("my.cool.MMixin");
```

Attaching mixins to a class

The `include` key contains either a reference to an single mixin, or an array of multiple mixins:

```
qx.Class.define("my.cool.Class",
{
  include : [my.cool.MMixin, my.other.cool.MMixin]
  ...
});
```

Attaching mixins to an already defined class

```
qx.Class.include(qx.ui.core.Widget, qx.MWidgetExtensions);
```

Access

By the following naming convention. Goal is to be as consistent as possible. During the build process private members can optionally be renamed to random names in order to ensure that they cannot be called from outside the class.

```
publicMember
_protectedMember
__privateMember
```

Static classes

Explicit declaration allows for useful checks during development. For example. `construct` or `members` are not allowed for such a purely static class.

```
qx.Class.define("my.cool.Class", {
  type : "static"
});
```

Abstract classes

Declaration allows for useful checks during development and does not require explicit code.

```
qx.Class.define("my.cool.Class", {
  type : "abstract"
});
```

Singletons

Declaration allows for useful checks during development and does not require explicit code. A method `getInstance()` is added to such a singleton class.

```
qx.Class.define("my.cool.Class",
{
  type : "singleton",
  extend :  my.great.SuperClass
});
```

Immediate access to previously defined members

The closed form of the class definition does not allow immediate access to other members, as they are part of the configuration data structure themselves. While it is typically not a feature used very often, it nonetheless needs to be supported by the new class declaration. Instead of some trailing code outside the closed form of the class declaration, an optional `defer` method is called after the other parts of the class definition have been finished. It allows access to all previously declared `statics`, `members` and dynamic `properties`.

Note: If the feature of accessing previously defined members is not absolutely necessary, `defer` **should not be used** in the class definition. It is missing some important capabilities compared to the regular members definition and it cannot take advantage of many crucial features of the build process (documentation, optimization, etc.).

```
qx.Class.define("my.cool.Class",
{
  statics:
  {
    driveLetter : "C"
  },
  defer: function(statics, members, properties)
  {
    statics.drive = statics.driveLetter + ":\\";
    members.whatsTheDrive = function() {
      return "Drive is " + statics.drive;
    };
  }
});
```

Browser specific methods

To maintain the closed form, browser switches on method level is done using *environment settings*. Since the generator knows about environment settings it is (optionally) possible to only keep the code for each specific browser and remove the implementation for all other browsers from the code and thus generate highly-optimized browser-specific builds. It is possible to use an logical "or" directly inside a environment key. If none of the keys matches the variant, the "default" key is used:

```
members:
{
  foo: qx.core.Environment.select("engine.name",
  {
    "mshtml|opera": function() {
       // Internet Explorer or Opera
    },
    "default": function() {
       // All other browsers
    }
  })
}
```

Events

qooxdoo's class definition has a special `events` key. The value of the key is a map, which maps each distinct event name to the name of the event class whose instances are passed to the event listeners. The event system can now (optionally) check whether an event type is supported by the class and issue a warning if an event type is unknown. This ensures that each supported event must be listed in the event map.

```
qx.Class.define("my.eventful.Class",
{
  extend: qx.core.Target,

  events :
  {
    /**  Fired when the widget is clicked. */
    "click": "qx.event.type.MouseEvent"
  }
  ...
})
```

2.1.3 Classes

qooxdoo's class definition is a concise and compact way to define new classes. Due to its closed form the JavaScript code that handles the actual class definition already "knows" all parts of the class at definition time. This allows for many useful checks during development as well as clever optimizations during the build process.

Declaration

Here is the most basic definition of a regular, non-static class `qx.test.Cat`. It has a constructor so that instances can be created. It also needs to extend some existing class, here we take the root class of all qooxdoo classes:

```
qx.Class.define("qx.test.Cat", {
  extend: qx.core.Object,
  construct : function() { /* ... */ }
});
```

As you can see, the `define()` method takes two arguments, the fully-qualified name of the new class, and a configuration map that contains a varying number of predefined keys and their values.

An instance of this class is created and its constructor is called by the usual statement:

```
var kitty = new qx.test.Cat;
```

Members

Members of a class come in two flavors:

- Class members (also called "static" members) are attached to the class itself, not to individual instances
- Instance members are attached to each individual instance of a class

Class Members

A static member of a class can be one of the following:

- Class Variable
- Class Method

In the `Cat` class we may attach a class variable `LEGS` (where uppercase notation is a common coding convention) and a class method `makeSound()`, both in a `statics` section of the class declaration:

```
qx.Class.define("qx.test.Cat", {
  /* ... */
  statics : {
    LEGS: 4,
    makeSound : function() { /* ... */ }
  }
});
```

Accessing those class members involves the fully-qualified class name:

```
var foo = qx.test.Cat.LEGS;
alert(qx.test.Cat.makeSound());
```

Instance Members

An instance member of a class can be one of the following:

- Instance Variable
- Instance Method

They may be defined in the `members` section of the class declaration:

```
qx.Class.define("qx.test.Cat", {
  ...
  members: {
    name : "Kitty",
    getName: function() { return this.name }
  }
});
```

Accessing those members involves an instance of the class:

```
var kitty = new qx.test.Cat;
kitty.name = "Sweetie";
alert(kitty.getName());
```

Primitive Types vs. Reference Types There is a fundamental JavaScript language feature that could lead to problems, if not properly understood. It centers around the different behavior in the assignment of JavaScript's two data types (*primitive types* vs. *reference types*).

Note: Please make sure you understand the following explanation to avoid possible future coding errors.

Primitive types include `Boolean`, `Number`, `String`, `null` and the rather unusual `undefined`. If such a primitive type is assigned to an instance variable in the class declaration, it behaves as if each instance had a copy of that value. They are never shared among instances.

Reference types include all other types, e.g. `Array`, `Function`, `RegExp` and the generic `Object`. As their name suggests, those reference types merely point to the corresponding data value, which is represented by a more complex data structure than the primitive types. If such a reference type is assigned to an instance variable in the class declaration, it behaves as if each instance just pointed to the complex data structure. All instances share the same value, unless the corresponding instance variable is assigned a different value.

Example: If an instance variable was assigned an array in the class declaration, any instance of the class could (knowingly or unknowingly) manipulate this array in such a way that each instance would be affected by the changes. Such a manipulation could be pushing a new item into the array or changing the value of a certain array item. All instances would share the array.

You have to be careful when using complex data types in the class declaration, because they are shared by default:

```
members:
{
  foo: [1, 2, 4]   // all instances would start to share this data structure
}
```

If you do *not* want that instances share the same data, you should defer the actual initialization into the constructor:

```
construct: function()
{
  this.foo = [1, 2, 4];   // each instance would get assigned its own data structure
},
members:
{
  foo: null   // to be initialized in the constructor
}
```

Access

In many object-oriented classes a concept exists that is referred to as "access" or "visibility" of members (well, or even classes, etc.). Based on the well-known access modifiers of Java, the following three types exist for qooxdoo members:

- *public*: To be accessed from any class/instance
- *protected*: To be accessed only from derived classes or their instances
- *private*: To be accessed only from the defining class/instance

Unfortunately, JavaScript is very limited in *enforcing* those protection mechanisms. Therefore, the following coding convention is to be used to declare the access type of members:

- *public*: members may *not* start with an underscore
- *protected*: members start with a single underscore _
- *private*: members start with a double underscore __

There are some possibilities to enforce or at least check the various degrees of accessibility:

- automatic renaming of private members in the build version could trigger errors when testing the final app
- checking instance of `this` in protected methods
- ...

Special Types of Classes

Besides a "regular" class there is built-in support for the following special types:

Static Classes A static class is not instantiated and only contains static members. Setting its type to `static` makes sure only such static members, no constructor and so on are given in the class definition. Otherwise error messages are presented to the developer:

```
qx.Class.define("qx.test.Cat", {
  type : "static"
  ...
});
```

Abstract Classes An abstract class may not be instantiated. It merely serves as a superclass that needs to be derived from. Concrete classes (or concrete members of such derived classes) contain the actual implementation of the abstract members. If an abstract class is to be instantiated, an error message is presented to the developer.

```
qx.Class.define("qx.test.Cat", {
  type : "abstract"
  ...
});
```

Singletons The singleton design pattern makes sure, only a single instance of a class may be created. Every time an instance is requested, either the already created instance is returned or, if no instance is available yet, a new one is created and returned. Requesting the instance of such a singleton class is done by using the `getInstance()` method.

```
qx.Class.define("qx.test.Cat", {
  type : "singleton"
  ...
});
```

Inheritance

Single Inheritance

JavaScript supports the concept of single inheritance. It does not support (true) multiple inheritance like C++. Most people agree on the fact that such a concept tends to be very complex and error-prone. There are other ways to shoot you in the foot. qooxdoo only allows for single inheritance as well:

```
qx.Class.define("qx.test.Cat", {
  extend: qx.test.Animal
});
```

Multiple Inheritance

Not supported. There are more practical and less error-prone solutions that allow for typical features of multiple inheritance: Interfaces and Mixins (see below).

Polymorphism (Overriding)

qooxdoo does, of course, allow for polymorphism, that is most easily seen in the ability to override methods in derived classes.

Calling the Superclass Constructor It is hard to come up with an appealing syntax and efficient implementation for calling the superclass constructor from the constructor of a derived class. You simply cannot top Java's `super()` here. At least there is some generic way that does not involve to use the superclass name explicitly:

```
qx.Class.define("qx.test.Cat", {
  extend: qx.test.Animal,
  construct: function(x) {
    this.base(arguments, x);
  }
});
```

Unfortunately, to mimic a `super()` call the special variable `arguments` is needed, which in JavaScript allows a context-independent access to the actual function. Don't get confused by its name, you would list your own arguments just afterwards (like the `x` in the example above).

`this.base(arguments, x)` is internally mapped to `arguments.callee.base.call(this, x)` (The *.base* property is maintained for every method through qooxdoo's class system). The latter form can be handled by JavaScript natively, which means it is quite efficient. As an optimization during the build process such a rewrite is done automatically for your deployable application.

Calling an Overridden Method Calling an overridden superclass method from within the overriding method (i.e. both methods have the same name) is similar to calling the superclass constructor:

```
qx.Class.define("qx.test.Cat", {
  extend: qx.test.Animal,
  members: {
    makeSound : function() {
      this.base(arguments);
    }
  }
});
```

Calling the Superclass Method or Constructor with all parameters This variant allows to pass all the parameters (unmodified):

```
qx.Class.define("qx.test.Animal", {
  members: {
    makeSound : function(howManyTimes) {
        ....
    }
  }
});

qx.Class.define("qx.test.Cat", {
```

```
  extend: qx.test.Animal,
  members: {
    makeSound : function() {
      this.debug("I'm a cat");
      /* howManyTimes or any other parameter are passed.  We don't need to know how many parameters a
      arguments.callee.base.apply(this, arguments);
    }
  }
});
```

Calling another Static Method Here is an example for calling a static member without using a fully-qualified class name (compare to `this.base(arguments)` above):

```
qx.Class.define("qx.test.Cat", {
  extend: qx.test.Animal,
  statics : {
    someStaticMethod : function(x) {
      ...
    }
  },
  members: {
    makeSound : function(x) {
      this.constructor.someStaticMethod(x);
    }
  }
});
```

The syntax for accessing static variables simply is `this.constructor.someStaticVar`. Please note, for `this.constructor` to be available, the class must be a derived class of `qx.core.Object`, which is usually the case for regular, non-static classes.

Instead of `this.constructor` you can also use the alternative syntax `this.self(arguments)`.

In purely static classes for calling a static method from another static method, you can directly use the `this` keyword, e.g. `this.someStaticMethod(x)`.

Usage of Interfaces and Mixins

Implementing an Interface

The class system supports *Interfaces*. The implementation is based on the feature set of Java interfaces. Most relevant features of Java-like interfaces are supported. A class can define which interface or multiple interfaces it implements by using the `implement` key:

```
qx.Class.define("qx.test.Cat", {
  implement : [qx.test.IPet, qx.test.IFoo]
});
```

Including a Mixin

Unlike interfaces, *Mixins* do contain concrete implementations of methods. They borrow some ideas from Ruby and similar scripting languages.

Features:

- Add mixins to the definition of a class: All members of the mixin are added to the class definition.
- Add a mixin to a class after the class is defined. Enhances the functionality but is not allowed to overwrite existing members.
- Patch existing classes. Change the implementation of existing methods. Should normally be avoided but, as some projects may need to patch qooxdoo, we better define a clean way to do so.

The concrete implementations of mixins are used in a class through the key `include`:

```
qx.Class.define("qx.test.Cat", {
  include : [qx.test.MPet, qx.test.MSleep]
});
```

Summary

Configuration

Key	Type	Description
type	String	Type of the class. Valid types are `abstract`, `static` and `singleton`. If unset it defaults to a regular non-static class.
extend	Class	The super class the current class inherits from.
implement	Interface | Interface[]	Single interface or array of interfaces the class implements.
include	Mixin | Mixin[]	Single mixin or array of mixins, which will be merged into the class.
construct	Function	The constructor of the class.
statics	Map	Map of static members of the class.
properties	Map	Map of property definitions. For a description of the format of a property definition see qx.core.Property.
members	Map	Map of instance members of the class.
environment	Map	Map of settings for this class. For a description of the format of a setting see qx.core.Environment.
events	Map	Map of events the class fires. The keys are the names of the events and the values are the corresponding event type class names.
defer	Function	Function that is called at the end of processing the class declaration. It allows access to the declared statics, members and properties.
destruct	Function	The destructor of the class.

References

- *Class Declaration Quick Ref* - a quick syntax overview
- API Documentation for Class

2.1.4 Interfaces

qooxdoo supports Java like interfaces.

Interface definitions look very similar to normal class definitions.

Example:

```
qx.Interface.define("qx.test.ISample",
 {
   extend: [SuperInterfaces],

   properties: {"color": {}, "name": {} },

   members:
   {
     meth1: function() {},
     meth2: function(a, b) {
       this.assertArgumentsCount(arguments, 2, 2);
     },
     meth3: function(c) {
       this.assertInterface(c, qx.some.IInterface);
     }
   },

   statics:
   {
     PI : 3.14
   },

   events :
   {
     keydown : "qx.event.type.KeyEvent"
   }
});
```

Definition

Interfaces are declared using `qx.Interface.define`. Interface names start by convention with an `I` (uppercase "i"). They can inherit from other interfaces using the `extend` key. Multiple inheritance of interfaces is supported.

Properties

Properties in interfaces state that each class implementing this interface must have a property of the given name. The *property definition* is not evaluated and may be empty.

Members

The member section of the interface lists all member functions which must be implemented. The function body is used as a precondition of the implementation. By implementing an interface the qooxdoo class definition automatically wraps all methods required by the interface. Before the actual implementation is called, the precondition of the interface is called with the same arguments. The precondition should raise an exception if the arguments are don't meet the expectations. Usually the methods defined in qx.core.MAssert are used to check the incoming parameters.

Statics

Statics behave exactly like statics defined in mixins and qooxdoo classes, with the different that only constants are allowed. They are accessible through their fully-qualified name. For example, the static variable `PI` could be used like this:

```
var a = 2 * qx.test.ISample.PI * (r*r);
```

Events

Each event defined in the interface must be declared in the implementing classes. The syntax matches the `events` key of the class declaration.

Implementation

With `implement` key of the class declaration, a list of interfaces can be listed, which the class implements. The class must implement all properties, members and events declared in the interfaces. Otherwise a runtime error will be thrown.

Example:

```
qx.Class.define("qx.test.Sample",
 {
   implement: [qx.test.ISample],

   properties: {
     "color": { check: "color"},
     "name": { check: "String"}
   },

   members:
   {
     meth1: function() { return 42; },
     meth2: function(a, b) { return a+b },
     meth3: function(c) { c.foo() }
   }

   events :
   {
     keydown : "qx.event.type.KeyEvent"
   }

});
```

Validation

`qx.Class` contains several static methods to check, whether a class or an object implements an interface:

- `qx.Class.hasInterface()`: Whether a given class or any of its superclasses includes a given interface.
- `qx.Class.implementsInterface()`: Checks whether all methods defined in the interface are implemented in the class. The class does not need to implement the interface explicitly.

It is further possible to use interfaces as property checks.

Summary

Configuration

Key	Type	Description
extend	Interface | Interface[]	Single interface or array of interfaces this interface inherits from.
members	Map	Map of members of the interface.
statics	Map	Map of statics of the interface. The statics will not get copied into the target class. This is the same behavior as statics in mixins.
properties	Map	Map of properties and their definitions.
events	Map	Map of event names and the corresponding event class name.

References

- *Interfaces Quick Ref* - a syntax quick reference for interfaces
- API Documentation for Interface

2.1.5 Mixins

Mixins are collections of code and variables, which can be merged into other classes. They are similar to classes but can not be instantiated. Unlike interfaces they do contain implementation code. Typically they are made up of only a few members that allow for a generic implementation of some very specific functionality.

Mixins are used to share functionality without using inheritance and to extend/patch the functionality of existing classes.

Definition

Example:

```
qx.Mixin.define("name",
{
  include: [SuperMixins],

  properties: {
    "tabIndex": {check: "Number", init: -1}
  },

  members:
  {
    prop1: "foo",
    meth1: function() {},
    meth2: function() {}
  }
});
```

Usage

Here a short example to see, how to use mixins (`MMixinA`, `MMixinB`) with a class (`ClassC`).

The first mixin:

```
qx.Mixin.define("demo.MMixinA",
{
  properties: {
    "propertyA":
    {
      check: "String",
      init: "Hello, I'm property A!\n"
    }
  },

  members:
  {
    methodA: function() {
      return "Hello, I'm method A!\n";
    }
  }
});
```

The second mixin:

```
qx.Mixin.define("demo.MMixinB",
{
  properties: {
    "propertyB":
    {
      check: "String",
      init: "Hello, I'm property B!\n"
    }
  },

  members:
  {
    methodB: function() {
      return "Hello, I'm method B!\n";
    }
  }
});
```

The usage in the class:

```
qx.Class.define("demo.ClassC",
{
  extend : qx.core.Object,

  include : [demo1.MMixinA, demo1.MMixinB],

  members :
  {
    methodC : function() {
      return this.getPropertyA() + this.methodA()
        + this.getPropertyB() + this.methodB()
        + "Nice to meet you. Thanks for your help!";
    }
```

```
  }
});
```

The result is when calling the method `methodC()` of `ClassC`:

```
var classC = new demo.ClassC;
var result = classC .methodC();
/*
 * Result:
 * Hello, I'm property A!
 * Hello, I'm method A!
 * Hello, I'm property B!
 * Hello, I'm method B!
 * Nice to meet you. Thanks for your help!
 */
```

Summary

Configuration

Key	Type	Description
include	Mixin or Mixin[]	Single mixin or array of mixins, which will be merged into the mixin.
construct	Function	An optional mixin constructor. It is called when instantiating a class that includes this mixin.
destruct	Function	An optional mixin destructor.
statics	Map	Map of static members of the mixin. The statics will not get copied into the target class. They remain accessible from the mixin. This is the same behaviour as for statics in interfaces
members	Map	Map of members of the mixin.
properties	Map	Map of *property definitions*.
events	Map	Map of events the mixin fires. The keys are the names of the events and the values are the corresponding event type classes.

References

- *Mixin Quick Ref* - a quick syntax reference for mixins
- API Documentation for Mixin

2.2 Properties

2.2.1 Introduction to Properties

qooxdoo comes with its own convenient and sophisticated property management system. In order to understand its power we will first take a look at the ordinary property handling in plain JavaScript first.

Ordinary Property Handling

Let's say we have a property `width` for an object `obj`.

As is a good practice in regular high-level programming languages you should not access object properties directly:

```
// NOT RECOMMENDED: direct access to properties
obj.width = 200;  // setting a value
var w = obj.width;  // getting the current value
```

Instead you should work with properties only through so-called *accessor methods* ("getters") and *mutator methods* ("setters"):

```
// direct access is no good practice
obj.setWidth(200);  // setting a value
var w = obj.getWidth();  // getting the current value
```

Of course, directly accessing properties may be faster because no indirection by a function call is needed. Nonetheless, in practice this does not outweigh the disadvantages. Direct access to properties does not hide internal implementation details and is a less maintainable solution (Well, you don't program web applications in assembler code, do you?).

A typical implementation of the accessor and mutator methods would look like the following, where those instance methods are declared in the `members` section of the class definition:

```
// ordinary example #1
members:
{
  getWidth : function() {
    return this._width;
  },

  setWidth : function(width)
  {
    this._width = width;
    return width;
  }
}
```

Something that is very familiar to the typical programmer of Java or any other comparable language. Still, it is not very convenient. Even this trivial implementation of only the basic feature requires a lot of keystrokes. More advanced features like type checks, performance optimizations, firing events for value changes, etc. need to be coded by hand. An improved version of the setter could read:

```
// ordinary example #2
members:
{
  setWidth : function(width)
  {
    if (typeof width != "number") {
      // Type check: Make sure it is a valid number
      throw new Error("Invalid value: Need a valid integer value: " + width);
    };

    if (this._width != width)
    {
      // Optimization: Only set value, if different from the existing value
      this._width = width;

      // User code that should be run for the new value
      this.setStyleProperty("width", width+ "px");
```

```
    };

    return width;
  }
}
```

Large part of the code found here is for managing the validation and storage of the incoming data. The property-specific user code is rather short.

qooxdoo Property Handling

Let's see how the above example can be written using qooxdoo's property implementation. The property itself is declared in the `properties` section of the class definition. Only if some property-specific code needs to be run in the setter, an additional `apply` method has to be given:

```
// qooxdoo version of ordinary example #2
properties : {
  width : { check : "Number", apply : "applyWidth" }
}

members :
{
  applyWidth : function(value) {
    this.setStyleProperty("width", value + "px");
  }
}
```

Compare that to the lengthy code of the ordinary code example above! Much shorter and nicer, also by objective means. And it almost only contains the "real code".

The apply method may optionally be defined for each property you add to your class. As soon as you define a key "apply" in your property declaration map the method gets automatically called on each property modification (but not during initial initialization). If you do not define an apply method, the property just handles the fundamental storage of your data and its disposal.

Despite needing much less explicit code (keep in mind, for *every* property), it actually contains at least as many features as the hand-tuned code: The type of the property is checked automatically (`Number` in the example above). Moreover, new values are only stored (and the optional apply method called) if different from the existing values. A tiny but important optimization.

Change Events

qooxdoo supports full-featured event-based programming throughout the framework. So-called *change events* are a good example for this powerful concept.

Each property may optionally behave as an observable. This means it can send out an event at any time the property value changes. Such a change event (an instance of `qx.event.type.Data`) is declared by providing a custom name in the `event` key of the property definition. While you are free to choose any event name you like, the qooxdoo framework tries to consistently use the naming convention `"change + Propertyname"`, e.g. `"changeWidth"` for a change of property `width`. In order to get notified of any value changes, you simply attach an event listener to the object instance containing the property in question.

For example, if you would like the `element` property of a Widget instance `widget` to fire an event named `"changeElement"` any time the value changes.

```
properties : {
  element: { event: "changeElement" }
}
```

If this happens, you would like to set the DOM element's content:

```
widget.addEventListener("changeElement", function(e) {
  e.getValue().innerHTML = "Hello World";
});
```

The anonymous function acts as an event handler that receives the event object as variable `e`. Calling the predefined method `getValue()` returns the new value of property `element`.

Available Methods

qooxdoo's dynamic properties not only make sure that all properties behave in a consistent way, but also guarantee that the API to access and manipulate properties are identical. The user is only confronted with a single interface, where the method names are easy to understand. Each property creates (at least) the following set of methods:

- `setPropertyName()`: Mutator method ("setter") to set a new property value.
- `getPropertyName()`: Accessor method ("getter") that returns the current value.

Additionally, all properties of boolean type (declared by `check: "Boolean"`) provide the following convenience methods:

- `isPropertyName()`: Identical to `getPropertyName()`.
- `togglePropertyName()`: Toggles between true and false.

Property Groups

Property groups is a layer above the property system explained in the last paragraphs. They make it possible to set multiple values in one step using one `set` call. `qx.ui.core.Widget` supports the property group `padding`. `padding` simply sets the `paddingLeft`, `paddingRight`, `paddingTop` and `paddingBottom` property.

```
widget.setPadding(10, 20, 30, 40);
```

The result is identical to:

```
widget.setPaddingTop(10);
widget.setPaddingRight(20);
widget.setPaddingBottom(30);
widget.setPaddingLeft(40);
```

As you can see the property groups are a nice really convenient feature.

Shorthand support

One more thing. The property group handling also supports some CSS like magic like the shorthand mode for example. This means that you can define only some edges in one call and the others get filled automatically:

```
// four arguments
widget.setPadding(top, right, bottom, left);

// three arguments
widget.setPadding(top, right+left, bottom);
```

```
// two arguments
widget.setPadding(top+bottom, right+left);

// one argument
widget.setPadding(top+right+bottom+left);
```

As you can see this can also reduce the code base and make it more user-friendly.

BTW: The values of a property group can also be given an array as first argument e.g. these two lines work identically:

```
// arguments list
widget.setPadding(10, 20, 30, 40);

// first argument as array
widget.setPadding([10, 20, 30, 40]);
```

Note: For more information regarding declaration, usage and internal functionality please see the *the developer documentation*.

2.2.2 Properties in more detail

Note: Please take a look at *Property features summarized* first to get an compact overview of the available features.

Declaration

The following code creates a property `myProperty` and the corresponding functions like `setMyProperty()` and `getMyProperty()`.

```
qx.Class.define(
...
properties : {
  myProperty : { nullable : true }
}
...
```

You should define at least one of the attributes `init`, `nullable` or `inheritable`. Otherwise, the first call to the getter would stop with an exception because the computed value is not (yet) defined.

Note: As an alternative to the `init` key you could set the init value of the property by calling an initializing function `this.initMyProperty(value)` in the constructor. See below for details.

Please also have a look at the *Quick Reference*.

Handling changes of property values

You have multiple possibilities to react on each property change. With *change* the modification of a property is meant, where the old and the new values differ from each other.

As a class developer the easiest solution with the best performance is to define an apply method. As a user of a class (the one who creates instances) it is the best to simply attach an event listener to the instance, if such an corresponding event is provided in the property declaration.

Defining an apply method

To attach an apply method you must add a key `apply` to your configuration which points to a name of a function which needs to be available in your `members` section. As the apply method normally should not be called directly, it is always a good idea to make the method at least protected by prefixing the name with an underscore _.

The return value of the apply method is ignored. The first argument is the actual value, the second one is the former or old value. The last argument is the name of the property which can come very handy if you use one apply method for more than one property. The second and third arguments are optional and may be left out.

Example

```
properties : {
  width : { apply : "_applyWidth" }
},

members :
{
  _applyWidth : function(value, old, name) {
    // do something...
  }
}
```

The applying method is only called when the value has changed.

Note: When using reference data types like `Object` or `Array` the apply method is **always** called, since these are different objects and indeed different values. This is JavaScript functionality and not qooxdoo specific.

For a more technical description, take a look at the API documentation of qx.core.Property

Providing an event interface

For the users of a class it is in many cases a nice idea to also support an event to react on property changes. The event is defined using the `event` key where the value is the name of the event which should be fired.

qooxdoo fires a `qx.event.type.Data` which supports the methods `getData()` and `getOldData()` to allow easy access to the new and old property value, respectively.

Note: Events are only useful for public properties. Events for protected and private properties are usually not a good idea.

Example

```
properties : {
  label : { event : "changeLabel" }
}
...
// later in your application code:
obj.addListener("changeLabel", function(e) {
  alert(e.getData());
});
```

Init values

Init values are supported by all properties. These values are stored separately by the property engine. This way it is possible to fallback to the init value when property values are being reset.

Defining an init value

There are two ways to set an init value of a property.

Init value in declaration The *preferred* way for regular init values is to simply declare them by an `init` key in the property configuration map. You can use this key standalone or in combination with `nullable` and/or `inheritable`.

```
properties : {
  myProperty : { init : "hello" }
}
```

Init value in constructor Alternatively, you could set the init value of the property in the constructor of the class. This is only recommended for cases where a declaration of an init value as explained above is not sufficient.

Using an initializing function `this.initMyProperty(value)` in the constructor would allow you to assign complex non-primitive types (so-called "reference types" like `Array`, `Object`) that should not be shared among instances, but be unique on instance level.

Another scenario would be to use a localizable init value when *internationalizing your application*: Because `this.tr()` cannot be used in the property definition, you may either use the static `qx.locale.Manager.tr()` there instead, or use `this.tr()` in the call of the initializing function in the constructor.

Note: You need to add a `deferredInit:true` to the property configuration to allow for a deferred initialization for reference types as mentioned above.

```
qx.Class.define("qx.MyClass", {
  construct: function() {
    this.initMyProperty([1, 2, 4, 8]);
  },
  properties : {
    myProperty : { deferredInit : true}
  }
};
```

Applying an init value

It is possible to apply the init value using an user-defined apply method. To do this call the init method `this.initMyProperty(value)` somewhere in your constructor - this "change" will than trigger calling the apply method. Of course, this only makes sense in cases where you have at least an `apply` or `event` entry in the property definition.

If you do not use the init method you must be sure that the instances created from the classes are in a consistent state. The getter will return the init value even if not initialized. This may be acceptable in some cases, e.g. for properties without `apply` or `event`. But there are other cases, where the developer needs to be carefully and call the init method because otherwise the getter returns wrong information about the internal state (due to an inconsistency between init and applied value).

Like calling the `this.initMyProperty(value)` method itself, you could call the setter and use the defined init value as parameter. This will call the apply method, not like in the usual cases when setting the same value which is already set.

```
construct : function()
{
  this.base(arguments);

  this.setColor("black"); // apply will be invoked
  this.setColor("black"); // apply will NOT be invoked
},

properties :
{
  color :
  {
    init : "black",
    apply : "_applyColor"
  }
},

members :
{
  _applyColor : function(value, old) {
    // do something...
  }
}
```

This example illustrates how the behavior differs from the default behavior of the property system due to the already mentioned inconsistency between init and applied value.

```
construct : function()
{
  this.base(arguments);

  // Initialize color with predefined value
  this.initColor();

  // Initialize store with empty array
  this.initStore([]);
},

properties :
{
  color :
  {
    init : "black",
    apply : "_applyColor"
  },

  store : {
    apply : "_applyStore"
  }
},

members :
{
  _applyColor : function(value, old) {
    // do something...
```

```
  },

  _applyStore : function(value, old) {
    // do something...
  }
}
```

In the above example you can see the different usage possibilities regarding properties and their init values. If you do not want to share "reference types" (like `Array`, `Object`) between instances, the init values of these have to be declared in the constructor and not in the property definition.

If an `init` value is given in the property declaration, the init method does not accept any parameters. The init methods always use the predefined init values. In cases where there is no `init` value given in the property declaration, it is possible to call the init method with one parameter, which represents the init value. This may be useful to apply reference types to each instance. Thus they would not be shared between instances.

Note: Please remember that init values are not for incoming user values. Please use `init` only for class defined things, not for user values. Otherwise you torpedo the multi-value idea behind the dynamic properties.

Refining init values

Derived classes can refine the init value of a property defined by their super class. This is however the only modification which is allowed through inheritance. To refine a property just define two keys inside the property (re-)definition: `init` and `refine`. `refine` is a simple boolean flag which must be configured to true.

Normally properties could not be overridden. This is the reason for the `refine` flag . The flag informs the implementation that the developer is aware of the feature and the modification which should be applied.

```
properties : {
  width : { refine : true, init : 100 }
}
```

This will change the default value at definition time. `refine` is a better solution than a simple `set` call inside the constructor because it the initial value is stored in a separate namespace as the user value and so it is possible for the user to fall back to the default value suggested by the developer of a class.

Checking incoming values

You can check incoming values by adding a `check` key to the corresponding property definition. But keep in mind that these checks only apply in the development (source) version of the application. Due to performance optimization, we strip these checks for the build version. If you want a property validation, take a look at the *validation section*.

Predefined types

You can check against one of these predefined types:

- `Boolean`, `String`, `Number`, `Integer`, `Float`, `Double`
- `Object`, `Array`, `Map`
- `Class`, `Mixin`, `Interface`, `Theme`
- `Error`, `RegExp`, `Function`, `Date`, `Node`, `Element`, `Document`, `Window`, `Event`

Due to the fact that JavaScript only supports the `Number` data type, `Float` and `Double` are handled identically to `Number`. Both are still useful, though, as they are supported by the Javadoc-like comments and the API viewer.

```
properties : {
  width : { init : 0, check: "Integer" }
}
```

Possible values

One can define an explicit list of possible values:

```
properties : {
  color: { init : "black", check : [ "red", "blue", "orange" ] }
}
```

Note: Providing a list of possible values only works with primitive types (like strings and numbers), but not with reference types (like objects, functions, etc.).

Instance checks

It is also possible to only allow for instances of a class. This is not an explicit class name check, but rather an `instanceof` check. This means also instances of *any* class derived from the given class will be accepted. The class is defined using a string, thereby to not influencing the load time dependencies of a class.

```
properties : {
  logger : { nullable : true, check : "qx.log.Logger" }
}
```

Interface checks

The incoming value can be checked against an interface, i.e. the value (typically an instance of a class) must implement the given interface. The interface is defined using a string, thereby not influencing the load time dependencies of a class.

```
properties : {
  application : { check : "qx.application.IApplication" }
}
```

Implementing custom checks

Custom checks are possible as well, using a custom function defined inside the property definition. This is useful for all complex checks which could not be solved with the built-in possibilities documented above.

```
properties :
{
  progress :
  {
    init : 0,
    check : function(value) {
      return !isNaN(value) && value >= 0 && value <= 100;
    }
```

```
  }
}
```

This example demonstrates how to handle numeric values which only accept a given range of numbers (here 0 .. 100). The possibilities for custom checks are only limited by the developer's imagination. ;-)

Alternative solution As an alternative to the custom check *function*, you may also define a *string* which will directly be incorporated into the setters and used in a very efficient way. The above example could be coded like this:

```
properties :
{
  progress :
  {
    init : 0,
    check : "!isNaN(value) && value >= 0 && value <= 100"
  }
}
```

This is more efficient, particularly for checks involving rather small tests, as it omits the function call that would be needed in the variant above. But make sure the identifier you are using is named **value**, otherwise you will not be checking the incoming property value.

Transforming incoming values

You can transform incoming values before they are stored by using the transform key to the corresponding property definition. The transform method occurs before the check and apply functions and can also throw an error if the value passed to it is invalid. This method is useful if you wish accept different formats or value types for a property.

Example

Here we define both a check and transform method for the width property. Though the check method requires that the property be a integer, we can use the transform method to accept a string and transform it into an integer. Note that we can still rely on the check method to catch any other incorrect values, such as if the user mistakenly assigned a Widget to the property.

```
properties :
{
   width :
   {
      init : 0,
      transform: "_transformWidth",
      check: "Integer"
   }
},

members :
{
   _transformWidth : function(value)
   {
      if ( qx.lang.Type.isString(value) )
      {
          value = parseInt(value, 10);
      }

      return value;
```

```
    }
}
```

Validation of incoming values

Validation of a property can prevent the property from being set if it is not valid. In that case, a validation error should be thrown by the validator function. Otherwise, the validator can just do nothing.

Using a predefined validator

If you use predefined validators, they will throw a validation error for you. You can find a set of predefined validators in qx.util.Validate. The following example shows the usage of a range validator.

```
properties : {
  application : { validate : qx.util.Validate.range(0, 100) }
}
```

Using a custom validator

If the predefined validators are not enough for you validation, you can specify your own validator.

```
properties : {
  application : { validate : function(value) {
      if (value > 10) {
        throw new qx.core.ValidationError(
          "Validation Error: ", value + " is greater than 10."
        );
      }
    }
  }
}
```

Validation method as member

You can define a validation method as a member of the class containing the property. If you have such a member validator, you can just specify the method name as a sting

```
properties : {
  application : { validate : "_validateApplication" }
}
```

Enabling theme support

The property system supports *multiple values per property* as explained in the paragraph about the init values. The theme value is another possible value that can be stored in a property. It has a lower priority than the user value and a higher priority than the init value. The `setThemed` and `resetThemed` methods are part of qooxdoo's theme layer and should not be invoked by the user directly.

```
setter                                  value                   resetter

setProperty(value)          ^           user          |         resetProperty()
```

```
                                |                          |
setThemedProperty(value)   Priority       theme      Fallback     resetThemedProperty()
                                |                          |
initProperty([value])           |           init           v        n.a.
```

To enable theme support it is sufficient to add a `themeable` key to the property definition and set its value to `true`.

```
properties : {
  width : { themeable : true, init : 100, check : "Number" }
}
```

Note: `themeable` should only be enabled for truly *theme-relevant* properties like color and decorator, but not for *functional* properties like enabled, tabIndex, etc.

Working with inheritance

Another great feature of the new property system is inheritance. This is primarily meant for widgets, but should be usable in independent parent-children architectures, too.

Inheritance quickly becomes nothing short of vital for the property system, if you consider that it can reduce redundancy dramatically. It is advantageous both in terms of coding size and storage space, because a value only needs to be declared once for multiple objects inside an hierarchy. Beyond declaring such an inheritable property once, only intended exceptions to the inherited values need to be given to locally override those values.

The inheritance as supported by qooxdoo's properties is comparable to the inheritance known from CSS. This means, for example, that all otherwise undefined values of inheritable properties automatically fall back to the corresponding parent's value.

Each property may also have an explicit user value of string `"inherit"`. The inherited value, which is normally only used as a fallback value, can thus be emphasized by setting `"inherit"` explicitly. The user may set a property to `"inherit"` in order to enforce lookup by inheritance, and thereby ignoring init and appearance values.

To mark a property as inheritable simply add the key `inheritable` and set it to `true`:

```
properties : {
  color : { inheritable : true, nullable : true }
}
```

Optionally, you can configure an init value of `inherit`. This is especially a good idea if the property should not be nullable:

```
properties : {
  color : { inheritable : true, init: "inherit" }
}
```

Inheritable CSS properties

To give you an idea for what kind of custom properties inheritance is particularly useful, the following list of prominent CSS properties which support inheritance may be a good orientation:

- `color`
- `cursor`
- `font`, `font-family`, ...
- `line-height`

- list-style
- text-align

Note: This list of CSS properties is only meant for orientation and does not reflect any of qooxdoo widget properties.

Internal methods

The property documentation in the user manual explains the public, non-internal methods for each property. However, there are some more, which are not meant for public use:

- this.resetProperty(value) : For properties which are inheritable. Used by the inheritance system to transfer values from parent to child widgets.
- this.setThemedProperty(value) : For properties with appearance enabled. Used to store a separate value for the appearance of this property. Used by the appearance layer.
- this.resetThemedProperty(value) : For properties with appearance enabled. Used to reset the separately stored appearance value of this property. Used by the appearance layer.

Defining property groups

Property groups is a convenient feature as it automatically generates setters and resetters (but no getters) for a group of properties. A definition of such a group reads:

```
properties : {
  location : { group : [ "left", "top" ] }
}
```

As you can see, property groups are defined in the same map as "regular" properties. From a user perspective the API with setters and resetters is equivalent to the API of regular properties:

```
obj.setLocation( 50, 100);

// instead of
// obj.setLeft(50);
// obj.setTop(100);
```

Shorthand support

Additionally, you may also provide a mode which modifies the incoming data before calling the setter of each group members. Currently, the only available modifier is shorthand, which emulates the well-known CSS shorthand support for qooxdoo properties. For more information regarding this feature, please have a look at the *user manual*. The definition of such a property group reads:

```
properties :
{
  padding :
  {
    group : [ "paddingTop", "paddingRight", "paddingBottom", "paddingLeft" ],
    mode : "shorthand"
  }
}
```

For example, this would allow to set the property in the following way:

```
obj.setPadding( 10, 20 );

// instead of
// obj.setPaddingTop(10);
// obj.setPaddingRight(20);
// obj.setPaddingBottom(10);
// obj.setPaddingLeft(20);
}
```

.. _pages/defining_properties#when_to_use_properties:

When to use properties?

Since properties in qooxdoo support advanced features like validation, events and so on, they might not be quite as lean and fast as an ordinarily coded property that only supports a setter and getter. If you do not need these advanced features or the variable you want to store is *extremely* time critical, it might be better not to use qooxdoo's dynamic properties in those cases. You might instead want to create your own setters and getters (if needed) and store the value just as a hidden private variable (e.g. `__varName`) inside your object.

2.2.3 Initialization Behavior

This document summarizes some thoughts about the behavior of the initialization of properties.

The Problem

Imagine a class containing a property named `a` with an init value, like the following:

```
qx.Class.define("A", {
        extend : qx.core.Object,
        properties : {
          a : {
            init : "b",
            event : "changeA"
          }
        }
      });
```

As you can see, the property `a` has an init value, `b`. Now, if you access `a` with its getter, you get the init value in return:

```
var a = new A();
a.getA();  // returns "b"
```

If you now set something different than the initial value, you get a change event, because the content of the property changed.

```
a.setA("x");  // changeA fired
```

As far, everything behaves as desired. But if set the init value instead of a new value, the change event will be also fired. The following code shows the problem:

```
var a = new A();
a.setA(a.getA()); // changeA fired (first set)
a.setA(a.getA()); // changeA NOT fired (every other set)
```

Why not just change this behaviour?

It's always hard to change a behavior like that because there is no deprecation strategy for it. If we change it, it is changed and every line of code relying on that behavior will fail. Even worse, the only thing we could use as a check for the wrong used behavior is to search for all properties having an init value and either an apply function or an event. Now you have to check if one of these properties could be set with the init value, before any other value has been set. If it is possible that the init value is set as first value, check if the attached apply is required to run or any listener registered to the change event of that property. A good example in the framework where we rely on the behavior is the Spinner:

```
// ...
  construct : function(min, value, max) {
// ...
    if (value !== undefined) {
      this.setValue(value);
    } else {
      this.initValue();
    }
// ...
    _applyValue: function(value, old)
// ...
            this._updateButtons();
// ...
```

The example shows the constructor and the apply of the value property. The problem begins in this case with the constructor parameter named `value`, which is optional. So we have three cases to consider.

1. The value argument is undefined: The initValue method is called, which invokes the apply function for the property with the init value as value.
2. A value is given different as the init value: So the value is not undefined and the setter for the value property will be called, which invokes the apply function.
3. A value is given and its exactly the init value: In this case, the setter will be called with the init value. The apply method is called and invokes the `_updateButtons` method. This method checks the given value and enables / disabled the buttons for increasing / decreasing the spinner. So it is necessary that the apply method is at least called once that the buttons have the proper states.

The problem with a possible change of this behavior is obvious. In the third case, the apply method is not called and the buttons enabled states could be wrong without throwing an error. And they are only wrong, if the value is exactly the init value and one of the minimum or maximum values is the same. Because only in that scenario, one of the buttons need to be disabled.

When can it be changed?

Currently we don't plan to change it because it can have some hard to track side effects as seen in the example above and we don't have any deprecation strategy. Maybe it can be change on a major version like 2.0 but currently there are no plans to do so.

2.2.4 Property features summarized

Note: The chapter gives you an compact but extensive overview of the features offered by qooxdoo's property system. Please refer to *Properties in more detail* for an explanation of how to define and use properties.

Value checks

- Built-in types for most common things
- Runtime checks (development version only)
- Instance checks by simply define the classname of the class to check for (always use an instanceof operation - a real classname is not available anymore)
- Custom check method by simply attaching a function to the declaration
- Custom check defined by a string which will be compiled into the resulting setters (faster than the above variant)
- Define multiple possible (primitive) values using an array

Validation

- Validation in both development and build version
- Predefined validators for default validation
- Throws a special validation error

Advanced value handling

- Multi value support. Support to store different values for init, inheritance, style and user including a automatic fallback mechanism between them.
- Inheritance support. Inheritance of properties defined by a parent widget e.g. inherit enabled from a groupbox to all form elements. Uses the inheritance if the computed value would be `undefined` or explicitly set to `"inherit"`. The getter simply returns `"inherit"` for inheritable properties which are otherwise unset.
- Blocks unintentionally `undefined` values in all setters with an exception. To reset a value one must use the `reset` or `unstyle` method which are available too.
- Overriding of a value by setting a property explicitly to `null`
- Properties must be explicitly configured as `"nullable"` (like in .Net). The default is `false` which means that incoming `null` values will result in an exception.
- Accessing nullable properties with `undefined` values will result in a normalization to `null`.

Convenience

- Convenient toggle method for boolean properties

Notification

- Support for a custom apply routine
- Event firing with a custom named event

Initialization

qooxdoo automatically correctly initializes properties. This is true for both, properties which have defined an `init` value and also for the other properties which are `nullable`. This means that after you have created an instance the properties correctly reflect the applied value. Default values assigned by `init` also execute the configured `apply` methods and dispatch configured events to inform already added listeners.

Initialization Behavior

Performance

Automatic optimization of all setters to the optimal highly-tuned result code. Impressive tailor made high performance setters are the result.

Please note that after the definition point of a property the setters are not yet available. Wrappers for them will be created with the first instance and the final code will be generated with the first use of such a setter. This first use will also automatically unwrap the property setter to directly use the generated one.

Memory Management

Automatic memory management. This means all so-configured properties which contain complex data objects get automatically disposed with the object disposal. The affected built-in types are already auto-configured this way. Also all properties which need an instance of a class, defined by using a classname as `check` are automatically handled.

Note: Note that this does not actually call dispose() on the object but just removes the property value etc i.e. dereferences the object. You still need to call dispose() if necessary.

For all other properties which contain complex data the developer must add a `dispose` key with a value of `true` to the property declaration. For example if there is no `check` defined or the `check` definition points to a function.

Note: This is not needed for primitive types like strings and numbers.

2.3 Environment

2.3.1 Environment

Introduction

The environment of an application is a set of values that can be queried through a well-defined interface. Values are referenced through unique keys. You can think of this set as a global key:value store for the application. Values are write-once, read-many, but there are also read-only values. If a value for a certain key can be set, it can be set in various ways, e.g. by code, through build configuration, etc., usually during startup of the application, and not changed later. Other environment values are automatically discovered when they are queried at run time, such as the name of the current browser, or the number of allowed server connections. This way, the environment API also implements browser feature detection, and these values cannot be arbitrarily set.

Environment settings are also used in the framework, among other things to add debug code in the form of additional tests and logging, to provide browser-specific implementations of certain methods, asf. Certain settable environment keys are pre-defined by qooxdoo, the values of which can be overridden by the application. Applications are also free to define their own environment keys and query their values at run time.

So for the application developer, the environment represents a set of global values that mirrors the general parameters under which the application runs. It can be used to both *detect* (e.g. browser features) as well as *inject* such parameters (e.g. through build configuration). For global values that are *not* derived from the outside world in some way, just use e.g. a static application class.

Motivation

Environment settings address various needs around JavaScript applications:

- Control initial settings of the framework, before the custom classes are loaded.
- Pass values from outside to the application.
- Trigger the creation of multiple build files.
- Query features of the platform at run time (browser engine, HTML5 support, etc.)
- Create builds optimized for a specific target environment, i.e. feature-based builds.

As there are a number of pre-defined settings in the framework, you can make use of them right away by querying their values in your application code. The next section deals with that. Afterwards, you learn how to override default values or define your own environment settings.

Querying Environment Settings

In general, there are two different kinds of settings, **synchronous** and **asynchronous**. The asynchronous settings are especially for feature checks where the check itself is asynchronous, like checking for data: URL support. Both kinds have two query methods at the qx.core.Environment class, *.get()* and *select()* for synchronous, and *.getAsync()* and *.selectAsync()* for asynchronous settings.

Synchronous

Let's first take a look at the synchronous API and the two possibilities of accessing the data:

```
qx.core.Environment.get("myapp.key");
```

The `get` method is likely the most important one. It returns the value for the given key, `myapp.key` in this example.

```
qx.core.Environment.select("myapp.key", {
  "value1" : resvalue1,
  "value2" : resvalue2,
  "default" : catchAllValue
}
```

The `select` method is a way to select a value from a given map. This offers a convenient way to select an expression for a given key value. It also allows you to specify the special map key **"default"**, that will be used if the current value of the environment key does not match any of the other map keys. This is very handy when only one of the expected values needs a special case treatment. In the example above, the `resvalue(s)` could be a function or any other valid JavaScript expression.

Asynchronous

The asynchronous methods are a direct mapping of their synchronous counterparts.

```
qx.core.Environment.getAsync("myapp.key", function(result) {
  // callback
}, context);
```

As the *.getAsync* does not return a result immediately, you have to specify a callback method which will be executed as soon as the value for the environment key is available. Your callback will be passed this value as the single argument, and the callback is responsible to integrate the result with your application.

This principle carries over to the corresponding select call:

```
qx.core.Environment.selectAsync("myapp.key", {
  "value" : function(result) {
    // callback value 1
  },
  "default" : function(result) {
    // catch all callback
  }
}, context)
```

In case of an asynchronous select the type of the values has to be a function, which will be called as soon as the key value is available. Again, you can provide a *"default"* case. As with the callbacks used for *.getAsync*, the callbacks used with *.selectAsync* will also get the key value as parameter, which might come handy especially in the *"default"* case.

Caching

It sure happens in the live cycle of an application that some key get queried quite often, like the engine name. The environment system caches every value to ensure the best possible performance on expensive feature tests. But in some edge cases, it might happen that you want to redo the test. For such use cases you can invalidate the cache for a given key, to force a re-calculation on the next query:

```
qx.core.Environment.invalidateCacheKey("myapp.key"}
```

This example would clear a previously calculated value for `myapp.key`.

Removal of Code

Usually, function calls like *qx.core.Environment.get()* are executed at run time and return the given value of the environment key. This is useful if such value is determined only at run time, or can change between runs. But if you want to pre-determine the value, you can set it in the generator config. The generator can then anticipate the outcome of a query and remove code that wouldn't be used at run time.

For example,

```
function foo(a, b) {
  if (qx.core.Environment.get("qx.debug") == true) {
    if ( (arguments.length != 2) || (typeof a != "string") ) {
      throw new Error("Bad arguments!");
    }
  }
  return 3;
}
```

will be reduced in the case *qx.debug* is *false* to

```
function foo(a, b) {
  return 3;
}
```

In the case of a *select* call,

```
qx.core.Environment.select("myapp.key", {
  "value1" : resvalue1,
  "value2" : resvalue2
}
```

will reduce if *myapp.key* has the value *value2* to just

```
resvalue2
```

The *generator documentation* has more details on optimization of *qx.core.Environment* calls.

Pre-defined Environment Keys

qooxdoo comes with a set of pre-defined environment settings. You can divide those into two big groups. One is a set of feature tests which cover browser features like support for certain CSS or HTML features. The second group are simple settings for the qooxdoo framework which drive the inner workings of the framework.

For a complete list of predefined environment keys, take a look at the API documentation of the qx.core.Environment class.

Defining New Environment Settings

Now to actually setting new or overriding existing environment settings. The value of an environment key can take one of two forms, as a concrete literal value, or as a function that returns a value at run time. The former can be achieve in various ways (see further), the latter only through application code. (An environment key with its current value is also referred to as an *environment setting*). We go through both ways now.

As Literal Values

As already mentioned, there are various possibilities to assign a literal value, like `"foo"`, `3` or `true`, to an environment key. You can define the setting

- in the class map
- in method code
- through inline `<script>` code in the index.html
- in the generator configuration
- via URL parameter

The list is sorted in ascending precedence, i.e. if a key is defined multiple times, mechanisms further down the list take higher precedence. Those possibilities are explained in the following sections.

In the Class Map You can define a key and its value through the *environment* key of the map defining a qooxdoo class:

```
qx.Class.define("myapp.ClassA",
{
  [...]

  environment : {
    "myapp.key" : value
  }
});
```

In Application Code You can define a key and its value in a class method using the *qx.core.Environment.add* method:

```
qx.core.Environment.add("key", "value");
```

In the Loading index.html In the web page loading your qooxdoo application, and before the `<script>` tag loading the initial qooxdoo file, add another `<script>` tag with code that assigns a map to `window.qx.$$environment`, containing your environment settings.

```
<script>
  window.qx =
  {
    $$environment : {
      "myapp.key" : value
    }
  }
</script>
```

In the Generator Config You can define a key and its value in the *environment* key of the job with which you build the script files of your application (e.g. *source-script*, *build-script*):

```
"myjob" :
{
  [...]

  "environment" : {
    "myapp.key" : value
  }
}
```

Using the generator config adds a special meaning to the provided environment settings. Specifying a **list** of values for a key triggers the creation of multiple output files by the generator. E.g. replacing **value** with **[value1, value2]** in the above example, the generator will create two output files. See the *environment* key for more information on multiple output generation.

Via URL parameter Before using URL parameter to define environment settings, you have to specify another environment setting in the generator configuration which is named `qx.allowUrlSettings`. If the application is generated with this config setting in place, you can then use URL parameter to add further key:value pairs.

```
http://my.server.com/path/to/app/index.html?qxenv:myapp.key:value
```

The pattern in the URL parameter is easy. It has three parts separated by colons. The first part is the constant `qxenv`, the second part is the key of the environment setting and the last part is the value of the setting.

Note: qx.allowUrlSettings and "variants" Optimization

Setting `qx.allowUrlSettings` to true in the configuration somewhat contradicts using the *variants* optimization in builds. The variants optimization takes advantage of the values of environment settings given in the configuration, to remove code like calls to `qx.core.Environment.get()` for such a setting and replace it with the corresponding value. That means that changing the value of such a key via URL parameter later has no effect, as the call to retrieve its value is no longer in the code. You can then only set environment values via URL parameter for those keys which have **not** been given a value in the configuration.

Alternatively, you could disable `variants` optimization in the build, or remove the setting you want to change via URL parameter from the config. In the latter case, you have other possibilities to set a default for this setting, by either providing an `environment` key in the JavaScript class map, or a `qx.core.Environment.add()` call in the class' `defer` function.

If you set `qx.allowUrlSettings` to true and have the `variants` optimization enabled for a particular build, the generator will issue a warning.

So much for setting simple key:value pairs. Now for providing a check function as the value of an environment key.

As a Check Function

As mentioned before, providing a function in place of a value can only be done in application code, so these environment settings are done at run time. The framework settings defined at run time are usually feature checks like checking for dedicated CSS or HTML features. The check function is executed and is responsible for returning a proper value when the environment key is queried later. These checks can be synchronous or asynchronous, and this corresponds to how they are queried. Synchronous checks are queried with the *.get()* and *.select()* methods, asynchronous checks with *.getAsync()* and *.selectAsync()* (see *Querying Environment Settings*).

Synchronous To add a synchronous check function, the standard *.add()* call is used:

```
qx.core.Environment.add("group.feature", function() {
  return !!window.feature;
});
```

This example shows the same API used for adding a key:value setting. The only difference is that you add a function as second parameter and not a simple value. This function is responsible for determining and returning the value for the given environment key. In this example, if `window.feature` is defined, the check will return `true`.

Asynchronous To add an asynchronous check, use *.addAsync()*:

```
qx.core.Environment.addAsync("group.feature", function(callback) {
  window.setTimeout(function() {
    callback.call(null, true);
  }, 1000);
});
```

This example shows how to add a asynchronous feature check. A timeout is used to get the asynchronous behavior in this simple example. That can be more complicated of course but the timeout is good enough to showcase the API. As you can see in the check function we are adding, it has one parameter called `callback` which is the callback passed by *.getAsync()* or *.selectAsync()* asynchronous queries. As before, the check function is responsible for computing the value of the environment key. But rather than just returning the value (as in the synchronous case), it calls the callback function and passes the value. The callback function is then responsible to integrate the result value with the querying layer. In this simple example, the check waits a second and calls the callback with the result `true`.

2.4 Data Binding

2.4.1 Data Binding

Data binding is a concept by which two data items are bound, so that changes to one are propagated to the second, and vice versa. This requires the possibility to detect such changes during runtime. In qooxdoo, *class properties* fulfill this requirement.

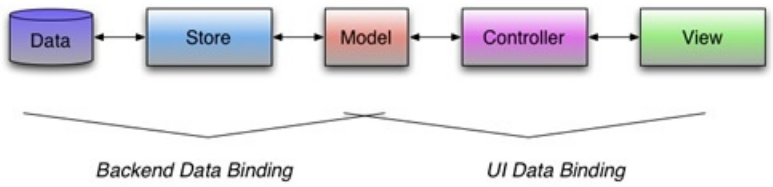
Using data binding allows you to e.g. keep two widgets automatically synchronized over the runtime of your application, although they might be spatially separated and have wildly different visual representations (e.g. a text field and a spinner).

Data Binding Introduction

Data binding is a functionality that allows to connect data from a source to a target. The entire topic can be divided into a low-level part, called "single value binding", and some higher-level concepts involving stores and controllers.

The main idea

The main idea of qooxdoo's data binding component is best summarized by the following diagram.



As you can see data binding includes five major components, which will be described in more detail in the following sections.

Data The data part is where the raw data is stored and can be retrieved from. This can be a plain local file, a regular web server or even a web service. There are all sources of data possible depending on the implementation of the actual store.

Store The store component is responsible for fetching the data from its source and for including it into a data model of an application. For more info about the available store components see the *stores section* below.

Model The model is the centerpiece of data binding. It holds the data and acts as an integration point for the store and for the controller. The stores provide a smart way to automatically the models classes during runtime. Take a look at the *models* for details.

Controller The main task of the controller components is to connect the data in the model to the view components. Details are available in the *controller section*. The base layer of all controllers, the *Single Value Binding* is explained later.

View The views for data binding can be almost any widget out of qooxdoo's rich set of widgets, depending on the type of controller. qooxdoo's data binding is not limited to some predefined data bound widgets. Please note that one of the most prominent data centric widgets, the virtual Table, currently still has its own model based layer and is not covered by the new data binding layer. The new infrastructure for virtual widgets is expected to nicely integrate the upcoming data binding layer, though.

Demos, API and CheatSheet

You should now have a basic idea of qooxdoo's data binding, so to see it in action, take a look at the online demos and the API reference. If you want to start programming, maybe the `CheatSheet` can help you during your programming.

Single Value Binding

The purpose of single value binding is to connect one property to another by tying them together. The connection is always in one direction only. If the reverse direction is needed, another binding needs to be created. The binding will be achieved by an event handler which assigns the data given by the event to the target property. Therefore it is necessary for the source event to fire a change event or some other kind of data event. The single value binding is mostly a basis for the higher concepts of the data binding.

Binding a single property to another property

The simplest form of single value binding is to bind one property to another. Technically the source property needs to fire a change event. Without that no binding is possible. But if this requirement is met, the binding itself is quite simple. You can see this in the following code snippet, which binds two properties of the label value together:

```
var label1 = new qx.ui.basic.Label();
var label2 = new qx.ui.basic.Label();

label1.bind("value", label2, "value");
```

`label1` is the source object to bind, with the following three arguments to that call:

1. The name of the property which should be the source of the binding.
2. The target object which has the target property.
3. The name of the property as the endpoint of the binding.

With that code every change of the value property of `label1` will automatically synchronize the value property of `label2`.

Binding a data event to property

Some properties of objects used as models can only be accessed through a method or an event. Those properties cannot be bound directly, but they can be bound through a method or an event that references them. One common case is the TextField widget, which does not have a direct `value` property, unlike the Label of the previous example, which does have a `value` property. The `value` of a TextField is only addressed through getter / setter methods and change events. Indirectly therefore Textfield does indeed have a property for binding, though it is not implemented as a direct property. Using the `changeValue` ' event, the value can be bound as is shown in the example snippet. The API is essentially the same as the property binding case.

```
var textField = new qx.ui.form.TextField();
var label = new qx.ui.basic.Label();

textField.bind("changeValue", label, "value");
```

As you can see, the same method has been used. The difference is that the first argument is a data event name and not a property name.

In a similar fashion, a controller can bind to the implicit `value` property of the TextField:

```
var textField = new qx.ui.form.TextField();

// create the controller
var controller = new qx.data.controller.Object(model);

// connect the name
controller.addTarget(textfield, "value", "name", true);
```

In this case the binding code translates the "value" property into getValue() and setValue() methods.

Bind a property chain to another property

A more advanced feature of the single value binding is to bind a hierarchy of properties to a target property. To understand what that means take a look at the following code. For using that code a qooxdoo class is needed which is named `Node` and does have a `child` and a `name` property, both firing change events.

```
// create the object hierarchy
var a = new Node("a");      // set the name to „a"
var b = new Node("b");      // set the name to „b"
a.setChild(b);

// bind the property to a labels value
a.bind("child.name", label, "value");
```

Now every change of the `name` of `b` will change the labels value. But also a change of the `child` property of `a` to another Node with another name will change the value of the label to the new name. With that mechanism a even deeper binding in a hierarchy is possible. Just separate every property with a dot. But always keep in mind that every property needs to fire a change event to work with the property binding.

Bind an array to a property

The next step in binding would be the ability to bind a value of an array. That's possible but the array needs to be a special data array because the binding component needs to know when the array changes one of its values. Such an array is the `qx.data.Array` class. It wraps the native array and adds the change event to every change in the array. The following code example shows what a binding of an array could look like. As a precondition there is an object `a` having a property of the `qx.data.Array` type and that array containing strings.

```
// bind the first array element to a label's value
a.bind("array[0]", labelFirst, "value");

// bind the last array element to a label's value
a.bind("array[last]", labelFirst, "value");
```

You can use any numeric value in the brackets or the string value `last` which maps to `length - 1`. That way you can easily map the top of a stack to something else. For binding of an array the same method will be used as for the binding of chains. So there is also the possibility to combine these two things and use arrays in such property chains.

Options: Conversion and Validation

The method for binding introduced so far has the same set of arguments. The first three arguments are mostly the same. There

- **converter**: A own converter which is a function with four arguments returning the converted value. (See the API for more details)
- **onUpdate**: A key in the options map under which you can add a method. This method will be called on a validation case if the validation was successful.
- **onSetFail**: The counterpart to onUpdate which will be called if the validation fails.

In addition there is a built in default conversion which takes care of the default conversion cases automatically. Default cases are, for example, string to number conversion. To get that working it is necessary to know the desired target type. This information is taken from the check key in the property definition of the target property.

Managing bindings

If you want to manage the bindings, there are some ways to get that. First aspect of managing is showing the existing bindings. You can find all these function on the static `qx.data.SingleValueBinding` class or parts of it on every object.

- **getAllBindingsForObject** is a function which is in the data binding class and returns all bindings for the given object. The object needs to be the source object.
- **getAllBindings** returns all bindings in a special map for all objects.

Another way of managing is removing. There are three ways to remove bindings.

- **removeBindingFromObject** removes the given binding from the given source object. As an id you should use exactly the id returned during the creation of the binding.
- **removeAllBindingsForObject** removes all binding from the source object. After that, the object is not synchronized anymore.
- **removeAllBindings** removes all single value bindings in the whole application. Be careful to use that function. Perhaps other parts of the application use the bindings and also that will be removed!

Debugging

Working with bindings is in most cases some magic and it just works. But the worse part of that magic is, if it does not work. For that the data binding component offers two methods for debugging on the static `qx.data.SingleValueBinding` class.

- **showBindingInLog** shows the given binding in the qooxdoo logger as a string. The result could look something like this: *Binding from 'qx.ui.form.TextField[1t]' (name) to the object 'qx.ui.form.TextField[1y]' (name).* That shows the source object and property and the target object and property.
- **showAllBindingsInLog** shows all bindings in the way the first method shows the bindings.

Tech notes

For everyone who is interested on how that whole thing works, here are some small notes on the inside of the data binding. Every binding function maps to the event binding function. This is where the heart of the data binding lies. In that function a listener will be added to the source object listening to the change event. The key part of the listener is the following code part.

```
targetObject["set" + qx.lang.String.firstUp(targetProperty)](data);
```

In that line the listener sets the data given by the data event to the target property.

Controller

The general idea of controllers is connecting a view component to a set of data stored in a model. The kind of controller you need depends on the view component. Currently there are four types of controller available:

- Object Controller
- List Controller
- Tree Controller
- Form Controller

You may miss the table controller. The currently available table will not be changed and therefore will not implement data binding features. The new virtual table, which is currently under development, will be considered for data binding.

In the following section, the selection will be discussed because it's a common feature of the list and tree controller. The delegation mechanism is another common feature of those two controllers and will also be described. After that, each of the available controllers will be discussed in detail.

Selection

Usually the selection of view components like the tree or the list handle their selection with tree folder or list items. As a user of data binding, you don't want to convert the view widgets to the model widgets. Therefore, the controller does that mapping for you. There is a selection array available on the controller containing the currently selected model items. When using the selection of the controller, there is no need to deal with view widgets like ListItems. It is also possible to change the array in place and add / remove something from the selection. As it is a data array, you can use all methods defined by that array to manipulate the selection of the corresponding controller.

Delegate

The list and tree controller are responsible for creating and binding the child widgets of the views. But what if you want to use something different in the list or bind not just the label and the icon. For that purpose, the delegation offers the possibility to enhance the controller code without having to subclass it.

In total, there are three methods which relate to the topic of creating and binding the child view widgets.

configureItem The `configureItem` function is the function which you can use if you just want to modify the created default widgets. This gives you the opportunity to set the labels to rich for example or modify anything else in the child widget. But this is not the place where you want to change / add the binding behavior.

bindItem That place is the `bindItem` method. But you don't want to use the single value binding all on your own and bind the stuff. Therefore, the controller offers you a method called `bindProperty`, which takes the source path to the data, the target property name and the options for the single value binding. The other two parameters will just mapped through. But keep in mind that if you use this function, the default binding of the label and the icon is gone and the properties used for those bindings do not work anymore. If you still want to have the default binding, use the `bindDefaultProperties` method and pass the two given parameters through. But keep in mind that the bindings set up with these two methods are unidirectional, from the model to the view. If you want to have b binding from the view to the model, use the `bindPropertyReverse` which takes the same arguments as the `bindProperty` method.

createItem The last method named `createItem` gives the user the chance to add something different as child widgets to the view. In that method you just create the widget you want to see in the view and return the new item. But keep in mind that the default bindings may not work on those widgets and the code will fail. So it is always a good idea to also define its own bindings with the `bindItem` method.

The following code shows how such a delegate could look like.

```
var delegate = {
  configureItem : function(item) {
    item.setPadding(3);
  },
  createItem : function() {
    return new qx.ui.form.CheckBox();
  },
  bindItem : function(controller, item, id) {
    controller.bindProperty("name", "label", null, item, id);
    controller.bindProperty("online", "checked", null, item, id);
  }
};
```

The delegate defines that `CheckBox`‘es should be used as child view items. As the `CheckBox`‘es don’t have an icon, the `bindItem` function needs to re-specify the bindings. It binds the name and the online property of the model to the label and checked property of the `CheckBox`.

Object Controller

The most simple and lightweight controller is the object controller. It connects a model object with one or more views. The data in the model can be anything a property can hold, i.e. a primitive data type like String or Number, or a reference type like a map. With that you can for instance bind views like textfields, sliders and other widgets visualizing primitive JavaScript types. But you can not only use views as targets. A target can be anything that has a property with the proper type. Take a look at the following code example to see the object controller in action:

```
// create two sliders
var slider1 = new qx.ui.form.Slider();
var slider2 = new qx.ui.form.Slider();
// create a controller and use the first slider as a model
var controller = new qx.data.controller.Object(slider1);
// add the second slider as a target
controller.addTarget(slider2, "value", "value");
```

This code snippet ensures that every value set by slider1 will automatically be set as value of slider two. As you can see, the object controller only wraps the fundamental single-value binding, trying to make its usage a little bit easier.

List Controller

A list controller could - as the name suggests - be used for list-like widgets. The supported list-like widgets in qooxdoo are List, SelectBox and ComboBox, all in the qx.ui.form package. The controller expects a data array as a data model, that contains the model objects. These objects are displayed in the list and can either have some primitive type or be real qooxdoo objects. The following code snippet shows how to bind an array of strings to a list widget:

```
// create the model
var model = new qx.data.Array(["a", "b", "c", "d", "e"]);
// create a list widget
var list = new qx.ui.form.List();
// create the controller
var listController = new qx.data.controller.List(model, list);
```

Now every change in the model array will invoke a change in the list widget.

As a unique feature of the list controller a filtering method is included. You can assign a filter function to the controller and the results will be filtered using your given function.

Tree Controller

Of course, also the tree does have its own controller. With that controller the Tree widget can automatically be filled with data from qooxdoo objects containing the data. As model nodes for the tree, only qooxdoo objects are allowed containing at least two properties, one for holding its own children in a data array and a second one holding the name of the node which should be showed as the label of the tree folder widgets. Imagine that a model class called Node (inheriting from qx.core.Object) is available containing the two already mentioned properties called ch for the children and n for the name. The following code will bind a data model containing Node objects to a tree widget:

```
// create the model
var rootNode = new Node();
rootNode.setN("root");
var childNode = new Node();
childNode.setN("child");
rootNode.getCh().push(childNode);
// create the tree view
var tree = new qx.ui.tree.Tree();
// create the controller
var treeController = new qx.data.controller.Tree(rootNode, tree, "ch", "n");
```

After that code snippet, every change in the name or of the children will be automatically mapped into the tree view. Selecting one of the tree folders will put the corresponding Node object into the selection array of the controller.

Form Controller

Also forms do have a special controller. The form controller uses a `qx.ui.form.Form` as target and a *Object controller* for the bidirectional bindings. The usage equals to the usage of all other controllers. The main properties of it are the model and target property. Given both, the controller connects the model and the target. An additional feature of the form controller is the possibility to create the model for a given form. See the following code to get an idea of using it.

```
// a form is available as 'form'
// create the controller
var formController = new qx.data.controller.Form(null, form);
// create the model
var model = formController.createModel();
```

If you nee additional information on forms, see *form handling documentation*. After executing this code, the controller and the model variable do have the model available and therefore, the controller can set up the bindings.

Combining Controller

As a more advanced example we connect the selection of a tree to a list. Therefore we extend the code sample of the tree controller section.

```
// create a list widget
var list = new qx.ui.form.List();
// create the controller
var listController = new qx.data.controller.List(null, list, "n");
```

```
// bind the selection of the tree to the list
treeController.bind("selection", listController, "model");
```

The example shows how the controller can work pretty well together with the single value binding. The trick is not to set the model of the list controller at creation time. The model will be set by the single value binding from the tree controllers selection. This works because the selection will be provided as data array.

Stores

The main purpose of the store components is to load data from a source and convert that data into a *model*. The task of loading data and converting the data into a model has been split up. The store itself takes care of loading the data but delegates the creation of model classes and instances to a marshaller. More information about the marshalling and the models itself can be found in the *models section*.

JSON Store

The JSON store takes an URL, fetches the given data from that URL and converts the data using the JSON marshaller to qooxdoo model instances, which will be available in the model property after loading. The state of the loading process is mapped to a state property. For the loading of the data, a `qx.io.request.Xhr` will be used in the store.

The following code shows how to use the JSON data store.

```
var url = "json/data.json";
var store = new qx.data.store.Json(url);
```

After setting the URL during the creation process, the loading will begin immediately. As soon as the data is loaded and converted, you can access the model with the following code.

```
store.getModel();
```

JSONP Store

The JSONP store is based on the *JSON store* but uses a script tag for loading the data. Therefore, a parameter name for the callback and an URL must be specified.

The following code shows how to use the JSONP data store.

```
var url = "json/data.json";
var store = new qx.data.store.Jsonp(url, null, "CallbackParamName");
```

After setting the URL and the callback parameter name during the creation process, the loading will begin immediately.

YQL Store

YQL is the Yahoo! Query Language. Yahoo! describes it as *"[...] an expressive SQL-like language that lets you query, filter, and join data across Web services."* Based on the *JSONP store*, qooxdoo offers a YQL store, where you can specify the YQL queries and qooxdoo handles the rest.

The following code demonstrates how to fetch some twitter messages.

```
var query = "select * from twitter.user.timeline where id='wittemann'";
var store = new qx.data.store.Yql(query);
```

Offline Store

The Offline store uses HTML local or session storage to store the data on the client. That can be used for offline storage as well as for other storage purposes on the client. You should use the *Environment* checks to make sure that the used storage technology is supported by the environment you want to run your code in.

The following code demonstrates how to initialize the data store.

```
if (qx.core.Environment.get("html.storage.local") {
  var store = new qx.data.store.Offline("my-test-key", "local");
  if (store.getModel() == null) {
    // initialize model ...
  }
}
```

Combining with controllers

As described in the section above, you can access the model in the property after loading. The best solution is to use the model with a controller and then bind the model properties with *Single Value Binding* together. The code for this could look something like this.

```
store.bind("model", controller, "model");
```

Using the *Single Value Binding*, the binding handles all the stuff related with the loading of the model data. That means that the data will be available in the controller as soon as its available in the store.

Models

The model is the centerpiece of data binding. It holds the data and acts as an integration point for the *stores* and for the *controller*. Almost all models are plain qooxdoo classes holding the data in simple properties, which are configured to fire events on every change. These change events are the most important part of the models and the reason, why plain JavaScript objects are not enough as models. The same is true for native JavaScript arrays. Since they do not fire events when items are changed as well, a complementary array is added for data binding purposes. More details about that in the data array section.

Still, there is no need to manually write own model classes for every data source you want to work with. The marshallers provide a smart way to automatically create these classes during runtime. Take a look at the JSON marshaller for details.

In the following sections, we first take a look at the models basics and how they work. After that, we dig into the role of arrays and how that is solved. As a last section, we check out how the model creation is done in qooxdoo, because you don't need to write all the simple models yourself.

Structure

As already mentioned in the introduction of this chapter, models are plain qooxdoo objects. The main idea of such a model is to hold all data in properties, which fire change events as soon as new data is available. Lets take a look at a simple example in which we use JSON data to demonstrate how models look. The data in the example looks like this:

```
{
  s: "string",
  b: true,
  a: []
}
```

A corresponding model should now be an object, which class defines three properties, named `s`, `b` and `a`. Lets take a look at the following qooxdoo code, in which we assume that we have a fitting model:

```
var model = new ExampleModel(); // this returns a fitting model
model.getS(); // return the value of the property 's' which is "string"
model.setB(false); // will fire a change event for the property 'b'
```

I guess it's clear now, how models are structured. There is not much code or magic about them, but they are the most important part in the whole binding scenario.

Data Array

If we take a second look at the example we used above, we also added an array as value of property `a`. This array should not be an plain JavaScript array, instead it should be a qooxdoo data array, which Class is located in `qx.data.Array`. The reason for that should be quite obvious right now, the binding needs to get an event as soon as some data changed to do all the necessary updates. As regular arrays can't offer such notifications, we added our own array implementation to the data binding layer. The data array is as close as possible to the native array but in some core things, we needed to change the API. The major difference is the accessing of items in the array. The following sample code, based on the sample above, shows the differences:

```
var array = model.getA();
array.setItem(0, "content"); // equals 'array[0] = "content"' and fires a change event
array.getItem(0); // equals 'array[0]' and returns "content"
array.length; // like the native API and returns '1'
```

You see, the read and write access needs to be done with the designated methods to ensure the firing of the events. But all the other API, like `push`, `pop` or `splice` is all the same and also capable of the events. Just take a look at the API-Documentation of the array for more information.

Importance of events

The two sections above explained how models look and why. The most mentioned reason is the need for change events, which gives them also an important role in the data binding. Check out the *separate page about events in data binding*.

Disposing

Those of you familiar with qooxdoo and its objects should know, that disposing is necessary. This is also true for model objects and data arrays. The model objects do have one special thing, the do a deep disposing, when created with the marshaller, which we get to know in the following section.

JSON Marshaller

The marshaller takes care of converting JavaScript Objects into qooxdoo classes and instances. You can initiate each of the two jobs with a method.

toClass This method converts a given JavaScript object into model classes. Every class will be stored and available in the `qx.data.model` namespace. The name of the class will be generated automatically depending on the data which should be stored in it. As an optional parameter you can enable the inclusion of bubbling events for every change of a property. If a model class is already created for the given data object, no new class will be created.

toModel The method requires that the classes for the models are available. So be sure to call the `toClass` method before calling this method. The main purpose of this method is to create instances of the created model classes and return the model corresponding to the given data object.

createModel (static) This method is static and can be used to invoke both methods at once. By that, you can create models for a given JavaScript objects with one line of code:

```
var model = qx.data.marshal.Json.createModel({a: {b: {c: "test"}}});
```

How to get my own code into the model?

What if you want to to bring your own code to the generated model classes or if you even want to use your own model classes? That's possible by adding and implementing a delegate to the data store. You can either

- Add your code by supporting a superclass for the created model classes.
- Add your code as a mixin to the created model classes.
- Use your own class instead of the created model classes.

Take a look at the API-Documentation of the qx.data.store.IStoreDelegate to see the available methods and how to implement them.

Events

Events are a key concept of data binding. They are responsible for notifying every connected view (which can be more than one) to update their representation of the data stored in the model. You can see the events as a nervous system for your data bound app. In general, there are two different kinds of events.

Change Events

The basic events used in the data binding are the change events of the *qooxdoo property system*. You will find some details about the *change events of properties* in the documentation. Those events are fired as soon as a property changes.

Array

There is also an event for *data arrays*, which will fire events on every change as well. This event is called `change` and is a data a

- `start`: The start index of the change e.g. 0 if the index 0 has been written.
- `end`: The end index of the change. This might often be the same as the start index but there are some operation which might take action on a range of items like `sort` or `splice`.
- `type`: The type of the change as a String. This can be 'add', 'remove' or 'order'.
- `items`: The items which has been changed (as a JavaScript array).

Bubbling Events

Regular change events might not be enough in every use case. If we consider a huge tree like data model, it's quite a lot of work to add a listener to every model object to get updates for the view. Therefore, the data binding also supports bubbling events named `changeBubbles`. These events are provided by a mixin named MEventBubbling.

Enabling These bubbling events are disabled by default because firing an additional event for every change is not always necessary. There are two ways for enabling the events. The most easy and preferred way is to use the *marhsaler* to create the models. You will find more details about how to do that in the *marhsaler section*. A second way is to include the mixin to your own classes. More details on that in the API documentation of that mixin.

Details This event, like the regular change event of the Array, also offers additional information on the kind of change and where the change initially happened. The data of the event contains a map offering the following keys:

- `value`: The new value of the property.
- `old`: The old value of the property.
- `name`: The name of the property including its parents e.g. `bar[3].baz`.
- `item`: The model item that has been changed.

Array The data array also offers bubble events with the same details. But the arrays don't have properties which change. You can see the index of the array as property instead. So here is a sample what a unshift action on an array might look like:

```
var array = new qx.data.Array("a", "b", "c");
array.addListener("changeBubble", function(e) {
  var data = e.getData();
  // do something with the data
});
array.unshift("X");
```

Think of the unshift action as something which manipulates the index 0 because it adds one item at the index 0 and moves every item by one index. This unshift will produce the following data in the changeBubble event:

- `value`: `['X']` (An array containing the new value at the index 0)
- `old`: `['a']` (An array containing the old value at the index 0)
- `name`: `0` (The name of the changed index)
- `item`: <*array*> (The array itself)

The properties `value` and `old` are always an array because there are operations which change several indexes at once like `splice`.

CHAPTER

THREE

QX.WEBSITE

You use qx.Website to build light-weight, integrated, low-level components for web sites or other browser-like environments where you don't want to add graphical elements with qooxdoo. It features a DOM selector engine (Sizzle), BOM and HTML abstraction layers, and cross-browser keyboard and mouse events. As it does not contain visual elements, it is independent of image resources and theming. Its code can be shrink-wrapped into a single JavaScript file, and is available as an individual download. You can include it like any other JavaScript library in your projects.

This section provides tutorials and introductory material. For your daily work with qx.Website the only other thing you need is the API reference.

3.1 General

3.1.1 qx.Website Overview

This page is an overview of qx.Website's capabilities. It collects the existing documentation and tries to show the big picture.

Basic Concept

The basic concept is simple. qx.Website offers one global object called `q` (short for query). This global object's main task is to query the DOM using selectors and offer convenience methods on the returned collection of elements.

```
q("#test").setStyle("color", "red");
```

As you can see in the example above, qx.Website's idea of API design is to have an explicit API with a clear scope and readable names. In most cases, methods come in pairs: a getter and a setter. Another API concept is chaining:

```
q("#test").setStyle("color", "red").appendTo(document.body);
```

Unless noted otherwise, methods return the collection for chaining, such as the setStyle method in the example. It returns the collection created with `q("#test")` on which the append method is called.

`q` also offers static utility functions. These functions are usually attached to q in their own sub object. Let's take a look at a sample:

```
q.type.get(123); // returns "Number"
```

The sub object (which could also be called a namespace) in the sample is `type` and contains a function `get` which will determine the type of a given argument.

The code base of q is organized in modules, as you can see in the API viewer for qx.Desktop. Using the generator, you can build your own library containing only the modules you need. Similarly, it is possible to include your own modules into a single, optimized file. Take a look at the *Documentation of the qx.Website skeleton* to learn more.

API Documentation

The best documentation is found in the API viewer for qx.Website. It offers a detailed documentation of all available methods, sorted into modules.

CSS Selector Support

qx.Website uses the same CSS selector engine as jQuery, which is called Sizzle. Please check the Sizzle Documentation for more details.

```
q("#id"); // query for id
q("div"); // query for all div's
```

Plugins

qx.Website supports a plugin mechanism. All modules are written as qx.Website plugins. For further details about how to write plugins, take a look at the *plugins documentation*.

Modules

qx.Website is divided into several modules. Besides using a single all-in-one qx.Website script file (e.g. `q-3.0.min.js`), which contains **every module**, you can also use the modules separately, i.e. only those modules you need (qx.Website splitted in n files). Note that you always need the core module when you decide to use the modules separately. So for example you could use `q-core-3.0.min.js`, `q-animation-3.0.min.js` and `q-cookie-3.0.min.js` together.

3.1.2 Module Overview

This page gives a short introduction into each module with samples attached. More samples can be found in the API viewer for qx.Website.

Note that you always need the core module when you decide to use the modules separately - which encloses all modules prefixed with **"Core:"** in the following list.

Core

This module contains elementary static functions and furthermore consolidates several other modules. Some of those elementary functions are:

```
q("#myId")...

q.define("MyObject", {
  construct : function() {},
  members : {
    method : function() {}
  }
});
```

```
q('.desc').map(function(elem) {
  return elem.parentNode;
})
```

Core: Attributes

qx.Website offers an easy and elegant way to manipulate attributes and properties of DOM elements. This also includes setting the HTML content of an element.

```
// sets the HTML content
q("#test").setHtml("<h2>TEST</h2>");
// returns the value of the placeholder attribute
q("#test").getAttribute("placeholder");
```

Core: CSS

Working with CSS can be easy with the help of qx.Website. The CSS module includes many convenient helpers to set styles, classes, or dimensions.

```
// cross browser opacity setting
q("#test").setStyle("opacity", 0.5);
// checks if 'myClass' is applied
q("#test").hasClass("myClass");
```

Core: Environment

qx.Website covers most cross browser issues. Still, the environment module offers a lot of information about the environment the app is running in. This includes simple checks like browser name as well as information about the application itself.

```
// returns e.g. "webkit"
q.env.get("engine.name");
// can be used to remove debugging code from the deployment version
q.env.get("qx.debug");
```

Core: Event

Of course there is also basic event handling available in qx.Website.

```
q.ready(function() {
  // ready to go
});

q('#someElement').on('keyup', handleInput, this);
```

Core: Manipulating

The manipulating module provides helpers to change the structure of the DOM. Appending or creating elements is also part of this module, as is manipulating the scroll position.

```
q("#test").setScrollTop(100);
q("#test").empty(); // removes all content
```

Core: Polyfill

A polyfill is best explained by a quote from an informative blog post:

> *"A polyfill, or polyfiller, is a piece of code (or plugin) that provides the technology that you, the developer, expect the browser to provide natively. Flattening the API landscape if you will."* [1]

A list of included polyfills can be found in the API documentation of the module.

Core: Traversing

In the traversing module, you'll find helpers that work with the collection. A good example is the filter method, which reduces the number of elements in the collection. Other methods of this module will find children, ancestors or siblings of the elements in the collection.

```
// returns the children
q("#test").getChildren();
// returns all siblings having the class 'myClass'
q("#test").getSiblings(".myClass");
```

Animation

Animations can enhance the user experience and help create appealing and user interfaces that feel natural. With modern browsers, CSS Animations and Transforms are emerging as new way of efficiently realizing this goal. No need to do it programmatically in JavaScript.

To use animations with qx.Website, you can use the animation module. This is a cross-browser wrapper for CSS Animations and Transforms with the goal to conform closely to the specifications wherever possible. If no CSS Animations are supported, a JavaScript solution will work in place offering the same API and almost the same functionality as the CSS based solution.

For further details, take a look at the *Animations and Transforms documentation*.

```
q("#test").fadeIn();
```

Blocker

The blocker module offers a way to block elements. This means they won't receive any native events until they are unblocked.

```
q("#test").block();
```

Cookie

A convenient way to work with cookies is implemented in the cookie module. Setting, reading and deleting cookies is supported across browsers.

[1] Remy Sharp, "What is a polyfill"

```
q.cookie.set("key", "value");
q.cookie.get("key");
```

Dataset

With this module you can operate on HTML5 `data-*` attributes concerning the elements in your current collection. It's a wrapper and polyfill around the native HTML5 `dataset` property.

```
q(".info a").setData("key", "value");
q(".info a").getData("key");
```

Dev

Currently there is only one utility available under the dev namespace and that's the FakeServer: A wrapper around Sinon.JS's FakeXMLHttpRequest and FakeServer features that allows quick and simple configuration of mock HTTP backends for testing and development. Head over to the qx.Website API viewer to see a sample.

IO

Pulling data from remote sources is another one of the most common use cases and usually the next logical step when it comes to improving your existing JavaScript powered website / application. Of course, you expect the underlying framework to provide you with a nice abstracted cross-browser solution that is easy to use. qx.Website offers multiple implementations to pull data.

The first option is XHR. qx.Website comes with *a wrapper around this widely used browser API* which hides inconsistencies and works around browser bugs. The second option is to use JSONP. This approach enables you to overcome same orgin policy restrictions and talk to any server which offers a JSON API like e.g Twitter. qx.Website provides a *nice and powerful API* with the same interface as the XHR transport to let you easily access any JSONP API out there.

```
q.io.xhr(url).on("loadend", function(xhr) {});
```

Matchmedia

A module for mediaqueries evaluation. This module is a wrapper for media.match.js that implements a polyfill for `window.matchMedia` when it's not supported natively.

```
q.matchMedia("screen and (min-width: 480px)").matches // true or false
```

Messaging

The messaging module offers a message bus. It offers a separation by channel and type and also offers a way to react on types for every channel.

```
q.messaging.on("CHANNEL-X", "test", function() {
  // do something clever
});
q.messaging.emit("CHANNEL-X", "test");
```

Placeholder

The placeholder module offers fallback implementation for placeholders. The module offers two methods, one for updating all input and textarea elements on the site and one for updating only the elements in the given collection

```
// update all elements on the page
q.placeholder.update();
// update only the placeholder for the given element
q("#nameInput").updatePlaceholder();
```

In case the executing browser supports native placeholders, those two method calls won't do anything. This is only relevant for browsers not supporting placeholders like IE < 10.

Placement

Sometimes it can be necessary to place an element right beside another one. Think about a popup message or tooltip offering some context sensitive help. The placement module offers a method to place one element relative to another using one of several algorithms and taking available space into account.

```
q("#test").placeTo(target, "top-right");
```

REST

The rest module can be used to work against RESTful web-services in an elegant way. Rather than requesting URLs with a specific HTTP method manually, a resource representing the remote resource is instantiated and actions are invoked on this resource.

```
var resourceDesc = {
  "get": { method: "GET", url: "/photo/{id}" },
  "put": { method: "PUT", url: "/photo/{id}"}
};
var resource = q.rest.resource(resourceDesc);

photo.get({id: 1});
photo.put({id: 1}, {title: "Monkey"});
```

Storage

The storage module offers a cross browser way to store data offline. For that, it uses the Web Storage API. If That's not available (i.e. in IE < 8) a fallback is used. If non of the storage API is available, a non persistent in memory storage is returned which means you can always use the same API. Check out the separate *page about storage* for more details.

```
var value = q.localStorage.get("my_custom_key");
```

Template

Templating is a powerful tool in web development. qx.Website uses mustache.js as its templating engine. For further information, see the mustache.js documentation.

```
// returns a collection containing the new element
q.template.get("templateId", {data: "test"});
```

Transform

The transform module offers a cross browser convenience API for CSS transforms. This includes scaling, skewing, rotating and translating.

```
q("#myId").rotate("45deg");
```

Util

As the name implies this module provides static utility functions for Strings and Arrays and generic helpers e.g. for requesting the type of a value.

```
// Strings
q.string.startsWith("hamster", "ham"); // true
q.string.camelCase("i-like-cookies");  // "ILikeCookies"

// Arrays
q.array.equals(["a", "b"], ["a", "b"]); // true
q.array.unique(["a", "b", "b", "c"]);   // ["a", "b", "c"]

// General
q.type.get(val); // "String", "Array", "Object", "Function" ...
```

3.2 Tutorials

3.2.1 Tutorial: Building Notifications

Introduction

In this tutorial we show some basic steps of using qx.Website. To do so, we build a simple notification system for web pages. The system should expose one method which brings up a bubble on the screen containing the notification message. The bubble should go away after a period of time. You might be familiar with Growl for OSX which offers similar functionality.

Basics

Let's get started! As qx.Website is a simple JavaScript file, we first need to download the script file. After that, we're going to create a simple HTML file in the same directory as the downloaded script and include it:

```
<!DOCTYPE html>
<html>
  <head>
    <title>qx.Website tutorial</title>
    <script type="text/javascript" src="q-3.0.min.js"></script>
  </head>
  <body>
  </body>
</html>
```

You can also use a version on a CDN. To do so, just include the following code instead of referencing the local script

```
<script type="text/javascript" src="http://cdnjs.cloudflare.com/ajax/libs/qooxdoo/3.0/q.min.js"></scr
```

Having done that, you can load the page in your favorite browser and check if the title is there and the qx.Website library has been loaded. For instance, simply open a JavaScript console in your browser and see if `q` is defined. If so, we've completed the first step and can start building the application.

Next, we need a script tag to write our code into. To keep it simple, we'll just put it in the head of the HTML page, right below the existing script tag.

```
<script type="text/javascript" charset="utf-8">
  // your code here...
  console.log("it works");
</script>
```

The `console.log` statement in the script will show us if it works. Reloading the page should bring up the log message in the browser's console. Now it's time to formulate a simple plan covering the next steps. We should first create the popup we want to show, then we can implement the notify method and finally, we can add some demo code to showcase our work. The following code should be placed in the script tag to replace the previous content.

```
// create the notification popup
var popup;

// create the notification API
var notify = function(message, delay, callback) {
 // do the notifying
}

// DEMO
notify("This is ...", 1000, function() {
 notify("... a qx.Website notification demo.", 2000);
});
```

As you see, we've defined three arguments for the `notify` method: First, the `message` to display, second a `delay` in milliseconds and finally a `callback` function, which will be executed as soon as the popup is gone. The demo code at the bottom shows how it should be used and should trigger two messages in sequence.

Popup

Let's take care of the popup now. This is where the qx.Website library comes in handy. The popup is going to be a simple div which can be added to the document's body. So we can do something like the following:

```
var popup = q.create("<div>").appendTo(document.body);
```

This line of code uses two essential methods of qx.Website. First, we create a new DOM element, which is wrapped in a collection. On that object, we call the `appendTo` method, which adds the newly created element to `document.body`. Now, reloading the page... brings up an error!?! Sure, we added our script in the head of the HTML document, which means `document.body` is not yet ready when our code gets executed. We need to wait until the document is ready until we can start. qx.Website offers a convenient way to do that. We just wrap the code we've written in a function and give that to `q.ready`:

```
q.ready(function() {
  // ...
});
```

Reloading the page, the error is gone but nothing else happens. How can we tell if it worked? Simple enough, we'll just style the div using CSS and make it visible. We won't go into any detail about the CSS here, so just copy and paste the following CSS rule into the HTML file's head section.

```
<style type="text/css" media="screen">
  .popup {
    position: absolute;
    top: 20px;
    right: 20px;
    width: 150px;
    background-color: #aaa;
    color: white;
    padding: 10px;
    font-family: "Lucida Grande", "DejaVu Sans", "Verdana", sans-serif;
    font-size: 14px;
    border: solid 1px #000000;
  }
</style>
```

Now, the only thing missing is to set the CSS class for the popup div. That's as easy as calling another method in our previous code.

```
var popup = q.create("<div>").appendTo(document.body).addClass("popup");
```

Now reload and you should see the popup in the upper right corner. Hmmm, but the styling is not done, right? A real popup has rounded corners! But wasn't that one of the newer CSS keys which is usually vendor prefixed? Yes! That means, we need to add a declaration for every known browser. No, wait a second. IE and Opera don't use the vendor prefix which means we only need to add the unprefixed key and one additional key each for WebKit and Mozilla.

```
-moz-border-radius: 5px;
-webkit-border-radius: 5px;
border-radius: 5px;
```

That was a lot of work for something as simple as a border radius! But we could have achieved that far more easily. Using qx.Website to set the style will take care of all the vendor prefix stuff! Just set the style on the newly created popup and you're done.

```
var popup = q.create("<div>").appendTo(document.body).addClass("popup").setStyle("border-radius", "5p
```

That's about it for the popup. Looks good enough for the first prototype.

notify

Next, let's implement the notify method. We already added the function and only need to fill in the implementation. First, we want to set the message and show the popup. But we want to show the popup with some style and fade it in.

```
var notify = function(message, delay, callback) {
  popup.setHtml(message);
  popup.fadeIn();
};
```

That was easy. The first line simply applies the message as inner HTML of the popup. The second line fades in the popup. This simple fadeIn applies a CSS animation in all browsers supporting CSS animations. If the browser doesn't support CSS animations, the fade in is done using JavaScript so you don't need to worry about that either! Reload the page and see your message in the popup fading in. As soon as the message is faded in, we should start a timer to trigger the fade out. But when does the animation end? Specifically for that, qx.Website offers an event named `animationEnd` which we can react to.

```
popup.fadeIn().once("animationEnd", function() {
  console.log("end");
});
```

Again, we used the native `console` API to check if our code works. Running the code now should show the `end` message in the console as soon as the popup is faded in. A little hint: Make sure you add the listener only once using the `once` method. We don't want to keep piling up listeners on the popup. Now we can start the timer which will be a simple `setTimeout` offered by the browser. As soon as the time is over, we can fade out.

```
popup.fadeIn().once("animationEnd", function() {
  window.setTimeout(function() {
     popup.fadeOut();
  }, delay);
});
```

Now we are almost there. The only thing missing is to execute the `callback` as soon as the fade out has ended. Again, we listen to the `animationEnd` event and call the callback. But as this should be an optional parameter, we should check its availability before executing.

```
popup.fadeIn().once("animationEnd", function() {
  window.setTimeout(function() {
     popup.fadeOut().once("animationEnd", function() {
       callback && callback.call();
     });
  }, delay);
});
```

Giving it a try should show both notification messages in sequence. Well done! We have implemented a (very) simple notification mechanism for web pages.

Summary

In this tutorial, we used a small part of the qx.Website API. First, we saw parts of the Manipulating module with `q.create` and `.appendTo`. After that, we used the CSS module with `.setStyle` and `.addClass` and the Attributes module with `.setHtml`. `.fadeIn` and `.fadeOut` are part of the Animation module and `.once` is part of the Event module. There are more methods in the named modules and there are additional modules you can experiment with.

3.3 Technical Topics

3.3.1 Plugins

The qx.Website library is built from separate modules. Each module offers a set of functionality covering a common topic like CSS, (DOM) Traversing or Animations. You can see a listing of all modules in the *overview*. These modules use the same plugin API that qx.Website offers to all developers. This developer API can be found in the API reference as well but by default, these methods are hidden and can be displayed using the little link in the top right corner.

Regular Plugins

The core module offers a plugin API to write common plugins. This is the default case and can be used to extend the static `q` object or the collections returned by the `q` function call.

Surely you've noticed that the plugin-related methods have one thing in common: They are all prefixed with `$`. Extending the static object is easily accomplished by using the `$attachStatic` function, which offers a convenient way to attach static modules with conflict detection.

```
// attach a new module
q.$attachStatic({"doSomethingAwesome" : function() {}});

// use the module
q.doSomethingAwesome();
```

Extending the returned collection is more interesting but just as easy as the first sample.

```
// attach a new module
q.$attach({"doSomethingAwesome" : function() {}});

// use the module
q("div").doSomethingAwesome();
```

In the attached method, you can access the collection using the `this` keyword. This means that you have access to all included methods and the items stored in the collection as well.

Event Normalization Plugins

Another kind of plugin is used to normalize events. qx.Website includes normalization for e.g. Keyboard or Mouse events. The plugin API for that use case is included in the events module and offers one important method.

```
var normalizer = function(event, element) {};
q.$registerEventNormalization(["click"], normalizer);
```

After adding these two lines of code, the normalizer will be called on every `click` event, giving the plugin author the chance to attach additional information to the event.

HowTo

Check out the *qx.Website skeleton* included in the SDK to get a starting point. This makes it easy to write unit tests and documentation for your plugin.

3.3.2 Referring to the qx.bom API

Technical view on the low-level APIs

Note: This document describes implementation details. The user API is covered in qx.Website and the *corresponding overview documentation*.

---

qx.bom - Browser Object Model

The classes contained in the `qx.bom` namespace provide a cross-browser abstraction layer for object classes of the browser JavaScript runtime.

The BOM classes mainly consists of the following three parts:

- DOM element manipulation
- wrappers for native layers/objects
- powerful low-level helper classes

See the API reference of qx.bom for more details.

DOM element manipulation The `qx.bom.element` package allows you to manipulate DOM elements in almost any way you can think of. Each class is offering several `static` methods that take a DOM element as their first argument. Since those BOM classes are static, no instances need to be created in order to manipulate a DOM element in the document.

The following manipulations are offered by the `qx.bom.element` package:

- Dimension and location
- Box-sizing - supports the modes `content-box` (W3C model) and `border-box` (Microsoft model)
- Scroll and overflow
- Style querying and modification
- CSS class name support - supports multiple class names for each element
- Scroll elements into view
- powerful low-level decoration support
- cross-browser support for opacity - optimized for animations
- CSS3 transforms and animations
- Attribute/Property handling
- Background images and support for the clip property
- Cursor property

Wrapper for native layers/objects These classes offer an unique and powerful way to deal with native layers and objects. Wrappers exist for:

- the current document
- DOM elements to be connected to qooxdoo's event system
- native event management
- flash embedding
- CSS font styles
- several native controls like `iframe`, `form elements`, `label` and `image` elements

As every object or layer is abstracted by a corresponding qooxdoo class you can use these BOM classes to interact without worrying about the underlying browser used.

Additional classes These additional classes help in developing low-level, cross-browser applications.

Features include:

- unified XMLHttp transport implementation
- powerful client detection classes
- low-level `Range` and `Selection` API
- helper class for browser history
- wrapper for working with CSS stylesheets
- string utility class
- helper class for the client's viewport

- helper class for VML

qx.dom - Cross-browser DOM manipulation

The Document Object Model (DOM) is a tree model that represents the document in a browser. The classes provided by this packages allow you to query, to manipulate (i.e. add, remove, change order or replace) and to check the nodes contained in the DOM.

Currently the `qx.dom` package consists of three classes:

- **Element**: manages children structures, inserts, removes and replaces nodes
- **Hierarchy**: for querying nodes
- **Node**: basic node creation and type detection

See the API reference of qx.dom for more details.

qx.xml - XML handling

This package is all about working with XML documents in a cross-browser way. Its three classes are:

- **Document**: creating an XML document
- **Element**: API to select, query and serialize XML elements
- **String**: escaping and unescaping of XML strings

See the API reference of qx.xml for more details.

Client-side Storage

A universal cross-browser storage API exists that offers client-side key-value pair storage. Most of the modern browsers support the WebStorage API. There also is a fallback implementation for IEs below version 8 based on userData. For all other runtimes, a fallback exists in the form of an in-memory storage. While the latter means you don't store the data in a persistent way, you still have the benefit of using the same API to access the storage.

API

The API is closely aligned with the native WebStorage API and offers some convenience on top of that. The main class for you to use is `qx.bom.Storage` and comes with three different implementation classes, one for each of the three implementations mentioned. Those implementations can be found in the `qx.bom.storage` namespace.

Basic Usage To get an idea of the basic API please have a look at the API docs, the MDC page or the W3C specification.

Convenience on top We added an `forEach` method, which can be used to execute a function for every stored item.

```
q.localStorage.forEach(function(key, value) {
  // ... do whatever you want
});
```

API for qx.Desktop and qx.Mobile There is also an static API which can be used in qx.Desktop and qx.Mobile. Just take a look at the API docs for qx.bom.Storage for more details.

Simple example

Here is a simple example: a counter that keeps track of how often you visited the page.

```
// load the number and parse it
var number = parseInt(q.localStorage.getItem("my-number-name"), 10) || 0;
// increment the number by one
number++;
// write back the number
q.localStorage.setItem("my-number-name", number);
```

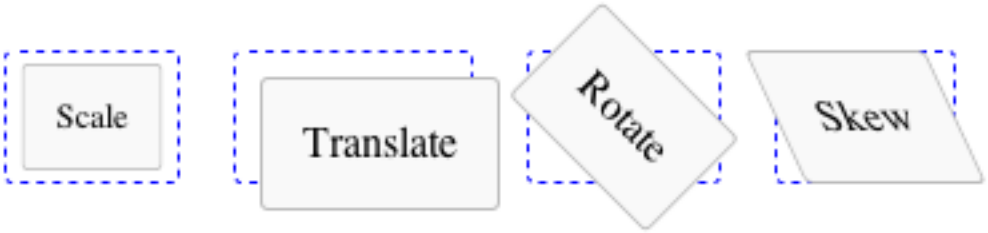
Transforms and Animations (CSS3)

One of the big pieces in the whole CSS3 world are animations and transforms with all the hype about 3D, hardware acceleration and the combinations of both of them. But as always, the various browser vendors don't introduce these new features at the same time, with divergent feature sets and using different CSS keys.

In order to address that, two classes have been added, one for transfoms (API) and one for animations (API). We kept the API close to the CSS spec, thus all those of you familiar with it will recognize it quickly. For all of you who have no idea about all that new CSS stuff yet, when you get in touch with the qooxdoo API, you will also learn parts of the spec!

Transforms

Transforms are basically defined by their transform function and are only good for transforming elements. They are not responsible for any dynamic movement of elements. The basic transform functions will give you an idea what is possible with transforms: Scale, Translate, Rotate, Skew.



But lets take a look at the transforms applied in the demo above.

```
var box = document.getElementById("scale");
qx.bom.element.Transform.scale(box, 0.8);

box = document.getElementById("translate");
qx.bom.element.Transform.translate(box, ["10px", "10px"]);

box = document.getElementById("rotate");
qx.bom.element.Transform.rotate(box, "45deg");

box = document.getElementById("skew");
qx.bom.element.Transform.skew(box, "25deg");
```

There is a lot of other stuff you can do with the new Transform class. A demo shows all the possibilities the native Transform API has to offer and with that, also what is provided by the qooxdoo wrapper. For the best result, use a webkit-based browser like Safari or Chrome to view the demo.

Animations

Only with animations does dynamic behavior come into the application. As you can expect, animations define a change of something over a given amount of time. That's the key feature of animations. But what can be changed and how can we define that? The first question is easy to answer: We can change CSS properties. To answer the second question, see the following code:

```
var desc = {duration: 1000, timing: "ease-out", keyFrames : {
  0 : {"width" : "30px"},
  70 : {"width" : "100px"},
  100 : {"width": "30px"}
}};
var box = document.getElementById("box");
qx.bom.element.Animation.animate(box, desc);
```

The main part of this code is the key frames map, here with three entries. The first one defined by 0 specifies the animations at the beginning of the animation. The next one defined by 70 holds the CSS properties at 70% of the animation time. The last one specifies the animation's state at 100% animation time. That is an easy animation which only takes simple CSS properties into account. But you can also animate transforms, which brings both technologies together.

Take a look at this demo, showing a 3D rotation which you can try yourself. It shows the best results if you use a webkit-based browser like Safari or Chrome.

Back-Button and Bookmark Support

Note: This document is outdated and does not reflect the proposed way of working with qx.Website. The history module is still under development. As soon as the module is ready, this document will be updated as well.

Overview

Many Ajax applications break the browser back button and bookmarking support. Since the main page is never reloaded, the URL of the application never changes and no new entries are added to the browser history.

Fortunately it is possible to restore the expected behavior with a JavaScript history manager like the one included with qooxdoo (qx.bom.History).

Adding History support to an Application

To add history support to an application four basic steps are required:

- identify application states
- retrieve initial application state
- add event listener to history changes
- update history on application state changes

Identify Application States

The first step to add history support to an Ajax application is to identify the application states, which should be added to the history. This state must be encoded into a string, which will be set as the fragment identifier of the URL (the part after the '#' sign).

What exactly the application state is depends on the application. It can range from coarse grained states for basic application navigation to fine grained undo/redo steps. The API viewer uses e.g. the currently displayed class as its state.

Retrieve Initial Application State

At application startup the initial state should be read from the history manager. This enables bookmarks to specific states of the application, since the state is encoded into the URL. The URL `http://api.qooxdoo.org#qx.bom.History` would for example open the API viewer with the initial state of `qx.client.History`.

This is the code to read the initial state (getState API documentation):

```
var state = qx.bom.History.getInstance().getState();
```

Add Event Listener to History Changes

Each time the history changes by hitting the browser's back or forward button, the history manager dispatches a `request` event. The event object holds information about the new state. The application must add an event listener to this event and update the application state (request API documentation):

```
// 'this' is a reference to your application instance
qx.bom.History.getInstance().addListener("request", function(e)
{
  var state = e.getData();

  // application specific state update (= application code)
  this.setApplicationState(state);
}, this);
```

Update History on Application State Changes

Every time the application state changes, the history manager must be informed about the new state. A state change in the API viewer would for example occur if the user selects another class (addToHistory API documentation).

```
qx.bom.History.getInstance().addToHistory(state, title);
```

The first parameter is the state encoded as a string, which will be set as the URL fragment identifier. The second parameter is optional and may contain a string, which is set as the title of the browser window for this state.

CHAPTER

FOUR

QX.DESKTOP

qooxdoo Desktop is the component to build rich and interactive, desktop-like applications. Its prominent feature is the comprehensive set of GUI widgets and controls, like buttons, sliders, tabviews, trees and tables. Layout managers organize the elements on the screen. Unified keyboard and mouse events provide cross-browser event handling. A dedicated theming system allows the application of styles to the graphical elements independent of the behavioral aspects. Text element like labels can be internationalized. qooxdoo Desktop requires that you use the *qooxdoo SDK* with its tool chain. See Overview for a more in-depth introduction.

4.1 Overview

4.1.1 Widgets

Widgets are the basic building blocks of graphical user interfaces (GUIs) in qooxdoo. Each GUI component, such as a button, label or window, is a widget and can be placed within an existing user interface. Each particular type of widget is provided by a corresponding subclass of Widget, which is itself a subclass of LayoutItem.

`Widget` can be subclassed with minimal effort to create custom widgets. The entire layout handling and children handling in this class is only available as "protected". It is possible to add some public API as needed.

Another framework class which extends `LayoutItem` is Spacer. A spacer is an empty area, which may be used as a temporary placeholder that is to be replaced later, or explicitly as a flexible part in certain dynamic UI designs.

To structure an interface it is common to insert widgets into each other. Each child is displayed within the screen area occupied by its parent. The hierarchical structure is also used to hide or show specific areas. This means for instance, that hiding a parent hides its children as well. Another example would be when a widget is being disposed, all the child widgets it contains are automatically being disposed as well.

4.1.2 Composites

As mentioned a few sentences above the normal `Widget` does not have public methods to manage the children. This is to allow the normal Widget to be used for inheritance. To allow the creation of structures in applications, the `Composite` was created.

Composite extends `Widget` and publishes the whole children and layout management of the `Widget` to the public. Typically it is used as a container for other widgets. Children can be managed through the methods `add()`, `remove()`, etc. In application code Composites are used to structure the interface.

4.1.3 Roots

A special category of widgets are the root widgets. These basically do the connection between the classic DOM and the qooxdoo widget system. There are different types of roots, each individually tuned for the requirements in the covered use case.

First of all, every application developer needs to decide if an application should be standalone, e.g. working with a minimal set of classic HTML, or will be integrated into an existing web page. Developers of a standalone application normally have no problem to give control over the page layout to the UI toolkit (maybe even preferring to give away this responsibility), but this would not work for integrating qooxdoo into an existing web page layout.

A standalone application normally only uses a really slimmed down set of HTML (in fact the customary `index.html` file only functions as a wrapper to load the application code). It normally does not include any CSS files and often comes with an empty body element. In fact even simple elements like headers, footers etc. are created using widgets (allowing them to benefit from typical qooxdoo features like internationalisation, theming etc.).

- Application: Build a full-blown stand-alone application from scratch. Application logic and UI are fully implemented using qooxdoo.
- Page: Build applications as isles into existing content. Ideal for the classic web developer. Requires HTML & CSS skills for non-qooxdoo content.

Either root element is attached directly to the document. The `Application` is automatically stretched to the full size of the viewport, allowing elements to be positioned in relation to the right or bottom edge, etc. This is not possible using the `Page` root.

The instantiation of the required root widget is normally nothing the developer has to do manually. This is done by the application class the developer chooses to extend. The next chapter will explain the concept behind applications in detail.

As even the `Page` root is attached to the document it would still be impossible to place children into a specific existing column or box within the existing layout. However, web page developers may use any number of optional isles to insert content into an existing layout (built with classic HTML markup). The isles are named Inline. They require an existing DOM element to attach themselves to (usually retrieved using `getElementById`). While most content is added to these isles, the `Page` root is required so that dynamically floating elements like tooltips, menus, windows etc. can be easily positioned.

4.1.4 Applications

The application is the starting point of every qooxdoo application. Every qooxdoo application should also come with a custom application class. The application is automatically initialized at the boot phase of qooxdoo (to be exact: when all required JavaScript packages are loaded).

The first method each developer needs to get familiar with is the main method. It is automatically executed after the initialization of the class. This method is typically used to initialize the GUI and to load any data the application needs.

There are different applications which can be used as a starting point for a custom application:

- Standalone: Uses the `Application` root to build full blown standalone qooxdoo applications
- Inline: Uses the `Page` root to build traditional web page based application which are embedded into isles in the classic HTML page.
- Native: This class is used for applications that do not involve qooxdoo's GUI toolkit. Typically they make only use of the IO ("Ajax") and BOM functionality (e.g. to manipulate the existing DOM).

4.1.5 Communication

Developing a qooxdoo application does not require a server. Its static application contents (initial HTML file, JavaScript files, images, etc.) can simply be loaded from the local file system. This means that full applications can be developed locally with no server infrastructure - not even an Internet connection is required.

Any practical qooxdoo client application will communicate with a server, for instance to retrieve and store certain application data, to do credit card validation and so on. To this end, qooxdoo includes a sophisticated IO layer featuring high-level abstractions for XMLHTTP requests and REST resources as well as support for cross-domain requests.

Additionally, an advanced *RPC mechanism* for direct calls to server-side methods is available. It allows you to write true client/server applications without having to worry about the communication details. qooxdoo offers several *optional* RPC backends for Java, PHP, Perl and Python. If you are missing your favorite backend language, you can even create your own RPC server by following a generic *server writer guide*.

4.2 How to Develop a qx.Desktop Application

4.2.1 General Cycle of Activities

The general cycle of development activities while creating a desktop application is roughly:

1. Create a *source* version of your app.
2. Load it in a browser.
3. Test, experiment, debug.
4. Make changes to the source code.
5. Cycle to 2.

This will be the main cycle of your activities.

Mind that you start with a Generator run creating your application. This is necessary to produce a runnable application that will work in a browser. You might have to re-run this step, depending on the variant of source version you created. (In such a case, you will cycle to 1. instead of 2.). The currently available source jobs include *source*, *source-all* and *source-hybrid*. You can also use our *watch* job which will mirror all your changes and start the generation job automatically. See their individual job descriptions for details.

4.2.2 Build Version

The basic programming model of qooxdoo suggests that you develop your application in its source version, and once you're satisfied create the *build* version of it, which is then deployed on a web server. qooxdoo's build versions of an application are self-contained, they encompass all script files, resources like images and style sheets, and any helper files that are necessary for the application. You can safely copy the build directory to the document forest of a web server, or zip it up in an archive and send it by mail; the recipient should be able to unpack it and run the application without flaws.

For a bit of background, here are more details of the build version.

Class Code

- Class code is compressed and optimized, and put in only a few script files, which are later loaded by the loader script.

- The number of script files is highly configurable, depending mainly on the us of *parts*. In general, the Generator tries to minimize the number of script files.

Resources

- Images like icons or decorators that are required by the classes which go into the application are copied from the various libraries they belong to. A *resource* directory tree is created in the build folder that reflects the various name spaces of the included images.
- The same applies to other static resources like style sheets, HTML files, or media files.
- The *index.html* file is copied from the source directory.

Translations and Localisation Data

- Translated strings and localisation data like calendar items are compiled into the JS script files, together with the class code.

4.2.3 Running the Source Version through a Web Server

Basically, the source version of an application can be run off of the file system (i.e. opening it with the *file://* protocol in your browser). But there are reasons why you would want to run it over a web server. You might need to integrate with backend services during development time, so frontend and backend service points need to be on the same web server. Same-origin-policy for other resources you want to use in your app might force you into the same direction. And, browsers have increasingly become constraint, e.g. when XHR requests go to the local disk from the *file://* protocol. This impedes applications that just want to load some JSON data.

The issue with the the source version is that the generated loader script just references source code and resources with relative paths, wherever they happen to be on your file system. This poses some challenges when run from a web server. Even if you include your application in a server-accessible path (somewhere down from its document root or one of the defined aliases), chances are that the source script references files which are **outside** the document scope of the web server.

Web Server Jobs

We have therefore provided two Generator jobs that address this situation, and which you can run in your application main directory. Both build on the fact that you can usually find a *common root* of all involved paths on the file system, and to use that common root as an entry point for a web server.

The *source-server* job starts a simple built-in web server that exports the common root as its document root. The *source-httpd-config* job, on the other hand, generates a web server configuration file, suitable for the most popular web servers, so you can include it with your existing web server setup. Both jobs will print on the console the URL with which you can load your source application.

Rolling your own

We recommend using one of the above jobs. But if you find yourself in the situation where you cannot utilize those, but need to work your own way through the issue, here are some hints to guide you:

- Make the *source* directory of your application accessible to the web server, so that it is reachable through a valid URL like *http://your.web.server/path/to/yourapp/source/index.html*.

- Make sure all components that are used by your application, as there are the qooxdoo SDK itself and any additional qooxdoo library or contribution that you use, are equally accessible by the web server.
  - In the case of contribs referenced through the *contrib://* pseudo protocol in your application configuration, these are downloaded and stored in the download cache directory so make sure this path is included in your considerations. Use the *info* job to find this path on your system.
- Make sure the relative paths on the web server match those on your file system, e.g. if your app lives on the file system at

  `/a/b/A/myapp`

  and your qooxdoo installation is at

  `/a/b/Z/qooxdoo-sdk`

  and the server path to your app is

  `/web/apps/myapp`

  then make sure the server path to qooxdoo is

  `/web/Z/qooxdoo-sdk`

  so that relative references like

  `../Z/qooxdoo-sdk`

  will work under the web server.

Summary

All of the above really boils down to the following: Running the source version from a web server requires having the web server root be higher in the file system hierarchy than ALL the application source root and the qooxdoo SDK root and any qooxdoo contribs you might be using, so that all libraries are accessible from the application via relative paths at the server. (It corresponds to *file://* usage if the web server root is in fact the file system root.)

4.3 Widgets Introduction

4.3.1 Widget

This is the base class for all widgets.

Features

- Integration with event system
- Focus handling
- Drag and drop
- Auto sizing
- Theming
- Tool tips
- Context menus

- Visibility handling
- Sub widget management

Description

The widget is the base class for all qooxdoo widgets. It contains the widget system's core functionality and usually consists of exactly one DOM element. Depending on its type, this element can be an image element, an iframe element or, as in most cases, a DIV element.

Demos

There are no explicit widget demos since the widget is typically sub classed.

API

Here is a link to the API of the Widget:
qx.ui.core.Widget

4.3.2 Basic Widgets

Note: This chapter introduces some of the widgets found in qooxdoo. For a full list of widgets, please refer to the *Widget Reference*.

Labels

Labels are one of the basic building blocks in applications. The qooxdoo Label supports two modes: One which combines simple single line text content with the possibility to automatically render an ellipsis in cases where not enough room is available. This is often the best choice for all types of simple labels and is the default mode in qooxdoo. Through technical restrictions it is not possible to insert HTML in a so-configured instance. The other mode allows rich content (HTML) and adds the option for multi-line content together with an advanced mechanism called *Height4Width* which automatically re-wraps content based on the available width. This mode however cannot handle automatic ellipsis (which makes less sense in multiline labels, but is also not technologically possible).

More details: *Label*

Images

The second building block of applications. The image class in qooxdoo is quite sophisticated. PNG transparency is available in all browsers. Image data (e.g. format and dimension) is automatically pre-cached by the build system and distributed to the application for optional performance (avoiding page reflow during application startup for example).

This data also makes it possible to allow semi-automatic image sprites, a feature which becomes more important in larger applications. Image sprites combine multiple images (perhaps even with multiple states) in a single image instance. Only the relevant part is shown, all other states or images are cropped. This has positive effects on the latency (e.g. number of HTTP requests needed) and also improves the runtime performance (switching a state in an image sprite is much faster than replacing the source of an image instance). Image sprites can be introduced in any application at any time without changing the application code. The original image path is automatically interpreted as

a clipped image source with the needed offsets. Please note that this feature largely depends on qooxdoo's tool chain which is required to generate the image data for the client.

A major restriction of this technology is that the options to resize images on the client side are crippled (the normal image is rendered through a background-image definition and allows no stretching at all). The alternate mode renders the image using a normal image element. This is a good alternative whenever a part of the application depends on this scaling feature but should not be used unless necessary.

More details: *Image*

Atoms

Atoms have been in qooxdoo for quite some time now. Basically, this widget combines an Image with a Label and allows some alignment options for them. Both content types are optional and toggle-able. The Atom supports shrinking like the Label while keeping the image intact. Atoms are used by many higher level widgets like Buttons (in Tab Views, Toolbars, ...) or List Items etc.

More details: *Atom*

Buttons

The Button is basically an Atom with some additional events. All relevant rendering features are already provided by the Atom. Several variants of the Button are available: Repeat, Radio or Toggle Button.

The Button can be connected to a Command (a class to work with key bindings etc.) and fires an `execute` event when clicked (or activated via the keyboard). The Repeat Button fires the `execute` event in an interval while being pressed. The Toggle Button (which toggles between checked and unchecked) is an exception to this and fires a `change` event on each transition of the `checked` property.

More details: *Button*

Text Fields

The Text Field is one of the most commonly used form elements. It fires two events: The `input` event is fired on every keystroke or other type of text modification. This event fires "live", i.e. whenever a modification is made. If the application does not need this level of detailed information, it should use the `change` event which fires after the modification is done, typically after the field has lost focus.

The Text Field supports basic label alignment to `left`, `center` or `right`. Preventing user inputs is possible through the property `enabled` or `readOnly`. Disabling a widget greys it out and makes it unresponsive for all types of interaction while `readOnly` only prevents the modification of the value and normally has no special visual indication when enabled.

More details: *TextField*

Popups

Popups and Tooltips are comparable in some way. Both are rendered above other content (while tooltips are even above Popups). Both widgets are automatically inserted into the application root widget (can be overridden when needed).

Popups may be used for notification panels or a type of modal sub dialog. Basically they are just a container (with a configurable layout) which lays above normal content.

By default, popups are automatically hidden if the user interacts with some other part of the application. This behavior is controllable through the `autoHide` property. Popups are automatically moved back inside the viewport. In fact, it

is not possible to place Popups outside the viewport (not even partly). This behavior makes sense in almost every case and improves the usability of popups in general.

With `bringToFront` and `sendToBack` the popups' zIndex can be controlled in relation to other visible popups.

More details: *PopUp*

Tooltips

Tooltips are basically Popups with an Atom in them. But Tooltips improve on many of the features of the normal Popup. The automatic positioning support as mentioned for the Popups supports offsets as well and automatically moves the Tooltip to the best possible side in relation to the mouse cursor's position.

Although it's generally not necessary, every popup can be configured with an individual timeout. This is useful when building different type of tooltips e.g. to display system notifications etc.

More details: *ToolTip*

4.3.3 Interaction

Register listeners

To register listeners to a widget or other qooxdoo object just call `addListener()` with the given event type and callback method on them. The method will be executed every time the event occurs. Some types of events will bubble up the parent widget chain (such as mouse events, ...) while others are only fired on the original object (e.g. property changes, ...). A typical registration might look like this:

```
obj.addListener("changeColor", this._onChangeColor, this);
```

The first parameter is the name of the event. The events supported by an object are listed in the API documentation of each class in the "Events" section. The second argument is a pointer to a function to call. The function can also be defined inline (in a closure). The third argument defines the context in which the function is executed. This argument is optional and defaults to the object which is listened to, e.g. a listener on a button will call a function on the button.

The method is called with the event object as the first and only argument. The event object contains all information about the target and state of the event and also contains some other useful data: Mouse events may contain mouse coordinates while focus events may contain the focused element. Data events typically contain the current value of the data field listened to.

Please note that event objects are automatically pooled after their dispatch. This is mainly for performance reasons; event objects are reused during the application runtime. That's why keeping references to event instances is not a good idea! If some of the data is needed later during the application runtime it is best to store the actual data and not the event object, e.g. store the coordinates instead of the mouse event object.

Event Phases

In the browser most user input events like mouse or keyboard events are propagated from the target element up to the document root. In qooxdoo these events bubble up the widget hierarchy. This event propagation happens in two phases, the capturing and the bubbling event phase. The last parameter of the `addListener(type, listener, context, capture)` method defines whether the listener should be attached to the capturing (`true`) or bubbling (`false`) phase.

In the capturing phase, the event is dispatched on the root widget first. Then it is dispatched on all widgets down the widget tree until the event target is reached. Now the event enters the bubbling phase. In this phase the event is dispatched in the opposite direction starting from the event target up to the root widget.

Most of the time only the bubbling phase is used but sometimes the capturing phase can be very useful. For example a capturing listener for "mousedown" events on the root widget is guaranteed to receive every "mousedown" event even if the target widget calls `stopPropagation()` on the event. Further it can be used to block events from sub widgets.

Mouse Events

qooxdoo supports all the typical mouse events: `mousedown`, `mouseup`, `click` and `dblclick` as well as `mouseover` and `mouseout`. For most action-related widgets `execute` is the better choice than `click` (see the *section about basic widgets*). All these events behave identically in all supported browsers, even the sequence in which they are fired is identical. All of them come with a usable `target` and sometimes even with a `relatedTarget` for `mouseover` and `mouseout` events.

Every mouse event propagates the screen (e.g. `getScreenLeft()`), document (e.g. `getDocumentLeft()`) or viewport (e.g. `getViewportLeft()`) coordinates through the available getters. The `getWheelDelta()` delta method provides information about the scroll amount of a `mousewheel` event. Some widgets like Spinners or SelectBoxes make use of this event already.

During every mouse event it is possible to check the status of modifier keys through the methods `isCtrlPressed()`, `isAltPressed()` or `isShiftPressed()`. The pressed button can be detected by calling one of the methods `isLeftPressed()`, `isMiddlePressed()` or `isRightPressed()` on the mouse event.

See the API documentation of the MouseEvent for a full list of all available methods.

Event Capturing

Usually only the widget underneath the mouse cursor will receive mouse events. This can be a problem in drag operations where the mouse cursor can easily leave the dragged widget. This issue can be resolved in qooxdoo by declaring this widget a capturing widget using the widget's `capture()` method.

If a widget is a capturing widget, all mouse events will be dispatched on this widget, regardless of the mouse cursor's position. Mouse capturing is active until either a different widget is set to capture mouse events, the browser loses focus or the user clicks the left mouse button. If a widget loses its capture state a `losecapture` event is dispatched on the widget.

Internally, qooxdoo uses mouse capturing in menus, split panes or sliders for example.

Keyboard Support

DOM3-like event handling was the prototype for qooxdoo's key event support. This means that key identifiers can be used (instead of non-unified key codes) which is much more comfortable than what is known from most web application frameworks. Basically each key on the keyboard has a name like `Ctrl`, `Shift`, `F3` or `Enter`. A complete list of all supported keys is available in the API documentation.

All the typical key sequence events `keyup`, `keydown` and `keypress` support the key identifier. The `keypress` event is repeated during the time the key is pressed. That's why `keypress` is the best candidate for most action related keyboard events. Only use `keyup` and `keydown` when you *really* depend on the status of the key.

To handle character inputs e.g. on text boxes, there is a special `keyinput` event which has nice unified accessors, `getChar()` and `getCharCode()`, to detect the pressed character. This even automatically respects the effects modifier keys have, supporting e.g. German umlauts. The API lists all available methods of the KeyInput event.

Working with Commands

Commands (API) are used to bundle a command to be used by multiple buttons. They can also be used to define a global shortcut to be used for this action.

Creating new commands is as easy as it can be. A shortcut can simply be defined through the constructor, e.g.:

```
var find = new qx.event.Command("Ctrl+F");
find.addListener("execute", this._onFind, this);
```

The command can easily be attached to many types of Buttons etc. Some of them, like the `MenuButtons`, automatically display the configured shortcut as well. As seen above, the Commands also make use of the key identifiers.

Focus Handling

Good keyboard support also means good focus support. One major feature is the seamless integration between DOM focus handling and qooxdoo's focus handling. Both system communicate with each other. This makes it possible to integrate qooxdoo into normal web pages while still supporting the advanced focus features qooxdoo has to offer in qooxdoo-powered isles.

Focus handling in qooxdoo also means sophisticated support for the `Tab` key. While qooxdoo can also use the functionality provided by the browser, it adds its own layer for tab focus handling by default. This layer supports focus roots: A focus root is basically a widget which manages its own tab sequence. This is frequently used for many types of windows inside complex applications: Instead of leaving the window when reaching the last of its child widgets, the focus is moved back to the first child widget. The tab handling in qooxdoo is based on coordinates of each widget on the screen. It follows the visible structure and not the internal application (or even markup) structure. This is often seen as a huge benefit as it improves the usability of such applications out-of-the-box. It is also possible to define a `tabIndex` on widgets which should be reachable in a static hard-coded way. It is not advisable to use this feature too much. The automatic handling works quite well out of the box without hard-wiring every widget to a specific tab position.

To make a widget focusable just enable the property `focusable` (API) on it. For most widgets, this will also means that the widget is reachable using the `Tab` key, but this depends on the widget's implementation of the method `isTabable()`.

Every widget can function as a focus root. To register a widget as a focus root just call the method `addRoot()` of the `FocusHandler` like this:

```
qx.ui.core.FocusHandler.getInstance().addRoot(myWidget);
```

Activation is related to focus. While focus is limited to widgets which are marked as `focusable`, any widget can be activated. Usually, the activation moves around while clicking on widgets (during the `mouseup` event). The focus is applied to the next focusable parent while the activation directly happens on the widget that was clicked on. Activation is mainly used for keyboard support (key events start bubbling from the active widget). Compared to the focus, there is no visual highlighting for this state. To change the currently focused or active widget just call `focus()` or `activate()`:

```
myInputField.focus();
```

The properties `keepFocus` and `keepActive` are targeted more towards advanced users and developers of custom widgets. Both prevent the focus or active state from moving away (from the widget that currently has it) to the widget which has the specified property disabled. This is appropriate for complex widgets like a ComboBox where the activation should be kept on the ComboBox itself when selecting items from the dropdown list.

4.3.4 Resources

Resources comprise images, icons, style sheets, Flash files, helper HTML files, and so forth. The framework itself provides many icons and some other useful resources you can use right away in your application without any customization. This article however explains how to specify and use custom resources for your application.

Technical overview

Resources live in the `source/resource/<namespace>` subtree of each library. You explicitly reference a resource in your application code by just naming the path of the corresponding file **under** this root (This is also referred to as the **resource id**).

So if there is a resource in your "myapp" application under the path `myapp/source/resource/myapp/icons/tray.png` you would refer to it in your application code with `myapp/icons/tray.png`.

To find the corresponding file during a build, qooxdoo searches all those paths of all the libraries your application is using. The first hit will be regarded as the resource you want to use. (During the generation of a `build` version of your app, these resource files will be copied to the `build` folder, so your build version will be self-contained).

The libraries are searched in the order they are declared in your config.json file. This usually means that your own resource folder comes first, then the framework's resource folder, and then the resource folders of all further libraries you have included. This way, you can *shadow* resources of like names, e.g. by adding a file `qx/static/blank.gif` under your source/resource folder you will shadow the file of the same resource id in the framework.

Declaring resources in the code

You have to declare the resources you wish to use in your application code in an `@asset` compiler hint near the top of your source file.

```
/**
 *
 * @asset(myapp/icons/16/folder-open.png)
 */
```

This is essential, since these hints are evaluated during the compile step, which searches for the corresponding files, generates appropriate URIs to them and copies them to the `build` folder.

Instead of adding meta information for each individual resource, you may as well use simple (shell) wildcards to specify a whole set of resources:

```
/**
 *
 * @asset(myapp/icons/16/*)
 */
```

This is all you need to configure if your application code uses any of the icons in the given folder.

Using resources with widgets

Once you've declared the resource in your code, you can equip any compatible widget with it.

Here's an example:

```
var button = new qx.ui.form.Button("Button B", "myapp/icons/16/folder-open.png");
```

Using qooxdoo icons with widgets

If you want to use some of the icons as resources that are part of the icon themes that come with qooxdoo, there are the following ways to do so:

1. Use the explicit resource ID of the icons from the *qx* namespace. The icons are then taken from the framework resource folder, and contain the icons' theme name explicitly.
2. Use a macro to get the icons from the current theme. This would allow for a later change of icon themes at the config file level, without the need to adjust any resource IDs in your application code. The *Generator documentation* explains how to declare these macros.
3. Copy the icons you are interested in from the original location in the qooxdoo framework to the local resource folder of your application. You are now independent of the qooxdoo icon theme folders and can manage these icons as you would with any other custom images.

```
/**
 * @asset(qx/icon/Oxygen/16/apps/utilities-dictionary.png)
 * @asset(qx/icon/${qx.icontheme}/16/apps/utilities-dictionary.png)
 * @asset(myapp/icons/16/utilities-dictionary.png)
 */

...

var button1 = new qx.ui.form.Button("First Button",
       "qx/icon/Oxygen/16/apps/utilities-dictionary.png");
var button2 = new qx.ui.form.Button("Second Button",
       "icon/16/apps/utilities-dictionary.png");
var button3 = new qx.ui.form.Button("Third Button",
       "myapp/icons/16/utilities-dictionary.png");
```

(The constructor call for *button2* also relies on a resource alias to hide the current icon theme).

When you use the asset macro variant the used theme and the used icon theme need to be in sync. The default icon set for most themes is *Tango*, but if you want to use the *Classic* theme make sure that icons from the *Oxygen* icon theme are used. You can achieve this by editing your *config.json* like this:

```
{
  "name"    : "myapp",

  ...

  "let" :
  {
    "APPLICATION"  : "myapp",
    ...
    "QXTHEME"      : "qx.theme.Classic",
    "QXICONTHEME"  : ["Oxygen"],
    ...
    "ROOT"         : "."
  }
}
```

Obtaining the URL for a resource

To obtain a URL for a resource, use the ResourceManager:

```
var iframe = new
qx.ui.embed.Iframe(qx.util.ResourceManager.getInstance().toUri("myapp/html/FAQ.htm"));
```

Modifying the resource or script URIs at runtime

In some usage scenarios, it can be necessary to modify the URIs used to reference code and resources after the application was started. This can be achieved using the Library Manager:

```
qx.util.LibraryManager.getInstance().set("myapp", "resourceUri", "http://example.com/resources");
qx.util.ResourceManager.getInstance().toUri("myapp/html/FAQ.htm"); //returns "http://example.com/reso
```

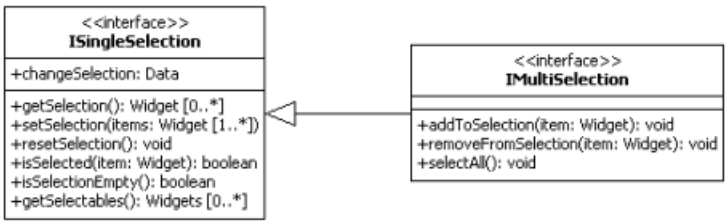
4.3.5 Selection Handling

The framework contains several widgets which support selection handling. These are divided into widgets that support `Single Selection` and others that support `Multi Selection`. A widget which supports multi selection also supports single selection.

Here is a list of widgets which support single and/or multi selection:

- Multi Selection:
  - Tree (API)
  - List (API)
- Single Selection:
  - SelectBox (API)
  - RadioGroup (API)
  - TabView (API)
  - Stack (API)

Selection Interfaces



Event

Both selections fire a `changeSelection` event if the selection has changed. Listeners can register with the event to be notified about the changes. The event contains an array with the newly selected widgets. If the array is empty, that means no widgets are selected.

```
list.addListener("changeSelection", function(e)
{
  var selection = e.getData();
  for (var i = 0; i < selection.length; i++) {
    this.debug("Selected item: " + selection[i]);
  }
}, this);
```

Selection Methods

The `ISingleSelection` interface specifies the methods for single selection handling. Since the methods of the single selection interface are re-used, the `IMultiSelection` only extends the interface with methods for multi selection handling.

Re-using the methods requires a uniform handling for setting and getting the current selection. This has been achieved by using an array for the selection handling, see `setSelection` and `getSelection`.

Single Selection

The listed single selection widgets above implement the `ISingleSelection`. To implement the behavior they use the MSingleSelectionHandling mixin. This mixin offers the methods for selection handling and also initializes the manager for selection management.

The widget itself configures the mixin to allowing an empty selection or not. Dependent on the configuration, `resetSelection` clears the current selection (empty array) or selects the first selectable element.

User interactions (mouse and keyboard) are managed from the widget, which only calls the selection methods if the user interaction has an effect on the selection. So the selection management and the user interaction handling are separated. This is one thing that has changed with the new selection API.

Multi Selection

The multi selection implementation has hardly changed at all. The widgets supporting multi selection, also listed above, have already used a mixin called MSelectionHandling for selection handling. Like the mixin for the single selection, it offers the selection methods and initializes the selection manager. The mixin has only been changed to conform to the new `IMultiSelection` interface.

Selection Modes

Due to the small changes the configuration for the selection mode hasn't changed. The widgets also support the property `selectionMode` with these different modes:

- **single:** Only one element or none at all can be selected.
- **one:** Exactly one item is selected if possible. The first selectable item is selected per default.
- **multi:** Multiple items can be selected by using the modifier keys together with mouse or keyboard actions. This type also allows empty selections.
- **adaptive:** Easy Web-2.0 selection mode: multiple items can be selected without modifier keys. Empty selections are possible.

Note: *Multi* and *Adaptive* selections dealing with **selection ranges**, *Single* and *One* dealing with one **selected item**.

```
list.setSelectionMode("multi");
```

Selection Options

These options change the way a selection is created or modified. By default, items can be selected by holding down the mouse button and hovering them or by holding down the modifier key and pressing the arrow keys to traverse them.

- **Quick:** One item can be selected by hovering it (no need to click on it or hit keys) Only possible for the modes *single* and *one*.
- **Drag:** Multiselection of items through dragging the mouse in pressed states. Only possible for the modes *multi* and *additive*.

```
list.setDragSelection(true);
```

How to use the selection API

Single Selection

The example below shows how to use the single selection API. This example uses the SelectBox widget:

```
// creates the SelectBox
var selectBox = new qx.ui.form.SelectBox();
this.getRoot().add(selectBox, {top: 20, left: 20});

// registers the listener
selectBox.addListener("changeSelection", function(event) {
  this.debug("Selected (event): " + event.getData()[0].getLabel());
}, this);

// creates the items and select one of them
for (var i = 0; i < 10; i++)
{
  var item = new qx.ui.form.ListItem("ListItem" + i);
  selectBox.add(item);

  if (i == 5) {
    selectBox.setSelection([item]);
  }
}

this.debug("Selected (selectBox): " + selectBox.getSelection()[0].getLabel());
```

The output should be:

```
(1) Selected (event): ListItem0
(2) Selected (event): ListItem5
(3) Selected (selectBox): ListItem5
```

The SelectBox's implementation doesn't allow empty selections, so if the first item is added to the SelectBox it will be selected (1). (2) occurs due to the selection and (3) from `getSelection`.

Multi Selection

The next example uses the List widget:

```
// creates the List and sets the selection mode
var list = new qx.ui.form.List();
list.setSelectionMode("multi");
this.getRoot().add(list, {top: 20, left: 20});

// registers the listener
list.addListener("changeSelection", function(event) {
  this.debug("Selection (event): " + event.getData());
}, this);

// creates the items
for (var i = 0; i < 10; i++)
{
  var item = new qx.ui.form.ListItem("ListItem" + i);
  list.add(item);
}

// sets selection
list.setSelection([list.getChildren()[1], list.getChildren()[4]]);

this.debug("Selection (list): " + list.getSelection());
```

The output should look like this:

```
(1) Selection (event): qx.ui.form.ListItem[1p],qx.ui.form.ListItem[2a]
(2) Selection (list): qx.ui.form.ListItem[1p],qx.ui.form.ListItem[2a]
```

4.3.6 Drag & Drop

Drag & Drop is one of the essential technologies in today's applications. An operation must have a starting point (e.g. where the mouse was clicked), may have any number of intermediate steps (widgets that the mouse moves over during a drag), and must either have an end point (the widget above which the mouse button was released), or be canceled.

qooxdoo comes with a powerful event-based layer which supports drag&drop with full data exchange capabilities. Every widget can be configured to cooperate with drag&drop be it as sender (draggable), receiver (droppable) or both. A sender (drag target) can send data to any receiver (drop target).

You may like to see an example first:

- Drag&Drop for Lists

Basics

To enable Drag & Drop the properties draggable and droppable must be enabled on the specific widgets. For list type sources or targets it's often enough to make the top-level widget drag- or droppable e.g. the list instead of the list items.

```
var dragTarget = new qx.ui.form.List;
dragTarget.setDraggable(true);

var dropTarget = new qx.ui.form.List;
dropTarget.setDroppable(true);
```

The basic drag&drop should start working with these properties enabled, but it will show the no-drop cursor over all potential targets. To fix this one needs to register actions (and optionally data types) supported by the drag target. This can be done during the `dragstart` event which is fired on the drag target:

```
dragTarget.addListener("dragstart", function(e) {
  e.addAction("move");
});
```

The drop target can then add a listener to react for the `drop` event.

```
dropTarget.addListener("drop", function(e) {
  alert(e.getRelatedTarget());
});
```

The listener now shows an alert box which should present the identification ID (classname + hash code) of the drag target. Theoretically this could already be used to transfer data from A to B.

Data Handling

qooxdoo also supports advanced data handling in drag&drop sessions. The basic idea is to register the supported drag data types and then let the drop target choose which one to handle (if any at all).

To register some types write a listener for `dragstart`:

```
source.addListener("dragstart", function(e)
{
  e.addAction("move");

  e.addType("qx/list-items");
  e.addType("html/list");
});
```

This is basically only the registration for the types which could theoretically be delivered to the target. The IDs used are just strings. They have no special meaning. They could be identical to typical mime-types like `text/plain` but there is no need for this.

The preparation of the data (if not directly available) is done lazily by the `droprequest` event which will explained later. The next step is to let the target work with the incoming data. The following code block appends all the dropped children to the end of the list.

```
target.addListener("drop", function(e)
{
  var items = e.getData("qx/list-items");
  for (var i=0, l=items.length; i<l; i++) {
    this.add(items[i]);
  }
});
```

The last step needed to get the thing to fly is to prepare the data for being dragged around. This might look like the following example:

```
source.addListener("droprequest", function(e)
{
  var type = e.getCurrentType();

  if (type == "qx/list-items")
  {
    var items = this.getSelection();

    // Add data to manager
    e.addData(type, items);
  }
```

```
  else if (type == "html/list")
  {
    // TODO: support for HTML markup
  }
});
```

Support Multiple Actions

One thing one might consider is to add support for multiple actions. In the above example it would be imaginable to copy or move the items around. To make this possible one could add all supported actions during the `drag` event. This might look like the following:

```
source.addListener("dragstart", function(e)
{
  // Register supported actions
  e.addAction("copy");
  e.addAction("move");

  // Register supported types
  e.addType("qx/list-items");
  e.addType("html/list");
});
```

The action to use is modifiable by the user through pressing of modifier keys during the drag&drop process. The preparation of the data is done through the `droprequest` as well. Here one can use the action (call `e.getCurrentAction()` to get the selected action) to apply different modifications on the original data. A modified version of the code listed above might look like the following:

```
source.addListener("droprequest", function(e)
{
  var action = e.getCurrentAction();
  var type = e.getCurrentType();
  var result;

  if (type === "qx/list-items")
  {
    result = this.getSelection();

    if (action == "copy")
    {
      var copy = [];
      for (var i=0, l=result.length; i<l; i++) {
        copy[i] = result[i].clone();
      }
      result = copy;
    }
  }
  else if (case == "html/list")
  {
    // TODO: support for HTML markup
  }

  // Remove selected items on move
  if (action == "move")
  {
    var selection = this.getSelection();
    for (var i=0, l=selection.length; i<l; i++) {
```

```
      this.remove(selection[i]);
    }
  }

  // Add data to manager
  e.addData(type, result);
});
```

As known from major operating systems, exactly three actions are supported:

- move
- copy
- alias

which could be combined in any way the developer likes. qooxdoo renders a matching cursor depending on the currently selected action during the drag&drop sequence. The event dragchange is fired on the source widget on every change of the currently selected action. It is also fired on the target and is cancelable which enables the developers to allow only certain actions on targets.

Runtime checks

There are a few other pleasantries. For example it is possible for droppable widgets to ignore a specific incoming data type. This can be done by preventing the default action on the incoming dragover event:

```
target.addListener("dragover", function(e)
{
  if (someRunTimeCheck()) {
    e.preventDefault();
  }
});
```

This could be used to dynamically accept or disallow specific types of drop events depending on the application status or any other given condition. The user then gets a nodrop cursor to signal that the hovered target does not accept the data. To query the source object for supported types or actions one would call the methods supportsAction or supportsType on the incoming event object.

Something comparable is possible during the dragstart event:

```
source.addListener("dragstart", function(e)
{
  if (someRunTimeCheck()) {
    e.preventDefault();
  }
});
```

This prevents the dragging of data from the source widget when some runtime condition is not solved. This is especially useful to call some external functionality to check whether a desired action is possible. In this case it might also depend on the other properties of the source widget e.g. in a mail program it is possible to drag the selection of the tree to another folder, with one exception: the inbox. This could easily be solved with such a feature.

Drag Session

During the drag session the drag event is fired for every move of the mouse. This event may be used to "attach" an image or widget to the mouse cursor to indicate the type of data or object dragged around. It may also be used to render a line during a reordering drag&drop session (see next paragraph). It supports the methods getDocumentLeft and getDocumentTop known from the mousemove event. This data may be used for the positioning of a cursor.

When hovering a widget the `dragover` event is fired on the "interim" target. When leaving the widget the `dragleave` event is fired. The `dragover` is cancelable and has information about the related target (the source widget) through `getRelatedTarget` on the incoming event object.

Another quite useful event is the `dragend` event which is fired at every end of the drag session. This event is fired in both cases, when the transaction has modified anything or not. It is fired when pressing Escape or stopping the session any other way as well.

A typical sequence of events could look like this:

- `dragstart` on source (once)
- `drag` on source (mouse move)
- `dragover` on target (mouse over)
- `dragchange` on source (action change)
- `dragleave` on target (mouse out)
- `drop` on target (once)
- `droprequest` on source (normally once)
- `dragend` on source (once)

Reordering Items

Items may also be reordered inside one widget using the drag&drop API. This action is normally not directly data related and may be used without adding any types to the drag&drop session.

```
reorder.addListener("dragstart", function(e) {
  e.addAction("move");
});

reorder.addListener("drop", function(e)
{
  // Using the selection sorted by the original index in the list
  var sel = this.getSortedSelection();

  // This is the original target hovered
  var orig = e.getOriginalTarget();

  for (var i=0, l=sel.length; i<l; i++)
  {
    // Insert before the marker
    this.addBefore(sel[i], orig);

    // Recover selection as it gets lost during child move
    this.addToSelection(sel[i]);
  }
});
```

4.3.7 Inline Widgets

This page describes how you can use qooxdoo widgets inside HTML-dominated pages. This use case is different from creating a regular, "standalone" qooxdoo application.

Target Audience

Integrating qooxdoo widgets into existing HTML pages could be interesting to all users who already have (many) existing pages, often some kind of "portal", and therefore don't want to transform these into a standalone rich Internet application (RIA).

Online Demos

Take a look at the online demos to see the use of inline widgets in action.

- Absolute positioning demo
- Page flow using Inline
- Dynamic resize for Inline
- Inline window

Set Up An Inline Application

An inline application is set up by using the `create-application` script described in the *Hello World* section. You just have to add the additional option `-t` with the value `inline` and you're done.

```
/opt/qooxdoo-sdk/tool/bin/create-application.py -n myapp -t inline
```

Once executed you get a skeleton application which is ready-to-use to develop an inline application. The skeleton also demonstrates the different integration approaches which are described in the next section.

Ways of Integration

There are basically two ways to integrate a qooxdoo widget into an existing HTML-dominated page:

- positioning a widget with absolute coordinates (maybe overlaying existing content)
- adding the widget within the page flow by using an existing DOM node as an isle

Which way you should choose depends on what you wish to achieve. Technically both share the same foundation.

Instead of using `qx.application.Standalone` as a base application class you need to extend from `qx.application.Inline` as a starting point. So basically your (empty) application looks like this:

```
qx.Class.define("myPortal.Application",
{
  extend : qx.application.Inline,

  members :
  {
    main: function()
    {
      this.base(arguments);

      // your code follows here
    }
  }
});
```

Absolute Positioning

Adding a widget to the page without regarding the page flow is a no-brainer. Just create the desired widget and add it to the application root. As the application root is an instance of qx.ui.layout.Basic you can only use `left` and `top` coordinates to position your widgets.

Note: Absolute positioning requires no existing DOM node in the target document.

```
qx.Class.define("myPortal.Application",
{
  extend : qx.application.Inline,

  members :
  {
    main: function()
    {
      this.base(arguments);

      // add a date chooser widget
      var dateChooser = new qx.ui.control.DateChooser();

      // add the date chooser widget to the page
      this.getRoot().add(dateChooser, { left : 100, top : 100 });
    }
  }
});
```

Page Flow

However, the former solution won't fit for e.g. a portal where the page is divided into several parts. In this case you won't have any absolute coordinates you could work with reliably.

To add widgets at certain locations inside the page you can create or reuse DOM nodes which act as islands where the qooxdoo widgets live in regard to the page flow.

Note: You need to define specific DOM nodes in your document which act as islands for the qooxdoo widgets.

Additionally if you use the dynamic mode (automatic resizing) it is important that the used DOM node is **not** styled using CSS rules concerning the *width* and *height* attribute. Instead style your DOM node with inline styles, otherwise the dynamic resizing won't work correctly.

```
qx.Class.define("myPortal.Application",
{
  extend : qx.application.Inline,

  members :
  {
    main: function()
    {
      this.base(arguments);

      // create the island by connecting it to the existing
      // "dateChooser" DOM element of your HTML page.
      // Typically this is a DIV as in <div id="dateChooser"></div>
```

```
      var dateChooserIsle = new qx.ui.root.Inline(document.getElementById("dateChooser"));

      // create the date chooser widget and add it to the inline widget (=island)
      var dateChooser = new qx.ui.control.DateChooser();
      dateChooserIsle.add(dateChooser);
    }
  }
});
```

4.3.8 Custom Widgets

Most widgets are built using a combination of pre-existing, more basic widgets. This is also true for custom widgets made for a specific application or as an extension to the existing feature set of qooxdoo.

Inheritance Structure

A more complex widget usually extends the base class `qx.ui.core.Widget`. A widget can manage children using a set of protected methods. Extending from a richer widget often has the side effect that the final class contains APIs which do not make sense in the derived class anymore. Also be sure not to extend from `Composite` or a widget based on this class. This is mainly because it has public methods for the normally internal layout and children handling and would propagate all the internal information to the outside when children are added or the layout is modified by the derived class.

A good example: Most rich text editors implemented in JavaScript make use of an iframe. One could imagine using the `Iframe` class as a base to build such a component. The problem is that most of the methods and properties like `setSource` or `reload` do not make a lot of sense on an editor component. It's better to embed the needed widgets into the outer widget to hide their functionality in the custom class.

The qooxdoo `Spinner` for example extends the `Widget` as well and adds a `TextField` and two `RepeatButton` instances. The layout is done by a Grid layout. All the children and the chosen layout are hidden from the outside. There are no public accessors for the layout or the children. This makes sense as no one is interested in the children of a `Spinner` widget. These methods would also mean a lot of bloat added to the API of such an widget.

Setup Content

For a Widget

The following methods may be used to manage children:

- `_getChildren`
- `_add`, `_addAt`, `_addBefore`, `_addAfter`
- `_remove`, `_removeAt`, `_removeAll`

It is possible to use any layout available. To set up the layout just use `_setLayout`. To access it afterwards use `_getLayout`.

For details refer to the API documentation of qx.ui.core.Widget.

For a Container

If the custom widget is a container widget, the author has to decide:

- Whether the children will be added directly to the widget or into some nested sub widget.
- Whether the user should be able to set a layout manager

This results in four possible combinations:

1. **The children are added directly to the container and setting a layout manager is possible:** Inherit from qx.ui.container.Composite. This class has the whole children and layout handling API exposed as public API.
2. **The children are added directly to the container but setting a layout manager is not possible:** Inherit from qx.ui.core.Widget and add the children handling API by including the mixin qx.ui.core.MChildrenHandling. (Example: HBox widget with predefined horizontal box layout)
3. **The children are added to a nested sub widget and setting a layout manager is possible:** Inherit from qx.ui.core.Widget and add the children and layout handling API by including the mixins qx.ui.core.MRemoteChildrenHandling and qx.ui.core.MRemoteLayoutHandling. The container must implement the method getChildrenContainer, which has to return the widget, to which the child widgets should be added. (Example: Window, Groupbox)
4. **The children are added to a nested sub widget and setting a layout manager is not possible:** The same as the previous case but don't include qx.ui.core.MRemoteLayoutHandling. (Example: List, SelectBox)

Child Controls

qooxdoo supports a mechanism called child controls. A child control is a widget as part of another widget. Child controls were introduced to have a common way of accessing these controls and to make it easy to refine them when a class should be extended. Each child control is accessible using an identifier which is basically a string. By convention these strings are all lower-case and use dashes to structure complex identifiers. Typical identifiers are `button`, `icon` or `arrow-up`. Never use slashes (`/`) as this might conflict with the appearance system.

Instances for the supported child controls are created dynamically as needed. A widget developer just needs to override the method `_createChildControlImpl`, let the method work on the customized controls, and just call the super class method when the incoming ID is not supported. For example, such a method might look like:

```
_createChildControlImpl : function(id)
{
  var control;

  switch(id)
  {
    case "icon":
      control = new qx.ui.basic.Image;
      this._add(control);
      break;
  }

  return control || this.base(arguments, id);
}
```

Each child control should directly add itself to the parent. As mentioned before child controls are automatically created as needed. This basically means that if nobody asks for a specific child control it is never created or added. This is an important feature for dynamic widgets as it reduces the initial memory and CPU usage. A child control is always created when some code asks for it. This can happen through different methods:

- `getChildControl(id, notcreate)`: Returns the child control with the given ID. May return `null` if the second argument is `true`. This is basically used to check if the child control has already been created and then apply something to it. In some more complex scenarios this makes sense, but it can be ignored for the moment.
- `_showChildControl(id)`: Executes `show()` on the child control. This method also creates the control if that hasn't happened yet. It also returns the control so other properties can be applied to it.
- `_excludeChildControl(id)`: Excludes the widget using `exclude()`. When the control is not yet created the function does nothing. The method has no return value.
- `_isChildControlVisible(id)`: Returns `true` if the child control with the given ID is created and visible.
- `hasChildControl(id)`: Returns `true` if the child control with the given ID has been created.

Styling

Child controls are automatically supported by the appearance system. For every child control a selector is generated which starts with the first widget which is not a child control itself. Typical selectors look like:

- `spinner/up-button`
- `groupbox/legend`
- `tree-item/icon`

As a container for child controls may be a child control for another container as well, even more complex selectors are possible:

- `list/scrollbar-x/slider`
- `splitbutton/button/icon`

This means that even the deepest child control can be easily accessed by theme authors. Widget authors should define the styling of a widget in the appearance theme and not in the widget itself. The widget and the `_createChildControlImpl` method should only apply functional properties like `zIndex` or `tabIndex`, but no decorations, colors or fonts for example.

As mentioned, a key always starts with the appearance of the first widget which is not itself a child control. Appearance values of the inner widgets are ignored as long as they are used as a child control. Instead, the ID of the child control is used. The `/` is used to separate the child controls. All widgets added through user code start with their own appearance. For example, the items of the `List` widget have the appearance `list-item`. Their appearance key is also `list-item` and not `list/item`.

For details about styling please refer to *the theming article*.

HTML Elements

A normal qooxdoo widget consists of one HTML Element (API), the content element.

This elements is an instances of `qx.html.Element` so it come with a cross-browser fixed API to apply styles and attributes to the DOM node. All of these things can be done without the DOM element needing to be created or inserted. For details on `qx.html.Element` please have a look at *the technical documentation*.

The element is accessible through the functions `getContentElement()` and is stored privately in each widget instance.

Custom Elements

qooxdoo normally generates a bunch of styled `div` elements. Some widgets like iframes or images need other elements, though. To use a different DOM element, the method `_createContentElement` needs to be overwritten. The overwritten method should create an instance of `qx.html.Element` (or a derived class), configure it with some static attributes or styles, and finally return it. For most natively supported types there exists a class which can be used already. In special cases the widget author also needs to write a special low-level class which is derived from `qx.html.Element`.

Working with Events

Events can be added to the HTML element as well as to the child controls. The names of the methods assigned should follow the following names for convention.

- For the HTML elements use: `_onContentXXX`
- For the child controls use: `_onIconXXX` or `_onFieldXXX` etc.

Where `XXX` stands for the name of the event or of the change that happens. This will result in names like `_onIframeLoad` or `_onContentInput`.

Anonymous Widgets

Anonymous widgets are ignored in the event hierarchy. This is useful for combined widgets where the internal structure does not have a custom appearance with a different styling from the enclosing element. This is especially true for widgets like checkboxes or buttons where the text or icon are handled synchronously for state changes to the outer widget.

A good example is the `SelectBox` widget where the `mouseover` event should affect the entire widget at once and not the different child controls of which it consists. So setting the child controls (in this case an `atom` and an `image` widget) to `anonymous` keeps these child control widgets from receiving any events and the event handling is done completely by the parent widget (the `SelectBox` itself).

Defining the API

The number of constructor parameters should be kept short. Long parameter lists especially with optional parameters can result in code, which is very hard to read. As an example lets take this hypothetical LinkAtom widget:

```
qx.Class.define("custom.LinkAtom", {
  extend : qx.ui.basic.Atom,

  construct : function(text, icon, toolTipText, underline, bold, wrap, underlineOnMouseover) { ... }
});
```

All parameters are optional. This can make the code using this class very hard to read:

```
var link = new custom.LinkAtom("Help");
var link = new custom.LinkAtom("create", null, null, false, true, false, true);
```

While the first line is perfectly readable, it is virtually impossible to understand the second line without referring to the API documentation of LinkAtom.

In this case it helps to keep only those parameters, which are required or used with almost every instance. All other parameters should be converted into properties:

```
qx.Class.define("custom.LinkAtom", {
  extend : qx.ui.basic.Atom,

  construct : function(text, icon) { ... },

  properties {
    toolTipText: { ... },
    underline: { ... },
    bold: { ... },
    wrap: { ... },
    underlineOnMouseover: { ... }
  }
});
```

Now only the text and icon parameter remain in the constructor. All other parameters have been converted into properties. The hard to read example now becomes:

```
var link = new custom.LinkAtom("create").set({
  underline: false
  bold: true,
  wrap: false,
  underlineOnMouseover: true
});
```

For someone reading this code it is immediately obvious, what's happening.

Note: Keep parameter lists small and use properties instead of optional constructor parameters.

4.3.9 Form Handling

The `qx.ui.form` package contains several classes for the construction of forms. Some widgets – like `Button`, `List` or `TextField` – may look familiar if you have worked with HTML before, but this package also contains more complex widgets that you may know from your operating system and/or native desktop applications (e.g. `Spinner`, `Slider` or `DateField`).

Idea

The idea of the form API is to make handling of form widgets as simple as possible, but also as generic as possible within the entire framework. There has been a thorough discussion on what would be the best solution and how to design a solid API. This is what we ended up with.

Demos

If you like to see some of qooxdoo's form management in action, take a look at the following samples in the demo browser:

Widgets

- All form widgets
- All form widgets with invalid states

Validation and Resetting

- Synchronous and asynchronous form validation
- Validation on different pages

Rendering

- Single column form
- Double column form
- Single column form using placeholders
- Custom form layout

Data Binding

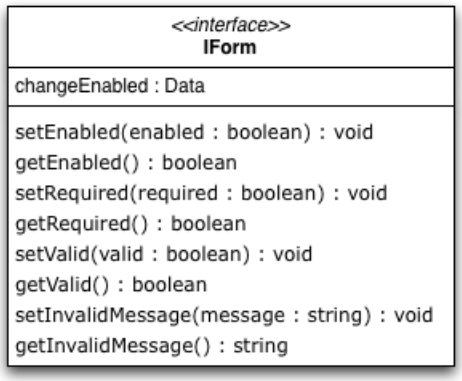
- Manual form binding
- Form Controller

Interfaces

The entire form API is defined by a couple of interfaces. These interfaces contain the most important methods and events for the form widgets. The following listing shows the interfaces, their purpose and how you can benefit from them.

Form

The interface `qx.ui.form.IForm` defines a set of methods and events for every visible form widget. It contains the listed events and methods.



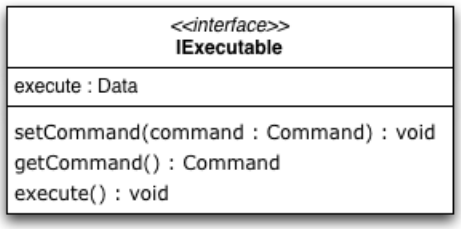
As you can see, the interface defines accessors for four different properties.

- The enabled property is usually inherited from the widget class and is used to deactivate a form element.
- The required property is just a boolean flag signaling that the form widget is required. This can be used by some kind of form manager or parent widget to display the status of the widget.

- The valid property is a boolean flag containing `true` if the content of the widget is valid, but the form widgets do not have any kind of code to set this property. It needs to be set from outside. If it is set to `false`, the appearance will change automatically to properly signal the invalid state.
- The invalidMessage property should contain a message which will be shown in a tooltip if the valid flag is set to `false`. If no message is given, no tooltip will appear.

Executable

The `qx.ui.form.IExecutable` interface defines the essential components for all executable widgets. The best example for an executable widget is a button. It defines the following events and methods.

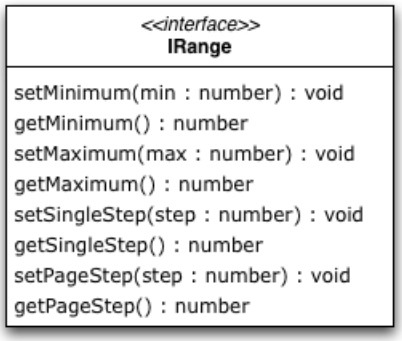


As you can see, the interface defines accessors for only one property.

- The command property can take a `qx.event.Command`. The execute method executes the given command.

Range

The `qx.ui.form.IRange` interface defines the essential components for all widgets dealing with ranges. It defines the following methods.



As you can see, the interface defines accessors for four properties.

- The minimum value of the range is defined by the Minimum property.
- The maximum value of the range is defined by the Maximum property.
- Each range has a single step value which is defined by the SingleStep property.
- Like the single step, there is a page step for every range which is defined by the PageStep property.

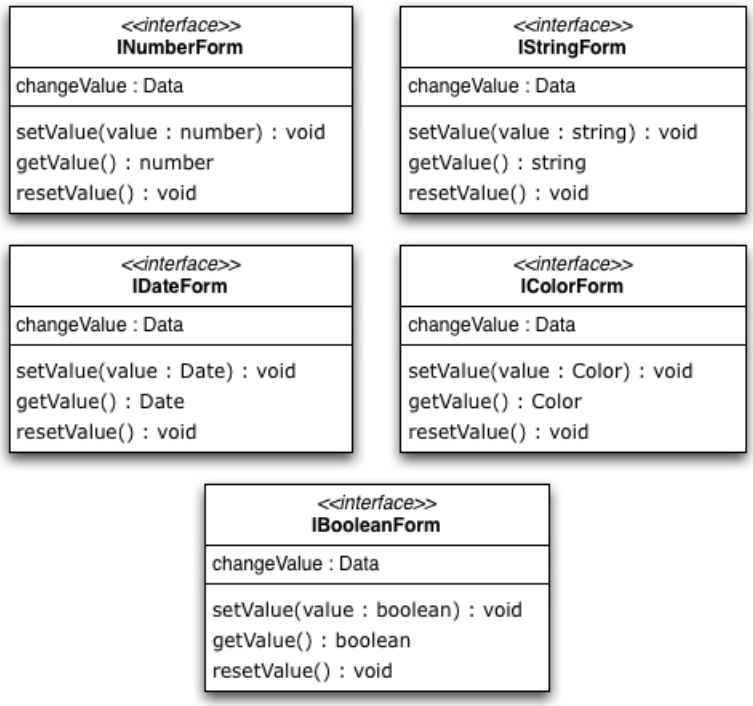
Number / String / Color / Date / Boolean

Each of the listed interfaces define the same methods and events. The only difference in the interfaces is - as the name says - the type of the data processed by the implementing widget. With that solution, we have the same API for every form widget but can still determinate which type of value the widget expects by checking for the different interfaces.

Interfaces

- Number : `qx.ui.form.INumberForm`
- String : `qx.ui.form.IStringForm`
- Color : `qx.ui.form.IColorForm`
- Date : `qx.ui.form.IDateForm`
- Boolean : `qx.ui.form.IBooleanForm`

The color interface takes a string which has to be formatted like the common colors in qooxdoo.

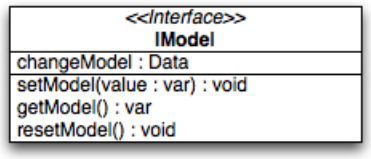


As you can see, the interface can be implemented with only one property.

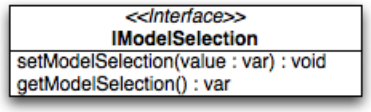
- The value property takes the value of the widget. This is for example a boolean in a checkbox widget or a string in a text field widget.

Model / ModelSelection

Most of the form items handling a selection had a value property in the old API. We replaced that with a model property since the value property is used for user input values. The methods for accessing the model data are defined in an interface called `qx.ui.form.IModel`.



The model property can be used to store additional data which is represented by the widget. The data does not need to be a string like in the old value property. You can store references to objects, numbers, strings and so on. Accessing the model is very easy. Every widget containing a widget implementing the `qx.ui.form.IModel` interface has its own interface to access the current selected model.



As you can see in the diagram, you can get the currently selected model and also set the selection using the models.

Widgets

The following listing shows the form widgets and their corresponding interfaces. To see more details about a widget, take a look at the *widgets* documentation.

Sample Usage

The first example is a simple one, showing how to use two widgets implementing the `IStringForm` interface:

```
// create and add a textfield
var textfield = new qx.ui.form.TextField();
this.getRoot().add(textfield, {left: 10, top: 10});

// create and add a label
var label = new qx.ui.basic.Label();
this.getRoot().add(label, {left: 10, top: 40});

// set the text of both widgets
textfield.setValue("Text");
label.setValue("Text");
```

The second example shows how to react on a change in a widget implementing the `INumberForm` interface. The value of the slider will be shown as a label:

```
// create and add a slider
var slider = new qx.ui.form.Slider();
slider.setWidth(200);
this.getRoot().add(slider, {left: 10, top: 10});

// create and add a label
var label = new qx.ui.basic.Label();
this.getRoot().add(label, {left: 220, top: 10});

// add the listener
slider.addListener("changeValue", function(e) {
  // convert the number to a string
```

```
  label.setValue(e.getData() + "");
}, this);
```

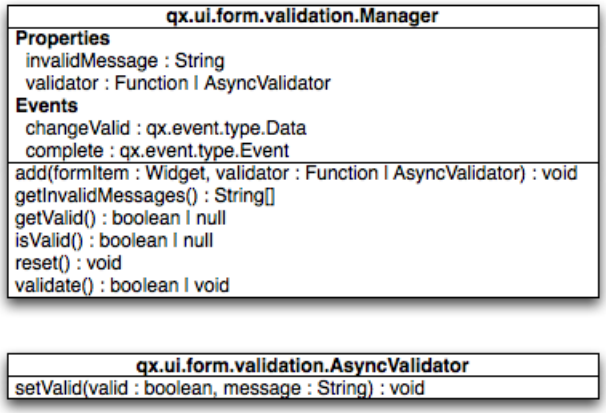
The last example shows how to use the `IForm` interface and how to mark a widget as invalid:

```
// create and add a slider
var slider = new qx.ui.form.Slider();
slider.setWidth(200);
slider.setValue(100);
this.getRoot().add(slider, {left: 10, top: 10});
// set the invalid message
slider.setInvalidMessage("Please use a number above 50.");

// add the validation
slider.addListener("changeValue", function(e) {
  if (e.getData() > 50) {
    slider.setValid(true);
  } else {
    slider.setValid(false);
  }
}, this);
```

All examples work in the Playground application.

Validation

Form validation is essential in most of the common use cases of forms. That's why qooxdoo supports the application developer with a validation component named `qx.ui.form.validation.Manager`. This manager is responsible for managing the form items which need to be validated. We tried to keep the API as minimal as possible but simultaneously as flexible as possible. The following class diagram shows the user API of the component.



The events, properties and methods can be divided into three groups:

- **Validation**
  - getValid()
  - isValid()
  - validate()
  - validator - property

  - complete - event
  - changeValid - event
- **Form Item Management**
  - add(formItem, validator)
  - reset()
- **Invalid Messages**
  - getInvalidMessages()
  - invalidMessage - property

The first part with which the application developer gets in contact is the add method. It takes form items and a validator. But what are form items?

Requirements

Form items need two things. First of all, a given form item must be able to handle an invalid state and must have an invalid message. This is guaranteed by the *IForm* interface already introduced. But that's not all: The manager needs to access the value of the form item. Therefore, the form item needs to specify a value property. This value property is defined in the *data specific form interfaces* also introduced above. So all widgets implementing the `IForm` interface and one of the value defining interfaces can be used by the validation. For a list of widgets and the interfaces they implement, take a look at the *widgets section* in this document.

Now that we know what the manager can validate, it's time to learn how to validate. In general, there are two different approaches in validation. The first approach is client side validation, which is commonly synchronous. On the other hand, server side validation is asynchronous in most cases. We will cover both possibilities in the following sections.

Synchronous

The following subsections cover some common scenarios of synchronous validation. See this code snippet as basis for all the examples shown in the subsections.

```
var manager = new qx.ui.form.validation.Manager();
var textField = new qx.ui.form.TextField();
var checkBox = new qx.ui.form.CheckBox();
```

Required Form Fields One of the most obvious validations is a check for a non-empty field. This can be seen in common forms as required fields, which are easy to define in qooxdoo. Just define the specific widget as required and add it to the validation manager without any validator.

```
textField.setRequired(true);
manager.add(textField);
```

The validation manager will take all the necessary steps to mark the field as invalid as soon as the validate method is invoked if the text field is empty.

Default Validator Another common use case of validation is to check for specific input types like email addresses, URLs or similar. For those common checks, qooxdoo offers a set of predefined validators in `qx.util.Validate`. The example here shows the usage of a predefined email validator.

```
manager.add(textField, qx.util.Validate.email());
```

Custom Validator Sometimes, the predefined validators are not enough and you need to create an application-specific validator. That's also no problem because the synchronous validator is just a JavaScript function. In this function, you can either return a boolean which signals the validation result or you can throw a `qx.core.ValidationError` containing the message to be displayed as an invalid message. The validation manager can handle both kinds of validators. The example here checks if the value of the text field has a length of at least 3.

```
manager.add(textField, function(value) {
  return value.length >= 3;
});
```

Validation in the context of the form All shown validation rules validate each form item in its own context. But it might be necessary to include more than one form item in the validation. For such scenarios, the manager itself can have a validator too. The example here demonstrates how to ensure that the text field is not empty if the checkbox is checked.

```
manager.setValidator(function(items) {
  if (checkBox.getValue()) {
    var value = textField.getValue();
    if (!value || value.length == 0) {
      textField.setValid(false);
      return false;
    }
  }
  textField.setValid(true);
  return true;
});
```

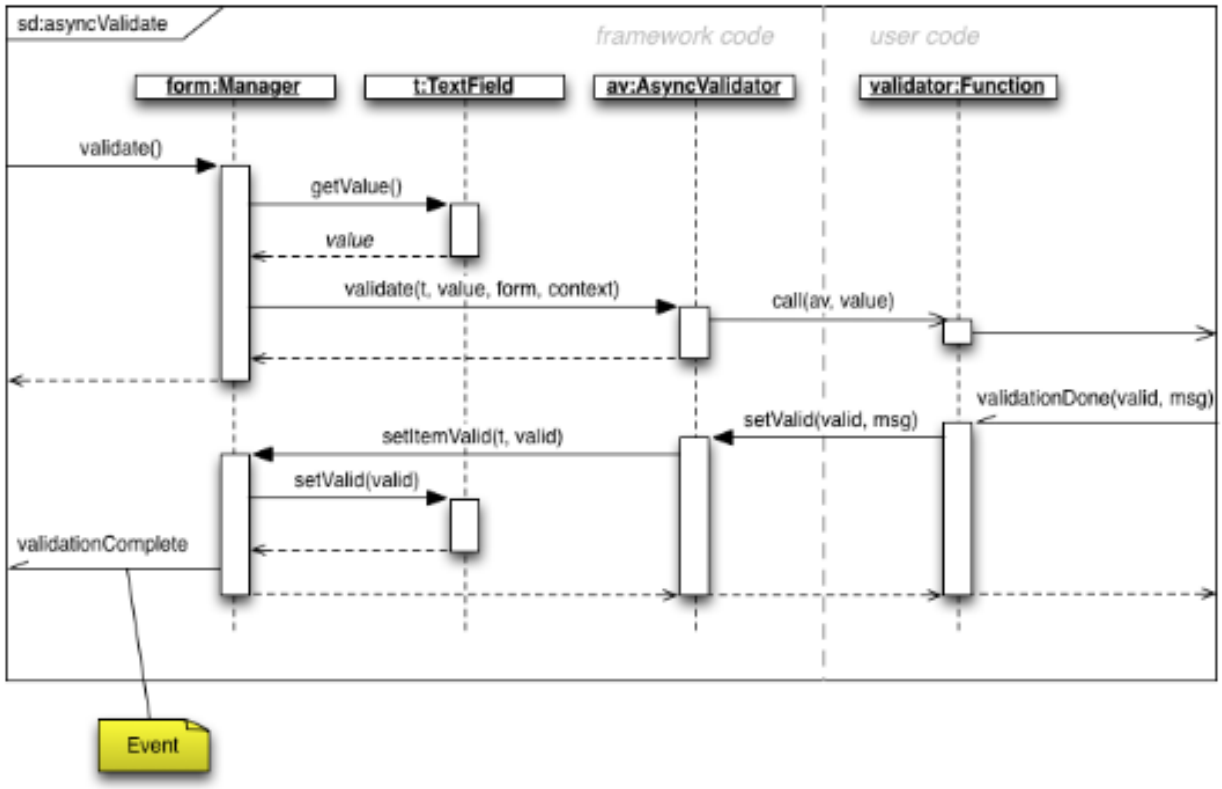
Asynchronous

Imagine a scenario where you want to check if a username is already taken during a registration process or you want to verify a credit card number. This type of validation can only be done by a server and not in the client. But you don't want the user to wait for the server to process your request and send the answer back. So you need some kind of asynchronous validation.

For all asynchronous validation cases, we need a wrapper for the validator, the `qx.ui.form.validation.AsyncValidator`. But that does not mean a lot work for the application developer. Just take a look at the following example to see the AsyncValidator in action.

```
manager.add(textField, new qx.ui.form.validation.AsyncValidator(
  function(validator, value) {
    // here comes the async call
    qx.event.Timer.once(function() {
      // callback for the async validation
      validator.setValid(false);
    }, this, 1000);
  }
));
```

The only difference to the synchronous case, at least from the application developer's point of view, is the wrapping of the validator function. Take a look at the following sequence diagram to get an insight on how the asynchronous validation is handled.



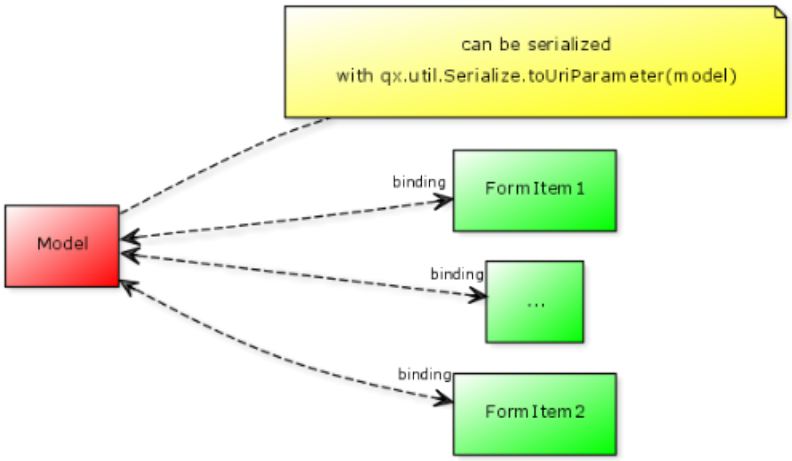
The asynchronous validation can not only be used for form items. Also, the manager itself can handle instances of the AsyncValidator as validator.

Serialization

Entering data into a form is one part of the process. But usually, that entered data needs to be sent to the server. So serialization is a major topic when it comes to forms. We decided not to integrate this in one form manager which would be responsible for both validation and serialization.

Idea

The main idea behind this was to ensure that it cooperates nicely with features like the form widgets and the corresponding data binding components. So we decided to split the problem into two different parts. The first part is storing the data held in the view components as a model. The second part takes that model and serializes its data. Sounds like *data binding*? It is data binding!



But you don't have to connect all these widgets yourself. qooxdoo offers an object controller which can take care of most of the work. But where do you get the model? Writing a specific qooxdoo class for every form sounds like a bit of overkill. But qooxdoo has a solution for that, too. The creation of classes and model instances is already a part of the data binding components and can also be used here. Sounds weird? Take a look at the following common scenarios to see how it works.

Common Scenarios

The most common scenario is to serialize a number of form items without any special additions. Just get the values of the entire form and serialize them.

```
// create the ui
var name = new qx.ui.form.TextField();
var password = new qx.ui.form.PasswordField();

// create the model
var model = qx.data.marshal.Json.createModel({name: "a", password: "b"});

// create the controller and connect the form items
var controller = new qx.data.controller.Object(model);
controller.addTarget(name, "value", "name", true);
controller.addTarget(password, "value", "password", true);

// serialize
qx.util.Serializer.toUriParameter(model);
```

The result will be `name=a&password=b` because the initial values of the model are `a` and `b`.

This way, the serialization is separated from the form itself. So hidden form fields are as easy as it could be. Just add another property to the model.

```
var model = qx.data.marshal.Json.createModel(
  {name: "a", password: "b", c: "i am hidden"}
);
```

Keep in mind that you're creating a model with that and you can access every property you created using the default getters and setters.

You might be asking yourself "What if i want to convert the values for serialization? My server needs some different values...". That brings us to the topic of conversion. But as we have seen before, the mapping from the view to the model is handled by the data binding layer which already includes conversion. Take a look at the *data binding documentation* for more information on conversion.

Need something special? In some cases, you might want to have something really special like serializing one value only if another value has a special value or something similar. In that case, you can write your own serializer which handles serialization the way you need it.

Resetting

A third useful feature of a form besides validation and serialization is resetting the entire form with one call. Doesn't sound complicated enough that a separate class is needed. But we decided to do it anyway for good reasons:

- The validation manager is not the right place for resetting because it handles only the validation.
- The form widget, responsible for layouting forms, is a good place, but we don't want to force developers to use it if they just want the reset feature.

So we decided to create a standalone implementation for resetting called `qx.ui.form.Resetter`.

Like the task of resetting itself, the API is not too complicated. We have one method for adding items, and another one for resetting all added items.

How It Works

Technically, it's not really a challenge thanks to the new form API. You can add any items either having a value property defined by one of the *data specific form interfaces* or implementing the *selection API* of qooxdoo. On every addition, the resetter grabs the current value and stores it. On a reset all stored values are set.

Sample Usage

The following sample shows how to use the resetter with three input fields: A textfield, a checkbox and a list.

```
// create a textfield
var textField = new qx.ui.form.TextField("acb");
this.getRoot().add(textField, {left: 10, top: 10});

// create a checkbox
var checkBox = new qx.ui.form.CheckBox("box");
this.getRoot().add(checkBox, {left: 10, top: 40});

// create a list
var list = new qx.ui.form.List();
list.add(new qx.ui.form.ListItem("a"));
list.add(new qx.ui.form.ListItem("b"));
list.setSelection([list.getSelectables()[0]]);
this.getRoot().add(list, {left: 10, top: 70});

// create the resetter
var resetter = new qx.ui.form.Resetter();
// add the form items
resetter.add(textField);
resetter.add(checkBox);
resetter.add(list);
```

```
// add a reset button
var resetButton = new qx.ui.form.Button("Reset");
resetButton.addListener("execute", function() {
  resetter.reset();
});
this.getRoot().add(resetButton, {left: 120, top: 10});
```

Form Object

We've already covered most parts of form handling. But one thing we've left out completely until now is layouting the form items. That's where the `qx.ui.form.Form` widget comes into play.

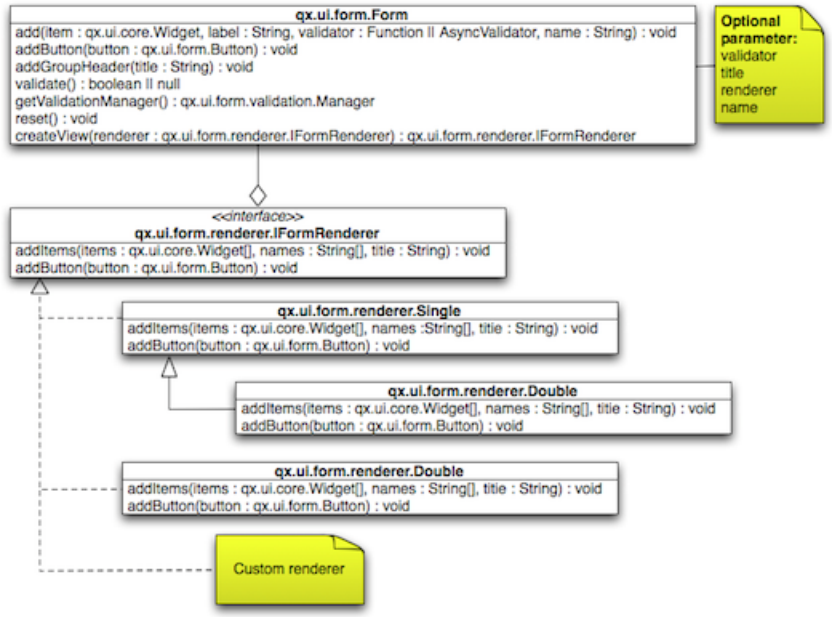
What is it?

The qooxdoo form is an object which includes three main parts.

- *Validation* using the `qx.ui.form.validation.Manager` class
- *Resetting* using the `qx.ui.form.Resetter` class
- Handling the layout of the form

As we have already talked about the first two items, I'll cover the last item in a more detailed way.

In most cases, a form's layout is specific to the application. It depends on the space available in the application and many other factors. That's why qooxdoo has this flexible form layouting tool, which includes a set of default options to layout a form. On of the main requirements of the solution was extensibility so that anyone could have the layout their application requires. To achieve this, we applied a pattern used widely across the qooxdoo framework, which moves all UI related code to renderer classes. These renderers are as lightweight as possible to make it easy for developers to write their own custom renderer, as you can see in this UML diagram:



Renderer

As the diagram shows, qooxdoo provides an interface for FormRenderer, the `IFormRenderer` interface. It defines two methods, one for adding a group of form items and one for adding buttons.

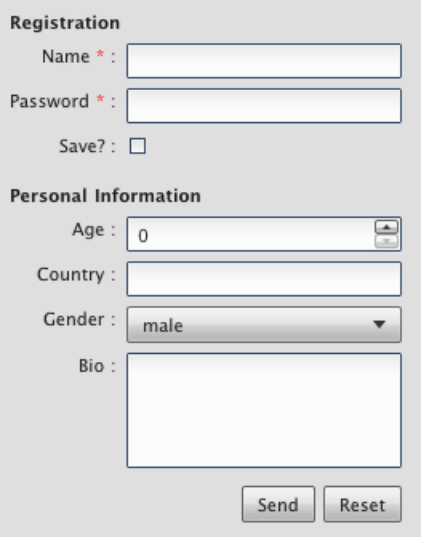
- addItems(items : qx.ui.form.IForm[], names : String[], title : String) : void
- addButton(button : qx.ui.form.Button) : void

Surely you've recognized the difference to the API of the form itself. Widgets are added to the form individually, but the renderer always gets a group of widgets at once. This gives the renderer additional information which it may need to render the form based on the number of groups rather then on the number of widgets.

You may ask yourself why we didn't use the layouts we usually use in such scenarios if we ant to render widgets on the screen. It may be necessary for a renderer to contain even more than one widget. Imagine a wizard or a form spread out over multiple tabs. That wouldn't be possible using layouts instead of renderer widgets.

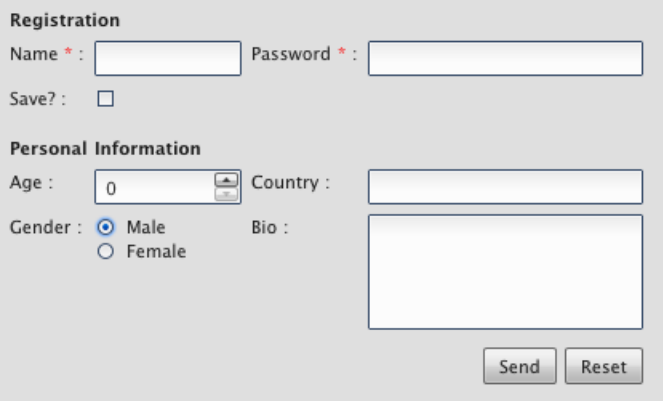
The following sections show the renderers included in qooxdoo, which can be used out of the box.

Default (Single Column) If you don't specify a renderer, the default is used, which is a single column renderer.

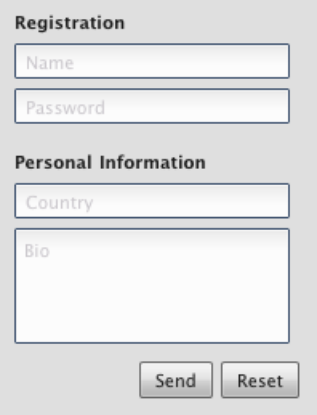


As you can see in the picture, the renderer adds an asterisk to every required field, adds a colon at the end of every label and defines the vertical layout.

Double Column The double column renderer has the same features as the previously introduced single column renderer but renders the fields in two columns, as you can see in the following picture.



Single Column with Placeholer This renderer is more a of demo showing how easy it can be to implement your own renderer. It has a limitation in that it can only render input fields which have the placeholder property. But the result is pretty nice:



Sample Usage

After we've seen how it should look, here come some examples showing how it works. In this example, we want to create a form for an address management tool. So we divide our input fields into two groups. The first group contains two text fields, one for the first name and one for the last name. The second group contains some contact data like email, phone number and company name. Finally, we want to add two buttons to the form, one for saving the data if it is valid and another for resetting the form. So here we go...

First, we need a form object.

```
// create the form
var form = new qx.ui.form.Form();
```

After that, we can create the first two input fields. As these two fields are required, we should mark them as such.

```
// create the first two input fields
var firstname = new qx.ui.form.TextField();
firstname.setRequired(true);
var lastname = new qx.ui.form.TextField();
lastname.setRequired(true);
```

As you can see, the input fields are text fields as described above. Next, we can add those input fields to the form.

```
// add the first group
form.addGroupHeader("Name");
form.add(firstname, "Firstname");
form.add(lastname, "Lastname");
```

First, we added a group header to create a headline above the two input fields. After that, we added them with a name but without a validator. The required flag we set earlier is enough. We need to add another group of input fields for the contact data.

```
// add the second group
form.addGroupHeader("Contact");
form.add(new qx.ui.form.TextField(), "Email", qx.util.Validate.email());
form.add(new qx.ui.form.TextField(), "Phone");
```

After adding the second group header, you'll see the text field for the email address, which uses a predefined email validator from the framework. The phone number does not get any validator at all. The last missing thing are the buttons. First, add the save button.

```
// add a save button
var savebutton = new qx.ui.form.Button("Save");
savebutton.addListener("execute", function() {
  if (form.validate()) {
    alert("You can save now...");
  }
});
form.addButton(savebutton);
```

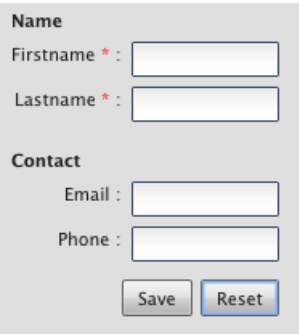
The save button gets an execute listener which first validates the form and, if the form is valid, alerts the user. The reset button is analogous.

```
// add a reset button
var resetbutton = new qx.ui.form.Button("Reset");
resetbutton.addListener("execute", function() {
  form.reset();
});
form.addButton(resetbutton);
```

Now the form is complete and we can use the default renderer to render the form and add it to the document.

```
// create the view and add it
this.getRoot().add(new qx.ui.form.renderer.Single(form), {left: 10, top: 10});
```

Running this code will create a form as described above which will look like this:



If you want to get a different look and feel, you can create a different renderer.

```
// create the view and add it
this.getRoot().add(
  new qx.ui.form.renderer.SinglePlaceholder(form),
  {left: 10, top: 10}
);
```

Just give it a try in the playground.

Form Controller

Data binding for a form certainly is a handy feature. Using a model to access data in the form brings form handling to another level of abstraction. That's exactly what the form controller offers.

The form controller is fully covered in the *data binding documentation*.

Sample Usage

The following example shows how to use the controller with a simple form, which contains three text fields: One for salutation, one for first name and one for last name.

First, we create the form:

```
// create the form
var form = new qx.ui.form.Form();
```

In a second step we add the three text fields. The important thing here is that if no name is given - as in the first two cases - each label will also be used as a name. For that, all spaces in the label are removed.

```
// add the first TextField ("Salutation" will be the property name)
form.add(new qx.ui.form.TextField(), "Salutation");
// add the second TextField ("FirstName" will be the property name)
form.add(new qx.ui.form.TextField(), "First Name");
// add the third TextField ("last" will be the property name)
form.add(new qx.ui.form.TextField(), "Last Name", null, "last");
```

After we add the text fields, we can add the view to the application root.

```
// add the form to the root
this.getRoot().add(new qx.ui.form.renderer.Single(form));
```

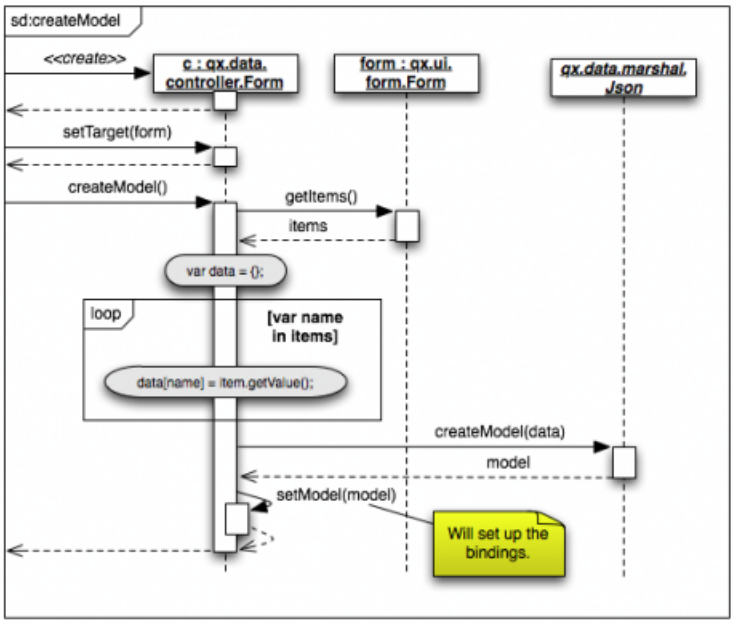
Now that the form has been created, we can take care of the data binding controller. We simply supply the form instance as an argument to the constructor. But we don't have a model yet, so we just pass `null` for the model.

```
// create the controller with the form
var controller = new qx.data.controller.Form(null, form);
```

The final step for data binding is to create the actual model.

```
// create the model
var model = controller.createModel();
```

Take a look at the following sequence diagram to see how it works internally.



Now we have managed to set up a form and a model connected by bidirectional bindings. So we can simply use the model to set values in the form.

```
// set some values in the form
model.setSalutation("Mr.");
model.setFirstName("Martin");
model.setLast("Wittemann");
```

As you can see here, the properties (and therefore setters) are defined according to the names we gave the text fields when adding them.

See the code in action in the playground.

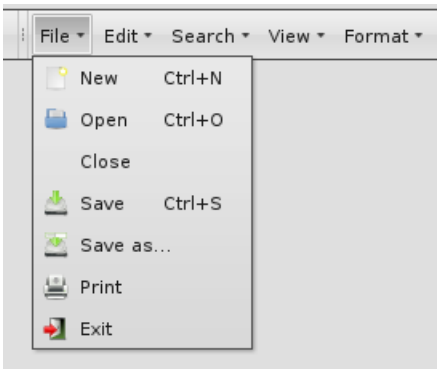
Still to come...

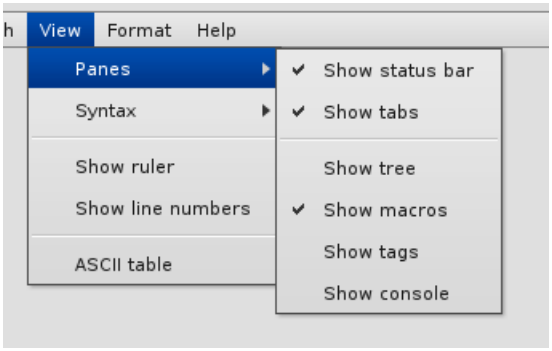
- A way to create a form out from a JSON definition

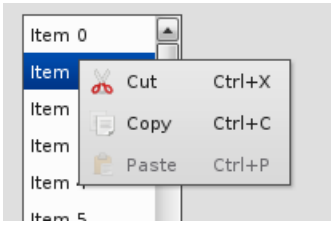
4.3.10 Menu Handling

Menus are well-established user interface elements in GUIs. They are popup-like controls that provide simple or cascading lists of buttons. Typical uses show menus opening off from buttons in tool bars, or popping up as context menus on mouse right-clicks e.g. on a tree element.

Here are a few examples:







The Demobrowser provides further examples.

Menus can be constructed in a qooxdoo application using widgets from the qx.ui.menu name space. The main class from this package is `Menu`. Other classes allow you to tailor the appearance and the behaviour of the menu you create. You can even use checkboxes and radiobuttons inside your menus.

Simple Example

Here is a simple menu example:

```
// Create the menu
var menu = new qx.ui.menu.Menu();

// Creates the command
var command = new qx.event.Command("Control+O");
command.addListener("execute", function() {
  this.debug("Open action");
},this);

// Add some content
var openButton = new qx.ui.menu.Button("Open", "icon/16/actions/document-open.png", command);
var closeButton = new qx.ui.menu.Button("Close");

menu.add(openButton);
```

```
menu.add(closeButton);

// Add behaviour
closeButton.addListener("execute", function() {
  this.debug("Close action");
}, this);

// Create a button that will hold the menu
var button = new qx.ui.form.MenuButton("Menu", null, menu);
```

There are a couple of things to note here:

- The main widget is the `menu` of type `qx.ui.menu.Menu`.
- Menu buttons are of type `qx.ui.menu.Button` and are created individually.
- They are then added to the menu. The buttons will appear in the menu in the order they are added.
- The `closeButton` is created with the minimal set of parameters, namely just the string for the button label. For a more advanced solution, see the `openButton`: you can optionally specify a button icon, and a command `qx.event.Command` that is invoked if the button or the shortcut is pressed/selected.
- You can supply missing or updated features after the widget's creation; e.g. the callback function for the `closeButton` is provided in a separate method call to `addListener()`.
- The canonical event for the selection of a menu button is the `execute` event. (This is in line with other button flavors throughout the qooxdoo framework, e.g. the regular `qx.ui.form.Button`).

Complex Menu Sample

This example should show how to create a menu structure with submenu and how to handle with groups.

Qooxdoo has some widgets that need a menu to handle user interaction. For this sample we will chose the `qx.ui.toolbar.ToolBar` to create the menu structure. To see a overview, witch widgets uses a menu, take a look in the *Menu*.

This code snippet show how to create a "ToolBar" with to menu items "File" and "View":

```
// Create the toolbar and add to the DOM
var toolBar = new qx.ui.toolbar.ToolBar();
this.getRoot().add(toolBar, {
  left: 20,
  top: 20,
  right: 20
});

// Create "File" menu
var fileButton = new qx.ui.toolbar.MenuButton("File");
toolBar.add(fileButton);

var fileMenu = new qx.ui.menu.Menu();
fileMenu.add(new qx.ui.menu.Button("New", null, null, this.__getNewMenu()));
fileMenu.add(new qx.ui.menu.Button("Open...", "icon/16/actions/document-open.png"));
fileMenu.add(new qx.ui.menu.Separator());
fileMenu.add(new qx.ui.menu.Button("Save", "icon/16/actions/document-save.png"));
fileMenu.add(new qx.ui.menu.Button("Save As...", "icon/16/actions/document-save-as.png"));
fileMenu.add(new qx.ui.menu.Separator());
fileMenu.add(new qx.ui.menu.Button("Exit", "icon/16/actions/application-exit.png"));
fileButton.setMenu(fileMenu);
```

```
// Create "View" menu
var viewButton = new qx.ui.toolbar.MenuButton("View");
toolBar.add(viewButton);
var viewMenu = new qx.ui.menu.Menu();
viewMenu.add(new qx.ui.menu.Button("Panes", null, null, this.__getPanesMenu()));
viewMenu.add(new qx.ui.menu.Button("Syntax", null, null, this.__getSyntaxMenu()));
viewMenu.add(new qx.ui.menu.Separator()); // First kind to add a separator
viewMenu.add(new qx.ui.menu.CheckBox("Show ruler"));
viewMenu.add(new qx.ui.menu.CheckBox("Show line numbers"));
viewMenu.addSeparator(); // A other kind to add a separator
viewMenu.add(new qx.ui.menu.Button("ASCII table..."));
viewButton.setMenu(viewMenu);
```

There are a couple of things to note here:

- The `qx.ui.menu.Menu` could get some different children (Button, Separator, CheckBox, ...)
- The fourth parameter in `qx.ui.menu.Button` is also a menu. So it is possible to create submenus.
- There are tow kinds to add a separator to a menu. The first kind is to create a `Separator` instance and add this to the menu. Or the other kind is to call the `addSeparator` method from the `Menu` instance.

The next code snipped should explain how to create a menu, which contain RadioButtons, but only one could be selected:

```
__getSyntaxMenu : function()
{
  var syntaxMenu = new qx.ui.menu.Menu();

  var cDialectMenu = new qx.ui.menu.Menu();
  cDialectMenu.add(new qx.ui.menu.RadioButton("C"));
  cDialectMenu.add(new qx.ui.menu.RadioButton("C Sharp"));
  cDialectMenu.add(new qx.ui.menu.RadioButton("C Plus Plus"));

  var htmlButton = new qx.ui.menu.RadioButton("HTML");
  var jsButton = new qx.ui.menu.RadioButton("JavaScript");
  var cdialectButton = new qx.ui.menu.Button("C Dialect", null, null, cDialectMenu);
  var pythonButton = new qx.ui.menu.RadioButton("Python");

  syntaxMenu.add(htmlButton);
  syntaxMenu.add(jsButton);
  syntaxMenu.add(cdialectButton);
  syntaxMenu.add(pythonButton);

  // Configure and fill radio group
  var langGroup = new qx.ui.form.RadioGroup();
  langGroup.add(htmlButton, jsButton, pythonButton);
  langGroup.add.apply(langGroup, cdialectButton.getMenu().getChildren());

  return syntaxMenu;
}
```

You can see, that the menu contains `RadioButton` and all `RadioButton` should grouped in one `RadioGroup`, but the `RadioButton` in the submenu “C Dialect” should also be considered in the `RadioGroup`.

To add a `RadioButton` to the `RadioGroup` call the `add()` method from the `RadioGroup`. The parameter from `add()` is a variable number of items which should be added. You can see that the code calls a `langGroup.add.apply()` method to add the `RadioButton` from the “C Dialect” submenu. This is no qooxdoo construction, the `apply()` method is a construction from JavaScript and it is not important to know how thus the method works.

Additional Menu Topics

Menu positioning

Qooxdoo will go a long way to position a menu sensibly and with regard to the enclosing container, so that menu buttons are always fully visible if the menu is opened.

The Placement demo shows how the menus are positioned.

4.3.11 Window Management

Window is a widget used to show dialogs or to realize a MDI (Multiple Document Interface) applications. Windows can only be added to `qx.ui.window.Desktop` widgets, or to widgets which implement the `qx.ui.window.IDesktop` interface.

Each Desktop widget must have a `qx.ui.window.Manager`. If none is provided, the default window manager (`qx.ui.window.Window#DEFAULT_MANAGER_CLASS`) is used. The desktop uses the manager to handle the contained windows.

The manager takes care of windows z-index order. Windows can be normal (default), always on top or modal. Always on top windows stay on top of normal windows and modal windows appear in front of all other windows. If there are a bunch of windows open and we close one, the manager will activate the window that is higher in the z-index order stack.

Let's see this in action. We'll create a tabview with one page, create a desktop widget for the page, and add different types of windows. You can see how the opened windows stack on each other and when you close one, the highest z-index order window will get activated.

```
var root = this.getRoot();
var tabView = new qx.ui.tabview.TabView();
var page = new qx.ui.tabview.Page("Desktop");
var windowManager = new qx.ui.window.Manager();
var desktop = new qx.ui.window.Desktop(windowManager);
var aWindow = null;

page.setLayout(new qx.ui.layout.Grow());
page.add(desktop);
tabView.add(page);
root.add(tabView, {edge: 0});

//create 3 normal windows and add them to the page's desktop
for (var i=0; i<3; i++)
{
  aWindow = new qx.ui.window.Window("Normal Window #" +i).set({
    width:300
  });
  desktop.add(aWindow);
  aWindow.open();
}

//create 3 alwaysOnTop windows and add them to the page's desktop
for (var i=0; i<3; i++)
{
  aWindow = new qx.ui.window.Window("AlwaysOnTop Window #" +i).set({
    width:300
  });
  aWindow.setAlwaysOnTop(true);
```

```
  desktop.add(aWindow);
  aWindow.open();
}

//create a modal window and add it to the page's desktop
aWindow = new qx.ui.window.Window("Modal Window #" +i).set({
  width:300
});
aWindow.setModal(true);
desktop.add(aWindow);
aWindow.open();
```

Like I said, windows can be added to widgets which implement the IDesktop interface. This interface is implemented by `qx.ui.window.MDesktop` mixin. You can use this mixin to make a custom widget behave like a Desktop. This is exactly what the superclass of all root widgets (`qx.ui.root.Abstract`) does. This is why we can add windows to a root widget.

```
var win = new qx.ui.window.Window("First Window");
var root = this.getRoot();
root.add(win);
win.open();
```

Related documentation

Window widget

Demos and API

To find out more, you can check the desktop demo and the API reference.

4.3.12 HTML Editing

HtmlArea is a html editing widget which is part of the framework. This widget is available as low-level and UI-level implementation. The first targets traditional webpages / single-page applications and the latter Rich Internet Applications (RIA) as preferred usecase.

Here you can find some interesting technical info.

Note: Please keep in mind that the HtmlArea component provides basic HTML editing functionality. It is **not** a full-blown HTML editor and will not be developed towards it.

Demo

Setup

One important step is necessary to get the HtmlArea up and running.

Note: If you setup the component without handing the **source** parameter you have to place a **blank.html** file next to your applications **index.html**.

This is necessary due the Same-Origin Policy implemented by most browsers.

Features

Feature List

This page aims to describe the features of the HtmlArea component. *Aims* because there are for sure features which are missing or considered as *must-have* to not enter the feature list as own entry.

This page should get you a good overview of what you can expect from this HTML editing component.

End-User Features

Text Formatting

- Bold
- Italic
- Underline
- Strikethrough

- Text Color
- Background Color
- Font Size
- Font Family

Alignment

- Left
- Center
- Right
- Justify

Lists

- Unordered lists
- Ordered lists

Inserting

- Tables
- Images
- Horizontal rulers
- Hyperlink
- HTML code

Document Wide Formatting

- Background Image
- Background Color

Additional Features

- Removing format
- Select the whole content
- Indent / Outdent
- Undo / Redo

Developer Features

Events

- Load / LoadingError and Ready
- Current cursor context
- Contextmenu
- Focus / Focus out

Content Manipulation

- Content as HTML output
- Post-process HTML output
- Current selected HTML
- Reset content
- Context Information of current focused node (e.g. to update a toolbar widget)

Advanced Paragraph-Handling

- Keeps formatting across multiple paragraphs
- Type of line-break adjustable (new paragraph or new line)
- Support for `Shift+Enter` and `Ctrl+Enter` to insert single line-break

Additional Features

- Hotkey Support
- Set own CSS for content at startup
- Access to content document and content body
- Access to editable iframe element

Technical Feature List

In comparison to the *Feature List* of the HtmlArea this page describes some technical insights of the component. If you plan to get to know some details of how to develop a WYSIWYG component and want to learn the pitfalls of the different browser implementations this is good place to start.

Startup The HtmlArea relies on a editable iframe. To take control over this iframe the component has to ensure that the iframe's document is fully loaded and accessible. For every browser the `load` event of the iframe object is used. Only for IE it is necessary to poll the document if it's not immediately available after the `load` event. The result of the startup phase is the `ready` event which informs the application developer that the startup was successful.

Content Wrapping Since the application developer only sets the content of the HtmlArea and not the whole document the component needs to setup the rest of the content (`DOCTYPE`, `HTML` and `BODY` elements). The difficult exercise here is to set the right style attribute at the right element for each browser.

The toughest thing is to get the right behaviour for native scrollbars. In IE for example the overflow handling with `overflow-x` and `overflow-y` does not work correctly. When both style attributes are set IE does mix them up by overwriting one with the others value.

Anyway, the correct content wrap is important for

- document is taking the whole space of the iframe
- no margins and paddings are set
- scrollbars are only shown if the user enters more content than space is available

Editable Document Another pitfall is how to set the document of the iframe object editable. There are two properties which can be be applied for an editable document: **designMode** and **editable**.

The `designMode` property is applied for all browsers and works at the `document` node of the iframe.

Setting the `editable` property is only needed for gecko browsers. And only if the HtmlArea was hidden and shown again. The `editable` property is applied to the `body` element.

Internet Explorer For IE it is important to set the document design mode **before** the content is rendered. Once the document is editable it does not loose this status even if the whole component is hidden and shown again.

Gecko, Webkit and Opera All three need to have rendered content to set the document design mode correctly.

Focus Management At least IE has problems whenever a native command (*execCommand* method) does manipulate the content of the editable iframe and the iframe document does **not** have the focus. If an application developer want to use a toolbar to offer the user an interface to manipulate the content he has to make sure that each of these buttons need a special setup. Otherwise the button would *steal* the focus from the editing component whenever clicked.

Luckily qooxdoo does offer this customization out-of-the-box. The application developer only has to set the properties *keepFocus* to *true* and *focusable* to *false*.

```
button.set({
  focusable: false,
  keepFocus: true
});
```

Advanced Key Events One major feature is to track the user input. To use the powerful key event handler in qooxdoo the HtmlArea does listen to all key events at the `body` element and handles various actions depending on the user's input. This way it is possible to work with a `keyIdentifier` instead of the `keyCode` or `charCode`.

Integration Guide

Integrate the HtmlArea into your application

Note: This explanations mainly do address the `0.8+ based` HtmlArea component.

This page does explain what you should consider when integrating the HtmlArea component in your application. However, it does **not** explain how to setup the component itself, it's rather an integration guide to avoid pitfalls.

Use Public API This one should be self-explaining. Do not use any internal API to get things done even it's the easy way to go. If it's hidden from the application developer then by purpose, but if you need access to specific parts of the component which is not offered don't hesitate to file a bug report.

Use Events The component does offer various events to work with e.g. the `ready` event to get informed of the finished loading.

The bottom line is the same as for the public API: use these events to interact with the component. If an event is missing feel free to file a bug report.

Lazy Initialization The HtmlArea widget is using a low-level editing component to offer a WYSIWYG editor solution. The widget does initialize this editing component after the first appear of the widget. So if you use e.g. a stack container which hides the HtmlArea keep in mind that the widget is only fully usable after it is shown.

Toolbar Details The HtmlArea does only offer the plain editing widget so if you do not use the HtmlEditor contribution and instead create your own toolbar you have to consider some specialities concerning the focus management of qooxdoo.

Since the HtmlArea relies on that the focus is not lost to another widget (e.g. a toolbar button) during the execution of a command you have to set two focus-specific properties on each widget which runs commands at the HtmlArea component.

The two properties `keepFocus` and `focusable` have to be used together to get the correct behaviour. The more important property is `keepFocus` which certainly ensures that the given widget `never` get the focus - even if this widget is clicked. This will leave the focus at the HtmlArea component solving many focus-related issues successfully (especially for IE browsers).

Example code snippet

```
button = new qx.ui.toolbar.Button(null, iconURL);
button.set({ focusable : false, keepFocus : true });
```

No Own Focus Management As already mentioned the focus management is important for HTML editing widgets and there are special solutions necessary for the component already. Implementing an own focus management on top in your application code `can` cause problems for your users. So if you encounter any issues that the component e.g. does not perform a certain command even a button is clicked it's probably a focus-related issue. As always: the component is far from perfect, don't hesitate to file a bug report for issues you encounter.

Keyboard Shortcuts Since you can use *keyboard shortcuts* to manipulate the content you should not implement shortcuts with the same key bindings. A possibility to disable the shortcuts completely will soon be available. See Bug #1193 for details.

Available Keyboard Shortcuts

The result of using the shortcuts `Control + Enter` and `Shift + Enter` are explained at the *Paragraph Handling* page.

The following keyboard shortcuts are implemented at the moment:

- `Ctrl + A` - Select the whole content
- `Ctrl + B` - Toggle the current selection to Bold / Normal text
- `Ctrl + I` and `Ctrl + K` - Toggle the current selection to Italic / Normal text
- `Ctrl + U` - Toggle the current selection to Underline / Normal text

If the Undo / Redo functionality is enabled the following shortcuts are additionally available:

- `Ctrl + Z` - Undo the last change

- `Ctrl + Y` - Redo the last undo step
- `Ctrl + Shift + Z` - Redo the last undo step

Recommendations

This page should help developers using the HtmlArea to stick with some recommendations to avoid known issues or to call attention how to use a specific feature.

Common Font Families Since the HtmlArea *"only"* is a editing component it does not offer a complete toolbar or other features which an full-blown Html Editor might offer. So if you setup an own toolbar and decide to offer the user a possibility to change the default font family you should be careful not to use a font family which is not widely available. If the client computer does not has the listed font family installed it will certainly fall back to the systems default. The user will be irritated by different choices which end up with the same result if he applies them to his written content.

To avoid this problem you should play safe and offer the following font families:

- Arial
- Arial Black
- Verdana
- Courier New
- Courier
- Georgia
- Impact
- Comic Sans MS
- Tahoma
- Lucida Console

A nice list of the most common font families is listed at Webdesign.about.com

InsertHtml Command This command lets you insert you HTML code directly into the component's document. It is powerful and can be an easy way to accomplish your goals, but you should keep in mind that this method should only be used if there is no other possibility offered.

If you e.g. want to insert an image into the document use the dedicated `insertImage` command instead of putting your HTML code together.

Avoid DIV elements with fixed width or height The problem with DIV elements which have *width* or *height* set with CSS styles is that IE offers for those DIV elements resize/move handles. This is in the most cases not desired. So better use *margin*, *padding* or *top|left|right|bottom* to position your DIV element.

Additionally if you set a width of 600px to a DIV element users with a small resolution (like 800 x 600) might end up with horizontal scrollbars.

Technical Background

HTML Editing In General

External Information

General info

- Rich HTML editing - Part 1

Browsers

Mozilla (“Midas”)

- Midas specification
- Demo
- Migrationguide IE -> Gecko
- Documentation
- DOM Client Object Cross-Reference

IE (“HTML Edit”)

- MSDN Overview and tutorials
- Documentation
- Overview of Command Identifiers
- A Note about the DHTML Editing Control in IE7+

Opera

- Opera Browser Wiki

Safari

- WebKit: HTML Editing
- Quietly, Safari Finally Gains WYSIWYG Editing Powers
- execCommand list

Compatibility

- The Mozile project contains code which adapts Internet Explorer’s Selection object to an interface like Mozilla’s.
- Converting your app from IE to Midas
- execCommand compatibility

General

- htmlarea.com
- cmsreview.com
- geniisoft.com
- Web-Based Rich Text Editors Listing

Overview of existing WYSIWYG editors Here is an overview table:

Editor	License	Pro/Con
YUI RTE	BSD	**Pro**: works with all well-known browsers (IE / Gecko / Opera / Safari / Konquerer); **Con**: Still in Beta (although the final release version should be out soon).
Xinha	HTMLArea (BSD based)	
RTE	Creative Commons	
RTEF	MIT	**Pro**: works with all well-known browsers (IE / Gecko / Opera / Safari / Konquerer); **Con**: no user-feedback e.g. which font or size is currently used.
WYMEditor	MIT/GPL	**Pro**: produces XHTML, uses CSS; **Con**: currently only available for IE and Gecko.
dojo	BSD	
TinyMCE	LGPL	
FCKEdit	GPL, LGPL and MPL	
Solmetra	GPL	
FreeRTE	Creative Commons	
CMSimple	AGPL	
XStandard lite	Freeware	
Loki	GPL	
Whizzywig		

command	Mozilla	IE	Opera	Safari
Bold	x	x	x	x
Italic	x	x	x	x
Underline	x	x	x	x
Strikethrough	x	x	x	x
Color				
BackColor	x	x	x	x
ForeColor	x	x	x	x
HiliteColor	x			x
Font Handling				

Continued on next page

Table 4.1 – continued from previous page

command	Mozilla	IE	Opera	Safari
FontName	x	x	x	x
FontSize	x	x	x	x
IncreaseFontSize	x		x	
DecreaseFontSize	x		x	
Subscript	x	x	x	x
Superscript	x	x	x	x
Formatting and CSS				
ContentReadOnly	x		x	
StyleWidthCSS	x			
UseCSS	x		x	
RemoveFormat	x	x	x	x
User actions				
Copy	x	x		x
Paste	x	x		x
Cut	x	x	x	x
Delete	x	x	x	x
Undo		x	x	x
Redo		x	x	x
Print		x		x
SaveAs		x		
Alignment				
JustifyLeft	x	x	x	x
JustifyCenter	x	x	x	x
JustifyRight	x	x	x	x
JustifyFull	x		x	x
Indent	x	x		x
Outdent	x	x		x
Hyperlinks				
CreateLink	x	x	x	x
Unlink	x	x	x	x
Lists				
InsertOrderedList	x	x	x	x
InsertUnorderedList	x	x	x	x
Basic (formatting) elements				
FormatBlock	x	x	x	x
Heading	x			
InsertParagraph	x	x	x	x
InsertImage	x	x	x	x
InsertButton		x		
InsertFieldset		x		
InsertHorizontalRule		x	x	x
InsertHTML	x		x	x
InsertIFrame		x		

Continued on next page

Table 4.1 – continued from previous page

command	Mozilla	IE	Opera	Safari
Form elements				
InsertInputButton		x		
InsertInputCheckbox		x		
InsertInputFileUpload		x		
InsertInputHidden		x		
InsertInputImage		x		
InsertInputPassword		x		
InsertInputRadio		x		
InsertInputReset		x		
InsertInputSubmit		x		
InsertInputText		x		
InsertSelectDropdown		x		
InsertSelectListbox		x		
InsertTextArea		x		
InsertMarquee		x		
Bookmarking				
CreateBookmark		x		
UnBookmark		x		
Selection and status handling				
SelectAll	x	x	x	x
Unselect		x	x	x
MultipleSelection		x		
Overwrite		x		
Refresh		x		
Misc				
2D-Position		x		
AbsolutePosition		x		
LiveResize		x		
gethtml	x			
contentReadOnly	x			
insertBrOnReturn	x			
enableObjectResizing	x			
enableInlineTableEditing	x			

Browser-specific overview of "execCommand"

Copy and Paste

For a HTML editor component it is important to get along with external content which is inserted with a `Copy and Paste` operation. This is especially important if any filter for the external content should be applied before the content is actually inserted in the editor.

However it is quite difficult to implement this across all major browsers. This short article should give a short overview about the existing events in the different browsers.

To get the detailed overview on this topic check out the section at quirksmode.org

IE This browser offers the most events. Besides `onpaste` and `oncopy` there are also events like `beforepaste`, `beforecopy` and `beforecut`. Additionally all events are stoppable and are bubbling up the DOM hierarchy.

Safari Follows almost the implementation of IE and goes partly beyond it. Safari offers a wide range of events to detect a `Copy and Paste` operation, but has currently no implementation at image elements.

Gecko In Firefox 2 there is no support for any event to detect a `Copy and Paste` operation directly. One can detect the pressed shortcuts, but if the user paste some text via the menu/contextmenu there is possibility to catch that. With the upcoming release of Firefox 3 this situation will improve. This version will have some support for such events like onpaste or oncopy

Opera Same situation as Firefox 2: no working implementation for `copy` or `paste` events.

Text align

The text align of a selection can be modified using the following exec commands: `JustifyLeft`, `JustifyCenter`, `JustifyRight` and `JustifyFull`.

Browsers

- **IE**: Text align is applied on the paragraph which contains the selection.
- **Gecko** and **Opera**: Text align is applied on selection only. The selection gets surrounded by a `<div>` tag containing a `text-align` style attribute.
- **Webkit**: Applies `text-align` style attribute on every `<div>` element that is (partly) selected.

Problems

- If `<br>` tags are used for line breaks, the textalign will be applied on the `<p>` tag in IE, even if only a part of this `<p>` has been selected!
- If `<p>` tags are used for line breaks, all style settings set will be "lost" after entering an other `<p>` tag in FF. It is necessary to "save" these settings manually and apply them on the new paragraph.

Browser Bugs

Gecko

- **Gecko 1.8** *needs* a `<br>` tag inside an element with `contenteditable="true"`, even if the element is empty! If no such element exists, Gecko automatically adds it. These elements can be recognized by the proprietary attribute *_moz_editor_bogus_node*: `<br _moz_editor_bogus_node="TRUE" _moz_dirty=""/>`
- **Gecko 1.9** will *always* insert this `<br>` tag, if `contenteditable="true"` is set. Even if the element contains content! This `<br>` tag is removed, as soon as any input is entered by the user: https://bugzilla.mozilla.org/attachment.cgi?id=119342
- **Undo/Redo** : it *could* happen that 2 content changes occurring right after another leading Gecko to remove both of these 2 changes in **one** undo step. This is especially important for the undo/redo stacks of the HtmlArea.

Internet Explorer

- If you want to use the `pasteHTML()` function, you have to select the textrange first using `select()`.

Webkit/Safari

- Setting a background color for text on *collapsed* selection is not working like in Gecko or IE. Instead of setting the background color and allowing the user to type ahead in the new background color (like in Gecko/IE) nothing happens. The current solution in the HtmlArea is to select the word currently under the caret and to set the background color on this selection. Working on a user-selection works as expected.
- Deleting a block element (e.g. an <p> tag) can cause an element to contain *two* text nodes:

  This wrong behavior can cause problems with selections.

Default Paragraph Handling

This section describes how browsers and other applications react on different keys to enter line breaks or paragraphs.

P = paragraph (`<p>` tag)

LB = line break (`<br />` tag)

Browsers

	Firefox	MSIE	Opera	Webkit
<enter>	LB	P	LB	
<shift> + <enter>	LB	LB	LB	
<strg> + <enter>	—	—	—	—

Word processors / E-mail clients

	MS Word	OO Writer	Outlook	Thunderbird
<enter>	P	P	P	LB
<shift> + <enter>	LB	LB	LB	LB
<strg> + <enter>	Page break	P	—	LB

Implementation Details

Undo and Redo

Limitations The implementation of undo/redo in the HtmlArea has some limitations you should be aware of. It is possible to `undo` all of your steps but `redo` is only possible when no other action occurred between the undo and the redo action. If you undo several steps and e.g. enter some text you **can not** execute redo anymore.

Note: If you use the Undo/Redo functionality you have to make sure you are not manipulating the content of the HtmlArea by using the `innerHTML` property of an element.

This will break Undo/Redo functionality!

Implementation: Description on a high-level The implementation is split up into two different approaches.

For Internet Explorer the `execCommand` approach can't be used anymore. The internal undo / redo stack gets broken on every DOM manipulation. So, if any qooxdoo decorator is used this approach is a dead end. Instead an own implementation using `innerHTML` is used for IE browsers.

For all other browsers the base of the Undo/Redo functionality is to use the `execCommand` method to manipulate the content **whenever** possible. Each change which is performed with a call of `execCommand` is easy to undo/redo. For any manipulation which cannot be achieved using the built-in `execCommand` a special implementation for each browser is necessary (e.g. changing the background color of the whole document).

Using the Decorator Pattern To easily integrate the undo/redo management with the commands of the HtmlArea the `UndoManager` class is a decorator of the `CommandManager` class. It takes the method calls from the HtmlArea class, collects the info for undo the action and calls the decorated `commandManager` class to actually perform the requested action. This keeps both implementations clean and separated.

Tracking changes using stacks Two stacks keep track of the changes which are done to the content: an **undo stack** and the corresponding **redo stack**. Currently each stack holds four different types of changes:

- Command
- Content-block
- Custom
- Internal

Each entry in the stacks is represented by an object which holds additional info (the type above is among this info).

Command Every change which is performed with the `execCommand` method is equipped with this type. These changes are the easiest to track and to undo/redo.

Content-block Each keypress event is observed to determine changes in the content and to mark a set of content changes as an own block which is capable for an undo/redo step. For example IE and Gecko do both recognize text changes as a content block if the text changes occurred between two calls of `execCommand`.

Custom These changes are the ones which cannot be handled with the built-in `execCommand` method. For example changing the background color of the whole document is a custom undo/redo step which needs to be handled in a special way by each browser.

Internal These steps are included to keep the stacks intact if the user e.g. resizes an images with the handles provided by the browsers. It is possible to undo/redo these internal changes with the common `execCommand` method. The primary task here is to record these changes and add them to the stack(s).

Paragraph Handling

The aim of the component is to facade all the browser differences concerning the behaviour when the user hits the `Enter`, the `Shift+Enter` or the `Control+Enter` combination. And this is by far not an easy task since the differences between the browsers are enormous.

Formatting across multiple paragraphs Every formatting info like *underline*, *bold*, *text color*, *text size* etc. are transferred to the new paragraph. It is likely that the user expects to write on with the same configuration/modifications he applied to the former paragraph.

Alignment A paragraph in always aligned completely - the way a word processor also work. This *can* be irritating at the first time of use if e.g. a paragraph contains multiple lines of text each separated by normal line-breaks, but concerning alignment the paragraph is treated only as whole. So every line of the paragraph (=the whole paragraph) is aligned and not only the line the cursor is currently located.

Customization The HtmlArea offers you two properties to customize the paragraph handling globally and thus customize the behaviour of the component.

insertParagraphOnLinebreak The default value of this property is `true`. It controls whether a new paragraph or a normal line-break is inserted when hitting the `Enter` key. Since the default behaviour of all word processors is to insert a new paragraph it is recommended to leave this property value with its default.

Note: As every word processor the HtmlArea also supports inserting a normal line-break by using the key combination `Shift+Enter`

---

insertLinebreakOnCtrlEnter This property also has a default value of `true`. Since some users are familiar with the key combination `Control+Enter` to insert a normal line-break the HtmlArea component does support this. So in the default setup `Control+Enter` and `Shift+Enter` will end up with the same result.

Technical Background

Paragraph-Handling in Firefox

Browser control Currently the HtmlArea does only take control and manage the paragraphs on its own if

- SHIFT and CTRL keys are not pressed
- caret is not within a word
- focus node is not an element (current line is not empty)
- the focus is inside a list

HtmlArea control If the HtmlArea with its paragraph handling takes control, the following actions are taken.

Phase 1: Collecting styles

- computed styles of the focus node are collected
- these styles are grouped in the correct order (e.g. special handling for text-decoration because the text-decoration is linked to the elements color value)

Phase 2: Style string creation

- a `style` attribute based on the computed styles is generated for the paragraph element -> only `margin`, `padding` and `text-align` can be applied at paragraph-level. All other styles need to be applied at span elements (=child elements)
- a string with nested `span` / `font` element string is created. This element string is applied to the paragraph element. The nested structure is necessary because some styles need to be applied in the right order

Phase 3: Nodes creation The following string is applied with the "insertHtml" command

- an empty `span` element with an ID
- a `p` element with the paragraph style
- the nested `span` / `font` string to reflect the formatting which can't be applied at paragraph level

Phase 4: Cleanup

- Gecko inserts a `p` element on his own even if we intercept. This element gets removed afterwards by selecting this paragraph and inserting an empty DIV element at the selection
- the ID of the empty `span` is removed (Gecko will remove an empty `span` then automatically)
- if an empty paragraph is detected it will be removed to avoid rendering problems

Reasons for own paragraph handling

- support to keep formatting across multiple paragraphs or lists
- keep the caret always inside a `p` element
- keep control of the kind of line-breaking which is inserted
- normalize line-breaking
- act like MS Word

Issues

- DOM manipulations **can** break Undo/Redo since Gecko is expecting a DOM node which does not exist anymore
- edge cases can occur which are not targeted yet
- future browser implementation can change and mess up the current implementation
- MS Word behaviour can not be achieved in a browser, yet

List Handling

The component offers `ordered` and `unordered` lists to group content.

If the user inserts a new list

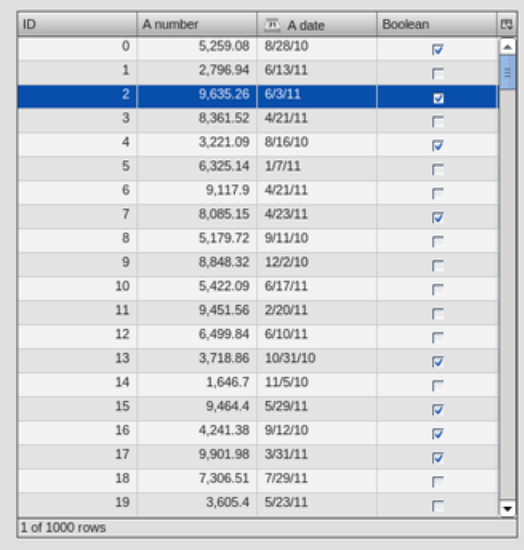
- `Enter` on a non-empty item: inserts a new list item
- `Enter` on an empty item: stops the editing of list
- `Shift+Enter`: inserts a new line within the current list item

These actions/key bindings are reflecting the default behaviour of word processors.

4.3.13 Table Styling

Ever wanted to style the table widget and missed an overview what can by styled exactly? If so, then read on and learn how to style the different parts of the table widget and which steps *can* be applied to customize the appearance of this widget.

By default (talking about the *Modern* theme) the table looks like this:



ID	A number	A date	Boolean
0	5,259.08	8/28/10	☑
1	2,796.94	6/13/11	☐
2	9,635.26	6/3/11	☑
3	8,361.52	4/21/11	☐
4	3,221.09	8/16/10	☑
5	6,325.14	1/7/11	☐
6	9,117.9	4/21/11	☐
7	8,085.15	4/23/11	☑
8	5,179.72	9/11/10	☐
9	8,848.32	12/2/10	☐
10	5,422.09	6/17/11	☐
11	9,451.56	2/20/11	☐
12	6,499.84	6/10/11	☐
13	3,718.86	10/31/10	☑
14	1,646.7	11/5/10	☐
15	9,464.4	5/29/11	☑
16	4,241.38	9/12/10	☑
17	9,901.98	3/31/11	☑
18	7,306.51	7/29/11	☐
19	3,605.4	5/23/11	☐

1 of 1000 rows

This tutorial takes a look at the several *visible* parts of the table such as

- Table widget itself
- Header
- Header cells
- Column visibility button
- Pane
- Row and column styling
- Cell styling
- Selection
- Focus Indicator
- Statusbar

- Scrollbar
- Editable Cells (controls like Textfield, SelectBox and ComboBox)

This tutorial assumes you're implementing all styling changes of the table widget in your own application theme classes. If you're new to the theming layer of qooxdoo it's a good idea to recap the manual section for the *theming layer*.

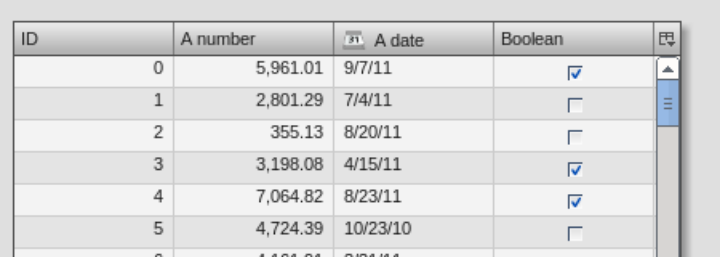
If you're familiar with the theming layer we can dive right into the first topic.

Note: Some of the examples are using CSS3 features, so they're not applicable to all browsers. If you need to achieve a styling which is almost completely identical (a pixel-perfect result is impossible) you have to use graphic files whenever CSS3 features are not present.

Table Widget

Since this widget is the container of all sub-components the styling possibilities are naturally limited. However, limited possibilities does not result in low importance. You can e.g. change the border of the widget which can have a great visual impact. Since the border is a *decorator* you can use all possibilities like different kind of borders, shadows and the like.

Sample of a table widget using a decorator with shadow:



To achieve this you can re-define the `table` decorator in your application theme as following:

```
"table" :
{
  // the decorator 'MBoxShadow' is only supported by modern browsers
  // Firefox 3.5+, IE9+, Safari 3.0+, Opera 10.5+ and Chrome 4.0+
  decorator: [
    qx.ui.decoration.MSingleBorder,
    qx.ui.decoration.MBoxShadow
  ],

  style :
  {
    width : 1,
    color : "table-border-main",

    shadowBlurRadius : 5,
    shadowLength : 4,
    // color is '#999999'
    shadowColor : "table-shadow"
  }
},
```

Note: To get this example working you additionally have to define the colors `table-border-main` and `table-shadow` in your color theme. It's considered as best practice to define all colors as named color in your color theme. This way you can use these named colors all over your application.

Header

Header styling

The header widget is a simple widget containing the header cells and the column visibility button. However, if you want to change the e.g. the background of the whole header you're here in the right place, since the container does the styling of the background and not the header cells themselves.

```
// change the whole background of the header by changing the decorator
"table-scroller-header-css" :
{
  decorator : [
    qx.ui.decoration.MSingleBorder,
    qx.ui.decoration.MBackgroundColor
  ],

  style :
  {
    // color is '#00AA00'
    backgroundColor: "table-header-background",

    widthBottom : 1,
    colorBottom : "border-main"
  }
}
```

Note: Make sure the color `table-header-background` is part of your color theme.

This code snippet will result in the following:

Additionally you can change the height of the whole header by using the `headerCellHeight` property. Changing this property might make sense if you also want to customize the appearance of the header cells (e.g. using a larger font).

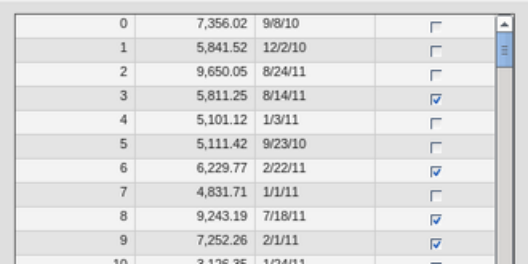
Removing the header

You want to get rid off the whole header? That's also possible by setting two additional themeable properties. So you only have to drop those two line in your appearance theme and you're done:

```
"table" :
{
  alias : "widget",
```

```
  style : function(states)
  {
    return {
      decorator : "table",
      headerCellsVisible : false,
      columnVisibilityButtonVisible : false
    };
  }
},
```

to get the following result



Header Cells

Customizing the appearance of the header cells can be divided into the following parts:

- Decorator for hover effects
- Padding
- Alignment
- Using a different sort icon
- Using a custom font

Beside the settings for alignment and paddings all other appearance customizations are directly applied to the header cell appearance. If you want to e.g. change the hover effect for the header cell you can easily change the decorator (and the padding if necessary) to get an custom styling. Exchanging the sort icon is also supported. The sort icons are shown whenever the user does click at one header cell the very first time.

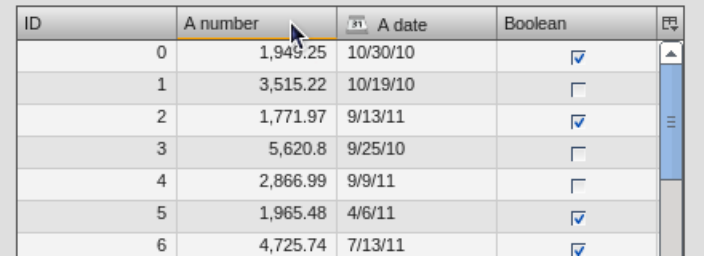
The default appearance for each header cell looks like this:

```
"table-header-cell" :
 {
   alias : "atom",
   style : function(states)
   {
     return {
       minWidth  : 13,
       minHeight : 20,
       padding   : states.hovered ? [ 3, 4, 2, 4 ] : [ 3, 4 ],
       decorator : states.hovered ? "table-header-cell-hovered" : "table-header-cell",
       sortIcon  : states.sorted ?
            (states.sortedAscending ? "decoration/table/ascending.png" : "decoration/table/descending
            : undefined
     };
   }
 },
```

The default decorator for the hover effect does show a 1 pixel border at the bottom of the hovered header cell. If you only want to change this color you can go ahead and add the `table-header-hovered` color in the color theme of your application

```
"table-header-hovered" : "orange",
```

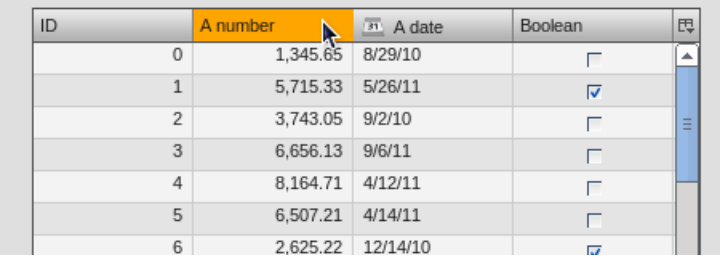
to get a result like this



A bigger change of the header cells might be to change the background color at hovering. To do so you can simply modify the existing `table-header-cell-hovered` decorator like

```
"table-header-cell-hovered" :
{
  style :
  {
    backgroundColor : "orange"
  }
},
```

and you're done!



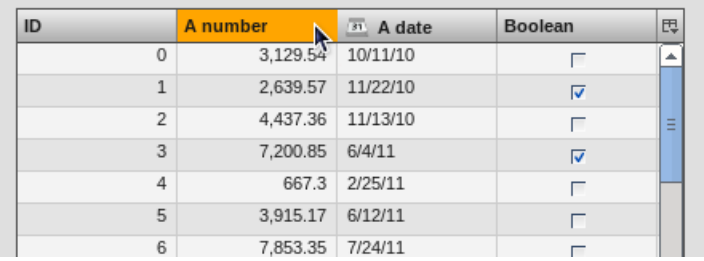
Additionally, you can change the styling of the different child controls (label, icon and sort icon) of the header cells. So if you want to change the font you can simply customize the label child control of the header cell to change the alignment, existing padding and the like.

The default appearance of the child controls are defined as

```
"table-header-cell/label" :
{
  style : function(states)
  {
    return {
      minWidth : 0,
      alignY : "middle",
      paddingRight : 5,
      paddingLeft: 5,

      // change of the default font setting
      font : "bold"
    };
  }
```

```
},

"table-header-cell/sort-icon" :
{
  style : function(states)
  {
    return {
      alignY : "middle",
      alignX : "right"
    };
  }
},

"table-header-cell/icon" :
{
  style : function(states)
  {
    return {
      minWidth : 0,
      alignY : "middle",
      paddingRight : 5
    };
  }
},
```

With the minor change above to the decorator and a font setting of the label you can achieve the following:



Pane

Pane Background

The pane itself is only styled using a background color and it is recommended to only change the background color in order to harmonize the color with the used row colors. The pane widget gets only visible if there is more open space left than occupied by the rows to show or at the very end of the table pane whenever scrollbars are necessary.

One picture says more than thousand words :) The pane with red background color to demonstrate:

The corresponding code in the color theme of your application is a simple one-liner:

```
"table-pane" : "red",
```

Row And Column Styling

Removing The Grid Lines If you take a second look at the picture above you can already recognize a customization of the row and column styling: the removal of the row and column lines.

Basically you can choose between two solutions:

- Setting the colors for the row and column line
- Writing your own cellrenderer **and** rowrenderer

The first solution path is the quick one which is done by customize color of the color theme and **no** additional coding. However, you have also limited possibilities to customize. The second solution is the coding one. Start right away and extend the classes `qx.ui.table.rowrenderer.Default` and `qx.ui.table.cellrenderer.Abstract`, implement the necessary interfaces and create your very own appearance by putting together the necessary CSS styles.

Since the latter solution is a more complex one, I'll only explain the first solution which helps you in styling the table rows and columns in a quick way.

```
// these two lines have to inserted in your application color theme
// to remove the grid lines
"table-row-line" : "transparent",
"table-column-line" : "transparent",
```

Okay, we're cheating here a bit by hiding and not removing them, but anyway the goal is achieved and this in a very quick manner, right?

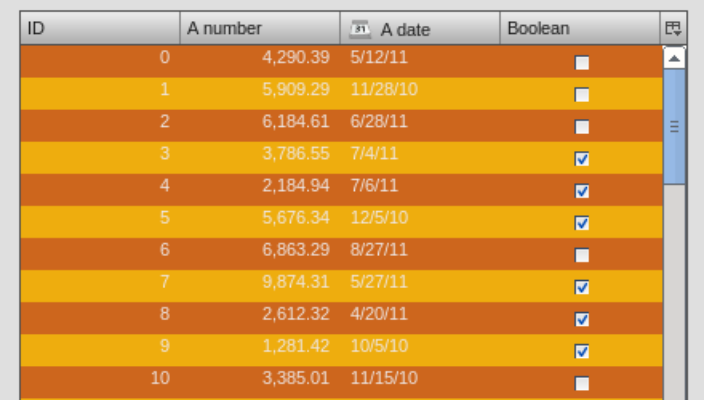
Note: The use of `transparent` as a named color is **not** working for the IE6. If you want to support this browser you have to write your own cellrenderer.

Text And Background Colors What about changing more than the grid lines of the cells? Like changing the colors of the row background and so. I'm glad you ask this :)

Customizing these colors is as easy as hiding the grid lines. You can adapt the styling of the rows and columns by just setting different colors. These colors are available and can be overwritten in your application color theme:

- `table-pane` - background color of the pane when less entries are used than available space
- `table-row` - text color of the cells
- `table-row-background-even` - background color of even rows
- `table-row-background-odd` - background color of odd rows

By changing one or more of these colors you can e.g. achieve this:



ID	A number	A date	Boolean
0	4,290.39	5/12/11	☐
1	5,909.29	11/28/10	☐
2	6,184.61	6/28/11	☐
3	3,786.55	7/4/11	☑
4	2,184.94	7/6/11	☑
5	5,676.34	12/5/10	☑
6	6,863.29	8/27/11	☐
7	9,874.31	5/27/11	☑
8	2,612.32	4/20/11	☑
9	1,281.42	10/5/10	☑
10	3,385.01	11/15/10	☐

by defining these colors:

```
"table-row-background-even" : "#CD661D",
"table-row-background-odd" : "#EEAD0E",
"table-row" : "#EEE9E9",

"table-row-line" : "transparent",
"table-column-line" : "transparent",
```

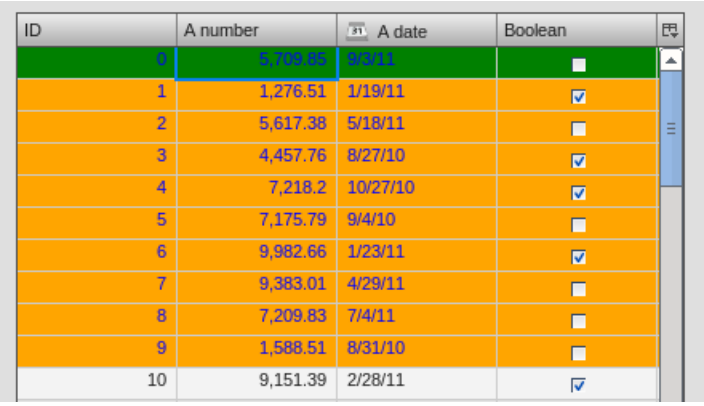
Selection If you customized the colors like above this is only the first part of it. Now the colors for the selection join the game. If you don't adapt these colors the result will for sure not satisfy you. So let's dive into this topic.

- `table-row-selected` - text color for cells are selected but **not** focused
- `table-row-background-selected` - cells are selected but **not** focused
- `table-row-background-focused-selected` - cells are selected **and** focused
- `table-row-background-focused` - cells are focused but **not** selected

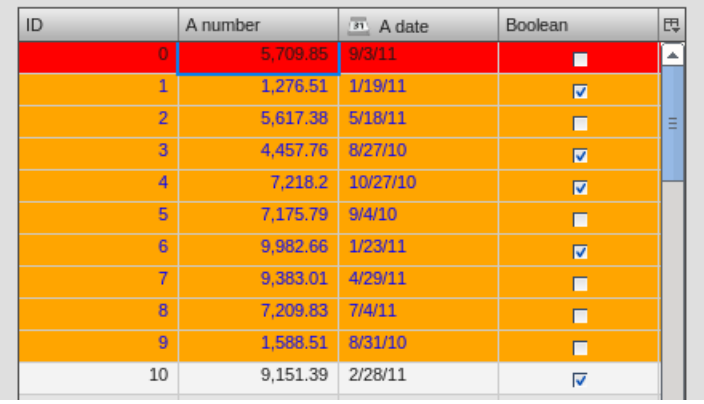
To better visualize this the following example does use colors which are easy to distinguish:

```
"table-row-selected" : "blue",
"table-row-background-selected" : "orange",
"table-row-background-focused-selected" : "green",
"table-row-background-focused" : "red",
```

This shows an active selection:



The same with an inactive selection:



Cell Styling This section is rather for the sake of completeness. If you want to have full control over the cell styling you can create your own cellrenderer classes and apply them for each column of your table. This topic is more a programmatic one and it does not fit in this scope of this article. However, a short introduction and a beginners guide will fit in here :)

A list of existing cell renderer is available at the API Viewer. If one of these is suitable for you all you have to do to use it is

```
var tcm = table.getTableColumnModel();

// Display a checkbox in column 3
tcm.setDataCellRenderer(3, new qx.ui.table.cellrenderer.Boolean());
```

to e.g. display a checkbox for the fourth column. This assumes the cell renderer fits with the provided data.

If that's still no a solution for you, because you really need some extras for the cell rendering the solution has to be an own cell renderer. To get into it it's recommended to take a look at the existing cell renderers and the base class. So basically you should study the implementation of the `qx.ui.table.cellrenderer.Abstract` class and as first start the implementation of `qx.ui.table.cellrenderer.Default` to give a good overview of this topic. Depending on your needs you can start right away by copying the `default` renderer and play around a bit to get a impression of how to customize it.

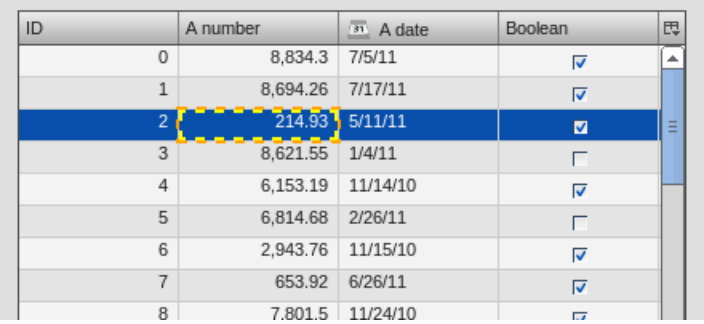
Focus Indicator

This widget in default visible whenever a selection is present. There are two ways of customzing this widget:

- change the decorator and the colors of this widget
- hide this indicator completely

The first possibility is the fast way for customization if you decided to keep the focus indicator visible. The available decorator is a simple 2 pixel border one and the color `table-focus-indicator` is defining this border color of the decorator. So either replacing the decorator by an own one or just changing the color has a direct effect. So let's look at an example where the decorator is changed:

```
"table-scroller-focus-indicator" :
{
  decorator : qx.ui.decoration.Double,

  style :
  {
    style : "dashed",

    // color value is 'orange'
    color : "table-focus-indicator",
    width: 2,

    innerColor : "yellow",
    innerWidth : 2
  }
},
```



Look's really weird, but for demonstration purpose is quite good enough :)

Note: It's better to stick with decorators which are only affecting the border for the focus indicator. A background-related decorator won't have any impact because of the background color styling of the cells.

If you want to hide the focus indicator itself this is a one-liner

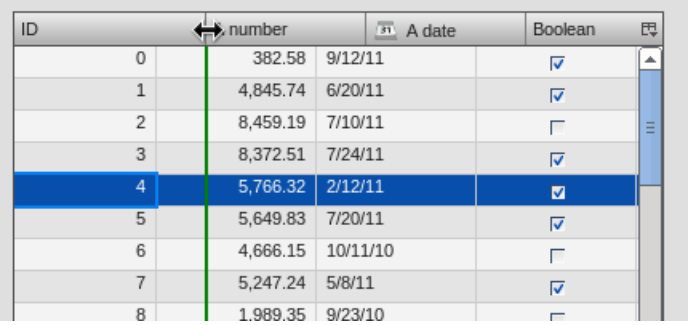
```
table.setShowCellFocusIndicator(false);
```

Resize Line

This is a minor topic, since it only can be customized by its color. You may ask: what is the resize line all about? Point your mouse cursor to a column border and start the resizing of the column by clicking at the border. The vertical line which gets visible is the resize line. So a table with a green resize line would like this:

```
"table-scroller/resize-line" :
 {
   style : function(states)
   {
```

```
      return {
        backgroundColor : "green",
        width : 2
      };
    }
  },
```



Statusbar

You might guessed it already: yes, the statusbar can also be hidden *or* customized by changing a decorator in your decorator theme of your application. This kind of repetition is quite nice, because if you do understand those basic things you can take a look at the `Modern` appearance or decorator theme and you quickly know what to include in your own theme in order to change the styling of a component.

Hiding the statusbar is again an one-liner:

```
table.setStatusBarVisible(false);
```

And the default implementation of the corresponding decorator looks like

```
"table-statusbar" :
{
  decorator : qx.ui.decoration.Single,

  style :
  {
    widthTop : 1,
    colorTop : "border-main",
    style    : "solid"
  }
},
```

As you can see there is no additional background and no other fancy stuff. If you like to change this e.g. setting an own background gradient you can use the following

```
"table-statusbar" :
 {
   decorator :  [
     qx.ui.decoration.MLinearBackgroundGradient,
     qx.ui.decoration.MSingleBorder
   ],

   style :
   {
     widthTop : 1,
     colorTop : "orange",
```

```
      style    : "solid",

      gradientStart : [ "orange", 10 ],
      gradientEnd : [ "red", 80 ]
    }
  },
```

The result of this little demo looks like:

Editable Cells

The table widget (respectively the cell renderer) do support inline editing of values. These widgets which are displayed for the inline editing can also be customized using the theming layer of qooxdoo. The following appearances are predefined:

- table-editor-textfield
- table-editor-selectbox
- table-editor-combobox

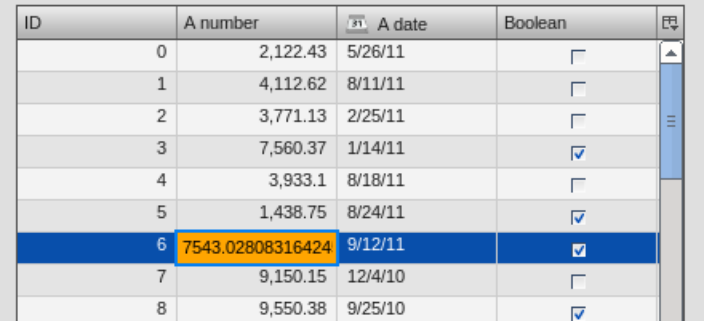
Basically those appearances do include the corresponding widget appearance and only modify single properties. In the `Modern` appearance theme this looks like this:

```
 "table-editor-textfield" :
{
  include : "textfield",

  style : function(states)
  {
    return {
      decorator : undefined,
      padding : [ 2, 2 ],
      backgroundColor : "background-light"
    };
  }
},

"table-editor-selectbox" :
{
  include : "selectbox",
  alias : "selectbox",

  style : function(states)
  {
    return {
      padding : [ 0, 2 ],
      backgroundColor : "background-light"
    };
  }
```

```
},

"table-editor-combobox" :
{
  include : "combobox",
  alias : "combobox",

  style : function(states)
  {
    return {
      decorator : undefined,
      backgroundColor : "background-light"
    };
  }
```

As you can see: only minor changes to the existing appearances. And that's also the hint for your customizations: start with the existing appearances and only modify single properties by overwriting or adding them.

Here's a little example with an editable textfield with `orange` background color:



ID	A number	A date	Boolean
0	2,122.43	5/26/11	☐
1	4,112.62	8/11/11	☐
2	3,771.13	2/25/11	☐
3	7,560.37	1/14/11	☑
4	3,933.1	8/18/11	☐
5	1,438.75	8/24/11	☑
6	7543.02808316424	9/12/11	☑
7	9,150.15	12/4/10	☐
8	9,550.38	9/25/10	☑

Scrollbars

Each widget which uses the scrolling capabilities (as the table pane scroller does) can use themed scrollbars. By using them you can also style them, since they are rendered by decorators which are now quite common to you, right? So this section won't dive too deep into styling scrollbars and just gives hints at which appearance you have to get your hands on. The default appearance of the scrollbars for the table is

```
"table-scroller/scrollbar-x": "scrollbar",
"table-scroller/scrollbar-y": "scrollbar",
```

so the scrollbars of the `table-scroller` widget integrates the scrollbars as child controls and does use the same decorators as the default scrollbars. If you want to theme those scrollbars you should take a look at the `scrollbar` appearance and all other child controls of this widget. As first step you can copy this definitions and modify it to suit your needs. Instead of using the default scrollbars for the table you have to point the `table-scroller/scrollbar-x` and `table-scroller/scrollbar-y` to your own appearance entries and you're done.

Here's a quick reminder how the table does look like with themed scrollbars:

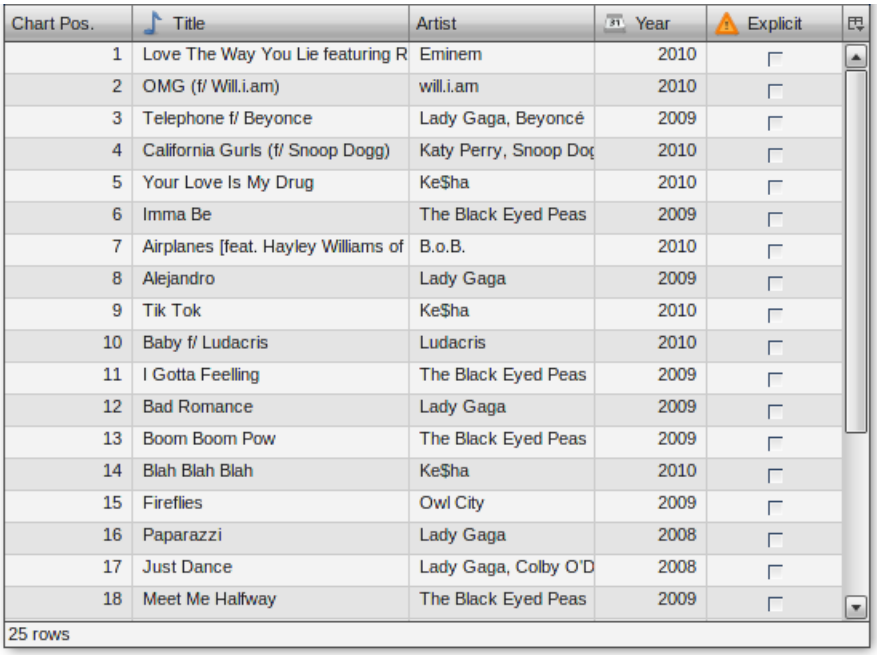


Chart Pos.	Title	Artist	Year	Explicit
1	Love The Way You Lie featuring R	Eminem	2010	
2	OMG (f/ Will.i.am)	will.i.am	2010	
3	Telephone f/ Beyonce	Lady Gaga, Beyoncé	2009	
4	California Gurls (f/ Snoop Dogg)	Katy Perry, Snoop Dog	2010	
5	Your Love Is My Drug	Ke$ha	2010	
6	Imma Be	The Black Eyed Peas	2009	
7	Airplanes [feat. Hayley Williams of	B.o.B.	2010	
8	Alejandro	Lady Gaga	2009	
9	Tik Tok	Ke$ha	2010	
10	Baby f/ Ludacris	Ludacris	2010	
11	I Gotta Feelling	The Black Eyed Peas	2009	
12	Bad Romance	Lady Gaga	2009	
13	Boom Boom Pow	The Black Eyed Peas	2009	
14	Blah Blah Blah	Ke$ha	2010	
15	Fireflies	Owl City	2009	
16	Paparazzi	Lady Gaga	2008	
17	Just Dance	Lady Gaga, Colby O'D	2008	
18	Meet Me Halfway	The Black Eyed Peas	2009	

25 rows

4.3.14 Widget Reference

- *Widget reference*

4.4 Layouts

4.4.1 Layouting

Introduction

A Layout manager defines the strategy of how to position the child widgets of a parent widget. They compute the position and size of each child by taking the size hints and layout properties of the children and the size hint of the parent into account.

Whenever the size of one widget changes, the layout engine will ask the layout manager of each affected widget to recompute its children's positions and sizes. Layout managers are only visible through the effects they have on the widgets they are responsible for.

It is possible to place and size all children directly to static positions using setUserBounds as well, but this is quite uncommon and only used in very special cases. It is almost always better to position children using a layout manager.

The layout manager can be configured on any widget, but most classes only have the protected methods to control the layout. In fact it doesn't make sense to control the layout manager of a `Spinner`, `ComboBox`, etc. from outside. So this scenario is quite common. Some widgets however publish the layout API. One of them is the above mentioned *Composite* widget. It exposes the layout system and the whole children API.

The nature of layout managers is that each one has specialized options for its children. For example, one layout allows specifying a left position of a child in the canvas while another one works with rows and cells instead. Given this fact, the best place to handle these options is the layout itself. Every `LayoutItem` has the methods setLayoutProperties and getLayoutProperties. Through this API the layout properties can be configured independently from the layout.

The validation of properties is lazy (compared to the classic qooxdoo properties). At the moment where a child with layout properties is inserted into a parent widget with a layout, these properties are checked against the rules of the layout. This validation is not possible earlier, e.g. at the definition of the *wrong* property, as at this moment the child may not have a parent yet.

To make layout properties available in a convenient fashion each add() has an optional second parameter: A map with all layout properties to configure. A basic example:

```
var canvas = new qx.ui.container.Composite(new qx.ui.layout.Canvas);
canvas.add(new qx.ui.form.Button("Say Hello"), {
  left : 20,
  top: 20
});
```

This example places a button at the position 20x20 of the composite created. As you can see, the `Composite` widget has a convenient way – using the constructor – to define the layout it uses.

Panes

Some widgets extend the `Composite` widget above. Typical examples here are:

- TabView Page
- Popup

These have the same API like the composite. A slightly other type are so-called composite-like widgets. These widgets offer the same type of children management and layout management to the outside, but they redirect these properties to an inner pane.

Typical widgets in this category are:

- Window
- GroupBox

Sensible defaults

By default, widgets are intelligently auto-sized. This means that most of the time you can create a widget and it will look nice. If you need greater control, you can override the defaults. Every property defined initially is also reconfigurable during the runtime of an application. When using layout managers any computed sizes are automatically refreshed and the arrangement of children is updated.

Every automatically detected size can be overridden. Common settings of a widget (or spacers) are configured through the widget itself. This for example includes properties like width or height. All these sizes are pixel values. Percent and other complex values are only supported by a few layout managers so these are implemented as layout properties (explained in detail later).

Automatic size detection means, that limits are detected as well. Any widget in qooxdoo knows how much it can shrink and how much it can grow without interfering the functionality. The application developer can override these min/max sizes as well. This is no problem as long as the new value is tougher than the automatically detected values (e.g. lower limit of maximum width). When overriding the automatic sizes to reduce the limits layout problems may occur. It is highly suggested to keep an eye on this to omit such scenarios.

One thing to keep in mind is that the `width` cannot override the `minWidth` or the `maxWidth`. Limitation properties may be overridden by the property itself, but not by the normal size property. The `minWidth` can override the minimal automatically detected size, but the `width` cannot. This decision makes the layout system more stable as unintended overrides of the limitations are omitted in most cases.

Often `width` and `height` are described as preferred sizes as the given size may not have an influence on the actual rendered size of the widget. Even if the `width` is configured by the user, this does not mean that the widget always get the desired width.

Growing & Shrinking

Dynamic GUIs often must work equally well in cases where not enough (or too much) room is available to render the GUI in the way meant by the developer. This may include simple cases where the size of tabs is reduced in order to handle the display of all open tabs without scrolling. More advanced cases are text which wraps to multiple lines depending on the available width (and this way influences the position of following children).

In the first case we often see that an application reduces the size of the label and uses an ellipsis symbol to show that the label was too long. This feature is built-in into both commonly used widgets: Label and Atom. When the underlying layout ask to reduce the width (or the developer using the `width` property) the widget tries to solve the requirement dynamically. This certainly works for the height as well.

```
var label = new qx.ui.basic.Label().set({
  value: "A long label text which has not enough room.",
  width: 60
});
```

The second case is handled by the height for width support. Lengthy name but basically a really strong feature which is required quite often. It means that the height may depend on the actual width available. This especially makes sense for multi-line text where the wrapping may be influenced by the available width. The Label widget includes support for this feature when using the rich output mode (HTML content).

```
var label = new qx.ui.basic.Label().set({
  value: "A long label text with auto-wrapping. This also may
    contain <b style='color:red'>rich HTML</b> markup.",
  rich : true,
  width: 120
});
```

Finally this means that every widget can grow and shrink depending on the limitations given for the respective axis. Two easy accessors which disable growing or shrinking respectively are allowGrowX and allowShrinkX. When the growing is disabled the configured or automatically detected maximum size is ignored and configured to the preferred size. When the shrinking is disabled the configured or automatically detected minimum size is ignored and configured to the preferred size. Two convenient methods to controlling these features without knowing of the exact dimensions.

Overflow Handling

This leads to the next question: how to handle scenarios where the content needs more room than provided by the parent but should not shrink. This is a common case for data widgets like Lists or Trees. Both extend the AbstractScrollArea to provide scrollbars to handle overflowing content.

The `ScrollArea` itself renders scrollbars in a custom way. It does not use the native scrollbars nor the native overflowing capabilities of the browser. Benefits of this decision are:

- Scroll bars can be themed.
- Optimal integration into layout system.
- Own implementation overrides browser quirks

The scrollbars are controlable in a way that is comparable to CSS. It is possible to have both scrollbars marked as `auto` to automatically detect the needs of the content. Or any other combination where a scrollbar may be statically hidden or visible. Each bar can be controlled separately. It is possible to enable one scrollbar statically and make the other one auto-displayed and vice-versa.

```
var big = new qx.ui.form.TextArea;
big.setWidth(600);
big.setHeight(600);

var area = new qx.ui.container.Scroll;
area.setWidth(200);
area.setHeight(200);
area.add(big);
```

The `ScrollArea` provides all typically needed methods like scrollToX to scroll to an absolute position or scrollByX to scroll by the given amount. The widget also supports the scrolling of any child into the viewport. This feature is provided through the method scrollItemIntoView. It just needs any child of the widget (at any depth).

```
var list = new qx.ui.form.List();
var item;
for (var i=0; i<20; i++)
{
  item = new qx.ui.form.ListItem("Item #" + i);
  list.add(item);

  if (i == 12) {
    list.select(item);
  }
}
```

One really interesting aspect of these scrolling features is, that they work all the time, even if the widget is not yet rendered. It is possible to scroll any `ScrollArea` before even rendered. It is even possible to scroll any child into view without the whole parent being visible. This is quite useful for selection handling (selected items should be visible). Selections of a list for example can be modified during the normal application runtime and are automatically applied and scrolled correctly after the first appearance on the screen.

Layout Properties

While there are a few core layout features which are normally respected by most layouts like the margin and alignment properties (have a look to the LayoutItem for these), there are layout specific properties which only makes sense in conjunction with the specified layout as well. These properties are called layout properties in qooxdoo.

These properties are normally defined with the addition to the parent widget. The children handling normally allows a second optional parameter `options`. The layout properties are given through a simple map e.g.

```
parent.add(child, {left:20, top: 100});
```

This is still good readable and directly defines the properties where the children is added to the parent (and the parent's layout). While this is the common use pattern of layout properties in qooxdoo applications, it is still possible to define layout properties afterwards using setLayoutProperties. The first parameter is like the second parameter in `add` and accepts a map of layout properties.

Units of Layout Properties

Pixel

Usually all position and size values are defined as pixel values. For example the `left` and `top` layout properties of the `Basic` layout are defined as pixel values.

Flex

The flex value indicates the flexibility of the item, which implies how an item's container distributes remaining empty space among its children. Flexible elements grow and shrink to fit their given space. Elements with larger flex values will be sized larger than elements with lower flex values, at the ratio determined by the two elements. The actual flex value is not relevant unless there are other flexible elements within the same container. Once the default sizes of elements in a box are calculated, the remaining space in the box is divided among the flexible elements, according to their flex ratios. Specifying a flex value of `0` has the same effect as leaving the flex attribute out entirely.

The easiest use case is to make exactly one child consuming the remaining space. This is often seen in modern application. For example the location field in common browsers are automatically configured to behave like this. To do this add a flex value of `1` to the child. In order to make more children behave like this, one could make them flexible the same way. The available space is automatically allocated between all of them. As `flex` allows integer values it is also possible to define weighted values. A flex value of `2` means double importance over `1`. The result is that from 100 pixel remaining space and two flexible children the one with `2` gets about 66 pixel and the other one 33 pixel.

Please note that in shrinking mode flex has an analogous effect. As a flex value of `2` means doubled importance compared to `1` the child with `2` is shrunken less than the child with `1`.

In contrast to qooxdoo 0.7 `flex` values are supplemental to the normal size values of a widget. First all children are positioned using their regular size hints. If after this step the combined size of the children is larger or smaller than the available size the `flex` value defines by how much each widget is stretched or shrunken.

The `flex` property is supported by both Box Layouts, the Dock Layout and the Grid (for columns and rows).

In some way the SplitPane supports flex as well, but it behaves a bit different there as it is regarded as an alternative to the preferred size.

Percent

With the above mentioned `flex` feature the use of percents is quite uncommon in most qooxdoo applications. Still, there are some cases where it might be interesting to define percent locations or dimensions.

The Canvas Layout for example allows a child's position to contain a percent value (e.g. the layout property `left` could be configured to `20%`). When there are 1000 pixel available the so-configured child is placed at a left coordinate of 200 pixel. The final coordinate is automatically updated when the outer dimensions are modified.

The LayoutItem's dimension properties only support integer values. To use percentage dimensions some qooxdoo layout managers allow to define width and height using layout properties. This dimensions are then *higher* prioritized than the width and height configured in the child using the *normal* properties. The limitations defined through `minWidth` etc. are still respected by the layout manager. Percentage dimensions are useful to allocate a specific part of the available space to a given widget without being dependent on the configuration of the other children.

It is possible to combine `flex` with percent dimensions. This is good because it allows to define *approximations* like `3` times `33%` instead of being forced to fill the `100%` completely. With flex enabled the layout manager automatically arranges the children to fill the remaining pixels.

The effects of percentage dimensions in box layouts are comparable to the result of flex in a SplitPane. The resulting size is computed from the available space less all statically configured gaps like spacings or margins. Layout managers with support for percentage dimensions are the already mentioned Box Layouts, but also the Canvas Layout as well as the Dock Layout.

Pre-configured Widgets

There are a few containers in qooxdoo which use a predefined immutable layout for rendering their children. Currently these containers are included:

- *Scroll*: Provides automatic scrollbars for larger content. Does not influence the size of the content which is rendered at the preferred size. Allows scrolling of the content. Supports advanced features like offset calculation and scroll into view.
- *Stack*: Scales every widget to the available space and put one over another. Allows selection of which child should be visible. Used internally by TabView etc.
- *SlideBar*: Comparable to the Scroll Container but only provides automatic forward and backward arrows. Supports only one axis per instance: horizontal or vertical. Buttons are automatically displayed as needed. Supports automatic shrinking of the children (other than the Scroll Container).
- *SplitPane*: Divides the available space into two areas and provides a possibility to resize the panes for the user. Automatically respects the limitations of each child.

Visibility Handling

Every widget can be hidden and shown at any time during the application runtime. In qooxdoo each widget's visibility might have three values: `visible`, `hidden` or `excluded`. While `hidden` and `excluded` both makes a widget invisible there is still a difference: `excluded` ignores the widget in during the layout process while `hidden` simply hides the widget and keeps the room for the widget during the layout process.

The `visibility` property is not commonly used in qooxdoo applications.There are a few nice accessor methods for each widget:

- To check the status of a widget: `isVisible()`, `isHidden()` and `isExcluded()`
- To modify the visibility: `show()`, `hide()` and `exclude()`

Please note that for performance reasons invisible widgets are not rendered or updated to the DOM which means that especially initially invisible parts could improve the startup of a qooxdoo application e.g. alternate Tab Pages, closed Window instances, Menus, etc.

To work with multiple layers like in a Tab View it is suggested to use a Stack Container instead of doing the visibility management on the own.

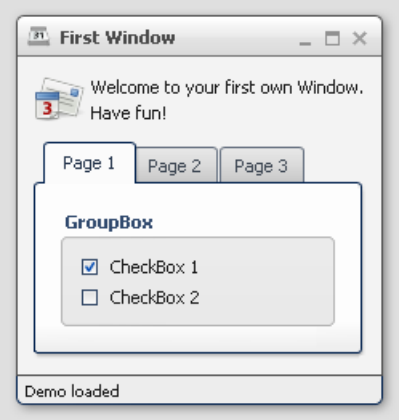
4.5 Themes

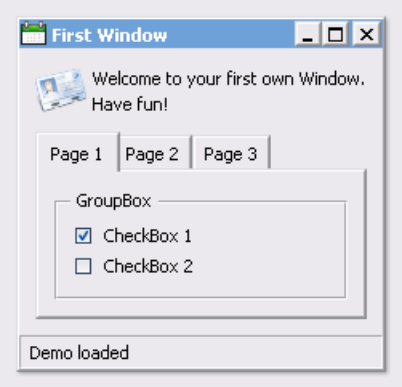
4.5.1 Theming

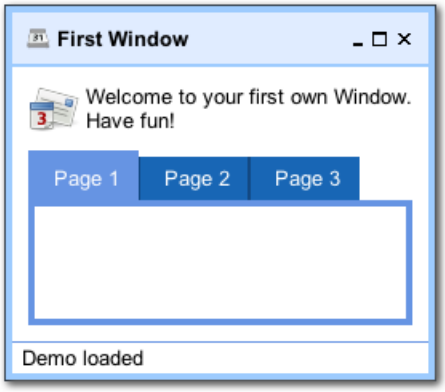
qooxdoo includes four themes:

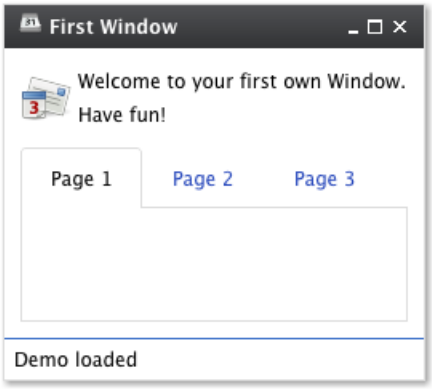
- `Modern` - a graphically rich theme, showcasing many UI capabilities of qooxdoo 3.0
- `Classic` - MS Windows oriented theme
- `Simple` - a lightweight theme, which looks more like a website.
- `Indigo` - a theme, based on simple but offers the style of the qooxdoo.org website.

Here some screenshots:


First Window
Welcome to your first own Window.
Have fun!
Page 1
Page 2
Page 3
GroupBox
CheckBox 1
CheckBox 2
Demo loaded


First Window
Welcome to your first own Window.
Have fun!
Page 1
Page 2
Page 3
GroupBox
CheckBox 1
CheckBox 2
Demo loaded


First Window
Welcome to your first own Window.
Have fun!
Page 1
Page 2
Page 3
Demo loaded



While those four themes run out-of-the-box, it is easy to create your own themes. Those custom themes can either be created by *extending existing ones* or they can be *created from scratch*.

A complete theme (a so-called *meta theme*) consists of several special themes, each designed to play a dedicated role and to setup the different parts of the whole theming. These special themes are described at the subsequent sections followed by a description of how to create own themes.

Meta Theme

A meta theme describes the whole theme itself by defining the specific parts. Each meta theme consists of five keys

- appearance
- color
- decoration
- font
- icon

each of them referencing to a specialized theme. So you can think of a meta theme as of collection whose parts can easily be changed.

Sample of a meta theme:

```
qx.Theme.define("qx.theme.Modern",
{
  meta :
  {
    color : qx.theme.modern.Color,
    decoration : qx.theme.modern.Decoration,
    font : qx.theme.modern.Font,
    appearance : qx.theme.modern.Appearance,
    icon : qx.theme.icon.Tango
  }
}
```

This section describes the different types of themes which are used for theming a whole application.

Color Theme

A color theme defines all colors used by the framework. Each color is defined by an unique name and a value which can be written as hex, rgb or named color. This defined name is usable throughout the whole framework and your

application.

Note: The best way to organize your color names is to use **semantic ones** like `background`, `text-input` or `text-disabled`. This way it is easier to use one color for multiple widgets.

Part of a sample color theme:

```
/**
 * sample color theme
 */
qx.Theme.define("myApplication.theme.sample.Color",
{
  colors :
  {
    /*
    ---------------------------------------------------------------------------
      SAMPLE COLORS
    ---------------------------------------------------------------------------
    */

    // color as hex value
    "background-application" : "#DFDFDF",

    // color as rgb array
    "background-pane" : [ 128, 128, 128 ],

    // color as named color
    "background-light" : "gray",
  }
});
```

Following names are recognized as named colors: `black`, `white`, `silver`, `gray`, `maroon`, `red`, `purple`, `fuchsia`, `green`, `lime`, `olive`, `yellow`, `navy`, `blue`, `teal`, `aqua`, `orange`, `brown`.

The color values are set in the class qx.util.ColorUtil

Decoration Theme

Each widget can be equipped with an independent decoration which can be used to set a background-color or -image, define a border, add a shadow and much more. In a decoration theme you can use several different decorators depending on the results you wish to achieve. Please take a look at the *decorator article* to get more information.

Note: It is recommended to define the decorations inside the theme instead of creating manually decorator instances inside your application code. This way the created decorators can be used by multiple widgets.

What a decoration theme can look like:

```
/**
 * Sample decoration theme.
 *
 * @asset(sample/decoration/myDecorationTheme/*)
 */
qx.Theme.define("myApplication.theme.sample.Decoration",
{
  aliases : {
    decoration : "myApplication/decoration/sample"
```

```
  },

  decorations :
  {
    "single" :
    {
      decorator: qx.ui.decoration.Single,

      style :
      {
        width : 1,

        color : "red",
        colorLeft : "black",
        colorRight : "white",

        style : "solid"
      }
    },

    "grid" :
    {
      decorator : qx.ui.decoration.Grid,

      style :
      {
        baseImage : "decoration/pane/grid.png"
      }
    },


    "combined" :
    {
      decorator : [
        qx.ui.decoration.MBackgroundColor,
        qx.ui.decoration.MBorderRadius
      ],

      style :
      {
        backgroundColor : "button",
        radius : 3
      }
    }
});
```

Noted the `@asset` at the top and the `aliases` key inside the theme declaration? This is needed to for the images used within the theme. A description of how to work with resources is available *here*.

Note: The `aliases` key is especially important when defining an own decorator theme. This entry does add a new alias at the `AliasManager` class and verifies that your images for the decoration theme are found by the `ResourceManager` which is working with the resolve URLs of the `AliasManager` class.

Font Theme

This theme is all about the information of the fonts used throughout your application. As the number of types/variants of fonts used with application isn't that big the font theme is normally a compact one. Web fonts are also defined here. See the *article on web fonts* for details.

Note: It is always a good idea to limit the number of types or variants of fonts to create a homogenous look.

To demonstrate how compact and powerful a font theme can look like, take a look at the example font theme:

```
/**
 * The modern font theme.
 */
qx.Theme.define("qx.theme.modern.Font",
{
  fonts :
  {
    "default" :
    {
      size : 11,
      lineHeight : 1.4,
      family : [ "Tahoma", "Liberation Sans", "Arial" ]
    },

    "bold" :
    {
      size : 12,
      lineHeight : 1.4,
      family : [ "Lucida Grande" ],
      bold : true
    }
  }
});
```

It is important to note that you can only specify values available as property on qx.bom.Font or qx.bom.webfonts.WebFont.

Icon Theme

This theme is to define which icon set is used and normally consists only of 2 main keys (title and aliases).

The important one is the `aliases` key which points the generator to the location of the icon set. The `icon` alias, which is used to reference icons in qooxdoo applications, is set to the value of this key. As qooxdoo uses the free available Tango and Oxygen icon sets it is not necessary to extend these.

Complete code for the `tango` icon theme:

```
/**
 * Tango icons
 */
qx.Theme.define("qx.theme.icon.Tango",
{
  aliases : {
    "icon" : "qx/icon/Tango"
  }
});
```

Appearance Theme

The appearance theme is by far the biggest theme. Its task is to describe every themable widget and their child controls. Since the widgets are styled using decorators, colors, fonts and icons the appearance theme uses the definitions of all the other themes namely the decoration, color, font and icon theme. You can think of the appearance theme as the central meeting point where the other themes (decorator, color, font and icon) get together.

To discover the power of the appearance theme please take a look at the *corresponding article* which should let you get an idea of the whole picture.

Applying Themes

Typically, your application will have a certain, pre-defined theme known *at build-time*. The best way to associate such a default outlook with your application is to use the config.json variable `QXTHEME` inside the "let" section. Setting this variable to a fully-qualified meta theme class lets the build process handle the proper inclusion and linkage of the theme classes automatically. E.g.:

```
...
QXTHEME : qx.theme.Modern,
...
```

Switching Themes During Runtime

It is also possible to set a theme *at runtime*:

```
qx.theme.manager.Meta.getInstance().setTheme(qx.theme.Classic);
```

Having e.g. the qooxdoo modern theme defined in your config.json file, this line of code switches the whole UI to the classic theme. Of course, this can also be a *custom theme*.

Note: Referencing a second theme in the code also adds a dependency to the theme and all the classes and resources necessary. This is only necessary if the theme switch is actively triggered. *Parts* offer a convenient way of on demand loading of code, like a second theme.

Multi-theme Applications

Building up on the previous section, here is how to create an application that provides multiple themes that can be switched at runtime.

- **Configure themes**: Add all meta theme classes of the themes you want to use to the *include* configuration key of the compile jobs. A good way to achieve this is to override the *includes* job in your config.json:

  ```
  "includes" : {
    "include" : [
      "qx.theme.Classic",
      "qx.theme.Indigo",
      "..."
    ]
  }
  ```

  If you use third-party themes (like the Aristo or RetroTheme contributions) make sure you also add their libraries to the *libraries* job, so their classes are actually available.

- **Implement theme switch**: Switch the theme in your application code. E.g. you can use qx.Theme.getAll() to retrieve all known theme classes, filter out the "meta" classes, decide which to use, and set it as the current theme, exemplified here through two methods:

```
_getThemeNames : function() {
  var theme, theme_names = [];
  var themes = qx.Theme.getAll();
  for (var key in themes) {
    theme = themes[key];
    if (theme.type === "meta") {
      theme_names.push(theme.name); }
  }
  return theme_names;
}

_setTheme : function(theme_name) {
  var theme = qx.Theme.getByName(theme_name);
  if (theme) {
    qx.theme.manager.Meta.getInstance().setTheme(theme); }
}
```

  Of course you can use these APIs in different ways, depending on your application needs.

- **Use theme-dependent icons (opt)**: So far switching the theme will result in widgets changing their appearance. Usually, themes also use a specific icon theme. If you use icons in your custom classes (widgets or themes), and you want them to adapt to the main theme you need to make sure that

  1. the relevant icons of all icon themes are registered with your application
  2. your code doesn't "hard-wire" icons but uses aliases. Here are code snippets to illustrate that.

  For 1. add macro definitions to your config.json which can later be used in the *@asset* hints of class code. E.g.:

```
// config.json :

"let" : {
  "QXICONTHEME" : ["Tango", "Oxygen"]
}
```

  In application code register icons for both icon themes with the class using them, by exploiting an asset macro instead of entering the icon theme literally. This also allows you to later add further icon themes just by adapting the configuration, without touching code:

```
// Application class:

// Use the asset macro "qx.icontheme" to register icons from both themes.
/**
 * @asset(myapp/icontheme/${qx.icontheme}/16/apps/utilities-terminal.png)
 */
```

  For 2. use an alias in application code to reference icons transparently:

```
// Use an aliased resource id for the icon
var b = qx.ui.form.Button("My button", "icon/16/apps/utilities-terminal.png");
```

  This is basically the same when you define your own icon themes (like with `qx.Theme.define("myapp.theme.icon.Foo)`) and define your own asset macros (like `"myapp.iconthemes" : ["Foo", "Bar"]`). For the latter you would just use an explicit *asset-let* in your config.json, rather than using the default *QXICONTHEME* macro. A suitable alias like *icon -> myapp/icontheme/Foo* can be *defined in the theme* directly.

4.5.2 Appearance

What is it?

An appearance theme is the main part of the theme. It contains all appearance definitions which are responsible for holding all styling information for the widgets. Usually the appearance theme is the biggest theme and uses all other theme classes like the Decorator- or Font-theme.

Theme Structure

A theme normally consists of a set of entries. Each entry has a key which is basically some kind of selector which matches to a specific widget. Missing selectors are presented as a warning when developing with debug code enabled.

```
qx.Theme.define("qx.theme.modern.Appearance",
{
  appearances :
  {
    selector : entry,
    [...]
  }
});
```

Selectors

In the most basic form each selector is identical to an appearance ID. This appearance ID is the value stored in the `appearance` property (API) of each widget.

The child control system ignores this appearance entry for widgets which function as a child control of another widget. In these cases the selector is the combination of the appearance ID of the parent widget plus the ID of the child control.

In a classic `Button` there is a child control `icon` for example. The appearance selector for the image element which represents the icon is `button/icon`. As you can see the divider between the appearance ID and the child control is a simple slash (`/`).

It is also possible that a widget, which is a child control itself, uses another child control. Generally the mechanism prepends the ID of each parent which is also a child control to the front of the selector. For example:

```
- pane
  - level1
    - level2
      - level3
```

the generated selector would be `pane/level1/level2/level3`. For `pane` which is not a child control of any other widget the appearance ID is used. For all others the child control ID is used. Again `pane` is not managed by any other widget so it is basically added by the developer of the application to another widget while `level1` to `level3` are managed by some type of combined widget and are added to each other without the work of the application developer.

A classic example for this is the `Spinner` widget. A `Spinner` is basically a Grid layout with a `TextField` and two `RepeatButtons`. The three internal widgets are available under the sub control IDs `textfield`, `upbutton` and `downbutton`. The selectors for these kind of child controls are then:

- `spinner/textfield`
- `spinner/upbutton`
- `spinner/downbutton`

Each of these selectors must be defined by the selected appearance. Otherwise a warning about missing selectors is displayed.

Aliases

A entry can be defined with two different values, a string or a map. The first option is named "alias", it is basically a string, redirecting to another selector. In the `Spinner` example from above we may just want to use aliases for the buttons. See the example:

```
qx.Theme.define("qx.theme.modern.Appearance",
{
  appearances :
  {
    [...],

    "spinner/upbutton" : "button",
    "spinner/downbutton" : "button",

    [...]
  }
});
```

So we have mastered one essential part for appearance themes. It is basically the easiest part, but seen quite often. Compared to CSS you always have a full control about the styling of such an child control. There is no type of implicit inheritance. This may also be seen negatively, but most developers tend to like it more.

Such an alias also redirects all child controls of the left hand selector to the right hand selector. This means that the icon inside the button is automatically redirected as well. Internally this mapping looks like this:

```
"spinner/upbutton" => "button"
"spinner/upbutton/icon" => "button/icon"
"spinner/upbutton/label" => "button/label"
```

This is super convenient for simple cases and additionally it is still possible to selectively override definitions for specific child controls.

```
qx.Theme.define("qx.theme.modern.Appearance",
{
  appearances :
  {
    [...],

    "myimage" : [...],

    "spinner/upbutton" : "button",
    "spinner/upbutton/icon" : "myimage",

    [...]
  }
});
```

Internally the above results into the following remapping:

```
"spinner/upbutton" => "button"
"spinner/upbutton/icon" => "myimage"
"spinner/upbutton/label" => "button/label"
```

Entries

The more complex full entry is a map with several sub entries where all are optional:

```
qx.Theme.define("qx.theme.modern.Appearance",
{
  appearances :
  {
    [...],

    "spinner/textfield" :
    {
      base : true/false,
      include : String,
      alias : String,

      style : function(states, styles)
      {
        return {
          property : states.hovered ? value1 : value2,
          [...]
        };
      }
    },

    [...]
  }
});
```

Style Method

Let's start with the `style` sub entry. The value under this key should be a function which returns a set of properties to apply to the target widget. The first parameter of the function is named `states`. This is a map containing keys with boolean values which signalize which states are switched on. The data could be used to react on specific states like `hovered`, `focused`, `selected`, etc. The second parameter `styles` is only available if a `include` key is given. If so, the `styles` parameter contains the styles of the included appearance. This may be very handy if you just want to add some padding and don't want to change it completely. In any case, you don't need to return the given styles. The returned styles and the `styles` argument will be merged by the appearance manager with a higher priority for the local (returned) styles.

It is required that all properties applied in one state are applied in all other states. Something like this is seen as bad style and may result in wrong styling:

```
style : function(states)
{
  var result = {};

  if (states.hovered) {
    result.backgroundColor = "red";
  }
  // BAD: backgroundColor missing when widget isn't hovered!

  return result;
}
```

Instead, you should always define the else case:

```
style : function(states)
{
  var result = {};

  if (states.hovered) {
    result.backgroundColor = "red";
  } else {
    // GOOD: there should be a setting for all possible states
    result.backgroundColor = undefined;
  }

  return result;
}
```

Note: The `undefined` value means that no value should be applied. When qooxdoo runs through the returned map it calls the `reset` method for properties with a value of `undefined`. In most cases it would be also perfectly valid to use `null` instead of `undefined`, but keep in mind that `null` is stored using the setter (explicit null) and this way it overrides values given through the inheritance or through the init values. In short this means that `undefined` is the better choice in almost all cases.

One thing we have also seen in the example is that it is perfectly possible to create the return map using standard JavaScript and fill in keys during the runtime of the `style` method. This allows to use more complex statements to solve the requirements of today's themes were a lot of states or dependencies between states can have great impact on the result map.

Includes

Includes are used to reuse the result of another key and merge it with the local data. Includes may also used standalone without the `style` key but this is merely the same like an alias. An alias is the faster and better choice in this case.

The results of the include block are merged with lower priority than the local data so it just gets added to the map. To remove a key from the included map just define the key locally as well (using the `style` method) and set it to `undefined`.

Includes do nothing to child controls. They just include exactly the given selector into the current selector.

Child Control Aliases

Child control aliases are compared to the normal aliases mentioned above, just define aliases for the child controls. They do not redirect the local selector to the selector defined by the alias. An example to make this more clear:

```
qx.Theme.define("qx.theme.modern.Appearance",
{
  appearances :
  {
    [...],

    "spinner/upbutton" :
    {
      alias : "button",

      style : function(states) {
        return {
          padding : 2,
```

```
          icon : "decoration/arrows/up.gif"
        }
      }
    },

    [...]
  }
});
```

The result mapping would look like the following:

```
"spinner/upbutton" => "spinner/upbutton"
"spinner/upbutton/icon" => "button/image"
"spinner/upbutton/label" => "button/label"
```

As you can see the `spinner/upbutton` is kept in its original state. This allows one to just refine a specific outer part of a complex widget instead of the whole widget. It is also possible to include the original part of the `button` into the `spinner/upbutton` as well. This is useful to just override a few properties like seen in the following example:

```
qx.Theme.define("qx.theme.modern.Appearance",
{
  appearances :
  {
    [...],

    "spinner/upbutton" :
    {
      alias : "button",
      include : "button",

      style : function(states)
      {
        return {
          padding : 2,
          icon : "decoration/arrows/up.gif"
        }
      }
    },

    [...]
  }
});
```

When `alias` and `include` are identically pointing to the same selector the result is identical to the real alias

Base Calls

When extending themes the so-named `base` flag can be enabled to include the result of this selector of the derived theme into the local selector. This is quite comparable to the `this.base(arguments, ...)` call in member functions of typical qooxdoo classes. It does all the things the super class has done plus the local things. Please note that all local definitions have higher priority than the inheritance. See next paragraph for details.

Priorities

Priority is quite an important topic when dealing with so many sources to fill a selector with styles. Logically the definitions of the `style` function are the ones with the highest priority followed by the `include` block. The least priority has the `base` flag for enabling the *base calls* in inherited themes.

States

A state is used for every visual state a widget may have. Every state has flag character. It could only be enabled or disabled via the API `addState` or `removeState`.

Performance

qooxdoo has a lot of impressive caching ideas behind the whole appearance handling. As one could easily imagine all these features are quite expensive when they are made on every widget instance and more important, each time a state is modified.

Appearance Queue

First of all we have the appearance queue. Widgets which are visible and inserted into a visible parent are automatically processed by this queue when changes happen or on the initial display of the widget. Otherwise the change is delayed until the widget gets visible (again).

The queue also minimizes the effect of multiple state changes when they happen at once. All changes are combined into one lookup to the theme e.g. changing `hovered` and `focused` directly after each other would only result into one update instead of two. In a modern GUI typically each click influence a few widgets at once and in these widgets a few states at once so this optimization really pays of.

Selector Caching

Each widget comes with an appearance or was created as a child control of another widget. Because the detection of the selector is quite complex with iterations up to the parent chain, the resulting selector of each widget is cached. The system benefits from the idea that child controls are never moved outside the parent they belong to. So a child controls which is cached once keeps the selector for lifetime. The only thing which could invalidate the selectors of a widget and all of its child controls is the change of the property `appearance` in the parent of the child control.

Alias Caching

The support for aliases is resolved once per application load. So after a while all aliases are resolved to their final destination. This process is lazy and fills the redirection map with selector usage. This means that the relatively complex process of resolving all aliases is only done once.

The list of resolved aliases can be seen when printing out the map under `qx.theme.manager.Appearance.getInstance().__aliasMap` to the log console. It just contains the fully resolved alias (aliases may redirect to each other as well).

Result Caching

Further the result of each selector for a specific set of states is cached as well. This is maybe the most massive source of performance tweaks in the system. With the first usage, qooxdoo caches for example the result of `button` with the states `hovered` and `focused`. The result is used for any further request for such an appearance with the identical set of states. This caching is by the way the most evident reason why the appearance has no access to the individual widget. This would interfere with the caching in some way.

This last caching also reduces the overhead of `include` and `base` statements which are quite intensive tasks because of the map merge character with which they have been implemented.

4.5.3 Custom Themes

There are certain circumstances when the built-in themes are no more sufficient for your application and your needs. You need to create a custom theme because you have either self-written widgets you wish to style or you like to change the theming of your application overall.

Basically you have two choices to create a custom theme depending on your needs and the amount you want to change. The next two sections describe both briefly.

Extending Themes

If you want to stick with an existing theme and only like to add or modify some appearances, change colors or fonts the best way to go is to extend a theme and to create an own meta theme which sets your extended theme.

For example you like to add some appearances (of your own widgets) to the Modern theme you can simply extend the appearance theme of the Modern theme.

```
qx.Theme.define("myApplication.theme.Appearance",
{
  extend : qx.theme.modern.Appearance,
  title : "my appearance theme",

  appearances :
  {
    "my-widget" :
    {
      alias : "atom",

      style : function(states)
      {
        return {
          width : 250,
          decorator : "main"
        };
      }
    }
  }
});
```

To enable your own appearance theme you also have to extend the Meta theme and set your appearance theme.

```
qx.Theme.define("myApplication.theme.Theme",
{
  title : "my meta theme",
```

```
  meta :
  {
    color : qx.theme.modern.Color,
    decoration : qx.theme.modern.Decoration,
    font : qx.theme.modern.Font,
    icon : qx.theme.icon.Tango,
    appearance : myApplication.theme.Appearance
  }
});
```

At last you have to tell the generator to actually use your meta theme. Therefore you have to edit your `config.json` file and add/edit the key `QXTHEME` in the `let` block.

```
"let" :
  {
    "APPLICATION"  : "myApplication",
    ...
    "QXTHEME"      : "myApplication.theme.Theme"
    ...
  },
```

After editing your `config.json` the very last step is to generate your application sources and you're done. Now you can adjust and extend your appearance theme to suit your needs.

Note: These steps are also applicable for the other themes.

Define Custom Themes

A custom theme is an own meta theme and the corresponding themes build from scratch. The main part of this work is mainly the appearance theme and the content of the other themes is mostly defined by the appearance theme, since this theme is the one who uses fonts, icons, decorators and colors.

Creating the meta theme is a no-brainer and when creating the several themes you only have to consider some rules:

- every theme has its own root key which also defines its type. `colors` for a color theme, `appearances` for an appearance theme and so on
- every widget has to be equipped with an appearance, otherwise you'll get a warning at application startup
- every used color, decorator or font has to be defined, otherwise you'll get an error at application startup. So be sure to define all used colors, fonts and decorators and to test your application always in the source version to get the error messages
- be sure to include every image you use in your appearance theme by defining corresponding `@asset` directives.
- Be sure to check all build in widgets with all states. A Widget may have a different looks and feel when disabled or invalid.
- Its a good idea to copy a existing appearance theme and edit all the stuff you need. That way, you can be sure that you have all the appearance keys included the framework needs.

4.5.4 Decorators

Introduction

Decorations are used to style widgets. The idea is to have an independent layer around the widget content that can be freely styled. This way you can have separate decorators that define all kinds of decoration (colors, background image, corners, ...), and apply them to existing widgets, without interfering with the widget code itself.

Using Decorators

Generally all decorators used should be part of the selected decorator theme. The convention is that each decorator instance is stored under a semantic name. To use names which describe the appearance of the decorator is bad because it may make themes less compatible to each other.

It is also regarded as bad style to make use of so-named inline decorators which are created by hand as part of a function call. The reason for this is that generally decorators defined by the theme may be used in multiple places. This means that widgets and application code should not directly deal with decorator instances.

Decoration Theme

As mentioned above, it is common to define the decorators in a decorator theme. This is really easy because you have to specify only a few details about the decorator.

```
"main" : {
  style : {
    width : 1,
    color : "background-selected"
  }
},
```

The first thing you see is the name of the decorator, in this case, `main`. The specified decorator is available using that name in the entire application code, especially in the appearance theme. Then there's the styles map which contains values for decorator properties. You can see all possible style value as properties of the Decorator class.

Sometimes it is very handy to change only little details about the decorator. Imagine a special decorator for hovered buttons. Inheritance comes in very handy in such a case.

```
"scroll-knob-pressed" : {
  include : "scroll-knob",

  style : {
    backgroundColor : "scrollbar-dark"
  }
},
```

As you can see here, we include the previously defined decorator and override the backgroundColor property. That's all you need to do!

Custom Decorators

Custom decorators are created by extending the decorator theme and adding new ones or overwriting existing ones. Each decorator class comes with a set of properties for configuration of the instance. These properties are defined by mixins in the qx.ui.decoration namespace. Following is a short description of the available mixins:

- **MBackgroundColor**: Renders a background color.

- **MBackgroundImage**: Renders a background image.
- **MSingleBorder**: Renders a single border.
- **MDoubleBorder**: Renders an outer and an inner border, e.g. to achieve a bevel effect.
- **MBorderImage**: Uses an image to create a border.
- **MBorderRadius**: Used to render rounded corners.
- **MBoxShadow**: Renders a shadow.
- **MLinearBackgroundGradient**: Renders a linear color gradient.

As you may have guessed, the last three mixins do not work cross browser due to the fact that they rely on CSS properties not available in all browsers. If you want more details, take a look at the API documentations of the mixins.

Each entry of the theme is automatically made available using the `setDecorator` function of the widget class. The instances needed are automatically created when required initially. This mechanism keeps instance numbers down and basically ignores decorators which are defined but never used.

Writing Decorators

It is easily possible to write custom decorators. The interface is quite trivial to implement. There are only five methods which needs to be implemented:

- `getInsets`: Returns a map of insets (space the decorator needs) e.g. the border width plus padding
- `getPadding`: Returns the configured padding minus the border width.
- `getStyle`: Returns the decorator's CSS styles as a map.

Decorators are regarded as immutable. Once they are used somewhere there is no need to be able to change them anymore.

Each decorator configuration means exactly one decorator instance (created with the first usage). Even when dozens of widgets use the decorator only one instance is used. To cache the styles is a good way to improve the initial time to create new element instances.

Writing Decorator Mixins

If you want to use your custom decorator with some build in decorator mixins, you can write you decorator as mixin and use it in combination with all the other mixins. Its comparable to writing a standalone decorator. You are able to implement the following methods:

- `_style<yourName>`: This method has a styles map as parameter which should be manipulated directly. That way, you can just append your styles and That's it.
- `_getDefaultInsetsFor<yourName>`: This method should return the desired insets for this feature. Again, the system takes care of calculating the proper insets for the combination of the mixins.

As you can see, every mixin can define its own methods for `style` and `insets`. The theme system combines all the methods given by the separate widgets to one big working method.

4.5.5 Web Fonts

qooxdoo's web fonts implementation is based on the @font-face CSS syntax. It attempts to abstract away cross-browser issues as far as possible, but due to the browser differences in web font support, it's up to the application developer to provide fonts in the appropriate formats. Tools like FontForge or services like FontSquirrel's font-face generator can be used to convert fonts.

Theme Definition

Like any font that should be used in a qooxdoo application, web fonts are defined in the *Font theme*. They simply use an additional **sources** key:

```
/**
 * @asset(custom/fonts/*)
 */

qx.Theme.define("custom.theme.Font",
{
  fonts :
  {
    "fancy" :
    {
      size : 11,
      lineHeight : 1.4,
      family : [ "Tahoma", "Liberation Sans", "Arial" ],
      sources:
      [
        {
          family : "YanoneKaffeesatzRegular",
          source:
          [
            "custom/fonts/yanonekaffeesatz-regular-webfont.eot",
            "custom/fonts/yanonekaffeesatz-regular-webfont.ttf",
            "custom/fonts/yanonekaffeesatz-regular-webfont.woff",
            "custom/fonts/yanonekaffeesatz-regular-webfont.svg#YanoneKaffeesatzRegular"
          ]
        }
      ]
    }
  }
});
```

There are a few things to note here:

- The value of **sources** is an Array. As with regular CSS font-family definitions, the first font in the list that is available at runtime (meaning in this case it has been successfully downloaded) will be applied to widgets using the "fancy" font.
- The value of the **family** key will also be added to the font-family style property of the widget's content element so there is a defined fallback path even if no web font at all could be loaded.
- Between one and four different formats of the same font can be provided depending on which browsers should be supported. For SVG, it is necessary to add the font's ID. This can be found by looking for the path svg/defs/font/@id in the XML definition, or copied from the CSS template created by the FontSquirrel generator.
- Each **source** entry can be either a URI or a *qooxdoo resource ID*. The latter is generally preferable since font files will then be copied to the output directory for the build version just like any other application resource. Also, this prevents issues in Firefox which applies Same-Origin Policy restrictions to web fonts.

Once configured, web fonts are applied like any other font, either by referencing them in the Appearance theme, e.g.:

```
"window/title" :
{
  style : function(states)
  {
    return {
```

```
      cursor : "default",
      font : "fancy",
      marginRight : 20,
      alignY: "middle"
    };
  }
}
```

or by calling a widget instance's setFont method:

```
var label = new qx.ui.basic.Label("A web font label");
label.setFont("fancy");
```

Asynchronous loading considerations

As web fonts are loaded over HTTP, there can be a noticeable delay between adding the CSS rule to the document and the font style being applied to DOM elements. This means text will be rendered in the first available fallback font, then once the web font has finished downloading, affected widgets will recalculate their content size and trigger a layout update, which can cause a visible "jump" in the GUI. While this effect is far less pronounced (if at all noticeable) once the fonts are cached, it is still advisable to use web fonts sparingly. Of course, using no more than two or three font-faces in an application is also good advice from a design point of view.

4.5.6 Using themes of contributions in your application

Note: This tutorial assumes you are using the latest GUI skeleton template which contains pre-defined theme classes.

Contributions are a powerful and easy way to enhance your application with e.g. widgets that had not (yet) found the way into the qooxdoo core framework. Nevertheless it is a no-brainer to use them in your application.

But if a contribution is providing its own theme (in most cases its own appearance theme) you have to manage this manually.

Note: A bug report to make this step superfluous is already filed (see #1591), but in the meantime you can stick with this little tutorial to get things done.

For an easier understanding this tutorial explains the necessary setup at the example of the TileView widget.

Adjust your configuration

The interesting part of the `config.json` looks like this:

```
...
"jobs" :
  {
    "libraries" :
    {
      "library" :
      [
        {
          "manifest" : "contrib://TileView/trunk/Manifest.json"
        },
       // as the tileView uses internally the FlowLayout you have
```

```
        // to add this to set it up correctly
        {
           "manifest" : "contrib://FlowLayout/trunk/Manifest.json"
         }
       ]
     }
  }
...
```

Include appearance theme

If you use the latest GUI skeleton template you will get an own appearance theme class (among all other theme classes) already setup for you. All you need to do is to include the appearance class provided by the `TileView` widget into your own appearance class.

Include the `TileView` appearance:

```
qx.Theme.define("yourApp.theme.Appearance",
{
  extend : qx.theme.modern.Appearance,

  // this include key does the magic
  include : tileview.theme.Appearance,

  // overwrite the appearances to customize the look of the modern theme
  // usually not needed
  appearances :
  {
  }
});
```

So all you need to add is this little `include` key with the corresponding appearance class to include it into your application.

Known issues

The following code which could reside in your `Application` class **won't** work:

```
qx.Theme.include(qx.theme.modern.Appearance, tileview.theme.Appearance);
```

The reason is that this include above will be resolved at **runtime** which does not work anymore. The first solution is resolved at **loading time**, so the include is already performed at startup. This issue is already filed under #1604.

4.5.7 Three steps for efficient theme development

The widgetbrowser application is used by the framework to showcase the widgets and the available themes. With the feature to switch the themes at run-time you can quickly get an overview of the theming capabilities of the desktop widget set.

So this should be a perfect match if you like to develop an own custom theme, right? Every widget is displayed within the widgetbrowser and this would help a lot to develop an own custom them from scratch.

To turn this into reality the widgetbrowser application got some enhancements and now it is very easy to use it for theme development. This little tutorial will show you the three steps you need.

Kickoff: Create a new contribution

A skeleton of the `contribution` type is perfectly suited to develop an own custom theme. Starting with a contribution you can easily integrate your own theme later on into the contrib infrastructure of qooxdoo and can share your theme with other users.

Creating a contribution skeleton is one command away:

```
create-application.py -t contribution -n <NAME_OF_YOUR_THEME>
```

Integration: How the widgetbrowser joins the game

Pulling in the widgetbrowser into your application is done by editing two files: the `config.json` and the `Application.js` of your demo application.

The configuration has to be edited like this (original values are commented out):

```
// Point the top-level include to the widgetbrowser configuration
"include" :
[
  {
    //"path" : "${QOOXDOO_PATH}/tool/data/config/application.json"
    "path" : "${QOOXDOO_PATH}/application/widgetbrowser/config.json"
  }
],


// Change the default theme of your application
"let" :
{
  // ...

  //"QXTHEME"      : "NAMESPACE.demo.theme.Theme",
  "QXTHEME"      : "NAMESPACE.theme.modern.Theme",

  // ...
}


// Add the widgetbrowser as library at the 'libraries' job
"libraries" :
{
  "library" :
  [
    {
      "manifest" : "../../Manifest.json"
    },

    {
      "manifest" : "${QOOXDOO_PATH}/application/widgetbrowser/Manifest.json"
    }
  ]
}


// Add a custom 'common' job right after the existing 'libraries' job
"common" :
{
```

```
  "packages" :
  {
    "parts" :
    {
      "boot" :
      {
        "include" : [ "${APPLICATION}.Application", "${QXTHEME}" ]
      }
    }
  }
}
```

With these modification you pulled the configuration of the widgetbrowser into your own application. Basically your application is now a kind of copy of the widgetbrowser. But wait: how about the JavaScript part?

Well this is done by editing the `Application.js` of your application. To keep it simple just replace your existing class by this:

```
qx.Class.define("NAMESPACE.demo.Application",
{
  // use the application class of the widgetbrowser as parent class
  extend : widgetbrowser.Application,

  /*
  *****************************************************************
     MEMBERS
  *****************************************************************
  */

  members :
  {
    // extend the 'getThemes' method and add your own theme to the list
    getThemes: function() {
      return ([
        {"Indigo" : "qx.theme.Indigo"},
        {"Modern" : "qx.theme.Modern"},
        {"Simple" : "qx.theme.Simple"},
        {"Classic" : "qx.theme.Classic"},
        {"new theme" : "NAMESPACE.theme.modern.Theme"}
      ]);
    }
  }
});
```

That's it! Run `generate.py` within the `demo` folder and open it in your favorite browser.

Final touch: Add your theme name and version

At the right upper corner of the widgetbrowser application you can easily replace the default name and version with your own to inform the user about the name of the theme and its version.

This is an additional minor adjustment in the `config.json` file:

```
// ...

// Add these lines to your 'common' job and adapt it to your needs
"environment" :
{
```

```
  "versionLabel.name" : "YOUR THEME NAME",
  "versionLabel.version" : "YOUR THEME VERSION"
},

// ...
```

Re-run the `generate.py` script to get this update into your application and enjoy!

4.6 Technical Concepts

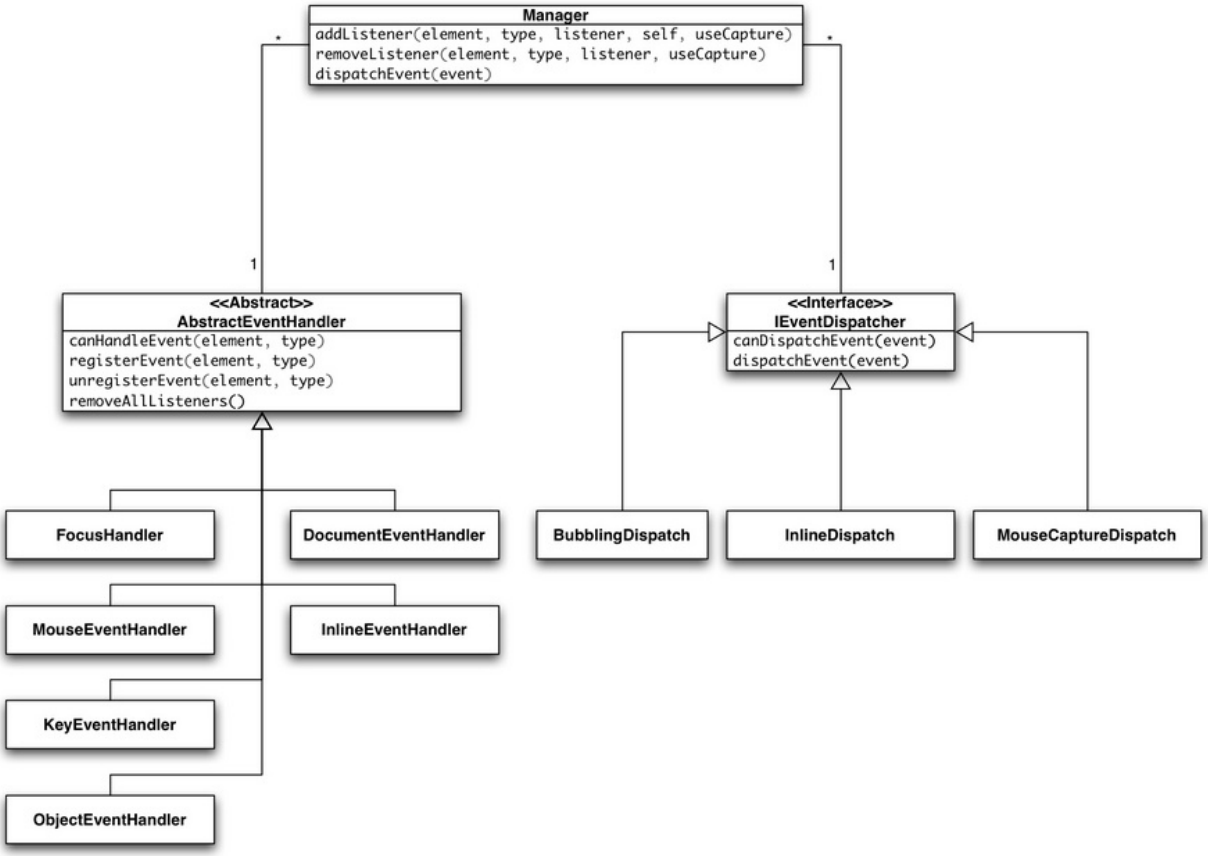
4.6.1 The Event Layer

The class qx.event.Manager provides a per-document wrapper for cross-browser DOM event handling. The implementation of the event layer is inside the qx.event namespace.

The following features work in all *supported browsers*:

- Canceling events: `stopPropagation()`
- Skipping the browser's default behavior: `preventDefault()`
- Unified event objects matching the W3C DOM 2 event interface
- Cross-browser event *bubbling* and *capturing* phase, even in Internet Explorer
- Mouse event capturing
- Port of the unified qooxdoo 0.7 key event handler to the 1.2 low-level layer. For a full list of available key identifiers see the getKeyIdentifier() method documentation of the `qx.event.type.KeySequence` class.
- Unified mouse events
  - Normalized double click event sequence `mousedown` -> `mouseup` -> `click` -> `mousedown` -> `mouseup` -> `click` -> `doubleclick` in Internet Explorer
  - Normalized right click sequence `mousedown` -> `mouseup` -> `contextmenu` in Safari 3 and Opera.
  - Always fire `click` events if the `mouseup` happens on a different target than the corresponding `mousedown` event. Natively only Internet Explorer behaves like that.

UML Class Diagram



4.6.2 HTML Element Handling

This document describes the ideas and concepts behind the classes in the `qx.html` namespace (API). qooxdoo also comes with a basic low-level abstraction API for DOM manipulation. For details about this API please have a look at the *corresponding documentation*.

Idea

The classes in `qx.html` are wrapper for native DOM elements, which basically were created to solve one major issue:

Automatically keeping care of DOM manipulation and creation while dealing with large number of elements.

In details this means:

- **Automatic performance**: Programmatically constructing DOM hierarchies is hard to get fast because the order in which elements are nested can heavily influence the runtime performance. What `qx.html.Element` does is trying to keep the number of element instances to the minimum actually needed (DOM nodes are expensive, both performance and memory aside) and to insert the DOM nodes in an efficient manner. Further all changes to the DOM are cached and applied in batch mode, which improves the performance even more.
- **Normalized API**: Working with HTML DOM elements usually involves many browser switches. Especially when it comes to reading and setting of attributes or styles. For each style one has to remember whether a normalization method should be called or if the value can be set directly. `qx.html.Element` does this kind of normalization transparently. The browser normalization is based on the *existing low-level APIs*.

- **Convenience methods**: These elements have additional convenience API, which is not available on pure DOM elements. They have e.g. the functionality to manage children with methods like `addBefore()` or `moveAfter()`.

Typical Use Cases

- Building a widget system on top
- Massively building DOM elements from data structures

It may be used for smaller things as well, but brings in quite some overhead. The size of the API, additional to a basic low-level package of qooxdoo is about 20 KB (5 KB gzipped). Also it consumes a bit more memory when all underlying DOM elements are created. Keep in mind that the instances are around all the time. Even when all jobs for a instance are done at the moment.

Features

- Automatic DOM insertion and element management
- Full cross-browser support through usage of low-level APIs e.g. `setStyle()`, `getAttribute()`, ...
- Advanced children handling with a lot of convenience methods e.g. `addAfter()`, ...
- Reuse existing markup as a base of any element via `useMarkup()`
- Reuse an existing DOM node via `useElement()`
- Powerful visibility handling to `include()` or `exclude()` specific sub trees
- Support for scrolling and scroll into view (`scrollTo()`, `scrollIntoView()`, ...)
- Integration of text selection APIs (`setSelection()`, `getSelection()`, ...)
- Automatic interaction with event managers (`addListener()`, `removeListener()`, ...)
- Connection to focus/activation handler

Specific HTML Elements

Roots

A root is one essential element type when dealing with the API. Every user of `qx.html.Element` needs at least one instance of `qx.html.Root` to insert children to it. The root is always marked as being visible and is typically the body DOM element or any other directly inserted element. This element can be assigned to be used by the root using the method `useElement()`.

Labels

Used for all types of text content. Supports text or HTML content togglable using the `setRich()` method. When using the text mode ellipsis is supports in all browsers to show an indication when the text is larger than the available space. Highly depends on the API of qx.bom.Label.

Images

An element pre-configured as a `IMG` tag. Supports scaled and unscaled images. Supports image clipping (without scaling) to more efficiently deal with a lot of images. Depends on the API brought in by qx.bom.element.Decoration.

Input

This element is used for all types of input fields. The type can be given using a constructor parameter. It allows configuration of the `value` and the text wrapping (requires type `textarea`). Depends on the API brought in by qx.bom.Input.

Iframe

This element is used to create iframes to embed content from other sources to the DOM. It wraps the features of qx.bom.Iframe. Supports to configure the source of the iframe as well as its name. Comes with accessors to the document or window object of the iframe.

Canvas

Renders a HTML5 Canvas to the DOM. Has methods to access the render context as well to configure the dimensions of the Canvas.

The Queue

Internally most actions applied to the instances of `qx.html.Element` are applied lazily to the DOM. All style or attribute changes are queued for example to set them at once. This is especially useful to allow to bump out changes at once to the browser even when these happens in multi places and more important on more than one element.

Even things like focus handling or scrolling may be queued. It depends on if the element is currently visible etc. whether these are queued. `focus` makes often more sense when it is directly executed as the following code may make assumptions that the changes are applied already. Generally qooxdoo allows it to apply most changes without the queue as well using a `direct` flag which is part of most setters offered by `qx.html.Element`.

4.6.3 The Focus Layer

History

This document is meant to talk about some internals of the focus system in qooxdoo since 1.2. This is a technology documentation targeted to interested developers. There is no need to understand these details as a user of the framework.

In previous versions of the focus handling we forced the application to our own implementation instead of working together with the browser. This was quite straightforward because the topic itself is quite complex and the differences between the browsers are huge. So just ignoring all these differences and implementing an own layer is highly attractive.

However this came with quite some costs. For example it's quite hard to catch all the edge cases when a input field loses the focus nor is it possible to recover the focus correctly when the browser does something after switching the window (send back/bring to front etc.). To listen on the browser might improve some types of out-of-sync problems in the previous versions. We caught most things correctly though, but it is quite hard to get 100% accuracy.

Focus Support

With 1.2 the focus system was reimplemented using the new low level event stack. Compared to the old focus system this basically means that the whole focus support is implemented low-level without any dependencies on the widget system. It directly uses the new event infrastructure and integrates fine with the other event handlers.

The new system tries to connect with all available native events which could help with detecting were the browser's focus is moving to. The implementation makes use of native events like `activate` or `focusin` where available. It uses a lot of browser behavior which is not explicitly documented or valid when reading the specifications, just to solve the issue of detecting where the focus currently is or is moved to.

It supports the events `focusin`, `focus`, `focusout` and `blur` on DOM nodes. It also supports `focus` and `blur` events on the `window`. There is support for `activate` and `deactivate` events on DOM nodes to track keyboard activation. It has the properties `focus` and `active` to ask for the currently focused or activated DOM node.

Activation Support

The activation, as part of the focus system, is also done by this manager. The keyboard handler for example asks the focus system which DOM element is the active one to start the bubble sequences for all keyboard events on this element. As the keyboard layer sits on top of the DOM and implements the event phases on its own there is no need to inform the browser about the active DOM node as it is simply not relevant when using this layer. It is also quite important as in every browser tested the methods to activate a DOM node (if available at all) might also influence the focus which creates some problems.

Window Focus/Blur

The handler also manages the focus state of the top-level window. It fires the `blur` and `focus` events on the `window` object one can listen to. Natively, these events are fired all over just by clicking somewhere in the document. The issue is to detect the *real* `focus`/`blur` events. This is implemented through some type of internal state representation.

Text Selection

Focus handling in qooxdoo also solves a lot of related issues. For example the whole support for unselectable text is done with the focus handler as well. Normally all text content on a page is selectable (with some exceptions like native form buttons etc.). In a typical GUI or during drag&drop sessions it is highly needed to stop the user from being able to select any text.

The only thing needed for the focus handler here is to add an attribute `qxSelectable` with the value `off` to the node which should not be selectable. I don't know about a way which is easier to solve this need.

Behind the scenes qooxdoo dynamically applies styles like `user-select` or attributes like `unselectable`. There are a lot of bugs in the browser when keeping these attributes or styles statically applied to the nodes so they are applied as needed dynamically which works surprisingly well. In Internet Explorer the handler stops the event `selectstart` for the affected elements.

Prevent Defaults

One thing we needed especially for the widget system, which is built on top, was support for preventing a widget or in this case a DOM node from being able to get the focus. This sounds simpler at first than it is. The major issue is to also keep the focus where it is while clicking somewhere else.

This is especially interesting when working with a text selection. Unfortunately in a browser the selection could only be where the focus is. This is a major issue when trying to apply any change to the currently selected text like needed for most kinds of editors (like a rich text editor used by a mail application for example). The type of fix we apply

in qooxdoo is not to allow the browser to focus a specific DOM node e.g. the "Bold" button of the text editor. This makes it easy to add listeners to the button which work with the still existing selection of the editor field. The feature could be applied easily to a DOM node like such a button just through an attribute `qxKeepFocus` with the value `on`. It affects all children of the element as well, as long as these do not define anything else.

A similar goal is to keep the activation where it is when the user clicks at a specific section of the document. This is mainly used to keep the keyboard processing where it is e.g. when clicking the opened list of a `SelectBox` widget. This feature could be used for other scenarios like this as well. Like in the previous block it can be enabled simply by setting the attribute `qxKeepActive` to `on` for the relevant DOM node. Internally, to stop the activation also means to stop the focus. It was not solvable in another way because the browser otherwise sends activation events to the focused DOM node which is contra-productive in this case.

Another unwanted side effect of some browsers is the possibility to drag around specific types of content. There is some type of native drag&drop support in most of today's browsers, but this is quite useless with the current quality of implementation. Still, the major issue remains: It is possible to drag around images for example which is often not wanted in a GUI toolkit. These native *features* compromise the behavior implemented by the application developer on top of them. To stop this, qooxdoo applies styles like `user-drag` on browsers that support it, or prevents the native `draggesture` event where available.

Other then this, most of these prevention is implemented internally through a `preventDefault` call on the global `mousedown` event when a specific target is detected. This has some side effects though. When preventing such a core event it means that most browsers also stop any type of selection happening through the mouse. This also stops them from focusing the DOM node natively. The qooxdoo code uses some explicit `focus` calls on the DOM nodes to fix this.

Please note that some settings may have side effects on other things. For example, to make a text region selectable but not activate able is not possible with the current implementation. This has not really a relevance in real-world applications, but may be still interesting to know about.

Finally

Finally, the whole implementation differs nearly completely for the supported browsers. Hopefully you get an impression of the complexity of the topic. May the browser with you.

4.6.4 Using qx.Website in qx.Desktop

Use Case

Sometimes it might be desirable to use the low-level part of qooxdoo (named qx.Website) in your qx.Desktop application. Use cases could be setting custom attributes or changing the style attribute of a DOM element. If you find yourself in such a situation, it is necessary to understand the setup of qx.Website.

Understanding the Setup

The basic structure of qx.Website is module-based and with that loosely coupled. The base class called `qxWeb`, or `q`, only contains minor functionality, e.g. the plugin API. All other functionality is offered by *modules*, even though the API Viewer shows a different picture. `qxWeb` does not have any built-in reference to any of these modules. This means that the dependency analysis, which is done by the generator and gathers all necessary classes, cannot detect the dependencies to the modules you are using.

Use require hints

But the generator offers an easy-to-use way to tell it what to include. Let's say you want to use the method named `fadeIn` like in the following sample.

```
var element = el; // DOM Element
qxWeb(element).fadeIn();
```

The generator detects the dependency to the class `qxWeb` and makes sure it is available for your application. But the module attaching the method `fadeIn` is still missing and that's where we need to take care of adding this requirement.

But which class adds this method? The API Viewer can tell you that. Just open that method and check the details. It shows you a link to the original method and the implementing module. That's the module we need to include by adding a *require hint* to the class. At the top of the file using the `fadeIn` method, add

```
@use(qx.module.Animation)
```

(assuming the call to `fadeIn` is executed after the entire application has been loaded). Once loaded the `qx.module.Animation` module will register itself with `qxWeb` and its API will be available.

Mind that there are *alternative ways* to declare additional dependencies towards the Generator.

The easy way

If you use a lot of the qx.Website API in your app, it might be worth to include the code modules by requiring `qx.module.Core` and with that the basic qx.Website modules. But keep in mind that you might include classes you don't need, which adds to the code size of your application.

4.6.5 Using qx.Desktop on Mobile Devices

Modern mobile devices usually supply a standard-compliant web browser, often Webkit-based. The most obvious difference between desktop and mobile browsers is found in the events fired. The desktop browsers supply mouse events, so that events for mouse buttons (up, down, click), hovered items (over and out), scroll and move are available. Mobile devices are typically based on touch interaction and therefore fire touch events. For backward compatibility mobile browsers emulate mouse events natively. Unfortunately, they introduce a slight delay compared to the genuine touch events. This delay is often responsible for a sluggish feel of the UI. The Apple documentation about handling events covers the event handling of mobile devices in more detail.

Emulate Mouse

To eliminate the browser-generated delay for mouse events, one has to rely on the touch events instead. Therefore qooxdoo can disable the mouse event handler regularly used for mouse interaction. A new handler is used internally that listens to the native touch events and emulates the corresponding mouse events. This allows typical qx.Desktop apps to continue to work on touch devices.

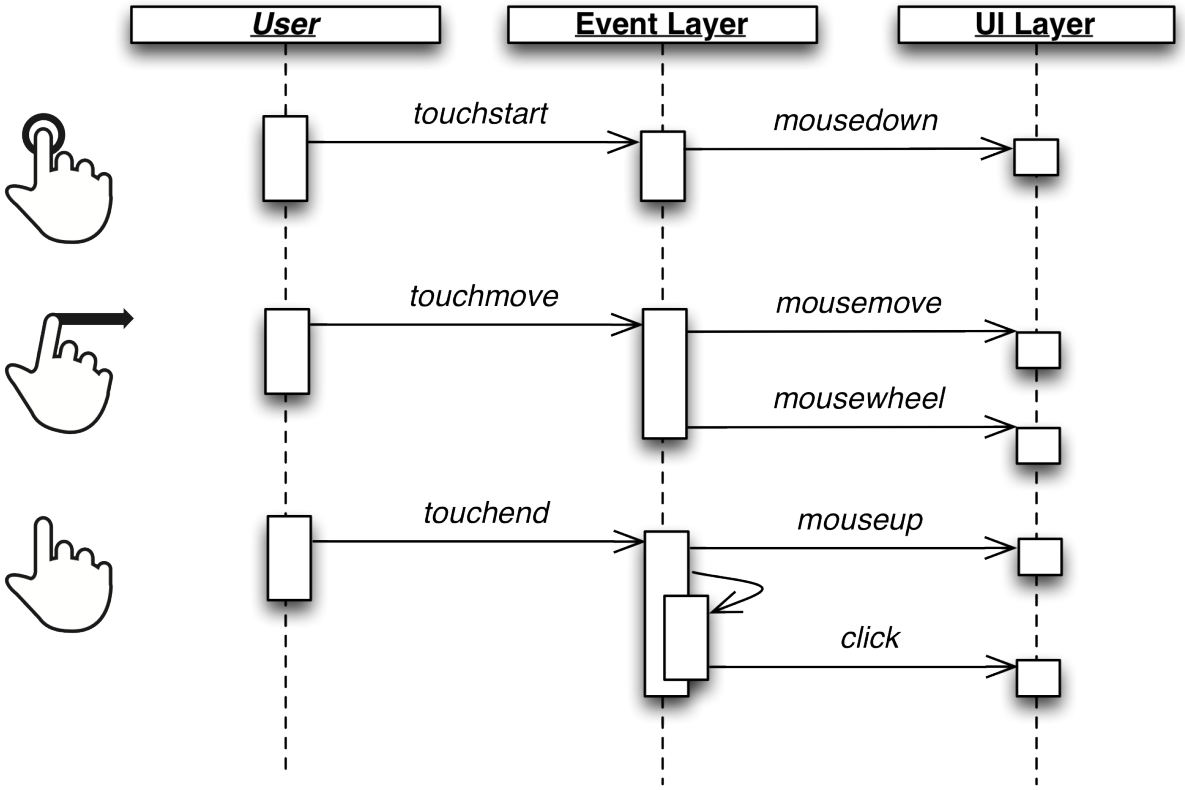
How to use it?

Enabling this feature is easy: It is available as an *environment* setting named `qx.emulatemouse`. Setting its value to `true` in the *config.json* of an app enables the mouse emulation on devices that natively support touch events.

Technical Realization

As you might have already guessed, emulating mouse events based on touch events can never cover every event a mouse has to offer. The most obvious events are mouseover / mouseout, as there are no corresponding touch events. Nevertheless the framework's emulation layer does a pretty good job as can be seen in the following overview:

- `touchstart`: triggers a `mousedown` event. Keep in mind that a `touchstart` event is also fired when you start scrolling or use any other gesture.
- `touchmove`: results in two different kind of events. The obvious one is the `mousemove` event. The second event is `mousewheel`, which is responsible for the scrolling behavior. An algorithm for momentum scrolling is included.
- `touchend`: triggers a `mouseup` event.
- `tap`: is a qooxdoo-based event which is already normalized and fires on a user tap. This results in a `click` event.
- `longtap`: is a qooxdoo-based event which is already normalized and fires if a user touches and holds the finger on the screen. This results in a `contextmenu` event.



4.7 Tutorials

4.7.1 Tutorial Part 1: The Beginning of a Tweets App

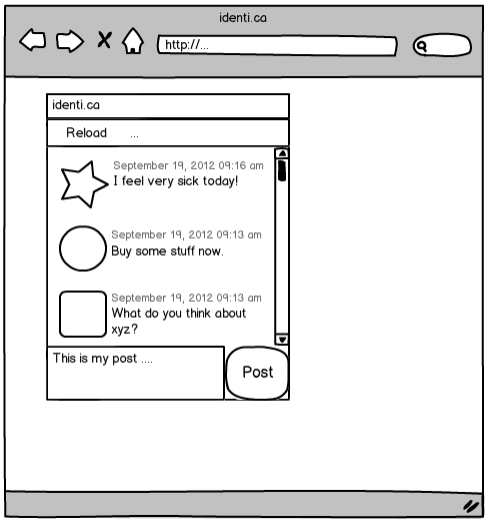
Introduction

This tutorial covers many practical aspects of developing desktop-like qooxdoo apps. It is set up as a series of tutorials that go beyond the must-read *"Hello World" tutorial*. For even more samples of app code you can check the demo applications included in the framework, for instance the Feedreader.

As the headline of this tutorial says, we are building a simple tweets application. identica is a twitter-like service for reading and posting public short messages - called "tweets". It has a twitter-compatible API for accessing data.

Twitter itself made its authorization scheme more complex, as it starts requiring OAuth even to read public tweets. For this basic tutorial it would be too complex to handle such advanced authorization. If your are interested in OAuth, check out how you could handle that in a qooxdoo app by looking at the Github demo.

The following mockup shows you how the application should look like at the end.



If you take a closer look at the mockup, you see a *window* containing a *toolbar*, a *list*, a *text area* and a *button* to post messages. This should cover some common scenarios of a typical qooxdoo application.

In the first part you'll learn how to create a new application and how to build a part of the main UI. But before we get started, be sure you looked at the *"Hello World" tutorial*. We rely on some of the fundamentals explained there.

Getting started

The first step is to get a working qooxdoo application where we can start our development. You should already have the qooxdoo SDK and know how to use `create-application.py`, so we just create an application called `tweets`.

```
create-application.py --name=tweets
```

After that, we should check that everything works as expected. Change the directory to tweets and run `./generate.py`. Now the skeleton application is ready to run and you can open the index file located in the `source` directory. After that, open the `Application.js` file located in `source/class/tweets/Application.js` with your favorite editor and we are set up for development!

You should see the unchanged skeleton code of the application containing the creation of a button. We don't need that anymore so you can delete it including all the listener stuff.

The first part is to create a Window. As the *Window* contains all the UI controls, we should extend from the qooxdoo Window and add the controls within that class. Adding a new class is as easy as creating a new file. Just create a file parallel to the `Application.js` file named `MainWindow.js`. Now it is time to add some code to that file. We want to create a class so we use the qooxdoo function `qx.Class.define` for that. Add the following lines to your newly created file.

```
qx.Class.define("tweets.MainWindow",
{
  extend : qx.ui.window.Window,

    construct : function()
    {
      this.base(arguments, "tweets");
    }
});
```

We have created our own class extending the qooxdoo Window. In the constructor, we already set the caption of the window, which is the first constructor parameter of the qooxdoo window. So you already have guessed it, `this.base(arguments)` calls the overridden method of the superclass, in this case the constructor. To test the window, we need to create an instance of it in the main application. Add these two lines of code in the Application.js file to create and open the window. Make sure to add it at the end of the main function in the application class.

```
var main = new tweets.MainWindow();
main.open();
```

Now its time to test the whole thing in the browser. But before we can do that, we need to run the generator once more because we added the window class as new dependency. So run `./generate.py` and open the page in the browser. You should see a window in the top left corner having the name "tweets".

Programming as Configuring

The last task of this tutorial part is to configure the window. Opening the window in the left corner does not look so good, so we should move the window a bit away from the edges of the viewport. To do this add the following line to your application file:

```
main.moveTo(50, 30);
```

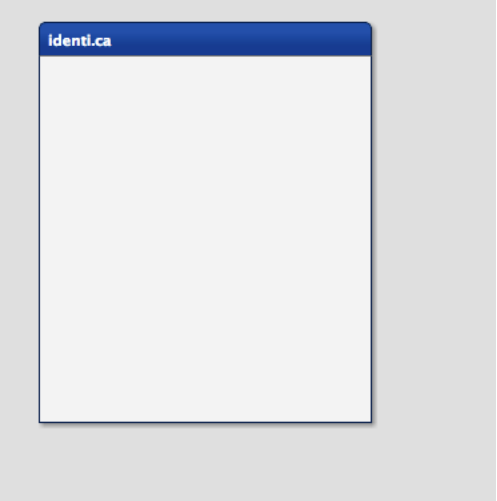
Another thing we should configure are the buttons of the window. The user should not be able to close, minimize nor maximize the window. So we add the following lines of code in our window constructor.

```
// hide the window buttons
this.setShowClose(false);
this.setShowMaximize(false);
this.setShowMinimize(false);
```

The last thing we could change is the size of the window on startup. Of course the user can resize the window but we should take care of a good looking startup of the application. Changing the size is as easy as hiding the buttons, just tell the window in its constructor:

```
// adjust size
this.setWidth(250);
this.setHeight(300);
```

At this point, your application should look like this.

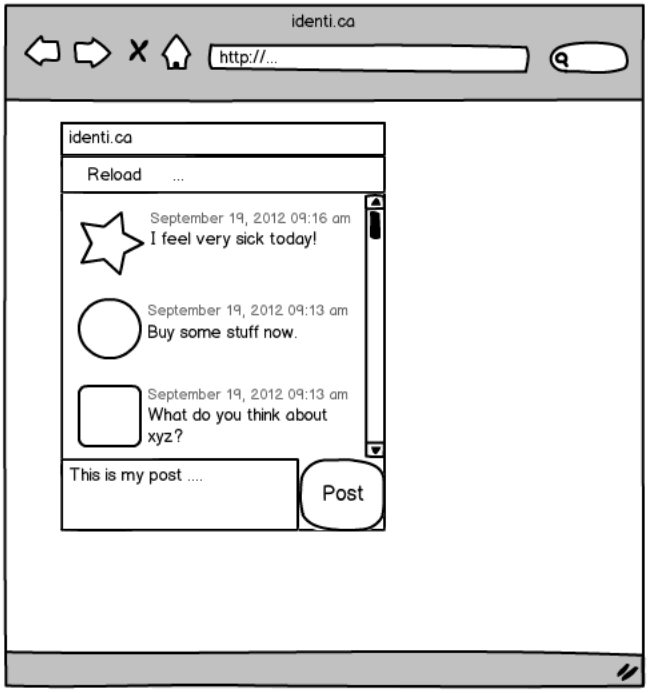


That's it for the first part. If you want to have the code from the tutorial, take a look at the project at Github and just fork the project. The next part of the tutorial will contain the building of the other parts of the UI. If you have feedback or want to see something special in further tutorials, just let us know!

4.7.2 Tutorial Part 2: Finishing the UI

In the *first part* of the tutorial, we built a basic window for our target application, a tweets client. In the second part of the tutorial, we want to finish the UI of the application. So lets get started, we got a lot to do!

I hope you remember the layout of the application we are trying to build. If not, here is a little reminder.



The first thing we need to do is to set a layout for our window. You can see that the text area and the button are side by side while all the other elements are ordered vertically. But all elements are aligned in a grid so we should

choose a grid layout for that. We can add the grid layout in our own window class. Just add these lines of code in `MainWindow.js`:

```
// add the layout
var layout = new qx.ui.layout.Grid(0, 0);
this.setLayout(layout);
```

But a layout without any content is boring so we should add some content to see if it's working. Lets add the first two elements to the window, the *toolbar* and the *list* view.

Layout and Toolbar

First, we need to create the toolbar before we can add it. Creating the toolbar and adding it is straight forward.

```
// toolbar
var toolbar = new qx.ui.toolbar.ToolBar();
this.add(toolbar, {row: 0, column: 0});
```

This will add the toolbar to the grid layout of our main window. The only thing you should take care of is the second parameter of .add(). It contains a map with layout properties. You can see the available layout properties in the API of the layout, in this case of the grid layout. Here, we use only the row and column property to tell the layout that this is the element in the first row and column (rows and columns start at index 0, you guessed it).

List and Layout, again

Adding the list should look familiar now.

```
// list
var list = new qx.ui.form.List();
this.add(list, {row: 1, column: 0});
```

Now its time to see our work in the browser. But again, we have added new class dependencies so we need to invoke the generator with `./generate.py`. After that, we can see the result in the browser. I guess it's not the way we like it to be. You cannot see any toolbar, the list has too much padding against the window border and doesn't fit the whole window. That's something we should take care of now.

First, get rid of that padding we don't need. The window object has a default content padding which we just to set to `0`.

```
this.setContentPadding(0);
```

Put that line in your windows constructor and the padding is gone.

Next, we take care of the size of the list. The layout does not know which column(s) or row(s) it should stretch. So we need to tell the layout which one it should use:

```
layout.setRowFlex(1, 1);
layout.setColumnFlex(0, 1);
```

The first line tells the layout to keep the second row (the row for the list) flexible. The second row does the same for the first column.

The last thing we need to fix was the invisible toolbar. If you know the reason why it's not visible, you sure know how to fix it. It contains not a single element so it won't be visible. Fixing it means adding an element, in our case we just add the reload button. We already know how to create and add widgets so just add the following lines of code.

```
// reload button
var reloadButton = new qx.ui.toolbar.Button("Reload");
toolbar.add(reloadButton);
```

Now its time to see if all the fixes work. But be sure to run the generator before you reload the browser page because we added (again) another class (the button). Now everything should look the way we want it to be.

Text Area and Button

After that success, we can got to the next task, adding the text area and "Post" button. This is also straight forward like we have seen in all the other adding scenarios.

```
// textarea
var textarea = new qx.ui.form.TextArea();
this.add(textarea, {row: 2, column: 0});

// post button
var postButton = new qx.ui.form.Button("Post");
this.add(postButton, {row: 2, column: 1});
```

This time, we have to add the button in the second column to get the button and the text area aligned horizontally. Its time to test this... again generate and reload.

Like the last time, the result is not quite what we want it to be. The list and toolbar do not fill the whole window. But that's a home-made problem because we extended our grid to two columns by adding the post button. The list and the toolbar need to span both available columns to have the result we want. But that's easy too, add `colSpan: 2` to the layout properties used by adding the list and the toolbar. Your code should look like this:

```
this.add(toolbar, {row: 0, column: 0, colSpan: 2});
// ...
this.add(list, {row: 1, column: 0, colSpan: 2});
```

This time, we did not add a new class dependency so we can just reload the index file and see the result.

Breathing Life into the UI

The UI now looks like the one we have seen in the mockup. But how does the UI communicate with the application logic? It's a good idea to decouple the UI from the logic and use events for notifying the behaviour. If you take a look we only have two actions where the UI needs to notify the rest of the application: reloading the tweets and posting a tweet.

These two events we add to our window. Adding events is a two step process. First, we need to declare what kind of event we want to fire. Therefore, we add an events section alongside to the constructor section of the window class definition:

```
events :
{
  "reload" : "qx.event.type.Event",
  "post"   : "qx.event.type.Data"
},
```

As you can see in the snippet here, it ends with a comma. It always depends on what position you copy the section if the comma is necessary. Just take care the class definition is a valid JavaScript object. But now back to the events. The reload event is a plain event which only notifies the receiver to reload. The post event is a data event which contains the data to post to identica. That's why there are two different types of events used.

Declaring the events is the first step of the process. The second part is firing the events! Let's take a look at the reload event. It needs to be fired when the reload button was triggered (or "was executed" in qooxdoo parlance). The button itself fires an event on execution so we could use this event to fire our own reload event.

```
reloadButton.addListener("execute", function() {
  this.fireEvent("reload");
}, this);
```

Here we see two things: First, how to add an event listener and second, that firing an event is as easy as a method call. The only parameter to .fireEvent() is the name of the event we have declared in the class definition. Another interesting thing here is the third parameter of the `addListener` call, **this**. It sets the context of the callback function to our window instance, so the this in this.fireEvent() is resolved correctly.

The next case is a bit different but also easy.

```
postButton.addListener("execute", function() {
  this.fireDataEvent("post", textarea.getValue());
}, this);
```

This time, we call the `fireDataEvent` method to get a data event fired. The second parameter is the data to embed in the event. We simply use the value of the text area. That's it for adding the events. To test both events we add a debug listener for each event in our application code, in the main() method of Application.js:

```
main.addListener("reload", function() {
  this.debug("reload");
}, this);

main.addListener("post", function(e) {
  this.debug("post: " + e.getData());
}, this);
```

You can see in the event listener functions that we use the qooxdoo debugging function `debug`. Now it's time to test the whole UI. Open the index file in a browser you like and see the UI. If you want to see the debugging messages you have to open either a the debugging tool of your chosen browser or use the qooxdoo debugging console. Press F7 to get the qooxdoo console visible.

Finishing Touches

As a last task, we can give the UI some finishing touches. Wouldn't it be nice if the text area had a placeholder text saying you should enter your message here and `ToolTips` showing some more info to the user? Easy task!

```
reloadButton.setToolTipText("Reload the tweets.");
//..
textarea.setPlaceholder("Enter your message here...");
//..
postButton.setToolTipText("Post this message on identi.ca");
```

Another nice tweak could be a identica logo in the windows caption bar. Just download this logo from identica and save it in the `source/resource/tweets` folder of your application. Adding the logo is easy because the window has also a property for an icon, which can be set in the constructor. Adding the reference to the icon in the base call should do the job.

```
this.base(arguments, "tweets", "tweets/logo.png");
```

This time, we added a new reference to an image. Like with class dependencies, we need to run the generator once more. After that, the image should be in the windows caption bar.

Two more minor things are left to finish. First, the button does not look very good. Why don't we just give it a fixed width to fit its height.

```
postButton.setWidth(60);
```

The last task is a bit more complicated than the other tweaks before. As you probably know, identica messages have a maximum length of 140 characters. So disabling the post button if the entered message has more the 140 characters could help us out in the communication layer. An identica message with no text at all is also useless and we can disable the post button in that case. To get that we need to know when the text was changed in the text area. Fortunately, the text area has a data event for text changes we can listen to:

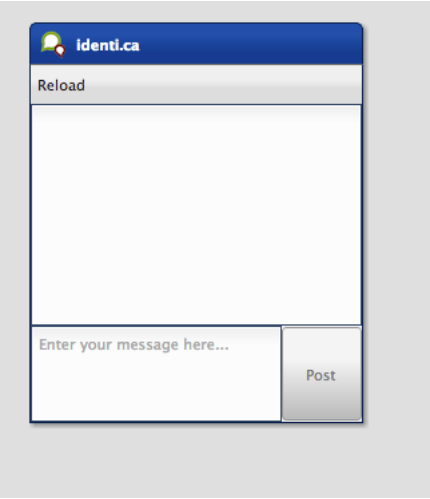
```
textarea.addListener("input", function(e) {
  var value = e.getData();
  postButton.setEnabled(value.length < 140 && value.length > 0);
}, this);
```

The event handler has only two rows. The first gets the changed text of the text area from the data event. The second row sets the enabled property of the post button if the length of the message is lower than 140 characters and not 0. Some of you might have a bad feeling about this code because the listener is called every time the user adds a character. But that's not a problem because the qooxdoo property system takes care of that. If the value passed into the setter is the same as the existing value, it is ignored and no event is fired.

The last thing we should consider is the startup of the application. The text area is empty but the button is enabled. Disabling the button on startup is the way to go here.

```
postButton.setEnabled(false);
```

Now go back to the browser and test your new tweaks. It should look like this.



That's it for building the UI. Again, if you want to take a look at the code, fork the project on github. Next time we take care of getting the data. If you have feedback on this post, just let us know!

4.7.3 Tutorial Part 3: Time for Communication

After we created the application and the main window in the *first tutorial* part and finished the UI in the *second*, we will build the communication layer today. With that part the application should be ready to use.

Pre-Evaluation

First, we need to specify what's the data we need to transfer. For that, we need to take a look what tasks our application can handle:

1. Show the public identica timeline.
2. Post a message.

So it's clear that we need to fetch the public timeline (that's how it is called by identica), and we need to post a message to identica. It's time to take a look at the identica API so that we know what we need to do to communicate with the service. But keep in mind that we are still on a website so we can't just send some `POST` or `GET` requests due to cross-site scripting restrictions. The one thing we can and should do is take advantage of JSONP. If you have never heard of JSONP, take some time to read the article on ajaxian to get further details. In this tutorial, we won't use the service itself due to API changes and availability of the service. Instead we use a simple JavaScript file which will fake the JSON-P call.

Creating the Data Access Class

Now, that we know how we want to communicate, we can tackle the first task, fetching the public timeline. identica offers a JSONP service for that which we can use. Luckily, there is no login process on the server side so we don't need to bother with that in the client. The following URL returns the public timeline wrapped in a JavaScript method call (that's what JSONP is about):

`http://demo.qooxdoo.org/3.0/tweets_step4.5/resource/tweets/service.js`

Now we know how to get the data from identica. Its time for us to go back to the qooxdoo code. It is, like in the case of the UI, a good idea to create a separate class for the communication layer. Therefore, we create a class named `IdenticaService`. We don't want to inherit from any advanced qooxdoo class so we extend straight from `qx.core.Object`. The code for that class should looks like this:

```
qx.Class.define("tweets.IdenticaService",
{
  extend : qx.core.Object,
  members :
  {
  }
});
```

Fetching the Data

As you can see, we omitted the constructor because we don't need it currently. But we already added a members block because we want to add a `method` named `fetchTweets`:

```
fetchTweets : function() {

}
```

Now it's time to get this method working. But how do we load the data in qooxdoo? As it is a JSONP service, we can use the *JSONP data store* contained in the data binding layer of qooxdoo. But we only want to create it once and not every time the method is called. That's why we save the store as a private instance member and check for the existence of it before we create the store. Just take a look at the method implementation to see how it works.

```
if (this.__store == null) {
  var url = "  http://demo.qooxdoo.org/3.0/tweets_step4.5/resource/tweets/service.js";
  this.__store = new qx.data.store.Jsonp();
  this.__store.setCallbackName("callback");
  this.__store.setUrl(url);
  // more to do
} else {
  this.__store.reload();
}
```

We already added the code in case the store exists. In that case, we can just invoke a reload. I also mentioned that the instance member should be private. The two underscores (__) *mark the member as private in qooxdoo*. The creation of the store or the reload method call starts the fetching of the data.

But where does the data go? The store has a property called model where the data is available as qooxdoo objects after it finished loading. This is pretty handy because all the data is already wrapped into *qooxdoo objects*! Wait, hold a second, what are *qooxdoo properties*? Properties are a way to store data. You only need to write a *definition for a property* and qooxdoo will generate the mutator and accessor methods for that property. You will see that in just a few moments.

We want the data to be available as a property on our own service object. First, we need to add a property definition to the `IdenticaService.js` file. As with the events specification, the property definition goes alongside with the `members` section:

```
properties : {
  tweets : {
    nullable: true,
    event: "changeTweets"
  }
},
```

We named our property tweets and added two configuration keys for it:

- `nullable` describes that the property can be null
- `event` takes the name of the event fired on a change of the property

The real advantage here is the `event` key which tells the qooxdoo property system to fire an event every time the property value changes. This event is mandatory for the whole *data binding* we want to use later. But that's it for setting up a property. You can find all possible property keys *in the documentation*.

Now we need to connect the property of the store with the property of the *identica service*. That's an easy task with the *single value binding* included in the qooxdoo data binding. Just add the following line after the creation of the data store:

```
this.__store.bind("model", this, "tweets");
```

This line takes care of synchronizing the two properties, the model property of the store and the tweets property of our service object. That means as soon as data is available in the store, the data will also be set as tweets in the identica service. That's all we need to do in the identica service class for fetching the data. Now its time to bring the data to the UI.

Bring the tweets to the UI

For that task we need to go back to our `Application.js` file and create an instance of the new service:

```
var service = new tweets.IdenticaService();
```

You remember the debug listener we added in the last tutorial? Now we change the reload listener to fetch the tweets:

```
// reload handling
main.addListener("reload", function() {
  service.fetchTweets();
}, this);
```

That's the first step of getting the data connected with the UI. We talk the whole time of data in general without even knowing how the data really looks like. Adding the following lines shows a dump of the fetched data in your debugging console.

```
service.addListener("changeTweets", function(e) {
  this.debug(qx.dev.Debug.debugProperties(e.getData()));
}, this);
```

Now it's time for a test. We added a new classes so we need to invoke the generator and load the index file of the application. Hit the reload button of the browser and see the data in your debugging console. The important thing you should see is that the data is an array containing objects holding the items we want to access: the identica message as `text` and `"user.profile_image_url"` for the users profile picture. After evaluating what we want to use, we can delete the debugging listener.

But how do we connect the available data to the UI? qooxdoo offers *controllers* for connecting data to a list widget. That's the right thing we need in that case. But we currently can't access the list of the UI. That's something we need to change.

Switch to the `MainWindow.js` file which implements the view and search for the line where you created the list. We need to implement an accessor for it so its a good idea to store the list as a private instance member:

```
this.__list = new qx.ui.form.List();
```

Of course, we need to change every occurrence of the old identifier `list` to the new `this.__list`. Next, we add an accessor method for the list in the members section:

```
getList : function() {
  return this.__list;
}
```

Data Binding Magic

That was an easy one! Now back to the application code in `Application.js`. We need to set up the already mentioned controller. Creating the controller is also straight forward:

```
// create the controller
var controller = new qx.data.controller.List(null, main.getList());
```

The first parameter takes a model we don't have right now so we just set it to null. The second parameter takes the target, the list. Next, we need to specify what the controller should use as label, and what to use as icon:

```
controller.setLabelPath("text");
controller.setIconPath("user.profile_image_url");
```

The last thing we need to do is to connect the data to the controller. For that, we use the already introduced bind method, which every qooxdoo object has:

```
service.bind("tweets", controller, "model");
```

As soon as the tweets are available the controller will know about it and show the data in the list. How about a test of the whole thing right now? You need (again) to tell the generator to build the source version of the application.

After the application has been loaded in the browser, I guess you see nothing until you hit the reload button of the UI. That's one thing we have to fix: Load the tweets at startup. Two other things are not quite the way we want them to be: The tweets get cut off at the end of the list, and the icons can be delivered by identica in different sizes. So let's fix those three problems.

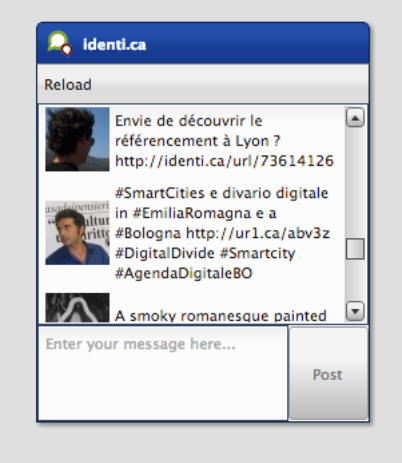
The first thing is quite easy. We just add a fetch at the end of our application code and that will initiate the whole process of getting the data to the UI:

```
// start the loading on startup
service.fetchTweets();
```

The other two problems have to be configured when creating the items for the list. But wait, we don't create the list items ourselves. Something in the data binding layer is doing that for us and that something is the controller we created. So we need to tell it how to configure the UI elements it is creating. For exactly such scenarios the controller has a way to handle code from the user, a delegate. You can implement the delegate method `configureItem` to manipulate the list item the controller creates:

```
controller.setDelegate({
  configureItem : function(item) {
    item.getChildControl("icon").setWidth(48);
    item.getChildControl("icon").setHeight(48);
    item.getChildControl("icon").setScale(true);
    item.setRich(true);
  }
});
```

You see that the method has one parameter which is the current UI element which needs to be configured. This item is a list item which stores its icon as a child control you can access with the `getChildControl` method. After that, you can set the width, height and the scaling of the icon. The last line in the configurator set the item to rich, which allows the text to be wrapped. Save your file and give it a try!



Now it should be the way we like it to be. Sure it's not perfect because it has no error handling but that should be good enough for the tutorial.

Posting tweets

As you have seen in the last paragraphs, creating the data access layer is not that hard using qooxdoo's data binding. That is why we want you to implement the rest of the application: Posting of tweets. But we will give you some hints so it does not take that much time for you.

- identica uses OAuth authentication for postings. Don't make yourself too much work by implementing the whole OAuth thing. Invoking an alert should be enough.

That should be possible for you right now! If you need to take a look at an implementation, you can always take a look at the code on github or fork the project.

That's it for the third part of the tutorial. With this tutorial, the application should be ready and we can continue our next tutorial lines based on this state of the application. As always, if you have any feedback, please let us know!

4.7.4 Tutorial Part 4.1: Form Handling

In the previous steps of this tutorial, we *laid the groundwork* for a tweets client application, gave it a *neat UI* and implemented a *communication layer*. One thing this application still lacks is a nice way for users to input their identica user name and password in order to post a status update. Fortunately, qooxdoo comes with a *forms API* that takes the pain out of creating form elements and handling user input.

Before we get started, make sure you're working on the version of the tweets tutorial application tagged with "Step 3" in the GitHub repository. This includes the posting part of the communication layer that we'll be using in this tutorial.

The plan

We want to create a new window with user name and password fields that pops up when the tweets application starts. The values will be used to retrieve the user's list of Tweets. Seems simple enough, so let's get right down to business.

Creating the login window

We start by creating a new class called tweets.LoginWindow that inherits from qx.ui.window.Window, similar to the MainWindow class from the first part of this tutorial:

```
qx.Class.define("tweets.LoginWindow",
{
  extend : qx.ui.window.Window,
  construct : function()
  {
    this.base(arguments, "Login", "tweets/logo.png");
  }
});
```

The Login window will only contain the form, which takes care of its own layout. So for the window itself, a Basic layout will suffice. We'll also make the window modal:

```
var layout = new qx.ui.layout.Basic();
this.setLayout(layout);
this.setModal(true);
```

Adding the Form

Now it's time to add a form and populate it with a pair of fields:

```
var form = new qx.ui.form.Form();

var username = new qx.ui.form.TextField();
username.setRequired(true);
form.add(username, "Username", null, "username");

var password = new qx.ui.form.PasswordField();
password.setRequired(true);
form.add(password, "Password", null, "password");
```

Note how the fields are marked as required. This is a simple kind of validation and in this case it's all we need, which is why the third argument for `form.add` is null instead of a validation function. Required fields will be displayed with an asterisk (*) next to their label.

The next step is to add a dash of data binding awesomeness:

```
var controller = new qx.data.controller.Form(null, form);
var model = controller.createModel();
```

Just like in the previous tutorial, we create a controller without a model. Then, we ask the controller to create a model from the form's elements. This model will be used to serialize the form data.

The form still needs a "submit" button, so we'll add one, plus a "cancel" button to close the window:

```
var loginbutton = new qx.ui.form.Button("Login");
form.addButton(loginbutton);

var cancelbutton = new qx.ui.form.Button("Cancel");
form.addButton(cancelbutton);
cancelbutton.addListener("execute", function() {
  this.close();
}, this);
```

That's all the elements we need, let's get them displayed. We'll let one of qooxdoo's built-in form renderer classes worry about the form's layout:

```
var renderer = new qx.ui.form.renderer.Single(form);
this.add(renderer);
```

The renderer is a widget, so we can just add it to the window. In addition to the standard renderers, it's fairly simple to create a custom renderer by subclassing qx.ui.form.renderer.AbstractRenderer, though that's outside the scope of this tutorial.

Accessing the form values

Similar to MainWindow, we'll use an event to notify the other parts of our application of changes to the form. As you'll remember, the "event" section is on the same level as the constructor in the class declaration:

```
events : {
  "changeLoginData" : "qx.event.type.Data"
},
```

Then we add a listener to the submit button that retrieves the values from the model object and attaches them to a data event, making sure the form validates, i.e. both fields aren't empty.

```
loginbutton.addListener("execute", function() {
  if (form.validate()) {
    var loginData = {
      username : controller.getModel().getUsername(),
      password : controller.getModel().getPassword()
    };
    this.fireDataEvent("changeLoginData", loginData);
    this.close();
  }
}, this);
```

Tying it all together

Now to integrate the login window with the other parts of the application. As we are using a mocked API for the tutorials, it is not possible to login or fetch the users tweets. So we skip that step.

All that's left is to show the login window when the application is started and call `fetchTweets` with the information from the `changeLoginData` event. In the main application class, we'll create an instance of tweets.LoginWindow, position it next to the MainWindow and open it:

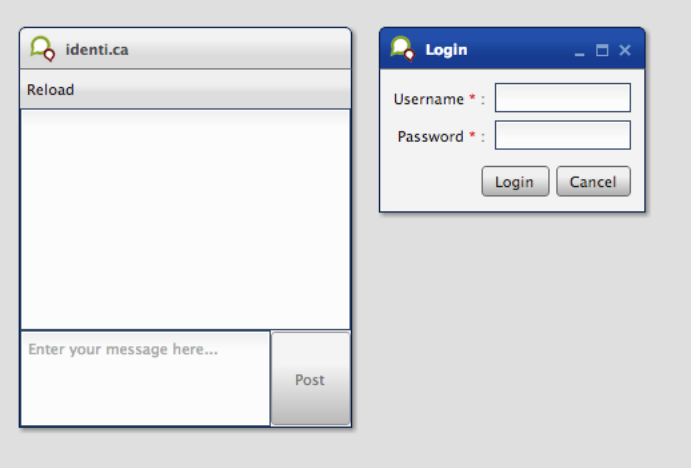
```
this.__loginWindow = new tweets.LoginWindow();
this.__loginWindow.moveTo(320,30);
this.__loginWindow.open();
```

And finally, we'll attach a listener to `changeLoginData`:

```
this.__loginWindow.addListener("changeLoginData", function(ev) {
  var loginData = ev.getData();
  service.fetchTweets(loginData.username, loginData.password);
});
```

Note how all the other calls to `service.fetchTweets` can remain unchanged: By making the login window modal, we've made sure the first call, which creates the store, contains the login data. Any subsequent calls (i.e. after reloading or posting an update) will use the same store so they won't need the login details.

OK, time to run `generate.py` and load the application in a browser to make sure everything works like it's supposed to.



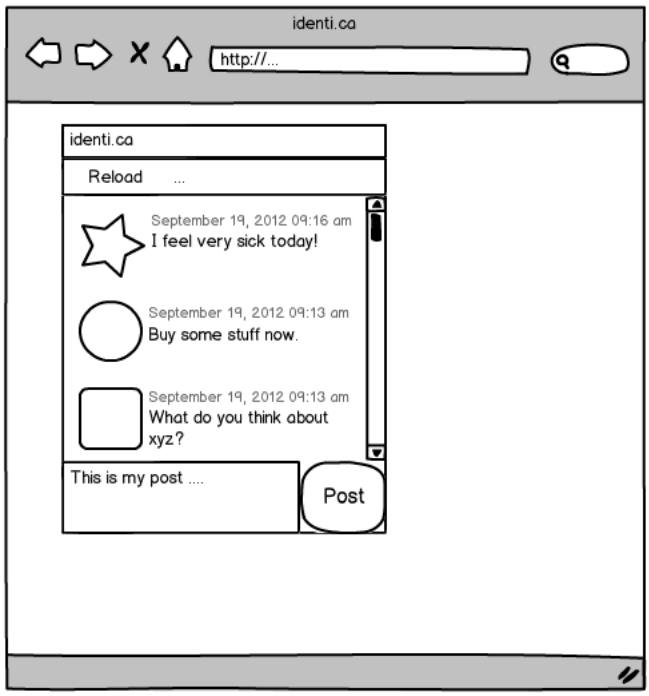
Tweets client application with login window

And that's it for the form handling chapter. As usual, you'll find the tutorial code on GitHub. Watch out for the next chapter, which will focus on developing your own custom widgets.

4.7.5 Tutorial Part 4.2: Custom Widgets

In this tutorial we will deal with how to create a custom widget for our tweets application. It is necessary that you finished the tutorials part 1 through part 3 to work with this tutorial, but previous knowledge from tutorial 4.1 is not needed.

Do you remember the mockup from tutorial part 1?



You can see that one tweet consists of a photo, a text and a creation date, but at the moment the tweets application doesn't show the creation date of a tweet. This is because we use the default ListItem to show a tweet and a ListItem can only show an image and/or label. To achieve our goal, we have to create a custom widget which we can use instead of the ListItem.

Note: The code in this tutorial should also work when you haven't completed the 4.1 tutorial because it doesn't depend on the code changes from tutorial 4.1. But if you have any problems to run the tutorial, you can also checkout the code from tutorial 4.1 on github.

The plan

First of all we have to create a custom widget which fulfills our requirements from the mockup. We will achieve this by combining a widget with two labels and one image. Afterwards we have to configure the controller so that it uses our custom widget for the tweets.

Create the custom widget class

You should know how to create a class from the previous tutorials. So please create a class for `tweets.TweetView`, but in our case we need to extend from `qx.ui.core.Widget`.

```
qx.Class.define("tweets.TweetView",
{
  extend : qx.ui.core.Widget,
  include : [qx.ui.form.MModelProperty],

  construct : function() {
    this.base(arguments);
  }
});
```

The attentive reader noticed that we use the `include` key for the first time. `include` is used to include a *mixin* in a class. This is necessary in our case to support Data Binding. Our tweets application uses it and therefore it is expected that the new widget implements the qx.ui.form.IModel interface. Otherwise the widget can't be used with Data Binding. But fortunately the mixin `qx.ui.form.MModelProperty` already implements it, so we can reuse the implementation.

Define the needed properties

Our widget should show a Tweet as shown in the mockup. To achieve this, we need properties to save the data for a Tweet. Add this definition to the `TweetView` class:

```
properties :
{
  appearance :
  {
    refine : true,
    init : "listitem"
  },

  icon :
  {
    check : "String",
    apply : "_applyIcon",
    nullable : true
  },

  time :
  {
    check : "Date",
    apply : "_applyTime",
    nullable : true
  },

  post :
  {
    check : "String",
    apply : "_applyPost",
    nullable : true
  }
},
```

The properties `icon`, `time` and `post` contain the data from a tweet. In this definition you'll also find a property `appearance`. This property is needed for the theming, it tells the appearance system that the `TweetView` should be styled like the `ListItem`. We could also use a new appearance id, but than we'd have to define an appearance for it and that's not part of this tutorial.

How to define properties was explained in *tutorial part 3*, so we don't repeat it. But we use some unfamiliar keys for definition and I will explain them:

- **check**: check ensures that the incoming value is of this type. But be careful, the check is only done in the source version.
- **apply**: here you can define which method should be called when the value changes.
- **refine**: this is needed when an already defined property should be overridden.
- **init**: defines the initialized value of a property.

Using Child Control

qooxdoo has a special system to realize combined widgets like in our case. This system is called child controls and you can find a detailed documentation in our *manual*.

Okay, back to our problem. To achieve the requirements we need an Image for the photo, a Label for the post and another Label for the creation time. So three widgets, also called sub widgets, are needed for our custom widget. And last but not least the familiar Grid layout for layouting, but that's not created in the child control implementation. We just need to keep it in mind when adding the child control with `_add`.

```
members :
{
  // overridden
  _createChildControlImpl : function(id)
  {
    var control;

    switch(id)
    {
      case "icon":
        control = new qx.ui.basic.Image(this.getIcon());
        control.setAnonymous(true);
        this._add(control, {row: 0, column: 0, rowSpan: 2});
        break;

      case "time":
        control = new qx.ui.basic.Label(this.getTime());
        control.setAnonymous(true);
        this._add(control, {row: 0, column: 1});
        break;

      case "post":
        control = new qx.ui.basic.Label(this.getPost());
        control.setAnonymous(true);
        control.setRich(true);
        this._add(control, {row: 1, column: 1});
        break;
    }

    return control || this.base(arguments, id);
  }
},
```

The child control system has a special method to create sub widgets. The method is called `_createChildControlImpl` and we override it to create our sub widgets. This method is called from the child control system when it notices that a sub widget is needed but not already created.

In our case:

- **icon**: for the photo
- **time**: for the creation time
- **post**: for the text from the tweet

Dependent on the passed id we create the correct sub widget, configure it and add it to the Grid layout at the right position. If an unknown id is passed, we delegate it to the superclass.

Finishing the constructor

Now it's time to finish the constructor.

```
// create a date format like "June 18, 2010 9:31 AM"
this._dateFormat = new qx.util.format.DateFormat(
  qx.locale.Date.getDateFormat("long") + " " +
  qx.locale.Date.getTimeFormat("short")
);
```

The property for the date saves only a date object and our requirement from the mockup describes a spacial format and a simple `toString` usage is not enough. Therefore we need a special transformation which we can achieve by using DateFormat.

```
// initialize the layout and allow wrap for "post"
var layout = new qx.ui.layout.Grid(4, 2);
layout.setColumnFlex(1, 1);
this._setLayout(layout);
```

Now we create a layout for our custom widget. This should be known from *tutorial part 2*.

```
// create the widgets
this._createChildControl("icon");
this._createChildControl("time");
this._createChildControl("post");
```

Time for our child control implementation. With these lines we trigger the subwidget creation which we implemented before.

Adding the apply methods

We have already defined the properties, but we haven't implemented the needed apply methods for them. So, time to add the missing apply method for the properties to the `members` section.

```
// property apply
_applyIcon : function(value, old) {
  var icon = this.getChildControl("icon");
  icon.setSource(value);
},

_applyPost : function(value, old) {
  var post = this.getChildControl("post");
  post.setValue(value);
},

// property apply
_applyTime : function(value, old) {
  var time = this.getChildControl("time");
  time.setValue(this._dateFormat.format(value));
}
```

The apply methods for `icon` and `post` are trivial, we have to ensure that we delegate the value change to the correct widget. To get the correct widget instance we can use the `getChildControl` method and afterwards we can set the value on the widget.

The date, however, needs some extra love. We have to use the DateFormat instance to format the date before we set the value.

Finishing the custom widget

At the end we have to add the attribute `_dateFormat` to the `members` section and a destructor to clean up the created DateFormat instance.

Just add this line at the beginning of the members section:

```
_dateFormat : null,
```

And the destructor after the members section:

```
destruct : function() {
  this._dateFormat.dispose();
  this._dateFormat = null;
}
```

Great, now we have finished the custom widget.

Configure the List Controller

At the moment the controller doesn't know that it should use our `TweetView` class. Therefore we have to change the old controller configuration. Search for these lines of code in the `Application.js` file:

```
// create the controller
var controller = new qx.data.controller.List(null, main.getList());
controller.setLabelPath("text");
controller.setIconPath("user.profile_image_url");
controller.setDelegate({
  configureItem : function(item) {
    item.getChildControl("icon").setWidth(48);
    item.getChildControl("icon").setHeight(48);
    item.getChildControl("icon").setScale(true);
    item.setRich(true);
  }
});
```

First of all, remove these two lines:

```
controller.setLabelPath("text");
controller.setIconPath("user.profile_image_url");
```

Now to the delegate, just replace the current delegate with this one:

```
controller.setDelegate({
  createItem : function() {
    return new tweets.TweetView();
  },

  bindItem : function(controller, item, id) {
    controller.bindProperty("text", "post", null, item, id);
    controller.bindProperty("user.profile_image_url", "icon", null, item, id);
    controller.bindProperty("created_at", "time", {
      converter: function(data) {
       return new Date(data);
     }
    }, item, id);
  },

  configureItem : function(item) {
```

```
    item.getChildControl("icon").setWidth(48);
    item.getChildControl("icon").setHeight(48);
    item.getChildControl("icon").setScale(true);
    item.setMinHeight(52);
  }
});
```

The concept of a delegate should be known from *tutorial part 3*, I will only explain the modifications.

You can see that we added a `createItem` method: With this method we can configure the controller to use our `TweetView` for item creation. The method `bindItem` is used to configure the controller to keep the properties of the model and the widget synchronized. In our case it is important to keep the photo, post and creation date synchronous.

```
controller.bindProperty("text", "post", null, item, id);
```

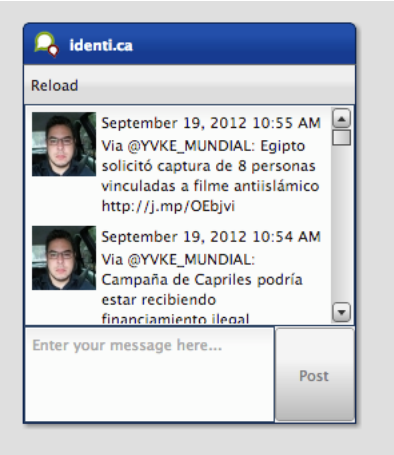
Let us have a look at the above example. The bindProperty method is responsible for the binding between model and widget. The first parameter is the path from the model, the second is the name of the property in the widget, the third parameter is an options map to do e. g. a conversion, the fourth parameter is the widget and the last is the index.

In our case the photo and the post need no conversion because the source data and target data are of the same type. But the creation time needs a conversion because the model contains a String with the UTC time while the widget expects a date object. So we have to convert the data:

```
converter: function(data) {
  return new Date(data);
}
```

The converter method creates a date object from the given number (time in milliseconds). The `configureItem` method should be known from *tutorial part 3*, there are only some improvements to keep the same behavior as before.

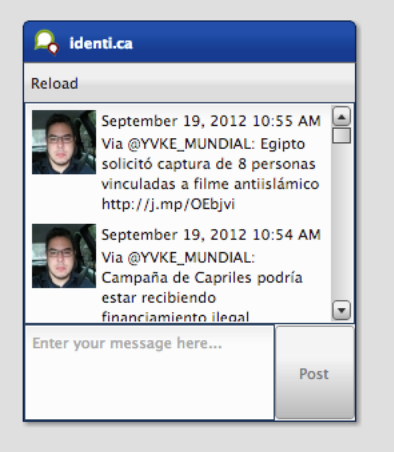
Great, now we've got it! Run `generate.py` to create the application.



Again, if you want to take a look at the code, fork the project on github.

4.7.6 Tutorial Part 4.2.1: Basic Theming

This time, we continue with a very exciting topic for the tutorials: Theming. As you might already know, the theming system in qooxdoo is not based on CSS which means you, as an application developer, don't have to bother with cross browser CSS. The qooxdoo framework takes care of all that for you. As a base for theming an app, we use the already known tweets client we built in the *former tutorials*. On the left is a picture how it should look to get you started. The the code of the tutorial on GitHub.



The plan

Giving the whole application a new look is too much detail and work for such a short tutorial. We concentrate on some basic key aspects which are important to get you an idea how to use the theming system and get you started. So I picked three basic tasks we could do to make the app look different.

- Style the widget we created for showing tweets.
- Change the default theme.
- Change the look of a built-in widget

Lets get started with the first one:

Style the widget we created for showing tweets

In *Tutorial 4.2*, we created a custom widget for showing the tweets icons, content and date. As you can see on the screenshot above, the time and the content have the same text color which might be irritating. That's why we want to change the time's color to a lighter gray. So how should we do that?

First, we need to get some knowledge about the theming system itself. Every widget has a so called *appearance*, which is used to identify the styling of a widget. In our case, we used the `listitem` appearance in the former tutorial, which is defined in qooxdoo's default theme, the *Modern theme*. But now we want to change that so we need to edit the `TweetView` class and change the appearance property's init value from `listitem` to a custom name we choose, lets say `tweet-view`. The new code should look like this:

```
appearance :
 {
   refine : true,
   init : "tweet-view"
 },
```

Now, we have defined a custom appearance key for our own widget but the appearance definition is still missing. But where should we put that definition?

The tweets application is based on a default GUI skeleton which has already a predefined custom theme. This can be found in the `theme` namespace of the applications source code (`source/class/tweets/theme/`). Taking a look at the namespace shows you five files in total:

- `Appearance.js` holds all appearance definitions
- `Color.js` holds all color definitions

- `Decoration.js` holds all decorator definitions
- `Font.js` holds all font definitions
- `Theme.js` meta theme which combines all others

Except the meta file, all other files are only a skeleton for adding custom theme definitions. So I guess you have already seen the file we should modify now: `Appearance.js`. The basic outline of such an appearance definition can be compared to a class definition. You can find a name, an extend key and something where the content should go called `appearances`. That's where we put our new appearance definition. First, we define a appearance definition for the `tweet-view` key we defined. That definition can be empty because we only want to style the label showing the date and time for the tweet. The code looks like this:

```
qx.Theme.define("tweets.theme.Appearance",
{
  extend : qx.theme.modern.Appearance,

  appearances :
  {
    "tweet-view" : {}
  }
});
```

The last missing piece of our first task is to style the label. But how do we access it in the appearance theme if we haven't assigned a separate appearance key for it?

Luckily, we defined the label as *child control* named `time` (take a look at the *custom widget tutorial* for more details). That way, we can assign a separate appearance key using that hierarchy:

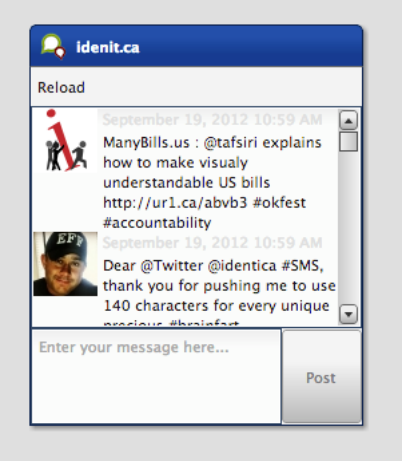
```
"tweet-view/time" : {
  style : function() {
    return {
      textColor: "#E0E0E0"
    }
  }
}
```

You can see a complete definition for the time label in the code above. The important part is the map, which is returned by the style function. It contains a set of themeable properties for the widget which will be assigned. In our case, we are styling a simple label, which has the property `textColor`. You can find all themeable properties in the API viewer (Hint: themeable properties are marked with a little icon). Now we are done and can give the application a try, which should result into something like this:

Now we have everything the way we want it to be but one little thing is still missing. We defined the color's value inline which is considered bad style because in case you want to use the same color somewhere else, you have to write the value again which results in hard-to-maintain code. That's where the color theme could help. We have already seen a file called `Color.js` which is responsible for holding color definitions. As in the appearance file, we have one main section but this time its called `colors`. Here we add a color definition for the color we want to use:

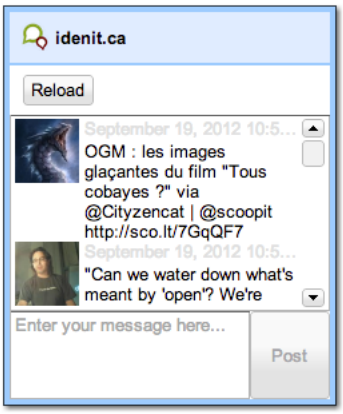
```
colors :
{
  "tweet-time" : "#E0E0E0"
}
```

Now, we have defined a color alias for our color which can be used in the whole application, no matter if it's in a theme or in some application class. As a final step, we change the explicit color definition from `"#E0E0E0"` to `"tweet-time"` in the custom appearance file.



Change the default theme

As a next step, we want to change the default theme, which is the *Modern theme*, to the *Simple theme*. For that, we have to take another look at the files in the `theme` folder. You might have already realized that all these files do have an "extend" key which extends from the Modern theme's files. That's what we are going to change now. Just open all the files in the theme folder and change the extend key from `qx.theme.modern.xyz` to `qx.theme.simple.xyz` with *xyz* as a placeholder for the name of the file you are editing. There is only one file you don't have to change which is the meta theme named `Theme.js`. It does not refer to the framework theme so there is nothing to change. With that change, we included new dependencies to classes and resources which means, we have to rebuild our application. Run `./generate.py` in the root folder of your application to rebuild the development version of the tweets application. After the process is done, we can reload the application and see a dramatically changed application using the Simple theme.

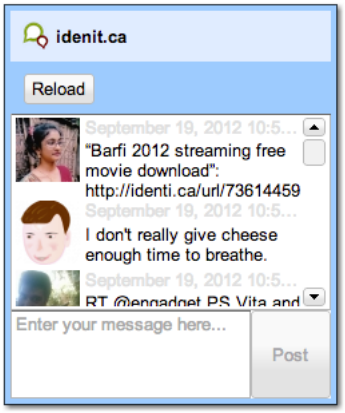


Change the look of a built in widget

As a last and final step, I like to show you how to change the styling of a built in qooxdoo widget. As you can see on the screenshot of the last step, the toolbar has the same background color as the windows caption bar. It might be nice if the toolbar had the same color as the window's inner border. So what we need to do is to override the appearance of the toolbar. For that, we need to find out how the appearance key for the toolbar is named. You can find that in the API viewer in the `appearance` property of toolbar. The init value is used for the styling, in this case, its `toolbar`. If we now use that key in our custom appearance file, we can set our own keys for styling the toolbar.

```
"toolbar" : {
  style : function() {
    return {
      backgroundColor : "window-border-inner"
    }
  }
}
```

Like in the former appearance we added, we define one property. In this case, we use the `backgroundColor` property to set the background color of the toolbar. But what color is `"window-border-inner"`? This is a named color which comes from the frameworks Simple theme. You can find all the colors of the theme in the framework in the namespace `qx.theme` or `qx.theme.simple` for the Simple theme. A little hint: Before overriding an appearance, check out the original appearance definition in the theme you are using. There might be some edge cases considered you want to consider writing your own appearance. The final result should look like this:



Job done

With the last step, we have finally managed to change the three basic things we wanted to change. If you are interested in more details about the theming possibilities in qooxdoo, *check out the manual* for more information. As always, the code of the tutorial is on GitHub.

4.7.7 Tutorial Part 4.3: Translation

We've already covered quite a few of qooxdoo's features to get to this point. In this tutorial, we want to *internationalize* the tweets client. Additionally, we want to add a preferences dialog allowing users to change the language during runtime. Adding a window containing a form should be familiar to you if you've read the *form handling tutorial*

The plan

The first step is to make the application aware of localization. We need to identify all the strings which need to change on a language change. After that, we need to create translations for our initial string set. After that is done, we can add a window containing a radio group with all available language options.

Identifying strings to translate

Now we can benefit from the good design of our application. We put all the view code in our main window which means that's the spot we need to look for strings. Here we can identify the following strings:

```
var reloadButton = new qx.ui.toolbar.Button("Reload");
// ...
reloadButton.setToolTipText("Reload the tweets.");
// ...
this.__textarea.setPlaceholder("Enter your message here...");
// ...
var postButton = new qx.ui.form.Button("Post");
// ...
postButton.setToolTipText("Post this message on identi.ca");
```

qooxdoo offers a handy way to tell both the JavaScript code and the generator which strings need to be translated. Wrapping the strings with `this.tr()` will mark them as translatable strings. That should be an easy task:

```
var reloadButton = new qx.ui.toolbar.Button(this.tr("Reload"));
// ...
reloadButton.setToolTipText(this.tr("Reload the tweets."));
// ...
this.__textarea.setPlaceholder(this.tr("Enter your message here...");)
// ...
var postButton = new qx.ui.form.Button(this.tr("Post"));
// ...
postButton.setToolTipText(this.tr("Post this message on identica."));
```

Generating the translation files

For the next step, we need to tell the generator what languages we want to support. But why does the generator or the tool chain in general care about that? The tool chain will help us by generating the files necessary for the translation. So we need to edit the config.json file located at the root folder of our application, which is the configuration file for the tool chain. As you can see, this is a plain JSON file which holds some predefined configuration data for the tool chain. You will find a `let` section holding a `LOCALES` key. This key has an array as value holding exactly one locale named `en`, right? In this example, I want to add a translation set for German so I need to add `de` to this array.

```
"LOCALES"      : [ "en" , "de" ],
```

Now we are set up to generate our translation files. For that, just invoke the generator with its translation job.

```
./generate.py translation
```

This will go through all the steps necessary to generate the translation files. But what are translation files anyway? Take a look at the folder `source/translation`. There you'll find the created files which as you'll see end with `.po`. You may be familiar with that file format from GNU gettext which is quite popular.

You should see two files, one for the default language, English (`en.po`), and one for the language you added, in my case German (`de.po`). For now, we just need the file for our alternative language because English is already used in the application so this should work right out of the box. Opening the second file, you'll notice some details about it at the top of the document. The important part starts with the following text.

```
#: tweets/MainWindow.js:30
msgid "Reload"
msgstr ""
```

The first line is a comment, which is a hint containing the class file and line number where the string is used. The second line holds the identifier we used in our application. The third line currently holds an empty string. This is the place where the translation should go for that specific string.

You may have already realized that the rest of the file is a list of blocks similar to this one. Now you should translate all strings and add them in the right spots.

Give it a try

After adding these translations, we should rebuild the application using `./generate.py` and load it in any browser. If your browser uses the locale you added by default, you should already see the application in the new language. If not, just tell qooxdoo's locale manager to switch the locale using e.g. the Firebug console.

```
qx.locale.Manager.getInstance().setLocale("de"); // or the locale you added
```

If you added a language like German in which most words are longer than in English, you may recognize that we made a mistake in our main window. `postButton.setWidth(60);` may cut off the text in the button because we set the width explicitly. Changing that to `postButton.setMinWidth(60);` will keep the layout flexible for different content sizes.

Adding the preferences window

As you should already be familiar with creating new classes and subclassing a window from the *form handling tutorial*, we won't go into any detail about that again. Just add a new class, subclass the window and override the constructor.

```
qx.Class.define("tweets.SettingsWindow",
{
  extend : qx.ui.window.Window,

  construct : function()
  {
    this.base(arguments, this.tr("Preferences"));
    // ... more to come
  }
});
```

As you can see here, we added another string: The window's caption, which should be translated as well. Keep in mind that you have to use `this.tr()` on every string you add and want to have in your translation file.

For the next step, we need to fill the window with controls. As in the form example, we use a basic layout, a form and some form elements. Add the following line to your constructor.

```
this.setLayout(new qx.ui.layout.Basic());

var form = new qx.ui.form.Form();
var radioGroup = new qx.ui.form.RadioButtonGroup();
form.add(radioGroup, this.tr("Language"));

// TODO: create a radio button for every available locale

var renderer = new qx.ui.form.renderer.Single(form);
this.add(renderer);
```

This code should be familiar to you except for the `RadioButtonGroup`, which is a container for radio buttons. It also makes sure that only one of the buttons is selected at any time. So we don't need to take care of that ourselves. Again, we use a translated string as the label for the radio buttons.

The next step is to access all available locales and the currently set locale. For that, qooxdoo offers a locale manager, as you'll see in the following code part.

```
var localeManager = qx.locale.Manager.getInstance();
var locales = localeManager.getAvailableLocales();
var currentLocale = localeManager.getLocale();
```

It is pretty easy to get this kind of information. You surely know how to continue from here, but before that, I'll show you a little trick. We want to keep the name of the selectable language in the translation file itself. That's a good place to keep that string because otherwise, we would need a mapping from the locale (e.g. en) to its human readable name (e.g. English). Instead we'll, add a special translation key to our application.

```
// mark this for translation (should hold the langauge name)
this.marktr("$$languagename");
```

We will use this key as the label for our radio buttons and then go on, as you would have expected, with a loop for all available locales.

```
// create a radio button for every available locale
for (var i = 0; i < locales.length; i++) {
  var locale = locales[i];
  var languageName = localeManager.translate("$$languagename", [], locale);
  var localeButton = new qx.ui.form.RadioButton(languageName.toString());
  // save the locale as model
  localeButton.setModel(locale);
  radioGroup.add(localeButton);

  // preselect the current locale
  if (currentLocale == locale) {
    localeButton.setValue(true);
  }
};
```

This code contains the rest of the trick. But let's take a detailed look at what we're doing here. The first line of the loop just stores the current locale we want to process. Keep in mind that this is the exact value we need to change the locale later. The second line tells the locale manager to translate the special id we set for the language name using the current locale. This will return a `LocalizedString` which is important to know because these strings update their content on locale switch. But that's not what we want because otherwise, every language will have the same name. That's why we use the `toString()` method to get the plain string of the current translated value as the label for the new radio button. With that, we exclude the labels for the radio buttons from being translated. The next two tasks are pretty easy: 1) we store the locale as the model of the radio button and 2) we add the radio button to the radio group. Preselecting the currently set locale is really easy as well.

The last thing missing in the window is changing the locale if the user selects a new radio button. For that, we stored the locales in the model property. We can now use the `modelSelection` of the radio button group to react on changes.

```
// get the model selection and listen to its change
radioGroup.getModelSelection().addListener("change", function(e) {
  // selection is the first item of the data array
  var newLocale = radioGroup.getModelSelection().getItem(0);
  localeManager.setLocale(newLocale);
}, this);
```

First, we get the model selection array, which is a data array and has a change event for every change in the array. The new locale is always the first element of the selection array itself, as you can see in the second line. You might have noticed that we need to access the item with a special method instead of the bracket notation normally used with arrays. That's a special method you have to use for data arrays. The third line simply hands the new locale to the manager, which will take care of all the necessary changes.

Accessing the preferences

With that, we are done with the preferences window, but we can't access it yet. We should add a button to the main window's toolbar. Add this code right after where you added the reload button.

```
// spacer
toolbar.addSpacer();

// settings button
var settingsWindow = null;
var settingsButton = new qx.ui.toolbar.Button(this.tr("Preferences"));
toolbar.add(settingsButton);
settingsButton.setToolTipText(this.tr("Change the applications settings."));
settingsButton.addListener("execute", function() {
  if (!settingsWindow) {
    settingsWindow = new tweets.SettingsWindow();
    settingsWindow.moveTo(320,30);
  }
  settingsWindow.open();
}, this);
```

The first thing we do is to add a spacer to attach the preferences button to the right side of the toolbar. This should be the only new thing you haven't seen before, so we won't go into details here.

Final steps

Now we have created some new code containing new strings to translate. Obviously, we need to add translations for these as well. Just run the generator again and let it add the new strings to your `po` files.

```
./generate.py translation
```

Now you can edit the `po` files again and add the new translations. Don't forget to add the translation for the special `$$languagename` key in the English `po` file as well.

After generating the source version of the application again you should be set up for testing and all should run as expected.

I hope you enjoyed this little exercise and gained an idea how easy it is to internationalize an application using qooxdoo's help. As always, you can find the entire code on GitHub. With that said, I want to encourage you to send me pull requests containing alternative translations we could add. It would be interesting to have the tweets app in many different languages. Really looking forward to your feedback and pull requests!

4.7.8 Tutorial Part 4.4: Unit Testing

In this tutorial, we'll be taking a closer look at qooxdoo's integrated unit testing framework. Armed with this new knowledge, we'll then define a few unit tests for the tweets application created in previous tutorials, generate the test runner application, and watch the tests in action. As usual, the code can be found on GitHub.

Background

qooxdoo's unit testing framework is similar to JSUnit but self-contained, so no external libraries are necessary. It consists of two main components:

The classes in the qx.dev.unit namespace provide the interface against which tests are written and the infrastructure needed to run them. The *Testrunner component* (located in the qooxdoo SDK's component/testrunner directory) provides a GUI to select and run tests and visualize the results.

Test class structure

The actual test code is contained in classes living within the namespace of the tested application, located in the `source/class/<$APPLICATION>/test` directory by default. A fresh qooxdoo application skeleton (GUI, Inline or Native flavor) contains a simple test class named **DemoTest**:

```
qx.Class.define("tweets.test.DemoTest",
{
  extend : qx.dev.unit.TestCase,

  members :
  {
    /*
    ---------------------------------------------------------------------------
    TESTS
    ---------------------------------------------------------------------------
    */

    /**
    * Here are some simple tests
    */
    testSimple : function()
    {
      this.assertEquals(4, 3+1, "This should never fail!");
      this.assertFalse(false, "Can false be true?!");
    },

    /**
    * Here are some more advanced tests
    */
    testAdvanced: function ()
    {
      var a = 3;
      var b = a;
      this.assertIdentical(a, b, "A rose by any other name is still a rose");
      this.assertInRange(3, 1, 10, "You must be kidding, 3 can never be outside [1,10]!");
    }
  }
});
```

All test classes share the same basic structure:

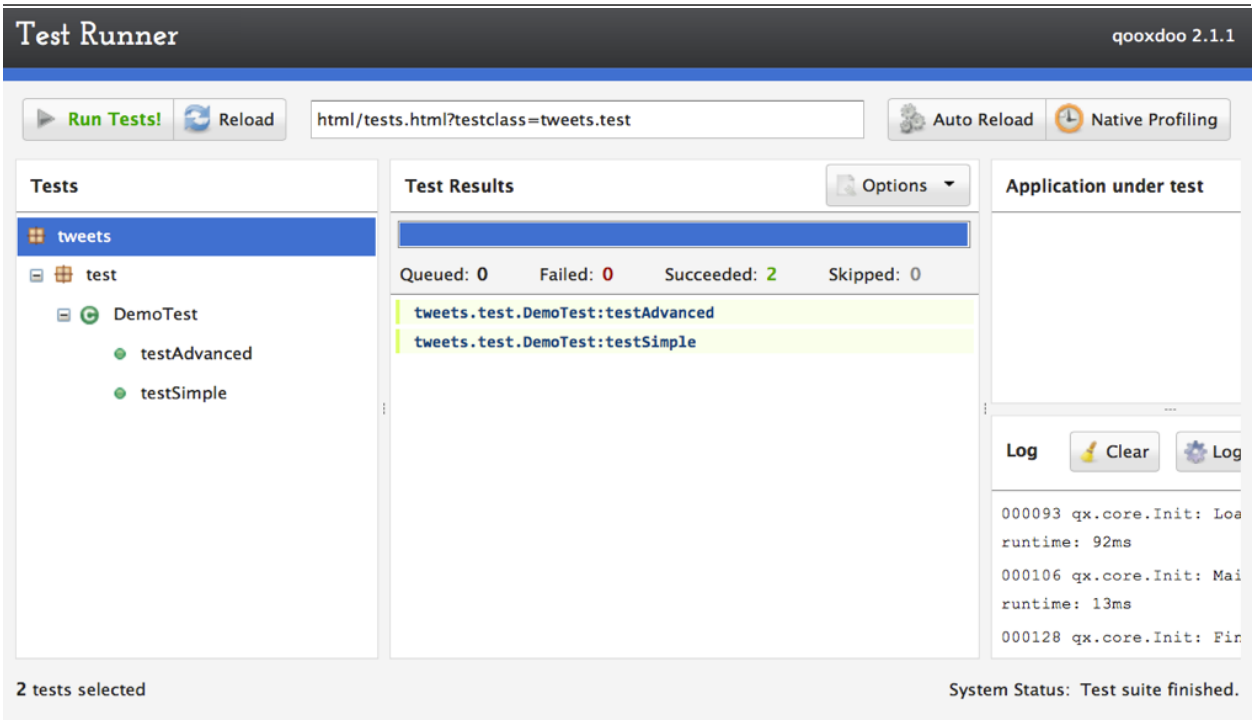
- They must inherit from qx.dev.unit.TestCase
- Individual tests must be defined as member functions with names beginning with `test`. Apart from that, they can contain other member functions, properties and so on. Usually, test functions instantiate classes of the tested application, invoke their methods and compare the results with expected values.
- Exceptions are used to communicate the test results back to the Testrunner. No exception means the test went fine, throwing any exception from the test method signals a failure. Return values from the test methods are not evaluated.

qx.dev.unit.TestCase includes the assertion functions from qx.core.Assert. These can be used to check values, e.g. by comparing a tested method's return value to an expected value. If the assertion fails, a qx.core.AssertionError is thrown.

Building and running the test application

In the top-level directory of the tweets tutorial application, run `generate.py test`. This command builds both a stand-alone application containing the test classes (the AUT, or "application under test") and the Testrunner GUI which loads the AUT in an Iframe and visualizes the results. Load the Testrunner by opening the file `test/index.html` in your favorite browser and click the "Run Tests" button.

Note: Some browsers, such as Google Chrome, severely restrict scripts from loading resources from the file system. In this case, the Testrunner should be loaded from a web server.



Creating a new test class

Now that we've got the basics covered, let's create some more meaningful tests for our tweets application, starting with the **tweets.TweetView** class. As you'll remember from the previous tutorials, it's responsible for displaying a single Tweet along with the user's icon. To this end, it has a property named `icon` with an apply method that sets the `source` property on the TweetView's `icon` child control. Our test will check if the `icon` property value is correctly applied to the icon widget. First of all, create a corresponding class **tweets.test.TweetView** in the `source/class/tweets/test` directory. (We won't be needing the DemoTest class any more, so feel free to delete it.)

```
/**
 * @asset(tweets/logo.png)
 */
qx.Class.define("tweets.test.TweetView",
{
  extend : qx.dev.unit.TestCase,

  members :
  {
    setUp : function()
    {
```

```
      this.__tweetView = new tweets.TweetView();
    },

    tearDown : function()
    {
      this.__tweetView.dispose();
      this.__tweetView = null;
    },

    testSetIcon : function()
    {
      var expectedSource = qx.util.ResourceManager.getInstance().toUri("logo.png");
      this.__tweetView.setIcon(expectedSource);
      var foundSource = this.__tweetView.getChildControl("icon").getSource();
      this.assertEquals(expectedSource, foundSource, "Icon source was not set correctly!");
    }
  }
});
```

Setting up and tearing down

Note the `setUp` and `tearDown` methods. Each test class can contain either or both (or none). setUp is called before each individual test function and is used to perform common initializations. Similarly, tearDown is called after each test method (even if the test failed), e.g. to dispose objects created by setUp or the test itself. Together, they can be used to make sure each test method runs in a "clean" environment: In this case, we create a new instance of the tested class for each test and dispose it afterwards, which is a very common pattern in unit testing.

The `tearDown` logic is actually quite an important part of developing unit tests since tests that don't clean up after themselves can lead to nasty dependencies where test B will pass when run individually but fail when run after test A. Singletons are particularly vulnerable since their state carries over between tests. So if, for example, test A checks how a class reacts to a locale change by calling `qx.locale.Manager.getInstance().setLocale` while test B relies on the locale still being the application's default, B would fail whenever A ran first.

For cases where the generic class-wide `tearDown` isn't enough, methods using the naming convention `tearDown<TestName>` can be defined. A method named e.g. `tearDownTestFoo` would be called after `testFoo` and the generic `tearDown` of the class were executed.

The test function

We need the URI of a valid image for this test, so we add an `@asset` hint to the class header that will cause the Generator to add the file `source/class/tweets/resource/logo.png` to the AUT's resources. In the test function, we first ask qooxdoo's resource manager to resolve the resource ID into a valid URI. This is the expected value for the icon child control's `source` property. Next, we apply this value to the TweetView's `icon` property, then get the child control's `source` property and compare the two values using assertEquals.

OK, time to build the AUT again. This time, run `generate.py test-source` instead of `test`. As you might expect, this will generate a source version of the AUT, which, like the source version of the actual application, is far better suited for development. Open the file `test/index-source.html` to load the Testrunner with the source tests.

Asynchronous Tests

As with many GUI applications, the various components of the tweets app use events to communicate. The `tweets.IdenticaService` class, for example, has a method `fetchTweets` that causes a `changeTweets`

event to fire once the data store has finished (re)loading. We can't know in advance just how long this takes, so we need some way to instruct the test to wait until the event fires. This is where asynchronous testing comes in.

Once again, create a new test class named **tweets.test.IdenticaService**. The `setUp` and `tearDown` methods are mostly identical to the ones from tweets.test.TweetView, except of course they initialize/destroy an instance of tweets.IdenticaService instead. Here's the actual test function:

```
testFetchTweets : function()
{
  this.__identicaService.addListener("changeTweets", function()
  {
    this.resume();
  }, this);

  this.__identicaService.fetchTweets();

  this.wait(5000);
}
```

First, we register a listener for the `changeTweets` event. The callback function invokes the resume method, which informs the Testrunner that the asynchronous test has finished. We could pass a function parameter to resume if, for example, we wanted to check the data associated with the `changeTweets` event, but for now we just want to verify that it fires at all.

Next, we invoke the `fetchTweets` method which should cause the event to fire.

Finally, the wait method informs the Testrunner that it should wait for a `resume` call. The first argument is the amount of time to wait (in milliseconds) before the test is marked as failed. Note that wait **must** always be the last call in an asynchronous test function. Any code that follows it will never be executed.

Now, if you run this test a couple times in quick succession, there's a good chance it will at some point fail with the error message "Error in asynchronous test: resume() called before wait()". This is because due to the browser caching the result of the identica API request sent by TweetService, the `changeTweets` listener callback is executed immediately after calling fetchTweets. This is a common problem in asynchronous tests, encountered whenever the tested code's behavior can be synchronous or asynchronous depending on external factors. Luckily, there's a simple fix for it: We just wrap the problematic method call in a timeout to make sure it's executed after `wait()`:

```
qx.event.Timer.once(function() {
  this.__identicaService.fetchTweets();
}, this, 100);
```

While we could use a simple `window.setTimeout` for this, it's preferable to use Timer.once since it uses qooxdoo's global error handling to catch and log any exceptions that might be thrown in the callback code. Otherwise, these would just land on the browser console.

Requirements

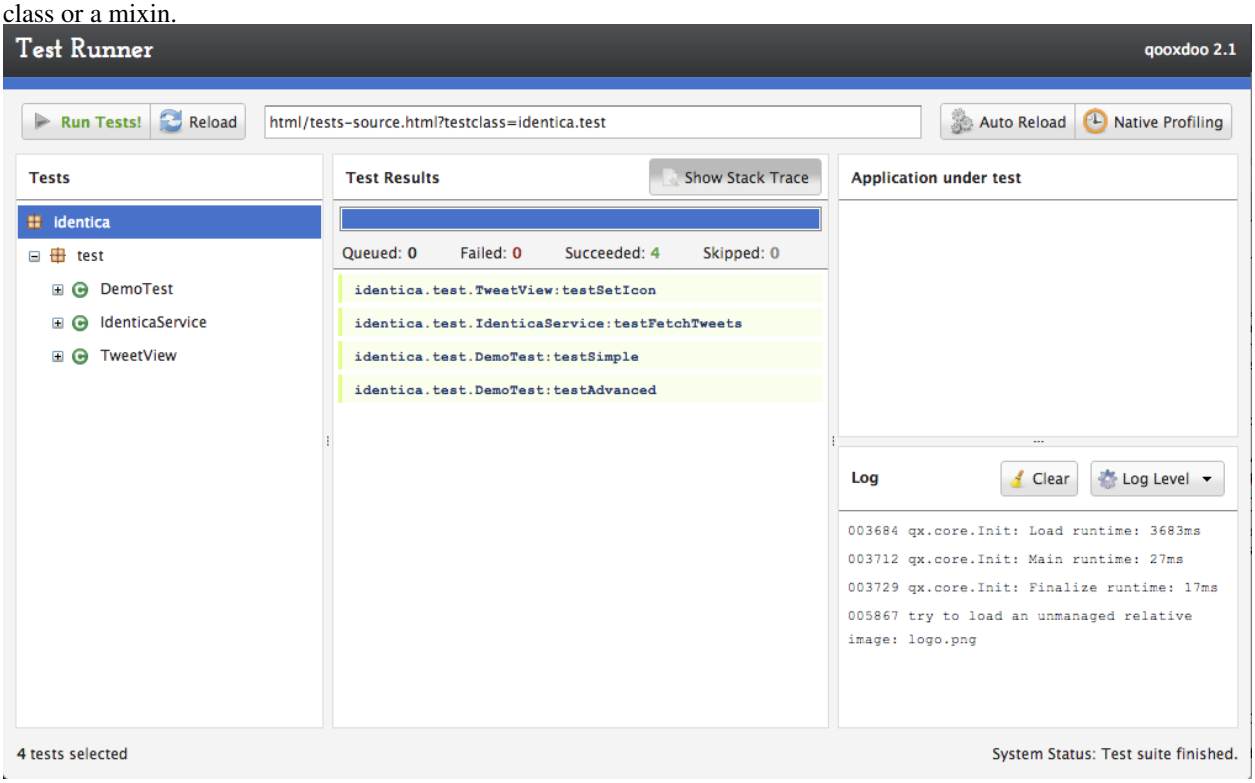
Finally, let's take a quick look at *test requirements*. This is a way to define preconditions that must be satisfied before a test can be run. If a requirement isn't met, the test will be skipped (and marked as such in the Testrunner GUI). Common requirements are:

- The test checks browser-specific behavior, so it should only be run in selected browsers
- The tested class performs secure backend communication, so the test should only execute if the AUT was loaded over HTTPS

In order to use requirements, you need to include the Mixin qx.dev.unit.MRequirements in your test class. Requirements are defined by calling the require method with an array of requirement ID strings as the only parameter. Usually, this will be the first call in either a test function or the `setUp` method. Requirement IDs are evaluated by looking for

a method name beginning with "has" followed by the requirement ID (starting with a capital letter) on the current test class and its ancestors. The method is called and its return value is checked: `true` means the requirement is met and the test can proceed, `false` means the test won't be executed and the Testrunner GUI will list it as "skipped".

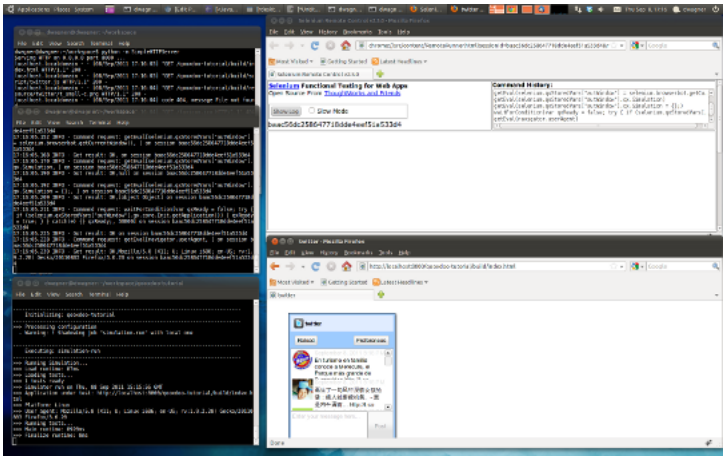
While qx.dev.unit.MRequirements contains a number of "has" methods for common scenarios, requirements are often application-specific and so test developers will implement their own checks in the test class itself, a common base class or a mixin.



And that's it for a first look at unit testing for qooxdoo applications. Note that qooxdoo comes with a wrapper for the powerful Sinon.js testing framework, which offers spies, stubs and mock objects that allow testing the very internals of a class, such as if and how many times a specific method was invoked. But that's a topic for a separate tutorial.

4.7.9 Tutorial Part 4.4.1: Automated UI Testing

Having previously covered *unit testing*, it's time to take a look at qooxdoo's built-in facilities for automated UI testing. Over the course of this tutorial, we'll set up the required infrastructure and develop a test case that interacts with the tweets application from the previous tutorials.



Simulator: Selenium support for qooxdoo

The *Simulator* component provides the infrastructure necessary to write GUI tests for qooxdoo applications and execute them in a real web browser by way of a Selenium server. The Simulator is based on those parts of the Selenium project that were formerly known as "Selenium RC" and are now referred to as "Selenium 1". While this tutorial doesn't require in-depth Selenium knowledge, you should at least familiarize yourself with its basic concepts and capabilities before reading on.

The testing API: QxSelenium

Simulator Test cases are defined as qooxdoo classes inheriting from `simulator.unit.TestCase`. Similar to unit tests, they live in the namespace of the application they're testing and support the setUp/testSomething/tearDown pattern. Test methods interact with an application by using the **QxSelenium API**. This consists of the DefaultSelenium API plus several qooxdoo-specific additions. You can get an API reference for these by running `generate.py api` in the qooxdoo SDK's `component/simulator` directory and then opening `/component/simulator/api/` in your browser.

Setting up the infrastructure

For the purposes of this tutorial, we'll assume that you're using a working directory named `workspace` which contains the tweets tutorial application in a subdirectory named `qooxdoo-tutorial`. Replace these paths with your own as appropriate.

The test browser will load the application under test (AUT) over HTTP, so make sure you're running a web server and qooxdoo-tutorial is accessible. If you don't want to install a full-blown HTTP server like Apache, you can use Python's built-in web server module. To do so, open a new shell in your `workspace` directory and run this command:

```
python -m SimpleHTTPServer
```

You should now be able to open the tutorial application by browsing to `http://localhost:8000/qooxdoo-tutorial/build/index.html`. Make sure to use `generate.py build` to create the build version of your application, which doesn't have any dependencies to your local qooxdoo sdk anymore.

Also, a regular Java Runtime Environment (JRE) is necessary on your machine to run Selenium.

Required Libraries

The Simulator depends on these external libraries:

- Mozilla Rhino: Download the ZIP archive, extract the ZIP and place `js.jar` in your workspace
- Selenium Server: Place `selenium-server-standalone-2.33.0.jar` in workspace
- Selenium Java Client Driver: Extract `selenium-java-2.33.0.jar` and the `libs` directory and place them in workspace.

Starting the Selenium Server

In a real testing environment, the Selenium server will probably run on a separate machine - in fact, the same client might use different servers to run tests e.g. in Internet Explorer on Windows, Safari on OS X and Firefox on Linux. To keep this tutorial straightforward, however, we'll run the server on the same machine as the AUT. Wherever selenium-server-standalone-2.33.0.jar is located, in order to test qooxdoo-based applications it needs to use the **qooxdoo user extensions for Selenium**. They're located in the Simulator component within the qooxdoo SDK, so start the server with the `-userExtensions` option set accordingly by running this command in a new shell window:

```
java -jar selenium-server-standalone-2.33.0.jar -userExtensions <QOOXDOO_PATH>/component/simulator/to
```

The server should now be listening on the default port, 4444.

Test Configuration Settings

The Simulator needs several configuration settings in order to run:

- The paths for the Rhino and Selenium Client Driver JARs
- the host name and port of the Selenium server
- the browser to be used for the test
- and the URI for the application under test
- All these settings are defined by overriding the `simulation-run` job in config.json (don't forget to uncomment the "jobs" section if necessary):

```
"simulation-run" :
{
  "let" :
  {
    "SIMULATOR_CLASSPATH" : [
      "../selenium-java-2.33.0.jar",
      "../libs/*",
      "../js.jar"]
  },

  "environment" :
  {
    "simulator.selServer"    : "localhost",
    "simulator.selPort"      : 4444,
    "simulator.testBrowser" : "*firefox",
    "simulator.autHost"      : "http://localhost:8000",
    "simulator.autPath"      : "/qooxdoo-tutorial/build/index.html"
  }
}
```

The `simulator.testBrowser` key is particularly noteworthy. The value must be one of the browser launcher strings supported by Selenium. `*firefox` (for Firefox 3+) and `*googlechrome` should work fine on any platform provided you're using Selenium 2.x as described in this tutorial. `*safari` usually only works on OS X. Internet Explorer requires *some additional configuration* but generally works fine for what it is. Whichever browser you choose, it must be installed on the machine that runs the Selenium Server.

The `simulator.autHost` and `simulator.autPath` settings are combined to form the URI of the tested application. Adjust these depending on your web server configuration. Also note that you can test either the source or build version of the application - just make sure it's generated before launching the test suite by running `generate.py build` or `generate.py source`.

Defining a test case

Now that we've got our infrastructure set up, we can finally start writing tests. First, navigate to the subfolder named `simulation` in `qooxdoo-tutorial/source/class/tweets`. This is the default location for Simulator tests. In this folder, delete the predefined `DemoSimulation.js` and create a new file named `Settings.js`. This will be our test case that is going to interact with the tweets application's settings dialog. For now, just add a test method stub that will cause the test to fail:

```
qx.Class.define("tweets.simulation.Settings", {

  extend : simulator.unit.TestCase,

  members :
  {
    testChangeLanguage : function()
    {
      this.fail("Test not implemented!");
    }
  }
});
```

Building and running the test suite

Time to see the Simulator in action. In the tweets application's directory, run `generate.py simulation-build` to create the test application. Note that there is no simulation-source job (yet) so you must run simulation-build every time you modify your test classes.

Once the build job is finished, run generate.py simulation-run. Assuming everything's set up correctly, two Firefox windows should (very briefly) open up and you should see the result of the failing test right on the shell:

```
------------------------------------------------------------------------------
    Initializing: qooxdoo-tutorial
------------------------------------------------------------------------------
>>> Processing configuration
  - Warning: ! Shadowing job "simulation-run" with local one

------------------------------------------------------------------------------
    Executing: simulation-run
------------------------------------------------------------------------------
>>> Running Simulation...
>>> Load runtime: 87ms
>>> Loading tests...
>>> 1 tests ready
>>> Simulator run on Thu, 08 Sep 2011 14:22:29 GMT
>>> Application under test: http://localhost:8000/qooxdoo-tutorial/build/index.html
```

```
>>> Platform: Linux
>>> User agent: Mozilla/5.0 (X11; Linux i686; rv:6.0.2) Gecko/20100101 Firefox/6.0.2
>>> Running tests...
>>> Main runtime: 8887ms
>>> Finalize runtime: 0ms
>>> Assertion error! Test not implemented!: Called fail().
>>> Stack trace:

>>> ERROR  tweets.simulation.Settings:testChangeLanguage
>>> Test not implemented!: Called fail().

>>> Test suite finished.
>>> 0 passed, 1 failed, 0 skipped.
>>> Simulator run finished in: 0 minutes 15 seconds.
>>> Done (0m17.20)
```

You'll notice a warning about the "simulation-run" job being shadowed. Since we're doing that on purpose, we can silence this warning by adding the top-level key *"config-warnings"* to config.json:

```
"config-warnings" :
{
  "job-shadowing" : ["simulation-run"]
},
```

Test development

Let's replace that stub with something useful now: We want Selenium to use the tweets application's preferences window to change the language. But first, we should set Selenium's execution speed (the delay after each command is executed) to a value that will allow us to actually see what's going on, say one second. To do so, replace the `this.fail` line:

```
testChangeLanguage : function()
{
  this.getQxSelenium().setSpeed(1000);
}
```

The first real action of the test will be to click the "Preferences" button. This leads us to one of the main challenges when developing Selenium tests: How to locate the right element.

Locator strategies

Elements can be located using several different strategies, generic as well as as qooxdoo-specific ones. See the manual for an overview:

Simulator: Locating elements

In this tutorial, we'll focus on the *qxhv* locator. Just like *qxh*, it traverses the application's widget hierarchy, using a syntax similar to XPath to match the widgets it finds to criteria defined by the user.

Note: The *Selenium IDE* Firefox add-on and the *qooxdoo Inspector* can be very helpful tools for finding locators and debugging Selenium tests.

The qxhv locator allows us to find any widget with a given "label" property value:

```
qxhv=*/[@label=Preferences]
```

A word about locales

As you'll be aware if you've completed the *Translation tutorial*, the tweets application is localized and will automatically switch the display language if the locale of the browser it's opened in matches one of the supported languages (German, English, French and Romanian). This means that depending on the locale of the browser you're using to run the test suite, you may have to adjust the target value of the Preferences label locator step, e.g. `qxhv=*/[@label=Einstellungen]` for a German language browser.

Executing commands

To simulate a user clicking on the target identified by the locator, we need to combine it with the `qxClick` command:

```
// Click the Preferences button
var preferencesButtonLocator = "qxhv=*/[@label=Preferences]";

this.getQxSelenium().qxClick(preferencesButtonLocator);
```

This should open the Preferences window. To make sure the command worked, we can employ the `isElementPresent` command, then use an assertion so the test will fail if the window didn't open:

```
// Check if the Preferences window opened
var settingsWindowLocator = "qxhv=[@classname=tweets.SettingsWindow]";
var settingsWindowPresent = this.getQxSelenium().isElementPresent(settingsWindowLocator);
this.assertTrue(settingsWindowPresent);
```

If the settings window was a `qx.ui.window.Window`, we could simply use the class name as the locator step. But that only works with classes from the qx.* name space. For a custom widget class like `tweets.SettingsWindow`, we need to search by `classname`, a plain JavaScript attribute supported by all qooxdoo objects. The `@propertyName=value` locator step covers these as well.

All right, time to execute the test again (don't forget to run `simulation-build` again first). Assuming all went well and the test passed, the next step is to select one of the language options from the Preferences window. `qx.ui.form.RadioButton` also has a `label` property (inherited from `qx.ui.basic.Atom`), so we'll use that:

```
// Click the radio button for Romanian
var romanianLabelLocator = "qxhv=[@classname=tweets.SettingsWindow]/*/[@label=Romanian]";
this.getQxSelenium().qxClick(romanianLabelLocator);
```

Obviously, if your browser's locale is Romanian, this option will already be selected so you should choose a different one.

Following that, we want to close the Preferences window. The close button doesn't have a label, but we can find it by looking for the file name of its icon:

```
// Click the window's close button
var windowCloseButtonLocator = "qxhv=[@classname=tweets.SettingsWindow]/qx.ui.container.Composite/[@i
this.getQxSelenium().qxClick(windowCloseButtonLocator);
```

We don't need to use the full resource ID of the icon since the `[@property=value]` step treats the value as a regular expression.

Again, we'll use `isElementPresent` to check the result:

```
// Check if the window was closed
settingsWindowPresent = this.getQxSelenium().isElementPresent(settingsWindowLocator);
this.assertFalse(settingsWindowPresent);
```

This would be a good time to re-generate and run the test to make sure everything works as expected.

Verifying the language change

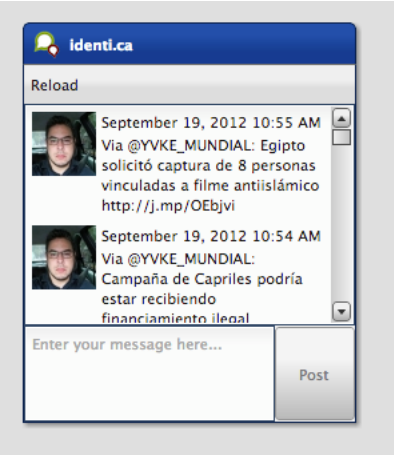
For the final step of this tutorial, we'll check if the language change was correctly applied to the tweets application. The first approach might be to use `isElementPresent` to check for the Preferences button with the translated label value (e.g. "Preferinte" for Romanian). That won't work, however, since the value of the "label" property is a qx.locale.LocalizedString object, so the `[@property=value]` locator step will try to call `toString` on it. This will return the original, untranslated label so the check will fail. To get the visible, translated string, we need to call the LocalizedString's `translate()` method. That's where `QxSelenium.getRunInContext` comes in: It takes a locator and a snippet of JavaScript code which it uses as the body of a new function. This function will then be called in the context of the widget identified by the locator, i.e. "this" will reference the widget instance. The function's return value is then serialized as JSON and returned by `getRunInContext`. We can use this to compare the translated label value to what we're expecting:

```
// Get the translated string for the Preferences button label
var translatedLabel = this.getQxSelenium().getRunInContext(preferencesButtonLocator,
"return this.getLabel().translate().toString()");
// Check if the label was translated
this.assertEquals("Preferinte", translatedLabel);
```

And that's it for this introduction to the Simulator. If you have further questions or encounter any problems getting the tutorial code to run, please contact us on the qooxdoo-devel mailing list.

4.7.10 Tutorial Part 4.5: Virtual List

This time we will have a look at the virtual widget stuff. The plan is to remove the normal List and use the virtual List. Using the virtual list has a big advantage when we have to render a huge count of items. The virtual list only creates widgets for visible items. This saves memory and execution time. As a base we use the already known tweets client we built in the *former tutorials*.



Change the instantiation

First, we have to use the virtual List instead. Open the `tweets.MainWindow` class and search for the list instantiation:

```
// list
this.__list = new qx.ui.form.List();
this.add(this.__list, {row: 1, column: 0, colSpan: 2});
```

And create a virtual List instead:

```
// list
this.__list = new qx.ui.list.List();
this.add(this.__list, {row: 1, column: 0, colSpan: 2});
```

Now we use the virtual List instead of the non virtual List. But before we can use the tweets application with the virtual List we have to configure the usage with a delegate.

Configure the virtual List

The current implementation uses the list controller to bind the tweets with the list. This makes it easy to reuse the delegation implementation, because the delegation interface from the virtual List has the same methods for `bindItem`, `createItem`, `configureItem` and `filter`. We only need to remove the controller stuff and use the virtual list instead. The controller is not needed anymore, because the virtual list has its own controller implementation. Open the `tweets.Application` and search for the controller instantiation:

```
// create the controller
var controller = new qx.data.controller.List(null, main.getList());
controller.setLabelPath("text");
controller.setIconPath("user.profile_image_url");
controller.setDelegate({
  configureItem : function(item) {
    item.getChildControl("icon").setWidth(48);
    item.getChildControl("icon").setHeight(48);
    item.getChildControl("icon").setScale(true);
    item.setRich(true);
  }
});
```

Instead of the controller use the virtual List:

```
// setup list binding
var list = main.getList();
list.setItemHeight(68);
list.setLabelPath("text");
list.setIconPath("user.profile_image_url");
list.setDelegate({
  configureItem : function(item) {
    item.getChildControl("icon").setWidth(48);
    item.getChildControl("icon").setHeight(48);
    item.getChildControl("icon").setScale(true);
    item.setRich(true);
  }
});
```

Now we have replaced the controller with the virtual List and reused the delegate implementation. We have only added one line to configure the default item height. This is necessary, because the virtual List has no auto sizing for the item height. This is due to the huge count of model items.

Update list binding

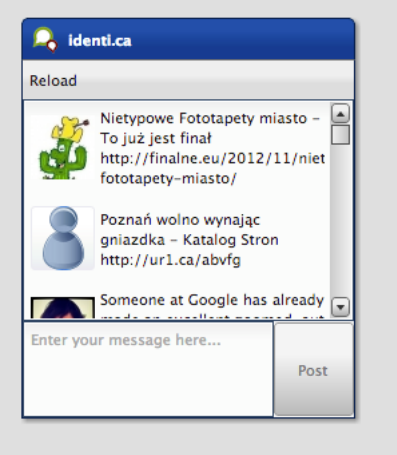
Finally, we have to adapt the binding between the tweets service and the virtual list. The virtual list always needs a model instance so we need to adapt the current binding:

```
service.bind("tweets", controller, "model");
```

We only use a converter which returns an empty model when the service returns `null`:

```
service.bind("tweets", list, "model", {
  converter : function(value) {
    return value || new qx.data.Array();
  }
});
```

Now we only need to run the generator to resolve the new dependencies:



The virtual List supports some more features like grouping, for additional details have a look at the virtual demos. As always, the code of the tutorial is on github.

4.8 Migration

4.8.1 Migration from qx.Desktop 2.x

qx.Desktop 3.0 introduces some major improvements to the internals of qooxdoo's desktop widget system. This was made possible by taking advantage of features in modern browsers while trying to implement graceful degradation in older browsers and discontinuing support for some legacy browsers.

In order to improve UI performance and decrease memory load, every widget now consists of **just one content element**. Before, each desktop widget consisted of (at least) two DOM elements and their JavaScript object representations: container and content. Usually widgets also had a decorator element. Now widgets no longer have decorator, container or protector elements.

Most modifications were made "under the hood", affecting mostly internal APIs. Therefore regular users should immediately benefit from those improvements without being required to adjust their application code. If custom themes and/or custom layouts are used however, some manual adjustments to existing applications based on qx.Desktop 2.x may be required. Additionally, some theming features no longer have fallback implementations for legacy browsers (see below for details).

Legacy Browsers

Some browsers unfortunately lack built-in functionality for some features common to modern browsers. To work around those technical limitations is either too complex or simply impossible. Therefore browser support in qx.Desktop 3.0 had to be adjusted accordingly:

- **Browser versions no longer supported:**
  - **IE 6, 7**

  - **Firefox 3.5** and below
  - **Safari 3**
  - **Opera 11** and below
- **Browser versions with limited support:**
  - **IE 8:**
    * double borders on input elements no longer supported
    * border-image decorations no longer supported
    * PNGs are no longer supported as background images in combination with the backgroundRepeat values 'scale' and 'no-repeat'
    * PNGs with alpha transparency are no longer supported as background images
  - **IE 9, 10:**
    * border-image decorations no longer supported

Built-in Themes

Along with the changes in the qx.Desktop GUI toolkit, the themes that ship with the SDK have also been adjusted. They no longer contain the image-based fallbacks for legacy browsers that were used to work around missing CSS3 features.

- Indigo, Simple: no changes from previous releases
- Modern: shadows and rounded borders no longer available in IE 8
- Classic: shadows no longer available in IE 8; text fields and text areas only with single not double borders

This is also relevant if you used some of the decorators for your custom widgets. They might have been renamed or deleted.

Custom Themes

The following information applies to user-defined themes. The framework's built-in themes are already up to date.

Decoration Theme

- The `inset` properties of the decorators have been set to read-only. Any inset definitions in your decoration theme or application code should be removed and replaced with the corresponding `padding` and/or `margin` in the appearance theme.
- The `decorator` theme key will be ignored. All decorations now use a common class, which supports all decoration features. You can simply remove any `decorator` keys from your custom theme.
- The decorators `qx.ui.decoration.Grid`, `qx.ui.decoration.GridDiv`, `qx.ui.decoration.BoxDiv`, `qx.ui.decoration.AbstractBox`, `qx.ui.decoration.HBox`, and `qx.ui.decoration.VBox` have been removed. These classes were responsible for providing image-based fallback implementations for border-image and background-gradient decorators, meaning **border-image decorations are no longer available in Internet Explorer 8 - 10**. The properties of MBorderImage provide these features for most modern browsers. Change every occurrence of the `baseImage` key to its new equivalent, borderImage.

- The qx.ui.decoration.Beveled and qx.ui.decoration.Uniform decorators are deprecated. Replace them with qx.ui.decoration.Decorator and use the width, style and color properties.
- The decorator qx.ui.decoration.Double is also deprecated. Replace it with qx.ui.decoration.Decorator and use the properties of MDoubleBorder.
- qx.ui.decoration.DynamicDecorator has been deprecated. Replace it with decoration.Decorator.

Custom Decorators

The qx.ui.decoration.IDecoration interface has been updated. The methods getMarkup, tint and resize were removed. getStyles was added: This method is responsible for adding the Decorator's CSS styles to a map of existing styles.

Appearance Theme

- The key shadow is no longer supported in the map returned by the style function. Use the properties of qx.ui.decoration.MBoxShadow instead (in the decoration theme).

Custom Layouts

Custom layouts extending qx.ui.layout.Abstract must be adjusted: The renderLayout method is now called with a map containing the container's top, bottom, left and right padding values as an additional third argument. These values must be taken into consideration when calculating the layout children's size and position.

Custom Widgets

The following information is only relevant for authors of custom widgets using the qx.html layer directly.

- With the removal of the decorator element, the method qx.ui.core.Widget.getDecoratorElement was also removed. For most use cases it should be sufficient to use the content element instead, which can be accessed by qx.ui.core.Widget.getContentElement.
- The same applies to the container element and qx.ui.core.Widget.getContainerElement. This method is deprecated and returns the content element. Use qx.ui.core.Widget.getContentElement instead.
- As with the container element itself, the method qx.ui.core.Widget.getContainerLocation is deprecated. Just use qx.ui.core.Widget.getContentLocation instead.
- The shadow property has been removed. Use a decorator setting the properties of qx.ui.decoration.MBoxShadow instead.

Other Code Changes

The blocking implementation (qx.ui.core.Blocker, qx.ui.core.MBlocker) was simplified:

- unblockContent was removed. Use unblock instead.
- isContentBlocked was removed. Use isBlocked instead.
- forceUnblockContent was removed. Use forceUnblock instead.

Implementation Details

This section lists all further internal changes. They should not be relevant for you as an application developer. Nevertheless, this information could be useful for anyone interested in the framework's internals.

- The new implementation is based on `box-sizing: border-box`. As a consequence, **Internet Explorer 6 and 7 is no longer supported**.
- Decorations are compiled as CSS classes and applied to a central style sheet.
- Background gradients are rendered using Canvas in IE9.
- CSS clip is used to apply padding to combined images.
- For the legacy browser fallback implementation of the text fields' placeholder property, the placeholder element is attached to the field's layout parent.
- The blocker element of `qx.ui.embed.Iframe` is now attached to the application root.
- `qx.ui.core.Blocker` is attached to the blocked widget's layout parent.
- The default `zIndex` value for Widgets is now 10.
- `qx.html.Element` now supports addition and removal of CSS classes.
- `qx.ui.tooltip.ToolTip` offers a new child control named `arrow`. It is used to render an arrow for error tooltips in the Modern theme.
- The padding of `qx.ui.basic.Image` instances is applied as background-position.
- Separators are now instances of `qx.ui.core.Widget` instead of `qx.html.Element`.
- The infrastructure classes `qx.ui.core.DecoratorFactory` and `qx.html.Decorator` have been removed.

CHAPTER

FIVE

QX.MOBILE

qx.Mobile is qooxdoo's mobile framework. It provides specific UI classes for touch devices, handling of mobile events like swiping, and specific styling. It is suitable for various mobile web browsers on iOS and Android platforms.

5.1 General

5.1.1 Overview

This is an introduction into qooxdoo's mobile framework. qooxdoo mobile provides a optimized widget set to build applications for mobile devices.

Supported Mobile Operating Systems

qooxdoo mobile was tested with the native browsers of the following operating systems:

- iOS
- Android 1.6+
- BlackBerry 10 OS (Playbook + Z10)
- Windows Phone 8 (Experimental)

Supported Desktop Browsers

qooxdoo mobile was tested with the following desktop browsers:

- Safari 5
- Chrome 10+
- Firefox 10+ (Experimental)
- Internet Explorer 10+

Features

- Mobile widget set
- *Theming via CSS and SCSS*
- iOS theme

- Android theme
- Custom theme
- Touch events: touchstart, touchmove, touchend, touchcancel
- Gesture events: swipe, tap, longtap
- Animations between pages
- Touch event emulation for debugging in desktop browsers
- Fixed toolbars and momentum scrolling via iScroll
- Basic PhoneGap support
- Support for high-resolution displays ("Retina display support")

API Documentation

- qx.application.Mobile: The mobile application.
- qx.ui.mobile: This package contains all mobile widgets. See the API documentation for more information.

Create a Mobile Application

To create a mobile application `mobileapp` in your home directory with your shell, change to your home directory (just `cd`). With a qooxdoo SDK available at `/opt/qooxdoo-3.0-sdk`, call the script as follows:

```
/opt/qooxdoo-3.0-sdk/create-application.py --type=mobile --name=mobileapp --out=.
```

Have a look into the API documentation of qx.ui.mobile.page.Page to understand the basic concepts of qooxdoo mobile.

To learn how to develop a basic mobile application, you should try the *mobile tweets client tutorial*.

If you are new to qooxdoo, make sure you have read the *getting started* tutorial to understand the basics of qooxdoo.

Environment Keys

The following environment keys are available:

- `qx.mobile.emulatetouch: true|false` - Enables desktop browser touch emulation. Enable this option if you want to debug the application in your desktop browser.
- `qx.mobile.nativescroll: true|false` - Whether to use native scrolling or iScroll for scrolling.
- `device.pixelRatio: Number` - the ratio between physical pixels and device-independent pixels (dips) on the device.
- `device.type: String` - Determines on what type of device the application is running. Valid values are: "mobile", "tablet" or "desktop".

Differences to Desktop Widgets

The qooxdoo mobile widget set is optimized for the use on mobile devices. In fact, the qooxdoo mobile widget set is up to six times faster than the desktop widget set on mobile devices. We have tried to keep the differences of the API as low as possible, so that a qooxdoo developer will have his first qooxdoo mobile application running within minutes.

Of course, respecting the speed advantage, not all features of the desktop widget set could be retained. There are some differences, listed below:

- Theming: The theming is done via CSS files. Have a look into the existing themes, to see how the styling is done. You can find the themes under `framework/source/resource/qx/mobile/css/`. To change the theme, just change the included CSS file in the `index.html` and change the loaded assets in your mobile application. There is a `index.html` file for the build version as well. You can find it in the `source/resource/` folder of your application.
- No layout item: Only a few, essential, styles are provided by a widget. You should set all other styles of a widget via CSS, using the `addCssClass` method of a widget.
- No queues: Elements are created directly. There is no element, layout, display queue. Keep this in mind when you create and add widgets.
- Layouts: Layouts are done via CSS(3). HBox / VBox layouts are implemented using the flexible box layout
- qx.ui.mobile.page.Page: A page is a widget that provides a screen which users can interact with in order to do something. Most times a page provides a single task or a group of related tasks. A qooxdoo mobile application is usually composed of one or more loosely bound pages. Typically there is one page that presents the "main" view.

Demo Applications

To see qooxdoo mobile applications in action or to see how to implement an application, you can have a look on the following demo applications:

- Mobile Showcase - see all mobile widgets in action
- Mobile Feedreader - the feedreader as a mobile app. Using the same logic and models as the feedreader for desktop browsers does.

All applications can be found in the `application` folder of your qooxdoo checkout.

How to contribute?

You can contribute in different ways:

- Testing: Test qooxdoo mobile on your mobile device and give us feedback.
- Theming: You can optimize the current CSS files or even create your own theme.
- Widgets: Widget / Feature missing? Create an widget an post it back to us.
- Bugs: If you have found a bug, or when you have fixed it already, please open a bug report in the qooxdoo Bugzilla with the `core-mobile` component.
- Devices: If you have an old smartphone (Android, iPhone, Blackberry, Windows Phone, WebOS, etc.) that you don't need anymore, you could donate it to qooxdoo. We would be happy to test qooxdoo mobile on it.
- Discussion/Feedback: Please post questions to our mailing list.

5.1.2 qx.Mobile Requirements

qooxdoo qx.Mobile runs on iOS 2.0+, Android 1.6+ and Windows Mobile devices. Working with qx.Mobile requires access to such a mobile device, with a suitable mobile browser, or a mobile emulator for the respective platform that runs on your desktop PC.

SDK

Working with qx.Mobile requires downloading and using qooxdoo's SDK. See here for the *SDK's requirements*, and follow its *Installation and Setup* section. This requirement applies to the development phase only, the final app is independent of the SDK.

Mobile Browsers

The following mobile browsers are supported:

	Safari Mobile
	Chrome for Android
	Android Native Browser
	Internet Explorer 10 (Windows Phone 8, Windows RT, Windows 8)

Other mobile browsers like Opera Mini might work, but are not officially supported.

Desktop Browsers

As qooxdoo is based on web technologies, you will need a running instance of a browser (Google Chrome, Apple Safari, Mozilla Firefox or Internet Explorer) on your system to run and test the application. An iOS, Android or Windows Phone 8 device is not necessarily required.

The following desktop browsers are supported:

	Apple Safari 5+
	Google Chrome 10+
	Mozilla Firefox 10+
	Internet Explorer 10

5.1.3 Getting Started with qooxdoo qx.Mobile

Working with qx.Mobile requires downloading and using qooxdoo's SDK. See here for the *SDK's requirements*, and follow its *Installation and Setup* section. This requirement applies to the development phase only, the final app is independent of the SDK.

The first step is to create a mobile skeleton, by calling the `create-applicaton.py` script from the command line. Navigate to the qooxdoo folder and execute the following command:

```
./tool/bin/create-application.py --type=mobile --name=helloworld --out=..
```

A new folder "helloworld" will be created next to the qooxdoo folder, containing the mobile skeleton application. Right now the application is pretty useless, until we create the `source` version of it. Navigate to the created folder and call the qooxdoo generator with the following command:

```
./generate.py source
```

After a few seconds the generator has analyzed all class dependencies and created a source version of the application. You can test the application by opening the `source/index.html` file in your Chrome / Safari browser. You should

see a page “Page 1” with a button “Next Page”. When you click on the button, the next page “Page 2”, with a “Back” button in the upper left corner, is displayed.

Congratulations, you have just created your first qooxdoo mobile application!

Now it is your turn. Just open `source/class/helloworld/Application.js` and enhance your cross-platform mobile application.

If you need a more detailed tutorial, please have a look at our mobiletweets tutorial:

qx.Mobile Tweets Client Tutorial

5.2 Tutorials

5.2.1 Tutorial: Creating a Tweets Client with qooxdoo mobile

In this tutorial you will learn how to create a simple tweets app with the qooxdoo mobile widgets.

identica is a twitter-like service for reading and posting public short messages - called “tweets”. It has a twitter-compatible API for accessing data.

Twitter itself made its authorization scheme more complex, as it starts requiring OAuth even to read public tweets. For this basic tutorial it would be too complex to handle such advanced authorization. If your are interested in OAuth, check out how you could handle that in a qooxdoo app by looking at the Github demo.

We use a mock for the identica service to be sure this tutorial always works.

The app that is to be created in this tutorial should display all tweets of a certain user. When a tweet is selected, the details of the tweet should be shown. You can find the code of the tutorial here.

Requirements and Getting Started

Please visit the *getting started section* and follow the introduction which describes how to create a qx.Mobile Application.

Creating your first Page

In this section we will create two pages, one page for entering the username whose tweets should be shown and another page for displaying the tweets.

But first of all we have to define what a page is:

> *A page is a widget which provides a screen with which users can interact in order to do something. Most times a page provides a single task or a group of related tasks. A qooxdoo mobile application is usually composed of one or more loosely connected pages. Typically there is one page that presents the “main” view.*

Open the “mobiletweets” folder in your favorite IDE, so that you can edit all the files. Navigate to the “source/class/mobiletweets” folder, were all of the application class files are located. Now you are ready to create the application.

First we have to create a new page class. In order to do so, create a new folder “page” under “source/class/mobiletweets”, representing a new namespace `mobiletweets.page`. In this folder create a new JavaScript file named “Input.js”. This file will contain the `mobiletweets.page.Input` class. Define the class like this:

```
qx.Class.define("mobiletweets.page.Input",
{
  extend : qx.ui.mobile.page.NavigationPage,

  construct : function() {
    this.base(arguments);
    this.setTitle("Identica Client");
  }
});
```

The "Input" class inherits from `qx.ui.mobile.page.NavigationPage`, a specialized page that consists of a `qx.ui.mobile.navigationbar.NavigationBar` including a title, back and action buttons, and a scrollable content area. In the constructor of the class we set the title of the page to "Identica Client".

To show the "Input" page, we have to create an instance of the class and a page manager. The manager does the layouting and displays our page on the screen. Additionally the manager gives us the possibility to use our application in a mobile or tablet device context. For our example, we just want to work in a mobile device context. That is why, we construct the manager with `false`.

After creation of the new manager, we have to add the "Input" page to it. In order to display the "Input" page on start, we then call its `show` method.

Open the "source/class/mobiletweets/Application.js" class file. You will find a comment in the `main` method "*Below is your actual application code...*" with example code below. As we don't need this example code, we can safely replace it with the following lines of code:

```
var manager = new qx.ui.mobile.page.Manager(false);

var inputPage = new mobiletweets.page.Input();
manager.addDetail(inputPage);

inputPage.show();
```

As we have changed the dependencies of our application, recreate the source version by calling the generator "source" target as above.

Refresh the index.html in your browser. You will see a page with a navigation bar and a title "Identica Client". That is all you have to do when you want to display a page.

Navigation between Pages

qooxdoo mobile comes with different animations for page transitions. Showing a second page is as easy as showing one page. Just call the `show` method of the second page and qooxdoo will do the rest. To navigate back to the first page you have to call, you have guessed it, the `show` method of the first page again. To play the animation of the page transition "reversed", call the `show` method with an object literal `{reverse:true}` as an argument. To change an animation, just add an animation key to the passed object literal, e.g. `{animation:fade}`:

```
page.show(); // show the page; "slide" is the default animation
//or
page.show({reverse:true}); // show the page and reverse the animation of the transition
//or
page.show({animation : "cube", reverse:true}); // show the page and reverse the "cube" animation
```

Page Lifecycle: *A page has predefined lifecycle methods that get called by the page manager when a page gets shown. Each time another page is requested to be shown the currently shown page is stopped. The other page, if shown for the first time, will be initialized and started afterwards. For all called lifecylce methods an event is fired.*

Calling the "show" method triggers the following lifecycle methods:

- `initialize`: Initializes the page to show
- `start`: Starts the page that should be shown
- `stop`: Stops the current shown page

IMPORTANT: Define all child widgets of a page when the "initialize" lifecycle method is called, either by listening to the "initialize" event or overriding the `_initialize` method. This is because a page can be instantiated during application startup and would then decrease performance if the widgets would be added during constructor call. The initialize event and the `_initialize` lifecycle method are only called when the page is shown for the first time.

Lets try it! Create another page class "Tweets" in the "source/class/mobiletweets/page" folder:

```
qx.Class.define("mobiletweets.page.Tweets",
{
  extend : qx.ui.mobile.page.NavigationPage,

  construct : function() {
    this.base(arguments);
    this.set({
      title : "", // will be replaced by username
      showBackButton : true,
      backButtonText : "Back"
    });
  }
});
```

In the constructor we setup setup the back button and set its text to "Back". The title will be replaced by the given username later.

Now we need a button on the "Input" page, so that we can navigate between the two pages. Create a new instance of a `qx.ui.mobile.form.Button` in the "Input" class and add it to the content of the page. By listening to the `tap` event of the button, the application can handle when the user taps on the button. Add a new `member` section to the class definition of the "Input" class and override the protected lifecycle method `_initialize` to do that:

```
members : {

  // overridden
  _initialize : function() {
    this.base(arguments);
    // Create a new button instance and set the title of the button to "Show"
    var button = new qx.ui.mobile.form.Button("Show");
    // Add the "tap" listener to the button
    button.addListener("tap", this._onTap, this);
    // Add the button the content of the page
    this.getContent().add(button);
  }
}
```

As you can see, the `tap` listener has the `_onTap` method as a handler. This method has to be implemented in the member section as well:

```
_onTap : function(evt)
{
   this.fireDataEvent("requestTweet", null); // Fire a data event.
       // Later we will send the entered "username" as a data.
}
```

In the `_onTap` method we fire a data event "requestTweet". The empty data will be replaced later with the username. The only thing which is missing now is to define the event itself. Add a new `events` section to the "Input" class:

```
events : {
  "requestTweet" : "qx.event.type.Data" // Define the event
}
```

In the "Application" class add the following code below the code we have just added:

```
// New instance of the Tweets page
var tweetsPage = new mobiletweets.page.Tweets();

// Add page to manager
manager.addDetail(tweetsPage);

// Show the tweets page, when the button is pressed
inputPage.addListener("requestTweet", function(evt) {
  tweetsPage.show();
}, this);

// Return to the Input page when the back button is pressed
tweetsPage.addListener("back", function(evt) {
  inputPage.show({reverse:true});
}, this);
```

After creating a new instance of our new "Tweets" class we listen to the `requestTweet` event of the "Input" page instance. In the event handler we call the `show` method of the `tweetsPage` page object to display the page. In the `back` event handler of the `tweetsPage`, the "Input" page will be shown with a reversed animation.

New classes mean new dependencies which means we have to generate the source code again. Refresh the application in the browser and navigate between the pages by clicking on the "Show" and on the "Back" button. Nice!

We need Data, lots of Data!

Ok, here we are. You have learned how to create two pages and to wire them by reacting on defined events. That is pretty cool, but without data to display our app is worthless. To display the tweets of a user we will use the public Tweet service of identica. Data binding is a powerful concept of qooxdoo which you can leverage off in your mobile applications as well. Extend the `members` section of the "Application" class by the following code:

```
__loadTweets : function() {
  // Mocked Identica Tweets API
  // Create a new JSONP store instance with the given url
  var self = this;
  var url = "http://demo.qooxdoo.org/" + qx.core.Environment.get("qx.version") + "/tweets_step4.5/res

  var store = new qx.data.store.Jsonp();
  store.setCallbackName("callback");
  store.setUrl(url);

  // Use data binding to bind the "model" property of the store to the "tweets" property
  store.bind("model", this, "tweets");
}
```

In the `__loadTweets` method we create a new JSONP store which will automatically retrieve the data from the given URL. By binding the `model` property to the `tweets` property, the `tweets` property will be automatically updated whenever the `model` property of the store is updated.

As you might have noticed the `__loadTweets` method uses two properties, `username` and `tweets`, that are not defined yet. We will define those properties now. Define a new section `properties` in the "Application" class and add the following two properties:

```
properties :
{
    tweets :
    {
      check : "qx.data.Array",
      nullable : true,
      init : null,
      event : "changeTweets",
      apply : "_applyTweets" // just for logging the data
    },

    username :
    {
      check : "String",
      nullable : false,
      init : null,
      event : "changeUsername",
      apply : "_applyUsername"  // this method is called when the username property is set
    }
}
```

In the apply method `_applyUsername` of the `username` property we will call the `__loadTweets` method. So every time the username is set the tweets for this username are loaded. To see which data is set for the `tweets` property, we will print the data in the debugging console. To do so, we call `this.debug` with the stringified value in the apply method `_applyTweets`. Add the following code to the member section of the "Application" class:

```
// property apply
_applyUsername : function(value, old) {
  this.__loadTweets();
},

_applyTweets : function(value, old) {
  // print the loaded data in the console
  this.debug("Tweets: ", qx.lang.Json.stringify(value));
}
```

Now the username has to be retrieved from the user input. To do so, we have to create an input form. The usage of the form classes should be familiar to you if you have used the RIA widget set before. Open the "Input" class again and place the following code, before the button instance in the `_initialize` method:

```
var title = new qx.ui.mobile.form.Title("Please enter an identi.ca username");
this.getContent().add(title);

var form = this.__form = new qx.ui.mobile.form.Form();

var input = this.__input = new qx.ui.mobile.form.TextField();
input.setPlaceholder("Username");
input.setRequired(true);
form.add(input, "Username");

// Add the form to the content of the page, using the Single to render
// the form.
this.getContent().add(new qx.ui.mobile.form.renderer.Single(form));
```

First we add an instance of `qx.ui.mobile.form.Title` to the content of the page. To an instance of `qx.ui.mobile.form.Form`, a `qx.ui.mobile.form.TextField` instance `input` is added. Both instances are assigned to member variables as well, for further reuse. A text is set for the `placeholder` property of the textfield. By setting the property `required` to true we indicate that the textfield requires an input. Finally we add

the form instance to the page content, by using a `qx.ui.mobile.form.renderer.SinglePlaceholder` renderer. The renderer is responsible for the look and feel of the form. In this case only the input fields with their placeholders are displayed.

In the `_onTap` method we have to retrieve now the value of the input field. Replace the code in the function body by the following code:

```
// validate the form
if (this.__form.validate())  {
  var username = this.__input.getValue();
  this.fireDataEvent("requestTweet", username);
}
```

After successfully validating the form, we retrieve the value of the textfield from the member variable and pass it as the data to the event.

As you surely remember we listen to the `requestTweet` event in the "Application" class. Open the Application class and add the following line to the event listener:

```
this.setUsername(evt.getData());
```

We've come full circle. By setting the username, the data will be loaded and we can proceed to display the data. Rebuild the application and refresh it in the browser. Type in a valid identica username (e.g. "qooxdoo") and click the "Show" button. Press the `F7` key to display the qooxdoo logging window or use the console of the browser developer tools. You will see the loaded tweets of the user.

Displaying the tweets

Now that we have the tweets for a certain user, it's gonna be pretty easy to display them. All we need for that is a `qx.ui.mobile.list.List` and to set up some data binding. Lets proceed with the tutorial.

First we have to add the following `_initialize` method to the members section of the "Tweets" page.

```
members : {
  __list : null,

  _initialize : function() {
    this.base(arguments);

    // Create a new list instance
    var list = this.__list = new qx.ui.mobile.list.List();
    var dateFormat = new qx.util.format.DateFormat();
```

```
    // Use a delegate to configure each single list item
    list.setDelegate({
      configureItem : function(item, value, row) {
        // set the data of the model
        item.setTitle(value.getText());
        // we use the dataFormat instance to format the data value of the identica API
        item.setSubtitle(dateFormat.format(new Date(value.getCreated_at())));
        item.setImage(value.getUser().getProfile_image_url());
        // we have more data to display, show an arrow
        item.setShowArrow(true);
      }
    });
    // bind the "tweets" property to the "model" property of the list instance
    this.bind("tweets", list, "model");
    // add the list to the content of the page
    this.getContent().add(list);
  }
}
```

The created list instance (we store it in a member variable for further usage) will use a delegate to configure each single list item. The delegate is set by the `setDelegate` method as a literal object. The `configureItem` method is responsible for configuring the list items. It has three parameters:

- `item`: The list item renderer instance. Use this parameter to set the title, subtitle or icon of the list item.
- `value`: The value of the row. Entry of the model for the current row index.
- `row`: The row index.

In this case the list item renderer is the `qx.ui.mobile.list.renderer.Default`. This renderer has a `title`, `subtitle` and a `image` property, which can be set individually per row. In addition to those properties, the `showArrow` property shows an arrow on the right side of the row, indicating that we have more data to display.

Finally the model of the list instance is bound to the `tweets` property, which we will add to the "Tweets" class right above the `member` section:

```
properties :  {
  tweets : {
     check : "qx.data.Array",
     nullable : true,
     init : null,
     event : "changeTweets"
   }
}
```

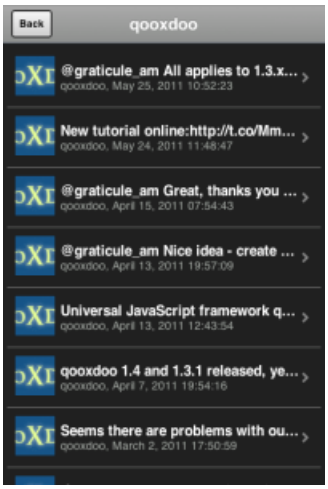
There are only two tasks left:

1. Bind the `tweets` property from the "Application" to the `tweets` property of the "Tweets" page instance.
2. Bind the `username` property form the "Application" to the `title` property of the "Tweets" page instance.

Open the "Application" class file and add under the instantiation of the "Tweets" page `tweetsPage` the following code:

```
this.bind("tweets", tweetsPage, "tweets");
this.bind("username", tweetsPage, "title");
```

Generate the source code again and refresh you browser tab. Try the username "qooxdoo" and push the "Show" button. It is magic!



Details of a tweet

Great, you have made it so far! In the last section we will display a tweet on a new page when the user selects a certain tweet. Sometimes it can happen that a tweet is too long for a list entry. Ellipses are then shown at the end of the tweet. That is why we want to give the user a chance to display the whole tweet. Lets create a simple "Tweet" page that only shows a `qx.ui.mobile.basic.Label` with the selected tweet text. To do so, we bind the `text` property of the tweet to the label's `value` property. Create the page, like you have done before, in the "source/class/mobiletweets/page" folder. The code of the page shouldn't be something new for you:

```
qx.Class.define("mobiletweets.page.Tweet",
{
  extend : qx.ui.mobile.page.NavigationPage,

  construct : function() {
    this.base(arguments);
    this.set({
      title : "Details",
      showBackButton : true,
      backButtonText : "Back"
    });
  },

  properties:
  {
    tweet :
    {
      check : "Object",
      nullable : true,
      init : null,
      event : "changeTweet"
    }
  },

  members :
  {
    _initialize : function()
    {
      this.base(arguments);
      // Create a new label instance
      var label = new qx.ui.mobile.basic.Label();
```

```
      this.getContent().add(label);
      // bind the "tweet.getText" property to the "value" of the label
      this.bind("tweet.text", label, "value");
    }
  }
});
```

Now create the instance of the "Tweet" page in the Application `main` method and return to the "Tweets" page, when the `back` listener is called.

```
var tweetPage = new mobiletweets.page.Tweet();

// Add page to manager
manager.addDetail(tweetPage);

// Return to the Tweets Page
tweetPage.addListener("back", function(evt) {
  tweetsPage.show({reverse:true});
}, this);
```

Until now we will never see the "Tweet" page as its `show` method is never called. First we have to react in the "Tweets" page on a selection change event of the list, by registering the `changeSelection` event on the list in the `_initialize` method:

```
list.addListener("changeSelection", this.__onChangeSelection, this);
```

The `__onChangeSelection` method looks like this:

```
__onChangeSelection : function(evt)
{
  // retrieve the index of the selected row
  var index = evt.getData();
  this.fireDataEvent("showTweet", index);
}
```

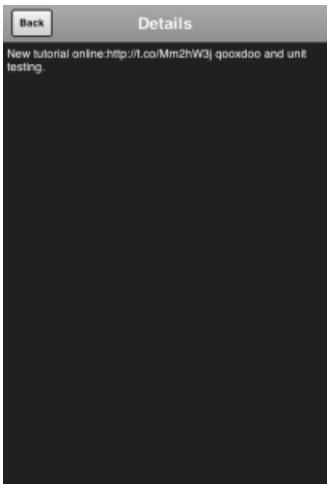
As you can see, a `showTweet` data event is fired here. This data event has to be defined in the `events` section of the "Tweets" class:

```
events : {
  showTweet : "qx.event.type.Data"
}
```

All we need to do now is to listen to the `showTweet` event in the "Application" class main method, retrieve the index from the data event and to get the corresponding tweet from the data. Finally we show our "Tweet" page.

```
// Show the selected tweet
tweetsPage.addListener("showTweet", function(evt) {
  var index = evt.getData();
  tweetPage.setTweet(this.getTweets().getItem(index));
  tweetPage.show();
}, this);
```

Rebuild the source code (or the `./generate.py build` version), refresh the application in your browser and enjoy your application! We are done here.



Now you are ready to develop your own applications

After you have finished this tutorial, you have learned the basics of qooxdoo mobile. You have seen how easy it is to develop qooxdoo mobile applications when you are familiar with qooxdoo. There are only some new concepts (e.g. Pages) to learn and you are good to go. All qooxdoo mobile applications work on Android and iOS devices.

qx.Mobile Deployment with Apache Cordova

5.3 Development

5.3.1 Mobile and tablet switch

Tablet support out of the box

On tablet devices you have a bigger screen size and more layout space than on mobile devices. An application in a tablet device context may even provide additional/other functions than on mobile device context.

qx.Mobile provides mobile and tablet distinction out of the box. It provides a detection of device type the application runs on.

Based upon this distinction, you can tell our page manager whether it should layout its navigation pages optimized for device class mobile (intended for mobile, 7" tablets), class tablet or device class desktop.

How to get the device type

The device type is accessible by the environment variable `device.type`. It is able to detect 3 classes: `mobile`, `tablet` and `desktop`.

```
var deviceType = qx.core.Environment.get("device.type");
```

Device type mapping table :

The device type is detected by resolving user agent strings. Device class mapping is done by searching a specific hardware class, an operation system or a browser type.

Tablets (returns `tablet`)

- Android Tablet
- iPad
- Blackberry Playbook
- Amazon Kindle
- Silk
- Sony PSP

Mobile (returns `mobile`)

- Android mobile phones
- iPhone
- iPod
- Bada
- Maemo
- Symbian
- Windows Phone
- Opera Mobile
- Fennec

Desktop (returns `desktop`)

- All other devices

How to enable device-based layouting

The device-based layouting is handled by `qx.ui.mobile.page.Manager`. In our examples at mobile playground and the tutorial, we always make usage of this manager to create a qx.Mobile application.

```
var isTablet = false;
var manager = new qx.ui.mobile.page.Manager(isTablet);
var page = new qx.ui.mobile.page.NavigationPage();
manager.addDetail(page);
page.show();
```

The manager has an optional constructor parameter `isTablet`. It indicates whether the page manager uses the mobile or the tablet layouting mode. In this examples, we deactivated tablet layout mode with `isTablet=false`.

If parameter `isTablet` is not defined in the constructor, the page manager always calls environment variable `device.type` to determine the layout mode. Tablet layout mode is active by default, if environment variable is `desktop` or `tablet`.

How the page manager arranges pages

The class `qx.ui.mobile.page.Manager` works with instances of `qx.ui.mobile.page.NavigationPage`. The manager arranges the pages on screen, based on flag `isTablet` and device orientation.

An device/window orientation change is detected by qx.Mobile and fires an `orientationchange` event, which is handled by page manager.

MasterPages and DetailPages

When page manager is on tablet mode, it arranges the NavigationPages in a different order than on mobile mode. For this arrangement it needs to know, whether a NavigationPage is important for the application flow, or not.

For this arrangement logic the instances of `qx.ui.mobile.page.NavigationPage` needs to be added as a MasterPage or a DetailPage.

MasterPages are usually used as navigation. They control the appearance of several DetailPages. A MasterPage should always be visible for controlling the application flow.

DetailPages do contain the content, or more precise: they show the detailed information. It is not necessary for the application flow, that a DetailPage is always visible.

When tablet support is not necessary, every page can be added as a detailPage.

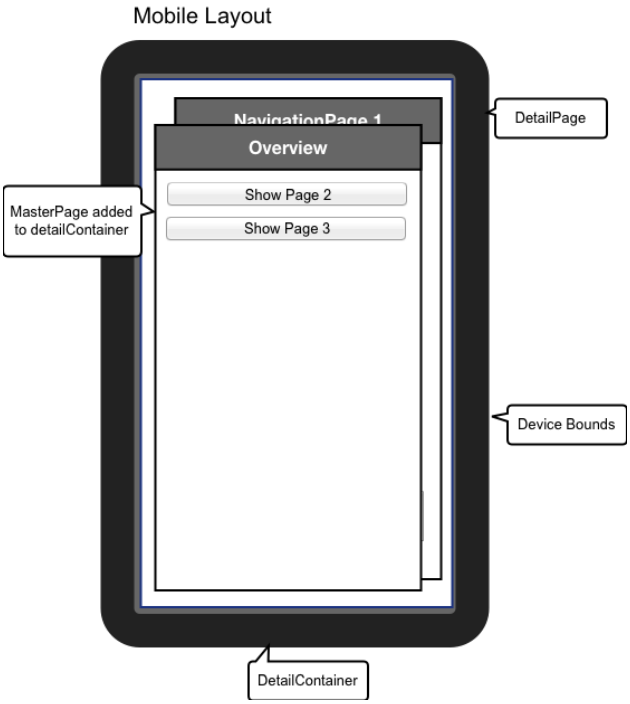
Page manager layout modes

There are 3 different layouting modes, used by `qx.ui.mobile.page.Manager`.

Mobile Layout

Used when `isTablet` of page manager is `false`.

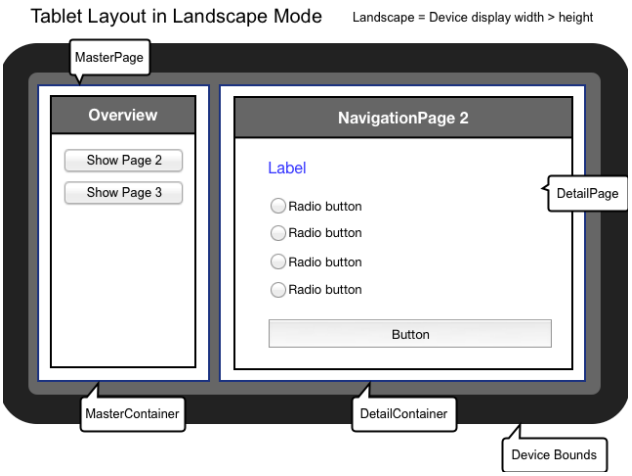
All MasterPages and DetailsPages are added to DetailContainer.



Tablet Landscape Layout

Used when `isTablet` of page manager is `true` and orientation is landscape.

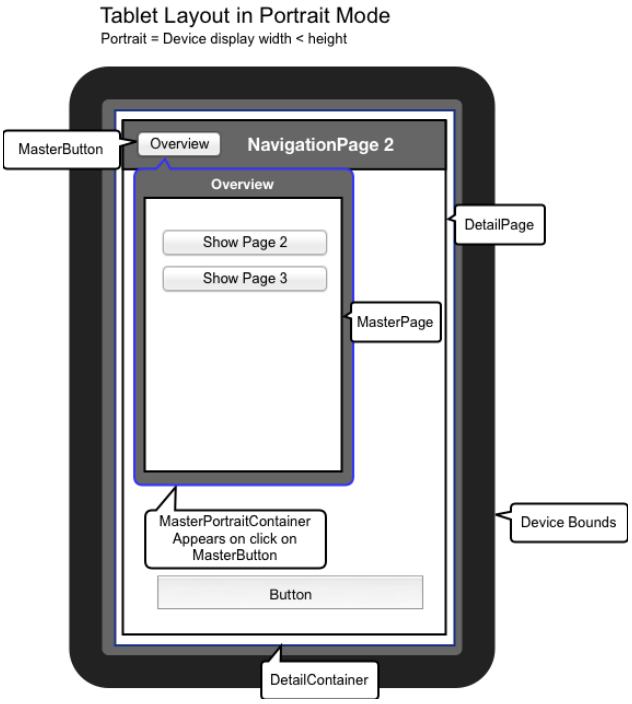
MasterPages are added to `masterContainer`. DetailPages are added to `detailContainer`.



Tablet Portrait Layout

Used when `isTablet` of page manager is `true` and orientation is portrait.

MasterPages are added to a `PortraitMasterContainer`. This container is hidden after orientation change. Visibility of this container can be controlled by MasterButton. The caption of the MasterButton and the title of `PortraitMasterContainer` are bound to show MasterPage's title.



Example for a qx.Mobile application with tablet support

Now, that you gained this knowledge about qx.Mobile tablet support, you surely want to create an application using this feature.

```
var manager = new qx.ui.mobile.page.Manager();
```

```
var masterPage = new qx.ui.mobile.page.NavigationPage();
var detailPage1 = new qx.ui.mobile.page.NavigationPage();
var detailPage2 = new qx.ui.mobile.page.NavigationPage();

manager.addMaster(masterPage);
manager.addDetail([detailPage1,detailPage2]);

masterPage.show();
detailPage1.show();
```

In the example above, we first create a page manager. To this manager we add `masterPage`. You could even add multiple MasterPages.

This MasterPage could be used as a menu or overview page to control visibility of DetailPages. The DetailPages can be added as an array, for convenience.

Finally you have to define which pages are visible at startup.

Page manager does not manage startup visibility, because this gives you full control about the application flow.

5.3.2 Theming

CSS and SCSS

Theming in qooxdoo mobile is done with SCSS. SCSS is an extension for CSS to enable style sheets to be more modular and maintainable. In SCSS you can you use variables, create mixins, import other style files and reuse CSS statements.

Despite our use of SCSS you do not have to be an SCSS expert. The main SCSS parts are maintained by us in the framework. You will usually just need some knowledge of CSS.

If you want to extend or change the qooxdoo mobile themes you should always modify the SCSS files (*.scss) in the folder `<APP_ROOT>/source/resource/<APP_NAMESPACE>/mobile/scss`. After you modified any SCSS files they have to be compiled into CSS, otherwise you will not see any changes.

SCSS Compilation

qx.Mobile comes with a built-in SCSS compiler that can be used to leverage the changes you make to your application's *.scss files. You can either invoke it manually through its `tool/bin/scss.py` frontend, or implicitly by running the `watch-scss` Generator job (see further).

Mind though that this compiler implements roughly version 3.2 of the SCSS language, with some omissions. Some of the issues we have come across are:

- Data URLs get broken across lines.
- The `...` syntax for variable arguments in mixin *calls* is not supported.
- If the first argument to `linear-gradient` is a degree value (like `-45deg`), an error will be printed (but the instruction is processed alright).
- Single quoted strings (i.e. `''`) *aren't preserved!* This means that a rule like

```
div {
  content: 'foo';
}
```

becomes (compressed):

```
div{content:foo}
```

To circumvent this **always** use double quotes:

```
div {
  content: "foo";
}
```

which becomes (compressed):

```
div{content:"foo"}
```

If you like to use one of those features, or want to use newer features of SCSS, you might want to install the SCSS reference implementation which requires a Ruby and RubyGems installation on your machine. You can use the Ruby compiler everywhere you would use the qooxdoo built-in compiler.

Watching SCSS files with qooxdoo's built-in SCSS compiler

Layout design through CSS is typically done by experimentation. You often change a stylesheet and reload the corresponding application to see the effect. Using SCSS you would need to compile the SCSS file after each change of your stylesheet files.

To automatically compile the SCSS files on change/save, you can use the generator *watch-scss* job:

```
./generate.py watch-scss
```

It recognizes any changes made to the SCSS files in your qx.Mobile application and triggers the compilation to CSS automatically.

Watching SCSS files with SASS tool

If you decide to use the official SASS compiler, please follow these steps for watching changes:

1. Switch to `<APP_ROOT>/source/resource/<APP_NAME>/mobile/scss`
2. Start the SASS watching tool with:

```
sass -I <QOOXDOO_PATH>/framework/source/resource/qx/mobile/scss/ --watch .:../css
```

As mentioned before, it needs the official SASS compiler installed on your system.

qx.Mobile Themes

qx.Mobile provides a theme for the iOS platform and one for Android. These themes are not intended to be changed/customized by developers directly, but can be extended.

The third one of our themes is the "Indigo" theme. This theme can be modified by developers in many ways, like setting colors or change the used border radius etc.

Switching themes in your qx.Mobile application

You can change the used theme of your qx.Mobile application by opening the `config.json` in your application root. There you find the macro called `MOBILE_THEME`. You can change the macro to one of the following values:

- `ios`
- `android`

- custom

After changing this macro you have to run the source job in your application's root:

```
./generate.py source
```

Extending the iOS or Android theme

You can add your own CSS rules on top of the iOS or Android theme. Just append your statements to the following file:

```
<APP_ROOT>/source/resource/<APP_NAME>/mobile/css/styles.css
```

Using a custom theme

In the qx.Mobile Showcase you can have a look at our default theme, called "Indigo". You can use and modify this theme in many ways.

For customization, please follow these steps:

1. For enabling the customized theming, you have to change the variable `MOBILE_THEME` in your `<APP_ROOT>/config.json` to `custom`:

   ```
   "MOBILE_THEME" : "custom"
   ```

   After changing the variable please run

   ```
   ./generate.py source
   ```

   once.

2. Now start the SCSS watch job by running

   ```
   ./generate.py watch-scss
   ```

   in your application's root.

3. Have a look in your application's resource folder: `<APP_ROOT>/source/resource/<APP_NAME>/mobile/scss/_sty`

   This is the key file for customizing our default theme to your needs.

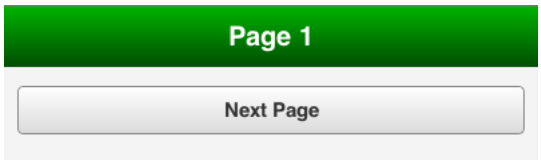
   In `_styles.scss` you find various variables for the customization of your qx.Mobile application. The variables overwrite the default theme "Indigo". Undeclared variables get styled like in the "Indigo" theme.

4. Give it a try: Change the background of the NavigationBar to the color `green`:

   ```
   $navigationbar-background-color: green;
   ```

   Your customized theme is compiled automatically by the SCSS watch job to: `<APP_ROOT>/source/resource/<APP_NAME>/mobile/css/styles.css`

5. Reload your qx.Mobile application and check your changes. It should look like this:

That is all you need to know for customizing the theme of a qx.Mobile app. Try the other SCSS variables of your `_styles.scss`!

Extending the customized theme with SCSS

Additionally to the customization of the variables in `_styles.scss` you can extend the theme with your own CSS rules. In this case you can append your CSS statement to the following file:

`<APP_ROOT>/source/resource/<APP_NAME>/mobile/css/styles.css`

As mentioned before, you do not need to be an expert in SCSS for theming. But if you want to know more about this exciting CSS enhancement technology, please have a look at the SASS website:

- SASS official website

Improving your theming workflow

With these steps you are able to improve the layouting workflow of your qx.Mobile application:

- CSS Auto Reload for Chrome

This plug-in recognizes when a website's CSS has changed and updates the CSS automatically, without a reload of the site. This plug-in works perfectly in combination with our SCSS watch-job.

The result: You just have to change a qx.Mobile's SCSS, save it and the qx.Mobile application in Chrome updates after a few seconds, and keeps the current state of the application.

5.3.3 Handling High Resolution Images

qx.Mobile is able to handle device displays with different pixel densities. The following device pixel ratios are common on mobile devices:

- **iOS**
  - 1
  - 2 ("Retina")
- **Android**
  - 1 (mdpi)
  - 1.5 (hdpi)
  - 2 (xhdpi)
  - 3 (xxhdpi)

When you use `qx.ui.mobile.basic.Image` and qx.Mobile detects that your app is running on a device with a device pixel ratio greater than 1, the app searches for images in a high resolution.

The high resolution images are assumed to be located in the same folder as the medium resolution image, but annotated with the pixel ratio before the file extension:

`<filename>@<devicePixelRatio>.<fileextension>`

Example

Assume the following medium resolution image (mdpi) is part of your project's resources: `source/resource/<APP_NAME>/icon/image.png`

Its higher pixel ratio versions are to be put into the same folder as the regular image and be named accordingly:

- hdpi: `image@1.5x.png`

- xhdpi: `image@2x.png`
- xxhdpi: `image@3x.png`

Fallback

For the best visual result qx.Mobile uses this fallback logic:

1. The logic first checks if there is an image available with the pixel ratio the environment variable `device.pixelRatio` returns.
2. If no image is available it checks the pixel ratio versions in the following order:

`@3x`, `@2x`, `@1.5x`

3. If there is no high resolution image available, the medium resolution image will be shown.

5.3.4 Debugging

Debugging with desktop browsers

You can easily debug your qooxdoo mobile applications on your machine, by using desktop browsers like Safari, Chrome or Mozilla Firefox. In case of webkit browser you have to open the pre-installed developer tools. In Firefox you must have installed the add-on "Firebug".

Remote debugging iOS6 devices with Safari

A comfortable way to debug your qx.Mobile application is provided by Apple Safari 6.0 with an iOS6 device.

Have a look at the official tutorial at Safari Developer Library:

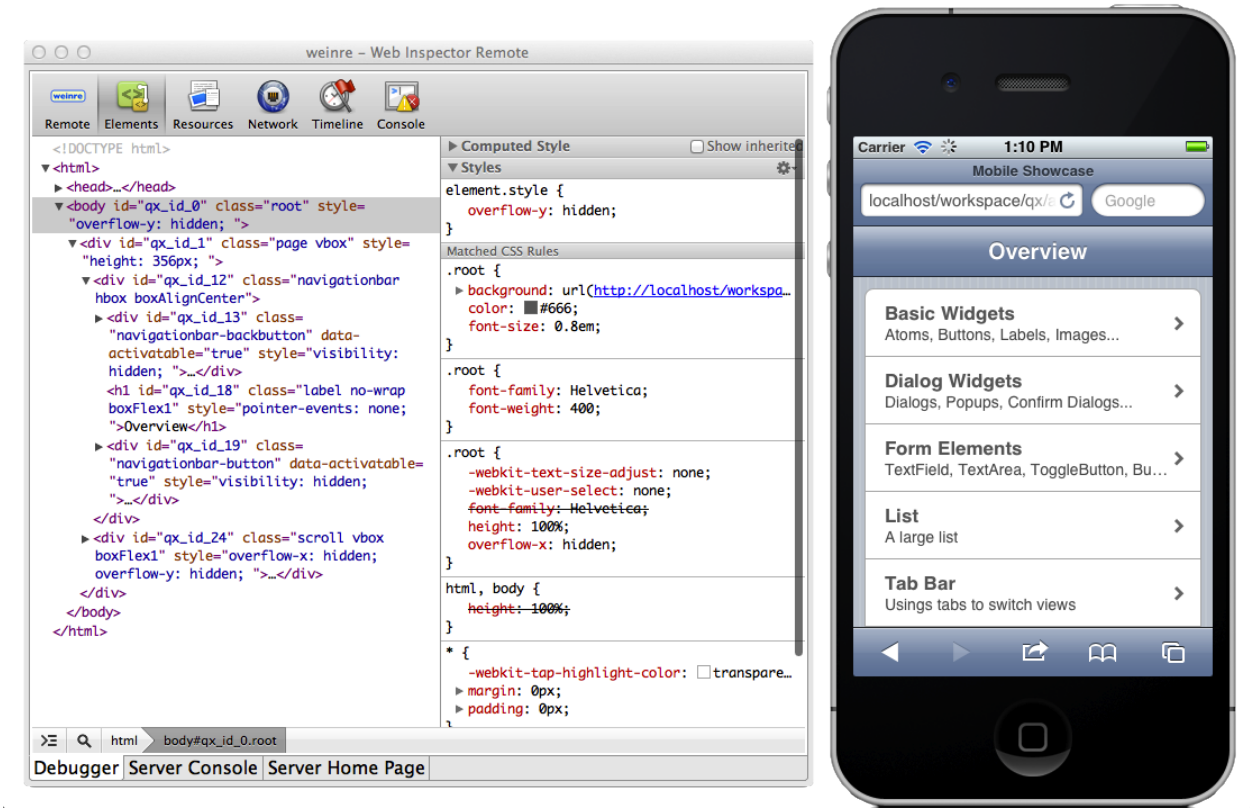
Debugging iOS6 devices

Remote debugging with weinre

Sometimes there are errors, that only occur on the mobile device. Debugging CSS or runtime-specific JS code can be challenging, if the application is running in the mobile browser or is deployed as a native app via PhoneGap.

If you want to debug your qooxdoo mobile application on a mobile device, we propose using a web remote debugger called "weinre":

weinre - Web Inspector Remote



Remote debugging allows a developer to use the browsers developer tools from a desktop computer while inspecting and manipulating the website on the mobile device.

Here are some hints for enabling remote debugging on your qooxdoo mobile application with weinre:

- Install weinre according to the weinre manual. Create a server.properties file, and change the port number to 8081 or similar.
- Add the following script tag to the index.html in your qooxdoo mobile application:

```
<script src="http://[ENTER_YOUR_HOST_IP_HERE]:8081/target/target-script-min.js"></scri
```

- Replace ip placeholder with your desktop computer ip on your “index.html”.
- Start weinre.
- Call your qooxdoo mobile application from your mobile device.

Important: Please make sure, not having the character “#”, behind the “index.html” on your url. Weinre uses debug ids, which are appended after the target url, just like *”..qooxdoo/foo/../index.html#anonymous”*. On mac computers “anonymous” is the default debug id. Any other debug id, results in a disconnect of target mobile device.

Unfortunately, there is a clash with qooxdoo mobile navigation logic. Qooxdoo navigation manager uses also the number sign, for navigating through pages:

”../mobileshowcase/source/index.html#/form”

So, if you navigate to a subpage with qooxdoo, and reload the page, weinre interprets *“#/form”* as the debug id *“/form”*. On mac computers, only “anonymous” is allowed, so the target device disconnects from debug server.

This means, debugging with weinre works fine, as long as you do not reload a subpage of your qooxdoo mobile page. Your starting point for remote debugging should always be the “index.html” without any strings attached.

Using browser instead of weinre client

Instead of using the weinre debug client, you can also use your webkit desktop browser (Safari or Chrome) for remote debugging.

The newest versions of webkit browsers and their debuggers might have more functions than the weinre debug client.

Just open the weinre debugging client with following URL:

```
http://localhost:8081/client/
```

5.4 Deployment

5.4.1 Deployment

Deploy your qx.Mobile application

You developed a great qx.Mobile application, and want to use or test it on your mobile device.

For this purpose, we propose using Apache Cordova.

It gives you the possibility to deploy native applications, that run the qooxdoo mobile JavaScript code in an wrapped native browser directly on your mobile device. Mobile applications, created with "Apache Cordova", can be published to the various App Stores and Marketplaces. A free distribution of Cordova is also available, it is called "PhoneGap".

On the Cordova website you find detailed tutorials which describe the deployment on different mobile platforms:

Cordova Getting Started Tutorial

Configure Cordova for deploying your qx.Mobile application

After you installed cordova, and followed the introductions of Cordova Getting Started Tutorial, you are able to deploy your qx.Mobile application on your mobile device.

Follow these steps:

1. Build your application with `generate.py build`.
2. Duplicate content of your qx.Mobile build folder, into Cordova deploy folder `assets/www` including the `index.html`.
3. Paste the following line in head part of `assets/www/index.html`:

   ```
   <script type="text/javascript" charset="utf-8" src="cordova-1.6.0.js"></script>
   ```

4. Cross-check the version of the "cordova.js" in script tag, against the version you use.

That should do the trick. Now Cordova can deploy your qx.Mobile application on the connected Mobile Device. For executing the deployment, have a look on Cordova Getting Started Tutorial.

Update application on your mobile device

If you want to update your qx.Mobile application, you just have to copy the folders `resource` and `script` into Cordova's deploy folder `assets/www/`. An update of the `assets/www/index.html` is not necessary.

CHAPTER

SIX

QX.SERVER

qooxdoo qx.Server is a basic component that runs in many different contexts and environments, with very little dependencies to the underlying runtime. It is suitable for development endeavors in environments that provide no DOM, like Node.js and Rhino, but also HTML5 Webworkers. It offers the basic infrastructure of *qooxdoo Core*, so you can e.g. create classes, interfaces and mixins, use properties and data binding.

6.1 Server Overview

This page is an overview of qooxdoo's server capabilities. It shows which parts of qooxdoo can be used in a server environment or comparable scenario. It also serves as an introduction to all interested in using qooxdoo on a JavaScript server environment.

6.1.1 Included Features

This listing shows the core features of the *qooxdoo qx.Server* package. If you build your own package with the skeleton way of using qooxdoo, the feature set might be extended depending on your application code.

- *Object Orientation*
  - *Classes*
  - *Mixins*
  - *Interfaces*
  - *Properties*
- *Events*
- *Single Value Binding*

Most of the features can be found in qooxdoo's core layer and should be familiar to qooxdoo developers.

6.1.2 Supported Runtimes

We currently support two types of runtimes:

- node.js
- Rhino

6.1.3 Installation

See *Requirements* for details on how to obtain and install qooxdoo qx.Server.

6.1.4 Basic Example

The following example shows how to use the *qooxdoo qx.Server* package in a node environment, having installed the package via npm.

```
var qx = require('qooxdoo');

// create anmial class
qx.Class.define("my.Animal", {
  extend : qx.core.Object,
  properties : {
    legs : {init: 4}
  }
});

// create dog class
qx.Class.define("my.Dog", {
  extend : my.Animal,
  members : {
    bark : function() {
      console.log("ARF! I have " + this.getLegs() + " legs!");
    }
  }
});

var dog = new my.Dog();
dog.bark();
```

Only two lines in this example are specific to the server environment: The first one, where you include the qooxdoo package and the implementation of the `bark` function, which uses node's `console` object. To run the example in Rhino, simply change the first line to something like this:

```
load(["path/to/qx-oo-3.0.js"]);
```

and replace `console.log` with `print`.

The rest of the code is plain qooxdoo-style JavaScript which can be run in a browser, too. For more information on that topic, take a look at the documentation about *Object Orientation*.

6.1.5 Additional Scenarios

The *qooxdoo qx.Server* package does not contain any server-dependent code so it can also be used in a browser e.g. to have the features described above without the need to use the rest of qooxdoo. Another interesting scenario might be to use the package in a web worker, which is also a DOM-less environment.

6.2 qx.Server Requirements

qooxdoo qx.Server is a basic component that runs in many different contexts and environments, as it has very little dependencies to the underlying runtime. For use in command-line tools and programs you will need a corresponding

JavaScript interpreter like Node.js or Mozilla Rhino. For use in HTML5 Web Workers you will need a browser that supports this technology.

6.2.1 Runtimes

The following runtimes are supported:

- Node.js
- Rhino

6.2.2 Installation

These are the options to get qooxdoo qx.Server.

Manual download

Download the qx.Server component from qooxdoo's download page and place it in a suitable path on your machine. Optimized and non-optimized versions are available.

Npm

If you are using Node.js, there is an alternative installation using npm, the Node package manager. If you have this installed, issue on your system shell:

```
$ npm install qooxdoo
```

This will install the qooxdoo package into your current folder from where you can include it easily into your applications.

In both cases, to verify the installation use your runtime's loading primitive to include it in a program, e.g. for Node:

```
var qx = require('qooxdoo')
```

SDK

You can also use the *SDK* to work with qx.Server. It provides a dedicated *skeleton* which you can utilize. This offers you additional features like dependency detection, optimization, API doc generation, unit testing and generated loaders that work under both Node.js and Rhino. As with all types of qooxdoo skeletons, `create-application.py` is used to create a new custom application:

```
$ qooxdoo-3.0-sdk/tool/bin/create-application.py --name=myapp --type=basic
```

6.3 RequireJS Support

Note: experimental

It is possible to use the generator to build a RequireJS compatible library using qooxdoo. Here is the description of RequireJS taken from the project's website:

> "RequireJS is a JavaScript file and module loader. It is optimized for in-browser use, but it can be used in other JavaScript environments, like Rhino and Node. Using a modular script loader like RequireJS will improve the speed and quality of your code."
>
> —http://requirejs.org/

A couple of steps are necessary to accomplish this:

- You need a class which represents the common interface you want to offer as a require.js module
- and a customized generator config file to build your library.

6.3.1 Representable interface

Let's assume you've implemented a class like the following:

```
qx.Bootstrap.define("my.super.Dog", {
  extend : Object,
  members : {
    bark : function() {
      alert("BARK!");
    }
  }
});
```

You want to export this class as a module usable with RequireJS. Usage could look something like this:

```
require("dog.js", function(dog) {
  dog.bark();
});
```

That's all you need to take care of on the JavaScript side.

6.3.2 Config file

There is some more work to be done on the config side (this might change at some point). Here is a sample config:

```
{
  "let" :
  {
    "APPLICATION"  : "library",
    "QOOXDOO_PATH" : "../..",
  },

    "build" :
    {
      "library" : [{
        "manifest" : "${QOOXDOO_PATH}/framework/Manifest.json"
      }],

      "include" : [
        "my.super.Dog"
      ],

      "environment" : {
        "qx.export" : {"dog" : "my.super.Dog"}
      },
```

```
      "compile-options" :
      {
        "paths" :
        {
          "file" : "dog.js",
          "app-root" : ".",
          "loader-template" : "${QOOXDOO_PATH}/tool/data/generator/require.loader.tmpl.js"
        },
        "uris" :
        {
          "script"   : ".",
          "resource" : "."
        },
        "code" :
        {
          "format"   : true,
          "optimize" : [ "variants", "base", "string", "privates", "variables" ],
          "except"   : []
        }
      },

      "compile" : { "type" : "build" }
    }
  }
}
```

We won't go much into detail here because most of this is covered by the *Generator Config Keys* page and others. But there are two things you should be aware of. First, a new loader template is set for the compile step. There's a special loader template for RequireJS which uses the other important thing: The `qx.export` environment key. It holds a map specifying which class should be exported as a module. Running the `build` job will then generate a RequireJS-compatible file named `dog.js` which exposes the `dog` class as a module.

CHAPTER

SEVEN

COMMUNICATION

Sending HTTP requests and receiving responses is an important feature of almost every application running in the browser. Most commonly, the technique used is termed Ajax. qooxdoo's communication stack offers many ways to facilitate HTTP communication at different levels of abstraction.

7.1 Low-level requests

At the very core, HTTP requests from the browser are made by interfacing with the HTTP client API or by adding a script tag to the document. Classes dealing with those low-level transport methods can be found in the `qx.bom.request` namespace. Usually they are not instantiated directly by the user.

`Xhr` is a wrapper of the HTTP client API offered by the browser. It's purpose is to hide inconsistencies and to work around bugs found in popular implementations. The interface of `qx.bom.request.Xhr` is similar to XMLHttpRequest, the HTTP client API specified by the W3C.

`Script` is a script loader. Internally, the class deals with adding and removing script tags to the document and keeping track of the load status. Just like `qx.bom.request.Xhr`, the interface is modeled based on XMLHttpRequest.

`Jsonp` builds on the script loader and adds functionality needed to receive JSONP responses. JSONP stands for JSON with padding and is a technique to safely receive remote data. It's main advantage compared to to `Xhr` is that cross-origin requests are supported in all browsers.

7.2 Higher-level requests

Classes found in `qx.io.request` build on the groundwork laid by `qx.bom.request`. Properties allow to conveniently setup a request and fine-grained events facilitate handling changes of the request's status or response.

7.2.1 Higher-level requests

Choosing an appropriate transport

qooxdoo ships with two transport methods, interfaced by `qx.io.request.Xhr` and `qx.io.request.Jsonp`.

- Choose `Xhr` whenever you can. `Xhr` offers true HTTP client functionality and exposes metadata associated with HTTP requests. It is agnostic of the data interchange format and does not make any specific demands on the backend.

- If you are making cross-origin requests and need to support all popular browsers and/or the target server is not configured to accept cross-origin request (`Access-Control-Allow-Origin` header), you will need to use `Jsonp`. Only JSON is supported as data interchange format and the server needs to wrap responses in a JavaScript function call.

`Xhr` and `Jsonp` share a common interface. `AbstractRequest` defines the lowest common denominator of both transport methods.

Basic Setup

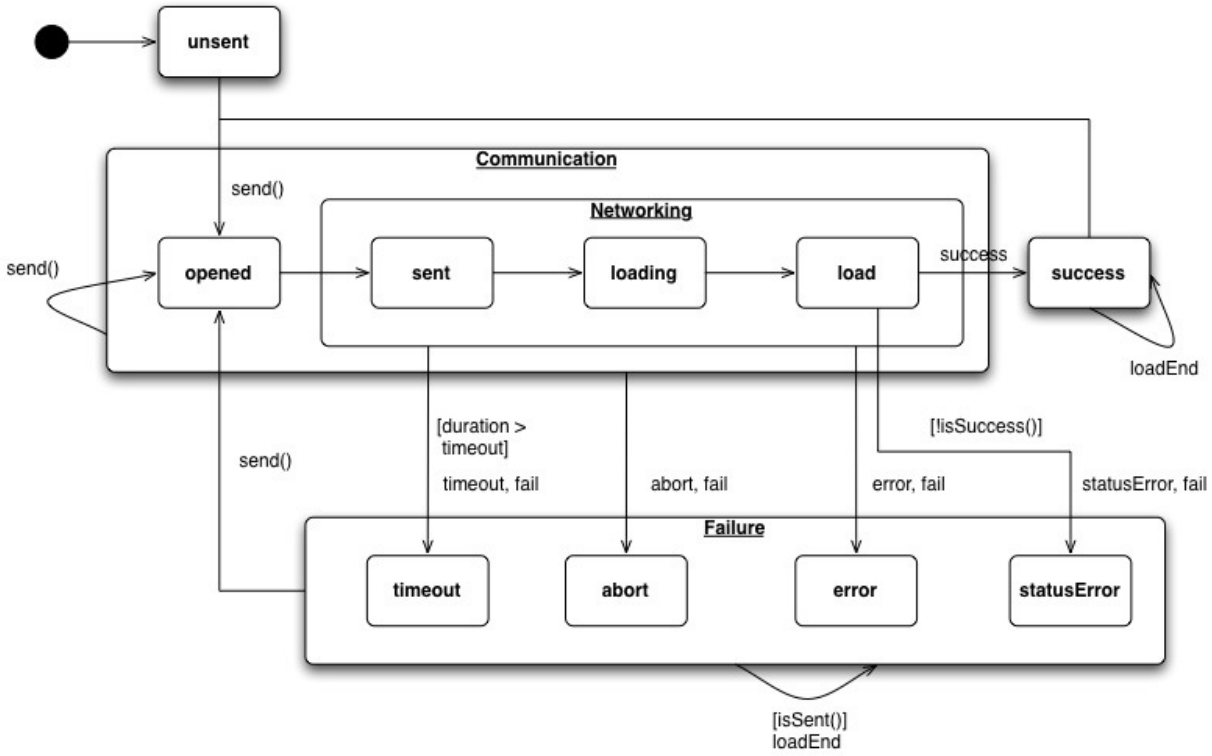
Before a request can be send, it must be configured. Configuration is accomplished by setting properties. The most commonly used properties include:

- **url**: The HTTP resource to request
- **method**: The HTTP method, sometimes also referred to as HTTP verb. `Script` only accepts the `GET` method.
- **requestData**: Data to be send as part of the request.
- **requestHeaders**: Headers to send with the request

For a complete list of properties, please refer to the API Documentation of qx.io.request:

```
// Instantiate request
var req = new qx.io.request.Xhr();

// Set URL (mandatory)
req.setUrl("/books");

// Set method (defaults to GET)
req.setMethod("POST");

// Alternative notation
// var req = new qx.io.request.Xhr("/books", "POST");

// Set request data. Accepts String, Map
// or qooxdoo Object.
req.setRequestData({"title": "The title"});

// Send request
req.send();
```

Events and states



Once a request is sent using the `send()` method, it traverses various states. There are two ways to query the current state of the request.

- **getReadyState()**: An integer (0-4) representing UNSENT, OPENED, HEADERS_RECEIVED, LOADING and DONE.
- **getPhase()**: Symbolic state mapping to deterministic events (success, abort, timeout, statusError) and intermediate readyStates.

Events are fired when the request is progressing from one state to the other. The most important events in the lifecycle of a request include:

- **load**: Request completed successfully.
- **success**: Request completed successfully (like `load`) *and* the response can be expected to contain the kind of data requested. For `Xhr` this means the HTTP status of the response indicates success (e.g. `200`). For `Jsonp`, the script received executed the expected callback.
- **statusError**: Request completed successfully (like `load`) *but* the additional requirements for `success` are not met. For `Xhr` this event is typically fired when the server reports that an erroneous or unknown resource was requested (e.g. `500` or `404`). For `Jsonp`, this event is associated with an invalid response for whatever reasons.
- **fail**: Any kind of error occurred. Catches distinct events `error`, `statusError` and `timeout`.

For a complete list of events, please refer to the API Documentation of qx.io.request:

```
req.addListener("success", function(e) {
  var req = e.getTarget();
  var response = req.getResponse();
  this.doSomething(response);
```

```
}, this);

// Send request
req.send();
```

Response

Once the request completed, a range of getters return details about the response.

- **getResponse()**: Response processed according to parser settings or content type (`Xhr`). Always JSON for (`Jsonp`).
- **getStatus()**: The numerical status of the response. For `Xhr` the status is the HTTP status. `Jsonp` only knows `200` (when callback was executed) and `500` (when it was not).

Authentication

There are two ways to handle authentication. The lower-level approach is to manually set the adequate request headers. The high-level, recommended way is to assign the `authentication` property an instance of a class that implements the `IAuthentication` interface. This class defines the necessary request headers and can handle the authentication logic. `Basic` implements the most basic kind of authentication (HTTP Basic) and serves as an example for more advanced authentication methods.

Data binding

The request's response can be bound to a widget, model or any other object using data binding. This feature is provided by the `changeResponse` event, fired on change of the (parsed) response.

```
// Bind response to value of a label
//
// req is an instance of qx.io.request.*,
// label an instance of qx.ui.basic.Label
req.bind("response", label, "value");
```

Debugging

If you encounter odd behavior, it might help to enable debugging of the IO classes. Debugging is controlled with the `qx.debug.io` setting. Provided you have allowed URL settings (`allowUrlSetting`), you can simply append `?qxenv:qx.debug.io:true` to the URL of your application.

Specific to XHR

Features specific to `Xhr`.

Parsing

By default, `response` is populated with the response parsed according to the response content type. For the built-in parsers, parsing always results in a JavaScript object.

The content type is read from `Content-Type` response header. If the response content type is unrecognized, no parsing is done and `response` equals `responseText`. Parsers associated to a content type are:

- **JSON**: application/json
- **XML**: application/xml

The parser can be explicitly set with `setParser()`. This can be useful if the content type returned from the server is wrong or the response needs special parsing. The setter accepts either a symbolic string (`"json"` or `"xml"`) or a function. If a function is given, this function is called once the request completes. It receives the raw response as first argument. The return value determines the `response`.

Response

- **getResponseText()**: Raw, unprocessed response
- **getResponseHeader(header)**
- **getAllResponseHeaders()**

Accepting

Some servers send distinct *representations* of the same resource depending on the content type accepted. For instance, a server may respond with either a JSON, XML or a HTML representation while requesting the *same* URL. By default, requests accept every content type. In effect, the server will respond with it's default representation. If the server has no default representation, it may respond with the status code `406` (Not Acceptable).

In order to choose a representation, set the accepted response content type with `setAccept()`. It is a good practice to always set the preferred representation to guard against possible changes of the server's default behavior.

For more details, see Accept header in the HTTP 1.1 specification.

Caching

Usually, one or more caches sit between the browser sending the request and the server answering the request. The most important cache is arguably the browser cache, which is enabled by default in all modern browsers. Other caches include various kinds of proxy servers. Understanding caches is vital to reduce latency and save bandwidth. However, a detailed introduction of HTTP caching is beyond the scope of this section. For more information, refer to the Caching tutorial.

To control the behavior of caches on the client-side, a number of HTTP Cache-Control directives can be sent as part of the request by setting the `cache` property. To circumvent caching, a common trick is to add a random string to the URL's query part. This is accomplished by setting `cache` to `false`.

Specific to JSON

Features specific to `Jsonp`.

Callback

Callback handling is done behind the scenes but can be customized. If the service only accepts a special callback parameter to read the desired callback function name from, this parameter can be set with `setCallbackParam()`. Some services do not allow custom callback names at all. In this case, `setCallbackName()` wires the request to the fixed callback name.

Caching

No Cache-Control directives can be set, but caching can be disabled by setting `cache` to `false`. Works by adding a random string to the URL's query part.

Note that historically, qooxdoo comes with two transport layers. The old transport layer is described below.

7.2.2 AJAX

Note: *qx.io.remote.Request* will be deprecated in a future release. Use *qx.io.request.Xhr* instead.

This system is (as everything else in qooxdoo) completely event based. It currently supports communication by **XMLHttp**, **Iframes** or **Script**. The system wraps most of the differences between the implementations and unifies them for the user/developer.

For all your communication needs you need to create a new instance of Request:

```
var req = new qx.io.remote.Request(url, "GET", "text/plain");
```

Constructor arguments of Request:

1. URL: Any valid http/https/file URL
2. Method: You can choose between POST and GET.
3. Response mimetype: What mimetype do you await as response

Mimetypes supported

- application/xml
- text/plain
- text/html
- text/javascript
- application/json

Note: `text/javascript` and `application/json` will be directly evaluated. As content you will get the return value.

If you use the iframe transport implementation the functionality of the type is more dependent on the server side response than for the XMLHttp case. For example the text/html mimetypes really need the response in HTML and can't convert it. This also depends greatly on the mimetype sent out by the server.

Request data

- `setRequestHeader(key, value)`: Setup a request header to send.
- `getRequestHeader(key)`: Returns the configured value of the request header.
- `setParameter(key, value)`: Add a parameter to send with your request.
- `getParameter(key)`: Returns the value of the given parameter.
- `setData(value)`: Sets the data which should be sent with the request (only useful for POST)

- `getData()`: Returns the data currently set for the request

Note: Parameters are always sent as part of the URL, even if you select POST. If you select POST, use the setData method to set the data for the request body.

Request configuration (properties)

- `asynchronous`: Should the request be asynchronous? This is `true` by default. Otherwise it will stop the script execution until the response was received.
- `data`: Data to send with the request. Only used for POST requests. This is the actual post data. Generally this is a string of url-encoded key-value pairs.
- `username`: The user name to authorize for the server. Configure this to enable authentication.
- `password`: The password to authenticate for the server.
- `timeout`: Configure the timeout in milliseconds of each request. After this timeout the request will be automatically canceled.
- `prohibitCaching`: Add a random numeric key-value pair to the url to securely prohibit caching in IE. Enabled by default.
- `crossDomain`: Enable/disable cross-domain transfers. This is `false` by default. If you need to acquire data from a server of a different domain you would need to setup this as `true`. (**Caution:** this would switch to "script" transport, which is a security risk as you evaluate code from an external source. Please understand the security issues involved.)
- `fileUpload`: Indicate that the request will be used for a file upload. The request will be used for a file upload. This switches the concrete implementation that is used for sending the request from `qx.io.remote.transport.XmlHttp` to `qx.io.remote.IFrameTransport`, because only the latter can handle file uploads.

Available events

- `sending`: Request was configured and is sending data to the server.
- `receiving`: The client receives the response of the server.
- `completed`: The request was executed successfully.
- `failed`: The request failed through some reason.
- `timeout`: The request has got a timeout event.
- `aborted`: The request was aborted.

The last four events give you a `qx.event.type.Data` as the first parameter of the event handler. As always for `qx.event.type.Data` you can access the stored data using `getData()`. The return value of this function is an instance of `qx.io.remote.Response`.

Response object

The response object `qx.io.remote.Response` stores all the returning data of a `qx.io.remote.Request`. This object comes with the following methods:

- `getContent`: Returns the content data of the response. This should be the type of content you acquired using the request.

- `getResponseHeader`: Returns the content of the given header entry.
- `getResponseHeaders`: Return all available response headers. This is a hash-map using typical key-values pairs.
- `getStatusCode`: Returns the HTTP status code.

Note: Response headers and status code information are not supported for iframe based communication!

Simple example

```
// get text from the server
req = new qx.io.remote.Request(val.getLabel(), "GET", "text/plain");
// request a javascript file from the server
// req = new qx.io.remote.Request(val.getLabel(), "GET", "text/javascript");

// Switching to POST
// req.setMethod("POST");
// req.setRequestHeader("Content-Type", "application/x-www-form-urlencoded");

// Adding parameters - will be added to the URL
// req.setParameter("test1", "value1");
// req.setParameter("test2", "value2");

// Adding data to the request body
// req.setData("foobar");

// Force to testing iframe implementation
// req.setCrossDomain(true);

req.addListener("completed", function(e) {
  alert(e.getContent());
  // use the following for qooxdoo versions <= 0.6.7:
  // alert(e.getData().getContent());
});

// Sending
req.send();
```

Please post questions to our mailinglist.

7.3 REST

`qx.io.rest.Resource` is a client-side wrapper of a REST resource.

7.3.1 REST (Representational State Transfer)

`qx.io.rest.Resource` allows to encapsulate the specifics of a REST interface. Rather than requesting URLs with a specific HTTP method manually, a resource representing the remote resource is instantiated and **actions** are invoked on this resource. A resource with its actions can be configured declaratively or programmatically.

Note: When to use `qx.bom.rest.Resource`? Mostly `qx.io.rest.Resource` delegates to `qx.bom.rest.Resource` and adds some features on top. For **qx.Desktop** apps you probably want to use

`qx.io.rest.Resource` but when developing an app/website with **qx.Website** only `qx.bom.rest.Resource` is available (i.e. exposed as website module).

See the package description for a detailed comparison: qx.bom.rest .

Configuring actions

Given a REST-like interface with URLs that comply to the following pattern.

```
GET      /photo/{id}
PUT      /photo/{id}
DELETE   /photo/{id}

GET      /photos
POST     /photos
```

Note `{id}` stands for a placeholder.

This interface comprises of two resources: `photo` and `photos`.

To declare the specifics of the REST interface declaratively, pass a description to the constructor.

```
// Singular resource
var photo = new qx.io.rest.Resource({
  // Retrieve photo
  get: {
   method: "GET",
   url: "/photo/{id}"
  },

  // Update photo
  put: {
    method: "POST",
    url: "/photo/{id}"
  },

  // Delete photo
  del: {
    method: "DELETE",
    url: "/photo/{id}"
  }
});

// Plural resource
var photos = new qx.io.rest.Resource({
  // Retrieve list of photos
  get: {
   method: "GET",
   url: "/photos"
  },

  // Create photo
  post: {
    method: "POST",
    url: "/photos"
  }
});
```

Or programmatically, for each action.

```
var photo = new qx.io.rest.Resource();
photo.map("get", "GET", "/photo/{id}");
```

Invoking actions

Once configured, actions can be invoked. They are invoked by calling a method that is dynamically added to the resource on configuration of the action.

```
photo.get({id: 1});
// Alternatively: photo.invoke("get", {id: 1});
// --> GET /photo/1

photos.get();
// Alternatively: photos.invoke("get");
// --> GET /photos
```

When an action is invoked, an appropriate request is configured and send automatically.

Parameters

If the URL contains parameters, the position where the parameters should be inserted can be specified by using URI templates. Parameters are optional unless a check is defined. A default value can be provided.

```
var photo = new qx.io.rest.Resource();
photo.map("get", "GET", "/photo/{id}/{size=medium}", {id:  qx.io.rest.Resource.REQUIRED});

photo.get({id: 1, size: "large"});
// --> GET /photo/1/large

photo.get({id: 1});
// --> GET /photo/1/medium

photo.get();
// --> Error: Missing parameter 'id'
```

Data

Data that should be included in the request's body can be given as second parameter. All types accepted by qx.io.request.AbstractRequest#requestData are supported.

```
photo.put({id: 1}, {title: "Monkey"}); // URL encoded
photo.put({id: 1}, "title=monkey"); // Raw
```

Note that the behavior changes when the request body content type is switched to `application/json`.

```
photos.configureRequest(function(req) {
  req.setRequestHeader("Content-Type", "application/json");
});

photos.map("post", "POST", "/photos/{id}");
photos.post({id: 1}, {location: "Karlsruhe"}); // JSON.stringify
```

Events

Events are fired by the resource when the request was successful or any kind of error occurred. There are general resource events and action specific events. Handlers receive a `qx.event.type.Rest` event that, among other properties, includes the response.

```
photo.get({id: 1});
photo.put({id: 1});

// "success" is fired when any request associated to resource receives a response
photos.addListener("success", function(e) {
  e.getAction();
  // --> "get" or "put"
});

// "getSuccess" is fired when the request associated to the get action receives a response
photos.addListener("getSuccess", function(e) {
  e.getAction();
  // --> "get"
});
```

If the same action should be invoked multiple times and the events fired for each request be handled differently, it is possible to remember the id of the action's invocation. The `Rest` event includes this id.

```
var getPhotoId = photo.get({id: 1});
var getLargePhotoId = photo.get({id: 1, size: "large"});
photo.addListener("getSuccess", function(e) {
  if (e.getId() === getLargePhotoId) {
    // Handle large photo
  }
});
```

Helpers

Helpers make it easy to accomplish common tasks when working with requests.

- **refresh(action)** Resend request associated to action. Uses parameters given before.
- **poll(action, params)** Periodically invoke action.
- **longPoll(action)** Use Ajax long-polling to update whenever new data is available.

Data binding

A `qx.data.store.Rest` store can be attached to an action. Whenever a response is received, the model property of the store is updated with the marshaled response.

```
var store = new qx.data.store.Rest(photos, "get");
var list = new qx.ui.form.List();
var controller = new qx.data.controller.List(null, list);
store.bind("model", controller, "model");
photos.longPoll("get");
```

7.4 Remote Procedure Calls (RPC)

7.4.1 RPC (Remote Procedure Call)

qooxdoo includes an advanced RPC mechanism for direct calls to server-side methods. It allows you to write true client/server applications without having to worry about the communication details.

The qooxdoo RPC is based on JSON-RPC as the serialization and method call protocol, and qooxdoo provides server backends for Java, PHP, and Perl projects. A Python backend library is also provided by a third party. All parameters and return values are automatically converted between JavaScript and the server-side language.

JSON-RPC Protocol

According to JSON-RPC (Wikipedia) "[JSON-RPC] is a very simple protocol (and very similar to XML-RPC), defining only a handful of data types and commands. In contrast to XML-RPC or SOAP, it allows for bidirectional communication between the service and the client, treating each more like peers and allowing peers to call one another or send notifications to one another. It also allows multiple calls to be sent to a peer which may be answered out of order." The current servers do not yet support bi-directional communication.

Setup

To make use of the RPC, you need to set up a server backend first.

Configuration of each server backend needs slightly different treatment. Please see the backend relevant to you.

Your favorite language is missing? Feel free to write your own qooxdoo RPC server, consult the *RPC Server Writer Guide* for details.

Making remote calls

Basic call syntax

To make remote calls, you need to create an instance of the Rpc class:

```
var rpc = new qx.io.remote.Rpc(
    "http://localhost:8080/qooxdoo/.qxrpc",
    "qooxdoo.test"
);
```

The first parameter is the URL of the backend (in this example a Java backend on localhost). The second is the name of the service you'd like to call. In Java, this is the fully qualified name of a class. (The Java backend includes the `qooxdoo.test` service used in the example. The class name is lowercase to keep it in sync with the PHP examples - in Java-only projects, you would of course use standard Java naming conventions.)

When you have the Rpc instance, you can make synchronous and asynchronous calls:

```
// synchronous call
try {
    var result = rpc.callSync("echo", "Test");
    alert("Result of sync call: " + result);
} catch (exc) {
    alert("Exception during sync call: " + exc);
}
```

```
// asynchronous call
var handler = function(result, exc) {
    if (exc == null) {
        alert("Result of async call: " + result);
    } else {
        alert("Exception during async call: " + exc);
    }
};
rpc.callAsync(handler, "echo", "Test");
```

For synchronous calls, the first parameter is the method name. After that, one or more parameters for this method may follow (in this case, a single string). Please note that synchronous calls typically block the browser UI until the result arrives, so they should only be used sparingly (if at all)!

Asynchronous calls work similarly. The only difference is an additional first parameter that specifies a handler function. This function is called when the result of the method call is available or when an exception occurred.

You can also use qooxdoo event listeners for asynchronous calls - just use `callAsyncListeners` instead of `callAsync`. More details can be found in the API documentation.

One difference between the qooxdoo RPC and other RPC implementations are client stubs. These are small wrapper classes that provide the same methods as the corresponding server classes, so they can be called like ordinary JavaScript methods. In qooxdoo, there are no such stubs by default, so you have to provide the method name as a string. The advantage is that there's no additional build step for generating stubs, and it's also not necessary to "register" your server classes at runtime (which would be a prerequisite for dynamic stub generation). If you really want or need client stubs, you currently have to write the stubs (or a generator for them) yourself. Future qooxdoo versions may include such a generator.

Parameter and result conversion

All method parameters and result values are automatically converted to and from the backend language. Using the Java backend, you can even have overloaded methods, and the correct one will be picked based on the provided parameters.

The following table lists the data types supported by the Java backend and the corresponding JavaScript types:

Java type	JavaScript type
int, long, double, Integer, Long, Double	number
boolean, Boolean	boolean
String	String
java.util.Date	Date
Array (of any of the supported types)	Array
java.util.Map	Object
JavaBean	Object

The first few cases are quite simple, but the last two need some more explanation. If a Java method expects a `java.util.Map`, you can send any JavaScript object to it. All properties of the object are converted to Java and become members of the Java Map. When a Map is used as a return value, it's converted to a JavaScript object in a similar way: A new object is created, and then all key/value pairs in the map are converted themselves and then added as properties to this object. (Please note that "properties" is used here in the native JavaScript sense, not in the sense of *qooxdoo properties*.)

JavaBeans are converted in a similar way. The properties of the JavaBean become JavaScript properties and vice versa. If a JavaScript object contains properties for which no corresponding setters exist in the JavaBean, they are ignored.

For performance reasons, recursive conversion of JavaBeans and Maps is performed without checking for cycles! If there's a reference cycle somewhere, you end up with a StackOverflowException. The same is true when you try to send a JavaScript object to the server: If it (indirectly) references itself, you get a recursion error in the browser.

Besides the fully-automatic conversions, there's also a class hinting mechanism. You can use it in case you need to send a specific sub-class to the server (see below for details). However, it can't be used to instantiate classes without a default constructor yet. Future qooxdoo versions may provide more extensive class hinting support.

Aborting a call

You can abort an asynchronous call while it's still being performed:

```
// Rpc instantiation and handler function left out for brevity

var callref = rpc.callAsync(handler, "echo", "Test");

// ...

rpc.abort(callref);
  // the handler will be called with an abort exception
```

Error handling

When you make a synchronous call, you can catch an exception to handle errors. In its `rpcdetails` property, the exception contains an object that describes the error in more detail. The same details are also available in the second parameter in an asynchronous handler function, as well as in the events fired by `callAsyncListeners`.

The following example shows how errors can be handled:

```
// creation of the Rpc instance left out for brevity

var showDetails = function(details) {
    alert(
        "origin: " + details.origin +
        "; code: " + details.code +
        "; message: " + details.message
    );
};

// error handling for sync calls
try {
    var result = rpc.callSync("echo", "Test");
} catch (exc) {
    showDetails(exc.rpcdetails);
}

// error handling for async calls
var handler = function(result, exc) {
    if (exc != null) {
        showDetails(exc);
    }
};
rpc.callAsync(handler, "echo", "Test");
```

The following `origin`'s are defined:

Constant	Meaning
qx.io.remote.Rpc.origin.server	The error occurred on the server • e.g. when a non-existing method is called
qx.io.remote.Rpc.origin.application	The error occurred inside the server application • i.e. during a method call in non-qooxdoo code
qx.io.remote.Rpc.origin.transport	The error occurred in the communication layer • e.g. when the Rpc instance was constructed with an URL where no backend is deployed, resulting in an HTTP 404 error
qx.io.remote.Rpc.origin.local	The error occurred locally • when the call timed out or when it was aborted

The `code` depends on the origin. For the server and application origins, the possible codes are defined by the backend implementation. For transport errors, it's the HTTP status code. For local errors, the following codes are defined:

Constant	Meaning
qx.io.remote.Rpc.localError.timeout	A timeout occurred.
qx.io.remote.Rpc.localError.abort	The call was aborted.

Cross-domain calls

Using the qooxdoo RPC implementation, you can also make calls across domain boundaries. On the client side, all you have to do is specify the correct destination URL in the Rpc constructor and set the crossDomain property to `true`:

```
var rpc = new qx.io.remote.Rpc("http://targetdomain.com/appname/.qxrpc");
rpc.setCrossDomain(true);
```

On the server side, you need to configure the backend to accept cross-domain calls (see the documentation comments in the various backend implementations).

Writing your own services

Java

Writing your own remotely callable methods is very easy. Just create a class like this:

```
package my.package;

import net.sf.qooxdoo.rpc.RemoteService;
import net.sf.qooxdoo.rpc.RemoteServiceException;

public class MyService implements RemoteService {

    public int add(int a, int b) throws RemoteServiceException {
        return a + b;
    }

}
```

All you need to do is include this class in your webapp (together with the qooxdoo backend classes), and it will be available for calls from JavaScript! You don't need to write or modify any configuration files, and you don't need to register this class anywhere. The only requirements are:

1. The class has to implement the `RemoteService` interface. This is a so-called tagging interface, i.e. it has no methods.
2. All methods that should be remotely available must be declared to throw a `RemoteServiceException`.

Both requirements are there to protect arbitrary Java code from being called.

Accessing the session There is one instance of a service class per session. To get access to the current session, you can provide an *injection* method called `setQooxdooEnvironment`:

```
package my.package;

import javax.servlet.http.HttpSession;

import net.sf.qooxdoo.rpc.Environment;
import net.sf.qooxdoo.rpc.RemoteService;
import net.sf.qooxdoo.rpc.RemoteServiceException;

public class MyService implements RemoteService {

    private Environment _env;

    public void setQooxdooEnvironment(Environment env) {
        _env = env;
    }

    public void someRemoteMethod() throws RemoteServiceException {
        HttpSession session = _env.getRequest().getSession();
    }

}
```

The environment provides access to the current request (via `getRequest`) and the RpcServlet instance that is handling the current call (via `getRpcServlet`).

Debugging Backends

In order to debug your service methods on the backend independently of the client application, use the RpcConsole contribution.

Creating mockup data

The RpcConsole also contains a mixin class for qx.io.remote.Rpc which allows to prepare code relying on a json-rpc backend to work with static mockup data independently of the server. This allows to develop client and server independently and to create static demos. For more information, see the documentation of the RpcConsole (project) contribution.

qooxdoo JSON-RPC specification

In order to qualify as a qooxdoo json-rpc backend, a server must comply with the qooxdoo JSON-RPC server specifications. See the *RPC Server Writer Guide* for more details.

Adding to the standard

If you think that the standard is missing a feature that should be implemented in all backends, please add it as a bug, marking it as a "core feature request".

Extending the standard

If a server *extends* the standard with a certain optional behavior, please add a detailed description to it on the JSON-RPC Extensions page, with information which server implements this behavior. Please also add a bug, marked as a "extension" so that other server maintainers can discuss the pros and cons of adding the extension to their own servers.

7.4.2 RPC Servers

RPC Server Writer Guide

Writing a new JSON-RPC server for use with qooxdoo is fairly easy. If you follow these rules, you should end up with a compliant implementation. See also the other available qooxdoo RPC servers.

JSON

With the exception of the formatting of JavaScript `Date` objects, all communication between client and server is formatted as JSON, as described and documented at http://json.org.

Date Objects Date objects are a problem in standard JSON encoding, because there is no "literal" syntax for a date in JavaScript. In JavaScript, nearly everything can be represented in literal form: objects by `{ ... }`; arrays by `[ ... ]`; etc. The only native type which can not be represented as a literal is a Date. For this reason, a format for passing Dates in JSON is defined here so that all conforming servers can parse the data received from clients.

Date objects are sent as the following 'tokens'.

- The string `new Date(Date.UTC(`
- The **year**, integer, e.g. `2006`
- A comma
- The **month**, 0-relative integer, e.g. `5` is June
- A comma
- The **day** of the month, integer, range: `1-31`
- A comma
- The **hour** of the day on a 24-hour clock, integer, range: `0-23`
- A comma
- The **minute** of the hour, integer, range: `0-59`
- A comma
- The **second** within the minute, integer, range: `0-59`
- A comma
- The **milliseconds** within the second, integer, range: `0-999`

- The string))

A resulting Date representation might therefore be:

```
new Date(Date.UTC(2006,5,20,22,18,42,223))
```

Whitespace

- when generating these date strings, implementations SHOULD NOT add white space before/after/between any of the fields within the date string
- when parsing these date strings, implementations SHOULD allow white space before/after/between any of the fields within the date string

Numbers

- when generating these date strings, implementations MUST NOT add leading zeros to the numeric values in the date string. Doing so will cause them to be parsed as octal values. Numbers MUST be passed in decimal (base 10) notation without leading zeros.
- when parsing these date strings, implementations MUST take the integer value of numeric portions of the string as base 10 values, even if leading zeros appear in the string representation of the numbers..

Within the JSON protocol and in JSON messages between peers, `Date` objects are always passed as UTC.

RPC

Remote procedure calls are issued using JSON seralization. The basis for the objects used to send requests and responses are described and defined at http://json-rpc.org, specifically http://json-rpc.org/wiki/specification. This document introduces a number of differences to that specification, based on real-life implementation discoveries and needs. This portion of this document is an edited version of the JSON-RPC specification.

request (method invocation) A remote method is invoked by sending a request to a remote service. The request is a single object serialized using JSON.

It has four properties:

- `service` - A String containing the name of the service. The server may use this to locate a set of related methods, all contained within the specified service. The format of the supported service strings is up to the server implementation.
- `method` - A String containing the name of the method to be invoked. The method must exist within the specified service. The format of the method string is up to the server implementation.
- `params` - An Array of objects to pass as arguments to the method.
- `id` - The request id. This can be of any type. It is used to match the response with the request that it is replying to. (qooxdoo always sends an integer value for id.)

response When the method invocation completes, the service must reply with a response. The response is a single object serialized using JSON.

It has three properties:

- `result` - The Object that was returned by the invoked method. This must be `null` in case there was an error invoking the method.

- `error` - An *Error Object* if there was an error invoking the method. It must be `null` if there was no error. Note that determination of whether an error occurred is based on this property being `null`, not on result being `null`. It is perfectly legal for both to be `null`, indicating a valid result with value `null`.
- `id` - This must be the same id as the request it is responding to.

The Error Object

An error object contains two properties, `origin` and `code`:

origin `origin` - An error can be originated in four locations, during the process of initiating and processing a remote procedure call. Each possible origin is assigned an integer value, assigned to this property, as follows:

- `1` = the server can return errors to the client
- `2` = methods invoked by the server can return errors
- `3` = Transport (e.g. HTTP) errors can occur
- `4` = the client determined that an error occurred, e.g. timeout

A conforming server implementation MUST send value `1` or `2` and MAY NOT send any other value, for origin. A client may detect Transport or locally-ascertained errors, but a server will never return those.

code `code` - An integer error code. The value of code is hierarchically linked to origin; e.g. the same code represents different errors depending on the value of origin.

One of these values of code SHALL be sent if origin = `1`, i.e. if the server detected the error.

- Error code, value `1`: Illegal Service The service name contains illegal characters or is otherwise deemed unacceptable to the JSON-RPC server.
- Error code, value `2`: Service Not Found The requested service does not exist at the JSON-RPC server.
- Error code, value `3`: Class Not Found If the JSON-RPC server divides service methods into subsets (classes), this indicates that the specified class was not found. This is slightly more detailed than "Method Not Found", but that error would always also be legal (and true) whenever this one is returned.
- Error code, value `4`: Method Not Found The method specified in the request is not found in the requested service.
- Error code, value `5`: Parameter Mismatch If a method discovers that the parameters (arguments) provided to it do not match the requisite types for the method's parameters, it should return this error code to indicate so to the caller.
- Error code, value `6`: Permission Denied A JSON-RPC service provider can require authentication, and that authentication can be implemented such the method takes authentication parameters, or such that a method or class of methods requires prior authentication. If the caller has not properly authenticated to use the requested method, this error code is returned.

If origin = `2`, i.e. the application (invoked method) detected the error, the value of the code property is entirely by agreement between the invoking client and the and invoked method.

message `message` - A free-form textual message describing the error.

Other Errors

Errors detected by the server which indicate that the received data is not a JSON-RPC request SHOULD be simple text strings returned to the invoker, describing the error. A web browser user who accidentally hits the URL of a JSON-RPC server should receive a textual, not Error Object, response, indicating that the server is expecting a JSON-RPC request.

Transport

There are exactly two standard transport facilities potentially used by qooxdoo's qx.io.remote.Rpc class:

- XmlHTTPRequest : The parameters of the remote procedure call are passed to the server using XmlHTTPRequest. The request will be issued using the `POST` method with `Content Type: application/json`. The data provided by the client will be the JSON-serialized request object. The JSON-serialized result object MUST be returned with `Content Type: application/json`. This transport will be used unless the request is issued as cross-domain.
- Script : If the client application invokes a cross-domain request, the request will be issued by URL-encoding the request object and wrapping it in a `<script>` tag. The request uses the `GET` method with `Content Type: text/javascript`. The response to a request received via this method MUST be a call to the static method `qx.io.remote.transport.Script._requestFinished` with parameters of the script id (a copy of the value of the incoming parameter `_ScriptTransport_id`) and the JSON-serialized result object.

A server SHOULD issue an `Other Error` (textual reply) if it detects a method / content type pair other than the two supported ones.

Testing A New Server

To validate that your new server is operating properly, the following test methods may be created at your server:

- `echo` - Echo the one and only parameter back to the client, in the form: `Client said: [ <parameter> ]` where all text is literal except for `<parameter>`.
- `sink` - Sink all data and never return. ("Never" is a long time, so it may be simulated by sleeping for 240 seconds.
- `sleep` - Sleep for the number of seconds provided as the first parameter, and then return that parameter.
- `getInteger` - Return the integer value `1`
- `getFloat` - Return the floating point value `1/3`
- `getString` - Return the string `"Hello world"`
- `getArrayInteger` - Return an array containing the four integers `[ 1, 2, 3, 4 ]` in that order.
- `getArrayString` - Return an array containing the four strings `[ "one", "two", "three", "four" ]` in that order
- `getObject` - Return some arbitrary object
- `getTrue` - Return the binary value `true`
- `getFalse` - Return the binary value `false`
- `getNull` - Return the value `null`
- `isInteger` - Return `true` if the first parameter is an integer; `false` otherwise
- `isFloat` - Return `true` if the first parameter is a float; `false` otherwise

- `isString` - Return `true` if the first parameter is a string; `false` otherwise
- `isBoolean` - Return `true` if the first parameter is either one of the boolean values `true` or `false`; return `false` otherwise.
- `isArray` - Return `true` if the first parameter is an array; `false` otherwise
- `isObject` - Return `true` if the first parameter is an object; `false` otherwise
- `isNull` - Return `true` if the first parameter is the value `null`; `false` otherwise.
- `getParams` - Echo all parameters back to the client, in received order
- `getParam` - Echo the first parameter back to the client. This is a synonym for the `echo` method.
- `getCurrentTimestamp` - Return an object which has two properties:
  - `now`: An integer representing the current time in a native format, e.g. as a number of seconds or milliseconds since midnight on 1 Jan 1970.
  - `json`: A *Date* object representing that same point in time

A test of all of the primitive RPC operations is available in the qooxdoo-contrib project RpcExample. The third tab provides a test of the operations using synchronous requests, and the fourth tab tests the operations using asynchronous requests. Note that the results are displayed in the debug log (in Firebug or in the debug console enabled by pressing `F7`). You can look for `true` as a result of each request.

A future test will validate that all returned values are as expected, and display a single "passed/fail" indication.

7.5 Specific Widget Communication

7.5.1 Using the remote table model

The remote table should be used whenever you want to display a large amount of data in a performant way.

As this table model loads its data on-demand from a backend, only those rows are loaded that are near the area the user is currently viewing. If the user scrolls, the rows that will be displayed soon are loaded asynchronously in the background. All loaded data is managed in a cache that automatically removes the last recently used rows when it gets full.

To get this model up and running you have to implement the actual loading of the row data by yourself in a subclass.

Implement your subclass

To correctly implement the remote table model you have to define/overwrite two methods `_loadRowCount` and `_loadRowData`. Both are automatically called by the table widget.

```
qx.Class.define("myApplication.table.RemoteDataModel",
{
  extend : qx.ui.table.model.Remote,

  members :
  {
     // overridden - called whenever the table requests the row count
    _loadRowCount : function()
    {
      // Call the backend service (example) - using XmlHttp
      var url  = "http://localhost/services/getTableCount.php";
      var req = new qx.io.remote.Request(url, "GET", "application/json");
```

```
      // Add listener
      req.addListener("completed", this._onRowCountCompleted, this);

      // send request
      req.send();
    },

    // Listener for request of "_loadRowCount" method
    _onRowCountCompleted : function(response)
    {
       var result = response.getContent();
       if (result != null)
       {
          // Apply it to the model - the method "_onRowCountLoaded" has to be called
          this._onRowCountLoaded(result);
       }
    },

    // overridden - called whenever the table requests new data
    _loadRowData : function(firstRow, lastRow)
    {
       // Call the backend service (example) - using XmlHttp
       var baseUrl  = "http://localhost/services/getTableRowData.php";
       var parameters = "?from=" + firstRow + "&to=" + lastRow;
       var url = baseUrl + parameters;
       var req = new qx.io.remote.Request(url, "GET", "application/json");

       // Add listener
       req.addListener("completed", this._onLoadRowDataCompleted, this);

       // send request
       req.send();
    },

     // Listener for request of "_loadRowData" method
    _onLoadRowDataCompleted : function(response)
    {
        var result = response.getContent();
       if (result != null)
       {
          // Apply it to the model - the method "_onRowDataLoaded" has to be called
          this._onRowDataLoaded(result);
       }
    }
  }
});
```

Using your remote model

Now that you've set up the remote table model the table component can use it.

```
var remoteTableModelInstance = new myApplication.table.RemoteDataModel();
yourTableInstance.setTableModel(remoteTableModelInstance);
```

That's all you need to ensure your table is using your remote model.

Sorting your data

The table component offers sortable columns to let users sort the data the way they like. You can enable this sorting ability for each column. Since you have to pull the data into the table yourself you have to update the table data once the user changes the sorting criteria. You have to enhance the `_loadRowData` method with this information to inform your backend how to sort the data.

```
// "_loadRowData" with sorting support
_loadRowData : function(firstRow, lastRow)
{
    // Call the backend service (example) - using XmlHttp
    var baseUrl  = "http://localhost/services/getTableRowData.php";
    var parameters = "?from=" + firstRow + "&to=" + lastRow;

    // get the column index to sort and the order
    var sortIndex = this.getSortColumnIndex();
    var sortOrder =  this.isSortAscending() ? "asc" : "desc";

    // setting the sort parameters - assuming the backend knows these
    parameters += "&sortOrder=" + sortOrder + "&sortIndex=" + sortIndex;

    var url = baseUrl + parameters;
    var req = new qx.io.remote.Request(url, "GET", "application/json");

    // Add listener
    req.addListener("completed", this._onLoadRowDataCompleted, this);

    // send request
    req.send();
}
```

Backend

The backend has to deliver the requested data in a JSON data structure in order to display the data correctly. The data structure has to use the same IDs as the remote table model instance at the client-side.

For example

```
var remoteModel = new myApplication.table.RemoteDataModel();

// first param: displayed names, second param: IDs
remoteModel.setColumns( [ "First name", "Last name" ], [ "first", "last" ] );
```

Then the data delivered by the backend should have the following structure:

```
result = {[
  { "first" : "John", "last" : "Doe"  },
  { "first" : "Homer", "last" : "Simpson"  },
  { "first" : "Charlie", "last" : "Brown"  },
  ...
]};
```

Moreover, the backend has to deliver the row count, i. e. the number of rows the table contains. This is what the `_loadRowCount` function of your subclass expects to get. Please make sure that the URLs `http://localhost/services/getTableCount.php` and `http://localhost/services/getTableRowData.php` of your subclass point to the right location.

Summary

This short and very basic example is far from complete and in your application you will have to implement some more features like error-handling, but it should give you a short overview of how to implement the remote table model in qooxdoo.

Another basic implementation which uses the PHP RPC backend is available in qooxdoo-contrib. Take a look at the RPCExample and setup the necessary RPC PHP backend.

7.6 Development & Testing

7.6.1 FakeServer

qx.dev.FakeServer provides a simple way to define a mock HTTP server in the browser. This can be used to test and develop applications that communicate with an HTTP backend even if the actual service is unavailable. It is based on the excellent Sinon.JS mocking library, in particular its FakeXMLHttpRequest interface which wraps the browser's XHR implementation, and is thus completely transparent: No modifications to the client code are required.

Configuration

FakeServer is configured by defining responses to HTTP method/request URL pairs. Only matching requests will receive a mock response, other requests will be processed by the browser as usual. Here is an example configuration that defines mock responses for two different requests:

```
var responseData = [
  {
    method: "GET",
    url: /\/api\/resource\/\d+/,
    response : function(request) {
      var status = 200;
      var headers = { "Content-Type": "application/json" };
      var responseData = {
        description: "Mock REST response for resource " + request.url
      };
      var body = qx.lang.Json.stringify(responseData);
      request.respond(status, headers, body);
    }
  },
  {
    method: "GET",
    url: "/users/{userId}",
    response: [
      200,
      { "Content-Type": "application/json" },
      qx.lang.Json.stringify({userId: 'someUser'})
    ]
  }
];
```

URL matching

The value of the *url* key can be either a regular expression or a string. If a URL string contains placeholders in curly brackets (a common pattern in REST client applications using *qx.io.rest.Resource*), they will be treated as wildcards.

Responses

Sinon's FakeServer accepts three types of responses:

- If the value of *response* is a string, it will be sent as the response body. The status code will be 200 and no response headers will be configured.
- The response can also be an array containing the status code, a map of response headers, and the response body text, e.g. *[200, { "Content-Type": "text/html", "Content-Length": 2 }, "OK"]*
- If the response value is a function, it will be called with a FakeXMLHttpRequest object as the only argument. Its respond method can be used to send a response.

Usage

It's a good idea to create separate classes to hold the FakeServer configuration, for example one mock class per REST resource class. By loading these classes only if a custom environment setting is active, it's easy to ensure the mock backend is never included in the deployment version of the application. Here is an example:

```
qx.Class.define("myapp.mock.User", {
  statics : {
    mockData :
    [
      {
        method: "GET",
        url: "/users/{userId}",
        response: [
          200,
          { "Content-Type": "application/json" },
          qx.lang.Json.stringify({userName: 'FakeUser'})
        ]
      }
    ]
  },

  defer : function(statics) {
    qx.dev.FakeServer.getInstance().configure(statics.mockData);
  }
});
```

By calling FakeServer's *configure* method in the class' *defer* block, we make sure that the mock backend is ready as soon as the class is loaded. In the application, we only need to add a dependency:

```
if (qx.core.Environment.get("myapp.mockBackend")) {
  myapp.mock.User;
}
```

CHAPTER

EIGHT

DEVELOPMENT

This section touches on various aspects and tools related to development activities with qooxdoo. Topics range from the various qooxdoo application types, over discussions of performance, unit testing and debugging, to internationalization and parts, a specific means to partition and lazily load application components.

8.1 Application Creation

8.1.1 Application Skeletons

qooxdoo comes with several different application templates or *skeletons*. Each is meant for a specific usage scenario and includes a different subset of the qooxdoo framework (see the *architecture diagram* for reference).

When creating a new application using *create-application.py*, the *-t* or *–type* parameter specifies the type of skeleton to be used, e.g.

```
qooxdoo-3.0-sdk/create-application.py --name=custom --type=mobile
```

The following skeletons are available (The application types are in fact all lower-case, but are capitalized in the following headings for better readability):

Desktop

For a GUI application that looks & feels like a native desktop application (often called "RIA" – Rich Internet Application).

Such a stand-alone application typically creates and updates all content dynamically. Often it is called a "single-page application", since the document itself is never reloaded or changed.

This is the default choice if the *–type* parameter is not specified.

Inherits from qx.application.Standalone

Included layers

- Core
- Runtime Abstraction
- Low-Level
- GUI Toolkit

Inline

For a GUI application on a traditional, HTML-dominated web page.

The ideal environment for typical portal sites which use just a few qooxdoo widgets, embedded into the page's existing HTML content.

Inherits from qx.application.Inline

Included layers

- Core
- Runtime Abstraction
- Low-Level
- GUI Toolkit

Mobile

For a *mobile application* running in a WebKit-based browser on iOS or Android (and also on desktop machines). Supports the mobile widget set.

Inherits from qx.application.Mobile

Included layers

- Core
- Runtime Abstraction
- Mobile UI

Native

For applications using custom HTML/CSS-based GUIs instead of qooxdoo's widget layer.

Inherits from qx.application.Native

Included layers

- Core
- Runtime Abstraction
- Low-Level

Website

This is an alternative to working with the *Website* library directly, which is a single-file download containing all the qx.Website API. If you deploy the download you use its API in your own code in a way that suits you, e.g. by adding custom code in an HTML page that also loads the library.

Getting started

The 'website' skeleton provides you with the same development model, with additional options. It contains a pre-built version of the Website library. You can just open the contained index.html file in a browser and see the default application running (If this is not the case and you just get an "Application needs generation..." message, just run `generate.py` on the shell). Then you start extending it, either in the index.html file directly or by creating other JavaScript files that use it, and include those in the HTML file.

Both approaches (download or skeleton) pretty much match up, with the skeleton giving you a little head start. In both cases you are using a static library file, and take care of organizing your application code yourself. Beyond that the 'website' skeleton provides you with some additional jobs:

- *build-min*: You can re-create the library file (located in *script/*), by running the `generate.py [build-min]` job. This is interesting if you e.g. upgrade to a new qooxdoo SDK and want to make sure you are working against the latest code.
- *build*: You can create a *non-optimized* version of the library, if you want to debug into its code. This is achieved by running the `generate.py build` job. Mind, though, that you then need to include *q-3.0.js* in your HTML code (rather than *q-3.0.min.js* which is the minified version).
- *test, test-source*: You can write unit tests for your custom code, and generate a local version of the *Portable Testrunner* using `generate.py test` or `generate.py test-source` (The linked description of the Portable Testrunner refers partly to the ready-built download version, hence it says *"no compile step"*). In order to sensibly test your code, you should put it in its own .js file, rather than inline it in the *index.html*. This way, you can load it both in the application *index.html* as well as in *test/index.html* where the unit tests are applied.
- *api*, *api-data*: These jobs re-create the qx.Website Apiviewer (or just the API data, respectively) in the skeleton. This is useful if you want to have the API documentation close-by.

Included layers

- See the *qx.Website* documentation.

Server

For applications running in "browserless" or server-side environments such as node.js and Rhino. The skeleton follows the normal qooxdoo development model, so you have a *source/* folder with classes and resources, and can create *source* and *build* versions of your app. It also supports other development jobs like *"test"*, *"api"* or *"lint"*. The special job *"library"* allows you to re-create the qx.Server library locally.

Inherits from qx.application.Basic.

Getting started

This skeleton depends on a generated Server library, located in *script/*. If this was not delivered with your SDK you can create it locally, by running `generate.py library`. (If you intend to create multiple 'server' skeletons, you might want to change to *${QOOXDOO_PATH}/component/standalone/server* and invoke `generate.py build`. This will generate the library for further 'server' skeletons).

The library will be used together with the application code to make up the final application. You need to generate the application first, e.g. by running `generate.py source`. The generated source file is saved under *source/script/<custom>.js*, the build file (with `generate.py build`) under *build/script/<custom>.js*. Those files can then be executed.

Invoking the application

After you have created the *source* or *build* version of a basic application, you can run it through either Node or Rhino. But as they have different loading primitives, Node allows you to run the app from a remote directory, while Rhino needs to run the application from the current working directory. So e.g. after creating the source version of an application *foo*, you can invoke it like this for Node:

```
$ node source/script/foo.js
```

or like this for Rhino:

```
$ cd source/script
$ java -cp path/to/js.jar org.mozilla.javascript.tools.shell.Main foo.js
```

Included layers

- See the *qx.Server* documentation.

Contribution

For a qooxdoo-contrib application, component or library. Enables integration with the Contribution Demo Browser.

8.1.2 How to Develop a qooxdoo Application

How you develop a qooxdoo application largely depends on for which target platform you develop (browser, server, mobile, ...), which in turn is reflected by the *qooxdoo component* (qx.Desktop, qx.Website, ...) and, to a lesser extend, which skeleton type you are using. Please refer to the particular component documentation for its specifics.

Here are some common traits, though, that you will come across when developing an application with qooxdoo:

Application Layout

Application code is organized in a particular directory layout which is necessary for the tool chain to work properly. The skeletons help you to adhere to that organisation.

Generate before Run

In general you need to invoke qooxdoo's tool chain, particularly the "Generator", before you can run your application. qooxdoo has a Java-like approach to source code, in that it just "sits around" like a bunch of resources. With the help of its configuration the Generator casts all these resources in a runnable application, e.g. by creating a specific loader that loads all necessary class code.

Source versus Build

You will usually develop your application in a so-called *source* mode. In this mode individual files are loaded from their original location on disk. This allows changes to source files become apparent immediately, and allows for better inspection and debugging during runtime. Everything is geared towards supporting development activities. There are various jobs of the Generator that generate a source version of your app (*source*, *source-all*, *source-hybrid*), depending on your preferences between convenience and speed.

Once you are satisfied with your application, you will create a *build* version of it. This version will be compressed and optimized, and will be all geared towards deployment and runtime efficiency. But it will be much less amenable to development.

8.2 Debugging

8.2.1 Logging System

The logging API allows for a definition of what is logged and where it is logged, while trying to keep usage as simple as possible.

Writing Log Messages

Every qooxdoo object has four logging methods `debug()`, `info()`, `warn()` and `error()`. Each method takes an arbitrary number of parameters which can be of any JavaScript data type: The logging system will create text representations of non-string parameters.

The name of the method defines the log level your log message will get. If you want to log a message that is interesting for debugging, then use `debug()`. If you want to log some general information, use `info()`. If you want to log a warning, use `warn()`. Errors should be logged with `error()`.

So to write a log message just call:

```
this.debug("Hello world");
```

All of qx.core.Object log methods delegates to qx.log.Logger. If you want to get into more details, you can check their API.

Now that we know how to log a message, let's see where it's written.

Log Appenders

Log appenders tells the logging system where to write log messages. When you create a brand new qooxdoo application, you may stumble upon this piece of code in Application.js file.

```
// Enable logging in debug variant
if (qx.core.Environment.get("qx.debug")) {
  qx.log.appender.Native;
  qx.log.appender.Console;
}
```

By default, every qooxdoo application comes with 2 activated log appenders, Native and Console.

The Native appender logs messages to the browser's console. For Firefox, that native console might be Firebug Console, while for Chrome or Safari is the Developer Tools' Console. The Console appender is a cross-browser solution, logging messages to a top-left absolute positioned window that can be opened by pressing F7.

Here's the complete list of appenders that qooxdoo provides by default:

- qx.log.appender.Native
- qx.log.appender.Console
- qx.log.appender.Element
- qx.log.appender.PhoneGap

- qx.log.appender.RhinoConsole

if none of the default appenders are right for you, you can also create a custom log appender.

Writing Custom Log Appenders

Writing your own appenders is easy. Here's a blueprint to get you started.

```
qx.Class.define("qx.log.appender.MyCustomAppender", {
  statics : {
    init : function() {
      // register to log engine
      qx.log.Logger.register(this);
    },

    process : function(entry) {
      //handle the entry map
    }
  }
});
```

As you can see, an appender is just a static class that implements a "process" method, and register itself to the logging system.

The process method will be called by the logger with an "entry" map as the only parameter. Log appenders that need only a text representation of the logged item(s) can pass this map to `qx.log.appender.Util.toText`. For other use cases, this is what an entry map consists of:

Log Entry Map

- *items* Array of maps containing information about the logged items, see below
- *time* When the message was logged appender is a static class with at (JavaScript Date)
- *level* The level of the log message
- *object* qx object registry hash of the object the log method was called on
- *win* The application's DOM window (necessary for cross-frame logging)
- *offset* Time in milliseconds since application startup

Logged Item Map

- *text* Text representation of the logged item. If the logged item is an array, the value of *text* is an array containing text representations of each of the logged array's entries. For maps, the value is an array of maps with the following fields:
- *key* The map key's name
- *text* Representation of the corresponding value
- *trace* Stack trace (if the logged item is an Error object)
- *type* One of "undefined", "null", "boolean", "number", "string", "function", "array", "error", "map", "class", "instance", "node", "stringify", "unknown" "stringify"

8.2.2 Debugging Applications

You have several options at hand when it comes to debugging a qooxdoo application.

Introspection

- `qx.io.Json.stringify()`
- `qx.dev.Debug()`

Included in the latter is qx.dev.Debug.debugObject() which will print out a complete recursive hierarchy (or up to some max level) of an object.

This is taken from a firebug interactive session:

```
>>> var myTest = {a:1, b:[2,3], c:4}
>>> qx.dev.Debug.debugObject(myTest)
1665905: Object, count=3:
----------------------------------------------------------------
a: 1
b: Array
 0: 2
 1: 3
c: 4
================================
```

Memory leaks

- Setting `qx.debug.dispose.level`

AJAX

- Setting `qx.debug.io.remote`
- Setting `qx.debug.io.remote.data`

Debugging Tools

Some browser-specific tools allow for a powerful and often convenient way of debugging applications.

Code Instrumentation Idioms

These are helpful idioms you might want to include in your code, i.e. you use them at *programming time*.

this.debug()

With `this.debug()` you can print out any string you want to see in the console during execution of your application. Of course you might want to interpolate variable values in the output. If you pass an entire object reference, the whole object will by stringified and printed. So beware: for big objects you get the entire instantiation in code printed out!

Example:

```
this.debug("I found this value for myVar: "+myVar);
```

console.log()

In contrast to this.debug(), if you pass an object reference to `console.log()` Firebug will provide you with a nice hyperlink to the live object which you can follow to inspect the object in a structured way. This is much easier to navigate than to skim through pages of source output.

```
var b = new qx.ui.form.Button();
console.log(b);
```

this.trace()

Will log the current stack trace using the defined logger. This can be useful to inspect from which method the current function was called.

```
this.trace()
```

Getting at your Objects

This section shows you how to access objects of your application at *run time*, i.e. while it executes. Access to those objects is possible through JavaScript, either in the form of another piece of JavaScript code, or - especially interesting for debugging - from an interactive shell, like Firebug or Venkman, that allows for interactive input and execution of JavaScript commands.

qx.core.Init.getApplication()

In your running app, the singleton `Init` object provides you with the `getApplication()` method, to access the root object of your application. All members and sub-members that you have attached to your application class in your code are accessible this way.

```
qx.core.Init.getApplication();
```

Firebug Usage Idioms

"Inspect"

Getting at your application objects fast is a common requirement when debugging. A useful idiom (or usage pattern) with Firebug is to press the *"Inspect"* button and select the visible page element you are interested in. This will take Firebug to its HTML tab in a split-pane view. The left side holds the HTML code underlying your selection (which is probably not very enlightening). The right side though has a *"DOM"* tab, among others. Selecting this will show a display of the underlying DOM node, which features a `qx_Widget` attribute. This attribute is added to the outermost HTML tag representing a qooxdoo widget. For complex widgets that are made up of nested HTML elements, make sure to select the outermost container node that actually has this attribute `qx_Widget`. It takes you straight to the qooxdoo object associated with the selected DOM node.

```
Inspect -> Web page element -> HTML tab -> right side -> DOM tab -> qx_Widget link
```

8.3 Performance

8.3.1 Memory Management

Introduction

Generally, qooxdoo's runtime will take care of most of the issues around object disposal, so you don't have to be too anxious if you get those 'missing destruct declaration' messages from a verbose disposer run.

To destruct existing objects at the end of your application is an important feature in the ever growing area of web applications. Widgets and models are normally handling a few storage fields on each instance. These fields need the dispose process to work without memory leaks.

Normally, JavaScript automatically cleans up. There is a built-in garbage collector in all engines. But these engines are more or less buggy. One problematic issue is that browsers differentiate between DOM and JavaScript and use different garbage collection systems for each (This does not affect all browsers, though). Problems arise when objects create links between the two systems. Another issue are circular references which could not be easily resolved, especially by engines which rely on a reference counter.

To help the buggy engines to collect the memory correctly it is helpful to dereference complex objects from each other, e.g. instances from maps, arrays and other instances. You don't need to delete primitive types like strings, booleans and numbers.

qooxdoo has solved this issue from the beginning using the included "dispose" methods which could be overridden and extended by each class. qooxdoo 0.7 introduced a new class declaration. This class declaration supports real "destructors" as known from other languages. These destructors are part of the class declaration. The new style makes it easier to write custom destructor/disposer methods because there are many new helper methods and the whole process has been streamlined to a great extend.

Disposing an application

You can dispose any qooxdoo based application by simply calling `qx.core.ObjectRegistry.shutdown()`. The simplest possibility is to use the command line included in Firebug. Another possibility is to add a HTML link or a button to your application which executes this command.

You can look at the dispose behaviour of your app if you set the disposer into a verbose mode and then invoke it deliberately while your app is running. This will usually render your app unusable, but you will get all those messages hinting you at object properties that might need to be looked after. How-To instructions can be found *here*. But mind that the disposer output contains only hints, that still need human interpretation.

Example destructor

```
destruct : function()
{
  this._data = this._moreData = null;
  this._disposeObjects("_buttonOk", "_buttonCancel");
  this._disposeArray("_children");
  this._disposeMap("_registry");
}
```

- `_disposeObjects`: Supports multiple arguments. Dispose the objects (qooxdoo objects) under each key and finally delete the key from the instance.
- `_disposeArray`: Disposes the array under the given key, but disposes all entries in this array first. It must contain instances of qx.core.Object only.

- _disposeMap: Disposes the map under the given key, but disposes all entries in this map first. It must contain instances of qx.core.Object only.

How to test the destructor

The destructor code allows you an in-depth analysis of the destructors and finds fields which may leak etc. The DOM tree gets also queried for back-references to qooxdoo instances. These checks are not enabled by default because of the time they need on each unload of a typical qooxdoo based application.

To enable these checks you need to select a variant and configure a setting.

The environment setting qx.debug must be true. The setting qx.debug.dispose.level must be at least at 1 to show not disposed qooxdoo objects if they need to be deleted. A setting of 2 will additionally show non qooxdoo objects. Higher values mean more output. Don't be alarmed if some qooxdoo internal showing up. Usually there is no need to delete all references. Garbage collection can do much for you here. For a general analysis 1 should be enough, a value of 2 should be used to be sure you did not miss anything. You can use the following code to adapt your config.json:

```
{
  "jobs" :
  {
    // existing jobs ...
    "source-disposerDebug" :
    {
      "desc" : "source version with 'qx.debug.dispose.level' for destruct support",

      "extend" : [ "source" ],

      "environment" :
      {
         "qx.debug.dispose.level" : "2"
      }
    }
  }
}
```

This snippet is also available at the Support for finding potential memory leaks .

Log output from these settings could look something like this:

```
35443 DEBUG: testgui.Report[1004]: Disposing: [object testgui.Report]FireBug.js (line 75)
Missing destruct definition for '_scroller' in qx.ui.table.pane.FocusIndicator[1111]: [object qx.ui.t
Missing destruct definition for '_lastMouseDownCell' in qx.ui.table.pane.Scroller[1083]: [object Obje
036394 DEBUG: testgui.Form[3306]: Disposing: [object testgui.Form]FireBug.js (line 75)
Missing destruct definition for '_dateFormat' in qx.ui.component.DateChooserButton[3579]: [object qx
Missing destruct definition for '_dateFormat' in qx.ui.component.DateChooserButton[3666]: [object qx
```

The nice thing here is that the log messages already indicate which dispose method to use: Every *"Missing destruct..."* line contains a hint to the type of member that is not being disposed properly, in the *"[object ...]"* part of the line. As a rule of thumb

- native Javascript types (Number, String, Object, ...) usually don't need to be disposed.
- for qooxdoo objects (e.g. qx.util.format.DateFormat, testgui.Report, ...) use _disposeObjects
- for arrays or maps of qooxdoo objects use _disposeArray or _disposeMap.
- be sure to cut all references to the DOM because garbage collection can not dispose object still connected to the DOM. This is also true for event listeners for example.

Finding memory leaks

qooxdoo contains a built-in dispose profiling feature that finds undisposed objects. This is useful mainly for applications that create and destroy objects as needed during their lifetime (instead of creating them once and re-using them). It cannot be used to find undisposed objects left over after the application was shut down.

Dispose profiling works by disabling a feature in qooxdoo's Object Registry where the hash codes used to identify objects are reused. That way, it is possible to iterate over all objects created between two specified points in the application's lifecycle and check if they're disposed. Since hash reusing is a performance feature, dispose profiling should only be activated for the development version of an application. It is activated by enabling the **qx.debug.dispose** environment setting for a compile job, e.g. *source-script*:

```
"source-script" :
{
  "environment" :
  {
    "qx.debug.dispose" : true
  }
}
```

After building the application, the dispose debugging workflow is as follows:

- Call qx.dev.Debug.startDisposeProfiling before the code you wish to debug is executed. This effectively sets a marker saying "ignore any objects created before this point in time".
- Execute the code to be debugged, e.g. create a view component, then destroy it.
- Call qx.dev.Debug.stopDisposeProfiling. It will return a list of maps containing references to the undisposed objects as well as stack traces taken at the time the objects were registered, which makes it easy to find where in the code they were instantiated. Go through the list and add `destroy` and/or `dispose` calls to the application as needed.

8.3.2 Profiling Applications

qooxdoo has built-in a cross-browser, pure JavaScript profiler. If the profiler is enabled, each call of a method defined by qooxdoo's class declaration can be measured. The profiler is able to compute both the total own time and the call count of any method.

Since the profiler is implemented in pure JavaScript, it is totally cross-browser and works on any supported browser.

How to enable the Profiler

Basically set the environment setting `qx.aspects` to `true` and be sure to include the class qx.dev.Profile. The class should be included before other classes. The easiest way to achieve that is to extend the `profiling` helper job in a job that creates your application. For example, to enable profiling in the source version of your app, go to the `"jobs"` section of your config.json, and add

```
"source-script" : {
  "extend" : [ "profiling" ]
}
```

How to use the Profiler

The profiler can be controlled either hard-wired in the application code, or interactively using a JavaScript shell like FireBug for Firefox or DebugBar for IE.

Profiling a certain action:

- Open the application in your browser
- At the JavaScript console type `qx.dev.Profile.stop()` to clear the current profiling data gathered during startup
- Start profiling using `qx.dev.Profile.start()`
- Perform the action you want to profile
- Stop profiling using `qx.dev.Profile.stop()`
- Open the profiler output window: `qx.dev.Profile.showResults(50)`. The parameter specifies how many items to display. Default value is set to 100. The output will be sorted by the total own time of each method. Alternatively you can work with the raw profiling data returned by `qx.dev.Profile.getProfileData()`.

Limitations

In order to interpret the results correctly it is important to know the limitations of this profiling approach. The most significant limitation is due to the fact that the profiler itself is written in JavaScript and runs in the same context as the application:

- The profiler adds some overhead to each function call. The profiler takes this overhead into account in the calculation of the own time but there can still be a small inaccuracy.
- The result of `new Date()`, which is used for timing, has a granularity of about 10ms on many platforms, so it is hard to measure especially small functions accurately.
- The application is slowed down because profiling is done by wrapping each function. Profiling should always be turned off in production code before deployment.

Summary

The output of the profiler can be of great value to find hot spots and time-consuming code. The timing data should be interpreted rather qualitatively than quantitatively, though, due to constraints of this approach.

Note: The application is slowed down because profiling is done by wrapping each function. Profiling should always be turned off in production code before deployment.

8.4 Testing

8.4.1 Unit Testing

qooxdoo comes with its own, nicely integrated unit testing environment and the corresponding application called Testrunner. While being similar to JSUnit, the solution that ships with the qooxdoo SDK does not require any additional software.

If you look at the component section of a qooxdoo distribution, you will find the Test Runner tailored to test the functionality of the qooxdoo *framework*. It provides a convenient interface to test classes that have been written to that end. You can run single tests, or a whole suite of them at once.

But the Test Runner framework can be deployed for your *own application*. It provides a GUI, a layer of infrastructure and a certain interface for arbitrary test classes. You can write your own test classes and take advantage of the Test Runner environment.

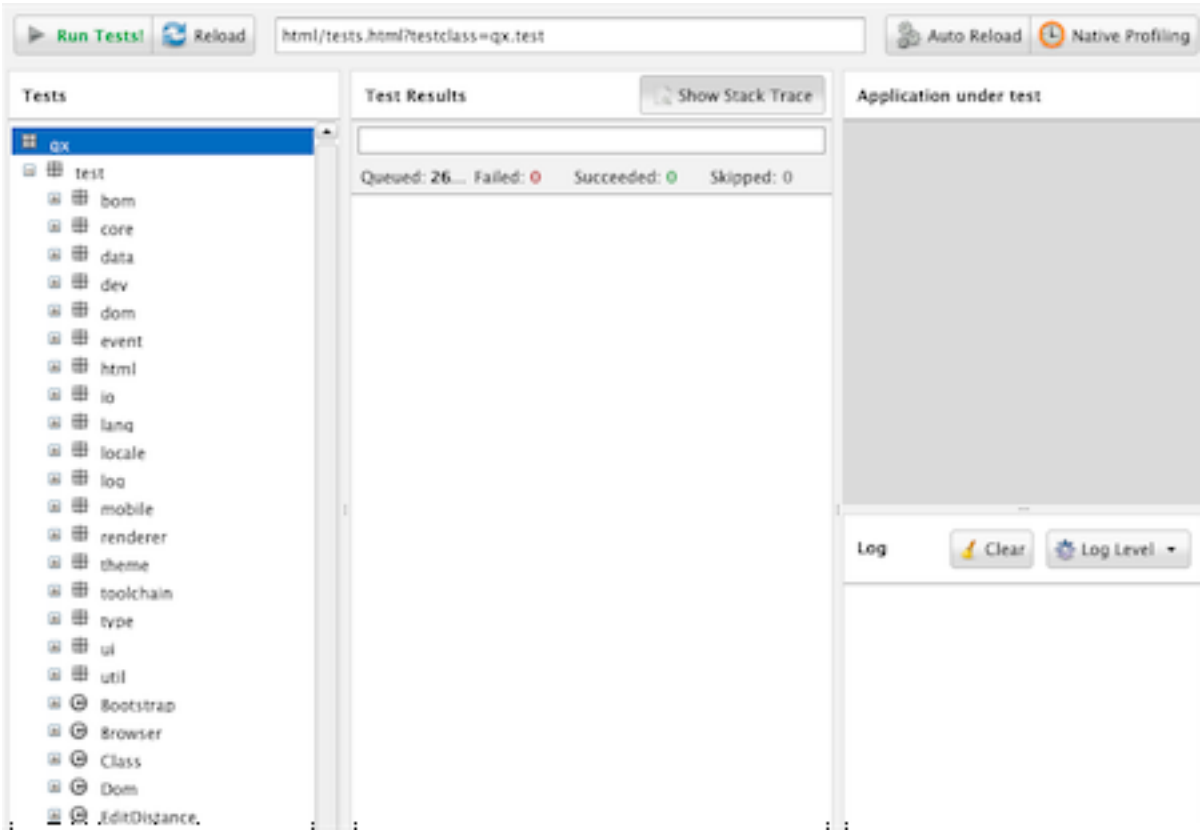
- Test Tools – an overview over test tools and approaches
- *Test Runner* – how to deploy the Testrunner component for your own application

8.4.2 Test Runner

"Test Runner" is a unit testing framework that fully supports testing qooxdoo classes. It is similar to but does not require JSUnit or any other JavaScript unit testing framework. If you look at the component section of a qooxdoo distribution under `component/testrunner/`, you will find the Test Runner sources, together with a mockup test class. In the `framework/` section you can create a Test Runner instance with all test classes from the qooxdoo framework by running:

```
./generate.py test
```

Test Runner provides a convenient interface to test classes that have been written to that end. You can run single tests, or run a whole suite of them at once.



Note: See the Test Runner in action in the online demo.

The Test Runner framework can also be deployed for *your own* application. It provides a GUI, a layer of infrastructure and a certain interface for arbitrary test classes. So now you can write your own test classes and take advantage of the Test Runner environment.

How to deploy Test Runner for your own development

This section assumes that your qooxdoo application bears on the structure of the qooxdoo *skeleton* application. Then this is what you have to do:

Writing Test Classes

- You have to code test classes that perform the individual tests. These test classes have to comply to the following constraints:
  - They have to be within the name space of your application.
  - They have to be derived from `qx.dev.unit.TestCase`.
  - They have to define member functions with names starting with `test*`. These methods will be available as individual tests.
  - Apart from that you are free to add other member functions, properties etc., and to instantiate other classes to your own content. But you will usually want to instantiate classes of your current application and invoke their methods in the test functions.
  - In order to communicate the test results back to the Test Runner framework exceptions are used. No exception means the test went fine, throwing an exception from the test method signals a failure. Return values from the test methods are not evaluated.
  - To model your test method behaviour, you can use the methods inherited from `qx.dev.unit.TestCase` which encapsulate exceptions in the form of assertions:
    * `assert`, `assertFalse`, `assertEquals`, `assertNumber`, ... - These functions take values which are compared (either among each other or to some predefined value) and a message string, and raise an exception if the comparison fails.
    * A similar list of methods of the form `assert*DebugOn` is available, which are only evaluated if the debug environment setting `qx.debug` is on (see *Environment*).
    * See the documentation for the qx.dev.unit.TestCase class for more information on the available assertions.

Generic setUp and tearDown Test classes can optionally define a `setUp` method. This is used to initialize common objects needed by some or all of the tests in the class. Since `setUp` is executed before each test, it helps to ensure that each test function runs in a "clean" environment. Similarly, a method named `tearDown` will be executed after each test, e.g. to dispose any objects created by `setUp` or the test itself.

Specific tearDown For cases where the generic class-wide `tearDown` isn't enough, methods using the naming convention `tearDown<TestFunctionName>` can be defined. A method named e.g. `tearDownTestFoo` would be called after `testFoo` and the generic `tearDown` of the class were executed.

Asynchronous Tests Asynchronous tests enable testing for methods that aren't called directly, such as event handlers:

- Test classes inheriting from `qx.dev.unit.TestCase` have a `wait()` method that stops the test's execution and sets a timeout. `wait()` should always be the last function to be called in a test since any code following it is ignored. `wait()` has two optional arguments: The **amount of time to wait** in milliseconds (defaults to 5000) and a **function to be executed** when the timeout is reached. If no function is specified, reaching the timeout will cause an exception to be thrown and the test to fail.

- The `resume()` method is used to (surprise!) resume a waiting test. It takes two arguments, a **function to be executed** when the test is resumed, typically containing assertions, and the object context it should be executed in.

Here's an example: In our test, we want to send an AJAX request to the local web server, then assert if the response is what we expect it to be.

```
testAjaxRequest : function()
{
  var request = new qx.io.request.Xhr("/index.html");
  request.addListener("success", function (e) {
    this.resume(function() {
      this.assertEquals(200, request.getStatus());
    }, this);
  }, this);
  request.send();

  this.wait(10000);
}
```

Defining Test Requirements Requirements are conditions that must be met before a test can be run. For example, a test might rely on the application having been loaded over HTTPS and would give false results otherwise. Requirements are defined for individual tests; if one or more aren't satisfied, the test code won't be executed and the test will be marked as "skipped" in the Test Runner's results list.

Using Requirements To make use of the requirements feature, test classes must include either the MRequirementsBasic mixin (for tests running in non-browser environments such as node.js or Rhino) or the MRequirements mixin which provides additional requirement checks for browser environments. The mixins provide a `require` method that takes an array of strings: The requirement IDs. This method is either called from the `setUp` method or from a test function **before** the actual logic of the test, e.g.:

```
testBackendRequest : function()
{
  this.require(["backend"]);
  // test code goes here
}
```

`require` then searches the current test instance for a method that verifies the listed requirements: The naming convention is "has" + the requirement ID with the first letter capitalized, e.g. `hasBackend`. This method is the called with the requirement ID as the only parameter. If it returns `true`, the test code will be executed. Otherwise a RequirementError is thrown. The Test Runner will catch these and mark the test as "skipped" in the results list. Any test code after the `require` call will not be executed.

If no "has" method for a given feature is found, qx.core.Environment will be checked for a key that matches the feature name. This way, any Environment key that has a boolean value can be used as a test requirement, e.g.:

```
this.require(["event.touch", "css.textoverflow"]);
```

Note that only Environment keys with **synchronous** checks are supported.

Spies, stubs and mocks Spies are test functions that records details for all its calls. Stubs are spies with pre-programmed behavior. Mocks are fake methods are like spies and stubs, but also come with pre-programmed expectations. Generally speaking, spies, stubs and mocks are fakes that allow fine-grained unit testing. They constitute important tools for test driven development.

In order to use fakes in your tests, test classes must include the MMock mixin. Here are some example tests that demonstrate the usage of spies and stubs.

```
"test: spy": function() {
  var spy = this.spy();
  spy();
  this.assertCalled(spy);
},

"test: stub": function() {
  var whoami = this.stub();
  whoami.returns("Affe");
  this.assertEquals("Affe", whoami());
}
```

MMock also provides custom assertions tailored to work with fakes. Whenever possible, custom assertions should be used instead of lower level assertions because they provide more detailed error messages.

```
"test: assert called": function() {
  var spy = this.sinon.spy();

  // Fail test deliberately
  // spy();

  // Recommended
  this.assertCalledOnce(spy);
  // --> expected spy to have been called once but was called 0 times

  // Lower level assertion
  this.assertTrue(spy.called);
  this.assertEquals(1, spy.callCount);
  // --> Called assertTrue with 'false'
  // --> Expected '1' but found '0'!
}
```

Mocks are different from spies and stubs. They have pre-programmed *expectations*, meaning that unexpected calls fail your tests. Mocks allow to enforce implementation details without explicit assertions.

```
"test: mock": function() {
  var obj = {method: function() {}};
  var mock = this.sinon.mock(obj);
  mock.expects("method").once();

  obj.method();
  // Would fail test (Unexpected second call)
  // obj.method();
  mock.verify();
},
```

For more details, please refer to the API documentation of MMock. Additional examples can be found in `qx.test.dev.unit.Sinon`.

MMock is based on Sinon.JS. The original `sinon` object can be retrieved by calling `qx.dev.unit.Sinon.getSinon()`.

Sandboxing Stubs can override original behavior. To prevent tests from leaking, it is recommended to restore fakes on tear down. Every fake (including stubs) created by MMock is contained within a sandbox. Here is how to restore all fakes recorded in the sandbox.

```
tearDown: function() {
  this.getSandbox().restore();
}
```

Faking XMLHttpRequest To replace the native implementation of `XMLHttpRequest` (XHR), call `useFakeXMLHttpRequest()`. The fake implementation behaves just like the original implementation only that no HTTP backend is required. Additional methods allow to simulate HTTP interaction. For example, the following test demonstrates the basic functionality of XHR.

```
"test: GET with XMLHttpRequest": function() {
  // Replace XMLHttpRequest host object with fake implementation
  this.useFakeXMLHttpRequest();

  var readyStates = [];
  var req = new XMLHttpRequest();

  req.open("GET", "/");
  req.onreadystatechange = this.spy(function() {
    readyStates.push(req.readyState);
  });

  req.send();

  // Fake server response
  // - Fires "readystatechange" event
  // - Updates status, responseText properties
  req.respond(200, {}, "Response");

  this.assertCalled(req.onreadystatechange);
  this.assertArrayEquals([1,2,3,4], readyStates);
  this.assertEquals(200, req.status);
  this.assertEquals("Response", req.responseText);
}
```

Usually, the unit under test does not directly expose requests. Rather, some other part of the program calls the XMLHttpRequest constructor. Whenever the request is not directly available within the test (or complicated to access), each request created by the fake implementation can be retrieved with `getRequests()`.

```
"test: GET with qx.io.request.Xhr": function() {
  this.useFakeXMLHttpRequest();
  var req = new qx.io.request.Xhr("GET", "/");
  var fakeReq = this.getRequests()[0];

  // qx.io.request.Xhr indirectly uses an instance of XMLHttpRequest.
  // The test should not be concerned with the implementation detail
  // about how to retrieve the instance. Instead, getRequests()
  // above provides an implementation indepent way to retrieve the
  // used object.
  //
  // this.assertEquals(fakeReq, req.getTransport().getRequest());

  req.send();

  this.assertEventFired(req, "statusError", function() {
    fakeReq.respond(500, {}, "Error");
  });
  this.assertEquals(500, req.getStatus());
```

```
}
```

Create the Test Application

- Run `generate.py test` from the top-level directory of your application. This will generate the appropriate test application for you, which will be available in the subfolder `test` as `test/index.html`. Open this file in your browser and run your tests.
- Equally, you can invoke `generate.py test-source`. This will generate the test application, but allows you to use the *source* version of your application to run the tests on. In doing so the test application links directly into the source tree of your application. This allows for test-driven development where you simultaneously develop your source classes, the test classes and run the tests. All you need to do is to change the URL of the "test backend application" (the textfield in the upper middle of the Test Runner frame) from `tests.html` (which is the default) to `tests-source.html`. (Caveat: If `generate.py test-source` is the first thing you do, you might get an error when Test Runner starts, since the default tests.html has not been built; just change the URL and continue). For example, the resulting URL will look something like this:

  ```
  html/tests-source.html?testclass=<your_app_name>
  ```

  After that, you just reload the backend application by hitting the reload button to the right to see and test your changes in the Test Runner.
- If you're working on an application based on qx.application.Native or qx.application.Inline (e.g. by starting with an Inline skeleton), you can run `generate.py test-native` or `generate.py test-inline` to create a test application of the same type as your actual application. The Test Runner's index file will be called `index-native.html` or `index-inline.html`, respectively.

Test Runner Views

The Test Runner architecture is split between the logic that executes tests and the view that displays the results and allows the user to select which tests to run. Views are selected by overriding the `TESTRUNNER_VIEW` configuration macro, specifying the desired view class. For example, to build the Test Runner using the HTML view, use the following shell command:

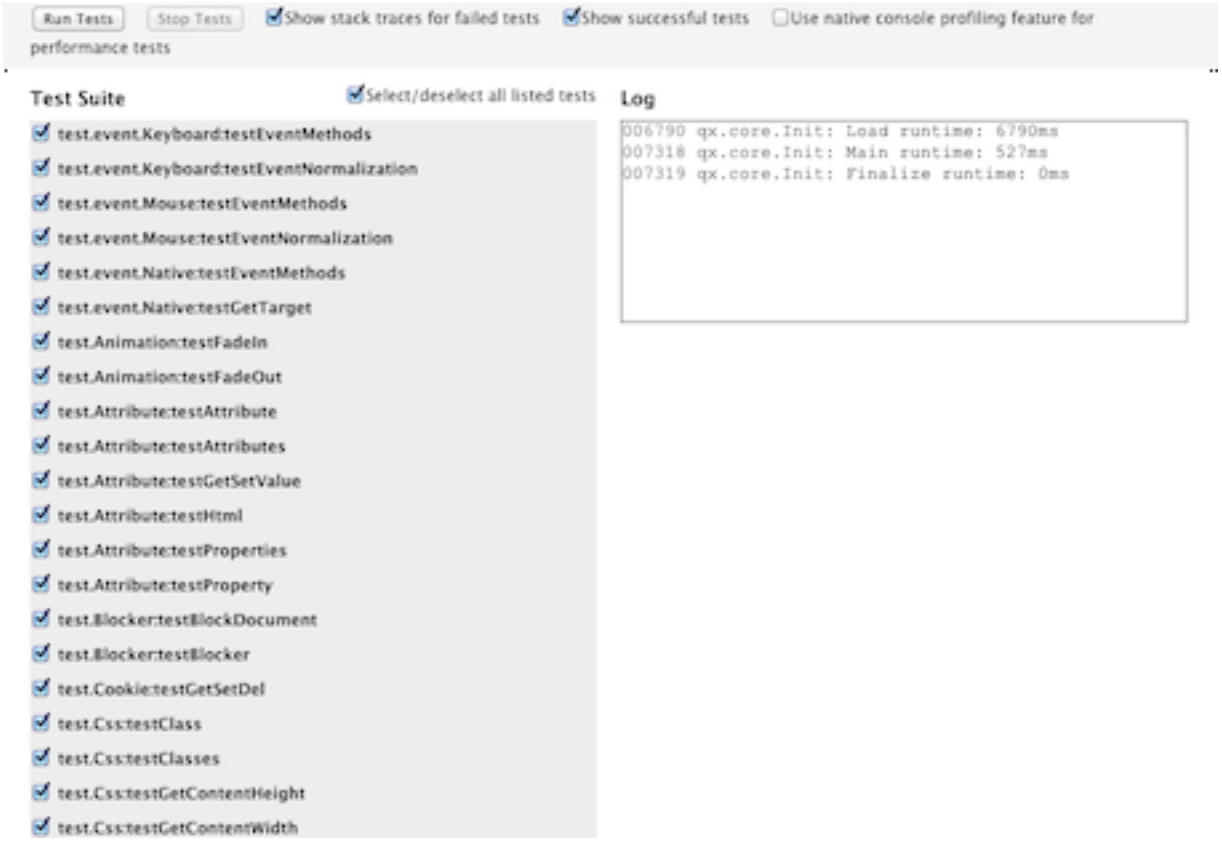
```
./generate.py test -m TESTRUNNER_VIEW:testrunner.view.Console
```

Several views are included with the Test Runner:

Widget

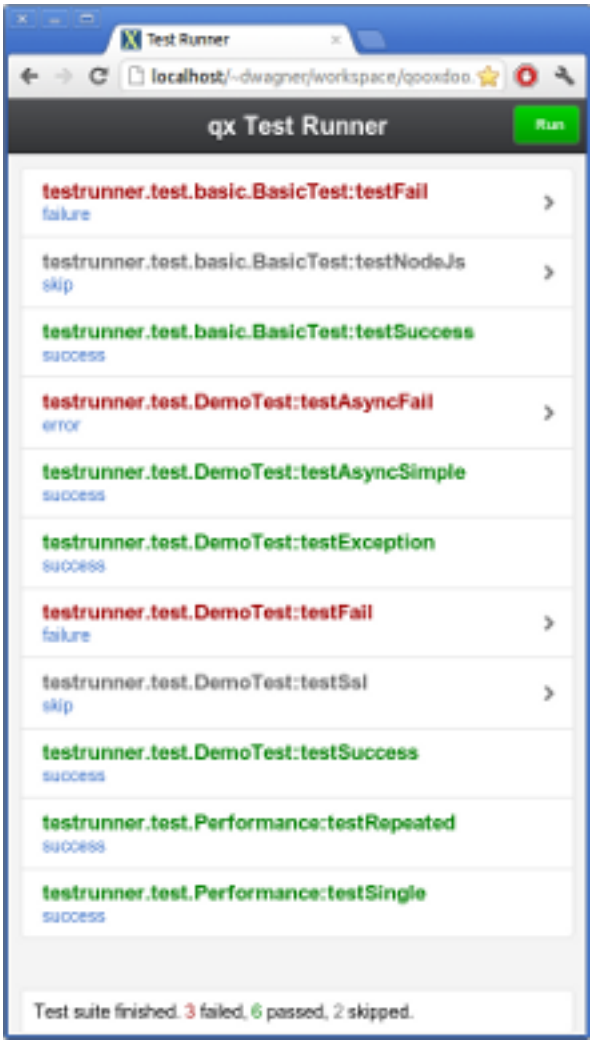
This is the default view used for the GUI, Native and Inline skeletons' *test* and *test-source* jobs. It is the most fully-featured and convenient to use, making heavy use of data binding to list available tests in a Virtual Tree and to visualize the results. The downside is that can it feel sluggish in environments with poor JavaScript performance.

HTML



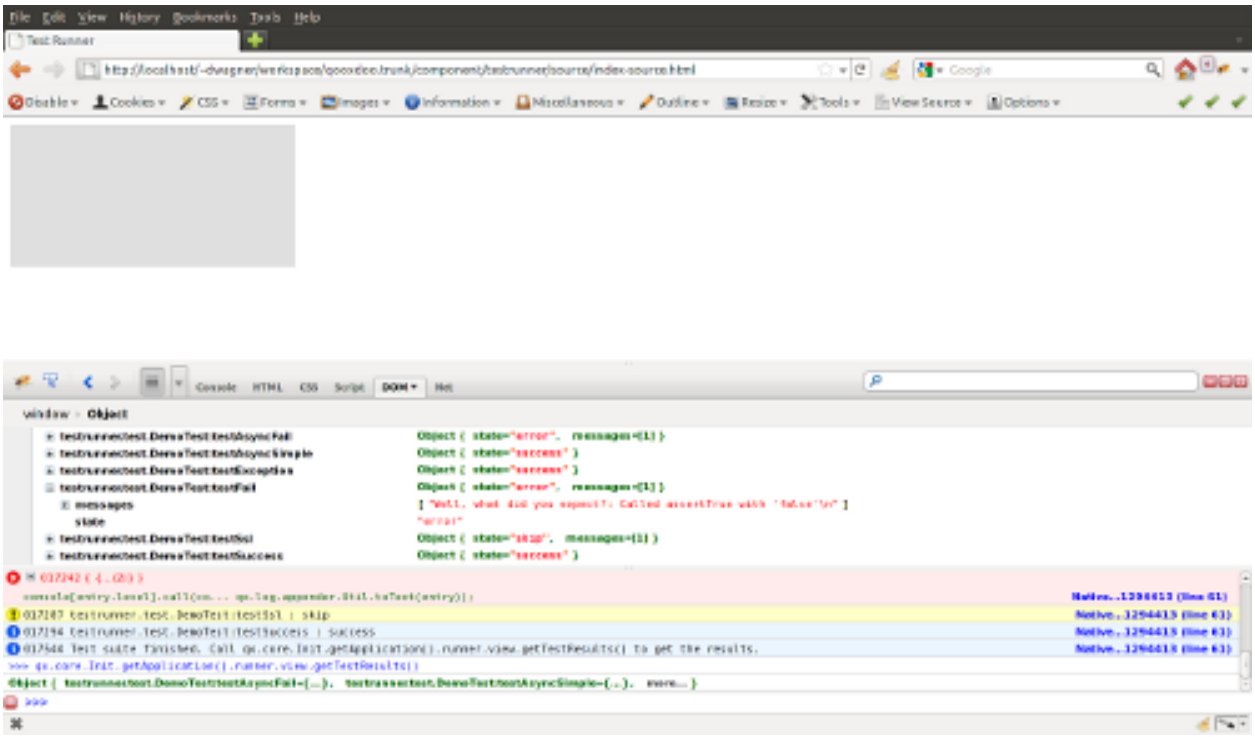
As the name indicates, this view uses plain (D)HTML instead of qooxdoo's UI layer. It is intended for usage scenarios where speed is more important than good looks.

Mobile



A view based on qx.Mobile's widget set. In an an application based on the *Mobile Skeleton*, run *generate.py test-mobile* or *generate.py test-mobile-source* to build a Test Runner with the Mobile view. For other application types, you'll need to add *test-mobile* and/or *test-mobile-source* to the top-level *exports* list in config.json first.

Console



Even more bare-bones than the HTML view, the Console view features no visual elements other than the Iframe containing the test application. Tests are started using the browser's JavaScript console. This is mostly intended as a base for specialized views.

Reporter

The Reporter is a specialized view used for automated unit test runs. Based on the Console view, it features (almost) no GUI. The test suite is automatically started as soon as it's ready. A method that returns a map of failed tests is its only means of interaction:

```
qx.core.Init.getApplication().runner.view.getFailedResults()
```

URI parameters

The following URI parameters can be used to modify the Test Runner's behavior:

- **testclass** Restrict the tests to be loaded. Takes a fully qualified class name or namespace that is a subset of the classes included in the test application, e.g. *custom.test.gui* or *custom.test.gui.PreferencesDialog*
- **autorun** Automatically execute all selected tests as soon as the suite is loaded. Takes any parameter, e.g. *1*.

Portable Test Runner

A stand-alone version of the qooxdoo's unit testing sub-system, requiring **no compile step** and with **no external dependencies**. It comes in the form of a single .js file that can simply be added to an HTML page along with the code to be tested and unit test definitions (as inline JavaScript).

Its main purpose is to provide a comprehensive unit testing framework including Assertions, Sinon, *Requirements* and a Test Runner GUI to developers working on non-qooxdoo JavaScript applications.

Example

The fictional non-qooxdoo JavaScript library `foo.js` provides a `Bar` class, with a constructor that takes a string parameter. This test checks if the `getName` method returns that string:

```
<!DOCTYPE html>
<head>
  <meta http-equiv="Content-Type" content="text/html; charset=utf-8" />
  <title>Test Runner</title>
  <script type="text/javascript" src="http://localhost/testrunner-portable.js"></script>
  <script type="text/javascript" src="http://localhost/foo.js"></script>
  <script type="text/javascript">
  testrunner.define({
    classname : "foo.Bar",

    __bar : null,

    setUp : function() {
      this.__bar = new foo.Bar("baz");
    },

    testName : function() {
      this.assertEquals("baz", this.__bar.getName());
    }
  });
  </script>
</head>
<body>
</body>
</html>
```

The important thing to note here is the map argument for `testrunner.define`: It's equivalent to the `members` section of a class extending qx.dev.unit.TestCase and including qx.dev.unit.MMock and qx.dev.unit.MRequirements, allowing full access to these APIs. Multiple test classes can be defined by additional calls to `testrunner.define`.

The `classname` key is optional. If present, its value will be used as the name of the test class, making it easier to create logical groups of tests. Otherwise, the generated classes will be named `TestN` where N is the running count of `testrunner.define` calls. All test classes will be grouped under the top-level name space `test`.

The Portable Test Runner can be downloaded from the Demo section of the qooxdoo website, or generated from within the SDK:

```
cd component/testrunner
generate.py portable-build
```

"Headless" Automated Unit Testing

In a Continuous Integration (CI) scenario, it can be very helpful to run unit tests automatically, perhaps as one step in an automated build process that is triggered either manually, in set intervals, or by changes to the project's sources. If any tests fail, the build could be marked as failed by the CI server and notifications sent to the developers.

It's possible to achieve this using a tool like WebDriver to remotely control a browser which runs the tests, but this would be a fairly complex task. Fortunately, there is a much simple solution: PhantomJS is a "headless" WebKit

browser that can be controlled through a JavaScript API. The qx-phantom Git repository provides a small script that loads the Test Runner in PhantomJS, gathers the results of the test suite, and logs them to the console.

The status code returned by the PhantomJS process on exit is the number of tests that failed. This is especially interesting if you are planning to integrate unit testing into a CI setup using Jenkins, or some other kind of automated workflow, such as commit hooks or reports.

Setup

1. Download or compile PhantomJS and add the binary to your path.
2. Get the script that drives PhantomJS by cloning the Git repository:

```
$ git clone https://github.com/qooxdoo/qx-phantom
```

3. Build the Test Runner for your project (named `myproject` in this example):

```
$ cd myproject
$ ./generate.py test -m TESTRUNNER_VIEW:testrunner.view.Console
```

Running the tests

Call the PhantomJS binary with the following arguments:

- The script from the Git repository (qx-phantom.js)
- The namespace of the tests you want to run
- The URL of the Test Runner. This can be an absolute URL if you're running a web server, or a file system path

```
$ phantomjs ../qx-phantom/qx-phantom.js myproject.test test/index.html
```

Debugging

To adjust the verbosity of the script, change the settings found at the top of the qx-phantom.js script. If you encounter any problems, set CONSOLE=true.

8.4.3 Simulator

Overview

The purpose of the Simulator component is to help developers rapidly develop and run a suite of simulated user interaction tests for their application with a minimum amount of configuration and using familiar technologies, e.g. qooxdoo-style JavaScript. To do so it uses a combination of qooxdoo's own toolchain, Mozilla's Rhino JavaScript engine and Selenium Remote Control.

Feature Highlights

The Simulator enables developers to:

- Define Selenium test cases by writing qooxdoo classes
- Use the JUnit-style setUp, test*, tearDown pattern

- Define test jobs using the qooxdoo toolchain's configuration system
- Utilize the standard Selenium API as well as qooxdoo-specific user extensions to locate and interact with qooxdoo widgets
- Capture and log uncaught exceptions thrown in the tested application
- Use Selenium Server to run tests in many different browser/platform combinations
- Write custom log appenders using qooxdoo's flexible logging system

How it works

Similar to *unit tests*, Simulator test cases are defined as qooxdoo classes living in the application's source directory. As such they support qooxdoo's OO features such as inheritance and nested namespaces. The setUp, testSomething, tearDown pattern is supported, as well as all assertion functions defined by qx.core.MAssert.

The main API that is used to define the test logic is **QxSelenium**, which means the DefaultSelenium API plus the Locator strategies and commands from the qooxdoo user extensions for Selenium.

As with qooxdoo's unit testing framework, the Generator is used to create a test runner application (the Simulator). User-defined test classes are included into this application, which extends qx.application.Native and uses a simplified loader so it can run in Rhino.

A separate Generator job is used to start Rhino and instruct it to load the Simulator application, which uses Selenium's Java API to send test commands to a Selenium server (over HTTP, so the server can run on a separate machine). The Server then launches the selected browser, loads the qooxdoo application to be tested and executes the commands specified in the test case.

Setting up the test environment

The following sections describe the steps necessary to set up Simulator tests for an application based on qooxdoo's GUI or Inline skeleton.

Required Libraries

The Simulator needs the following external resources to run:

- Java Runtime Environment: Version 1.6 is known to work.
- Selenium Server and Java Client Driver: Version 1.0.3 or later. All versions up to and including 2.26.0 are known to work. Newer versions should generally be OK as long as the Selenium API remains stable.
- Mozilla Rhino: Versions 1.7R1 through 1.7R3 are supported. **Version 1.7R4 does not work!**

The Java archives for the Selenium client driver and Rhino must be located on the same machine as the application to be tested. For Rhino, this means js.jar. Older versions of Selenium provide a single archive (selenium-java-client-driver.jar), while newer ones are split up into the actual driver (selenium-java-<x.y.z>.jar) and several external libraries found in the "libs" folder of the ZIP archive.

The Selenium Server (selenium-server.jar, or selenium-server-standalone.jar for newer releases) can optionally run on a physically separate host (see the Selenium RC documentation for details). The qooxdoo user extensions must be located on the same machine as the server (see below).

Generator Configuration

Unlike other framework components, the Simulator isn't ready to run out of the box: The application developer needs to specify the location of the required external libraries (Selenium's Java bindings and Mozilla Rhino). This is easily accomplished by redefining the *SIMULATOR_CLASSPATH* macro (in the application's config.json file; be sure to heed the *general information about paths* in config files):

```
"let" :
{
  "SIMULATOR_CLASSPATH" :
  [
    "../selenium/selenium-java-2.22.0.jar",
    "../selenium/libs/*",
    "../rhino/js.jar"
  ]
}
```

The "environment" section of the "simulation-run" job configures where the AUT is located and how to reach the Selenium server that will launch the test browser and run the test commands. The following example shows the minimum configuration needed to launch a Simulator application that will test the source version of the current application in Firefox 3 using a Selenium server instance running on the same machine (localhost):

```
"simulation-run" :
{
  "let" :
  {
    "SIMULATOR_CLASSPATH" :
    [
      "../selenium/selenium-java-2.22.0.jar",
      "../selenium/libs/*",
      "../rhino/js.jar"
    ]
  },

  "environment" :
  {
    "simulator.testBrowser" : "*firefox",
    "simulator.selServer" : "localhost",
    "simulator.selPort" : 4444,
    "simulator.autHost" : "http://localhost",
    "simulator.autPath" : "/${APPLICATION}/source/index.html"
  }
}
```

See the *job reference* for a listing of all supported settings and their default values. Additional runtime options are available, although their default settings should be fine for most cases. See the *simulate job key reference* for details.

Writing Test Cases

As mentioned above, Simulator test cases are qooxdoo classes living (at least by default) in the application's **simulation** name space. They inherit from simulator.unit.TestCase, which includes the assertion functions from qx.core.MAssert. Simulator tests look very similar to qooxdoo unit tests as they follow the same pattern of **setUp**, **testSomething**, **tearDown**. Typically, each test* method will use the QxSelenium API to interact with some part of the AUT, then use assertions to check if the AUT's state has changed as expected, e.g. by querying the value of a qooxdoo property.

Locating Elements

In order to simulate interaction with a qooxdoo widget, Selenium needs to locate it first. This is accomplished by using one or more of the locator strategies described on this page:

- *Locating elements*

Simulating Interaction

In addition to Selenium's built-in commands, a number of qooxdoo-specific methods are available in the simulator.QxSelenium and simulator.Simulation classes. Run **generate.py api** in the *component/simulator* directory of the qooxdoo SDK to create an API Viewer for these classes.

Test Development Tools

Selenium IDE

This Firefox plugin allows test developers to run Selenium commands against a web application, making it a very useful to debug locators and check if commands produce the expected results. In order to use Selenium IDE with the qooxdoo-specific locators and commands, open the Options menu and enter the path to the qooxdoo extensions for Selenium in the field labeled *Selenium Core extensions*, e.g.:

```
C:\workspace\qooxdoo-3.0-sdk\component\simulator\tool\user-extensions\user-extensions.js
```

Inspector

qooxdoo's *Inspector component* can provide assistance to test developers by automatically determining locators for widgets.

Generating the Simulator

The "simulation-build" job explained above is used to generate the Simulator application (in the AUT's root directory):

```
generate.py simulation-build
```

Note that the Simulator application contains the test classes. This means that it must be re-generated whenever existing tests are modified or new ones are added.

Starting the Selenium server

The Selenium server must be started with the *-userExtensions* command line option pointing to the qooxdoo user extensions for Selenium mentioned above:

```
java -jar selenium-server-standalone-2.22.0.jar -userExtensions <QOOXDOO-TRUNK>/component/simulator/t
```

Running the Tests

Once the Simulator application is configured and compiled and the Selenium server is running, the test suite can be executed using the "simulation-run" job:

```
generate.py simulation-run
```

The Simulator's default logger writes the result of each test to the shell as it's executed. The full output looks something like this:

```
================================================================================
    EXECUTING: SIMULATION-RUN
================================================================================
>>> Initializing cache...
>>> Running Simulation...
>>> Load runtime: 360ms
>>> Simulator run on Thu, 02 Dec 2010 15:57:30 GMT
>>> Application under test: http://localhost/~dwagner/workspace/myApplication/source/index.html
>>> Platform: Linux
>>> User agent: Mozilla/5.0 (X11; U; Linux i686; en-US; rv:1.9.2.12) Gecko/20101026 Firefox/3.6.12
>>> PASS  myapplication.simulation.DemoSimulation:testButtonPresent
>>> PASS  myapplication.simulation.DemoSimulation:testButtonClick
>>> Main runtime: 11476ms
>>> Finalize runtime: 0ms
>>> Done
```

Testing multiple browser/OS combinations

General

Since the Simulator uses Selenium RC to start the browser and run tests, the relevant sections from the Selenium documentation apply. Due to the special nature of qooxdoo applications, however, some browsers require additional configuration steps before they can be tested.

Firefox, Chrome

Firefox and Chrome are generally well supported by Selenium, just make sure to use a Selenium version that isn't (much) older than the browser you intend to use for testing.

Internet Explorer 6, 7, 8 and 9

Starting the server When testing with IE, the Selenium server **must** be started with the *-singleWindow* option so the AUT will be loaded in an iframe. This is deactivated by default so two separate windows are opened for Selenium and the AUT. IE restricts cross-window JavaScript object access, causing the tests to fail.

```
java -jar selenium-server-standalone.jar -singleWindow -userExtension [...]
```

Launching the browser To launch IE, the **iexploreproxy* launcher should be used. The **iexplore* launcher starts the embedded version of IE which in some ways behaves differently from the full-blown browser.

```
"simulation-run" :
{
  "environment" :
  {
    "simulator.testBrowser" : "*iexploreproxy",
    [...]
  }
}
```

8.4.4 Simulator: Locating elements

Selenium locators

Selenium offers several built-in locator strategies.

- Identifier locators are very fast and reliable, but IDs must be assigned manually by the application developer, e.g.:

```
firstButton.getContainerElement().getDomElement().id = "firstButton";
```

- XPath locators are not well suited for qooxdoo applications which usually consist of a great number of DOM elements that can take quite a while to traverse, especially when using wildcards. More importantly, the DOM is likely to change during the application's runtime, making XPath locators unreliable.
- The same caveat applies to DOM locators

qooxdoo-specific locators

These are custom locator strategies designed specifically for qooxdoo applications.

qxh Locator: Search the qooxdoo widget hierarchy

This strategy locates elements within the application's widget hierarchy by following relations between JavaScript objects. In order to achieve this, it uses a syntax that is very similar to XPath, but also differs in significant ways.

A qxh locator is a sequence of one or more location steps, separated by /. No leading or trailing / is allowed. All searches are anchored to the root object (which is either the Application object or the application root widget, see further down). During the search each location step selects an object which will be used as the root for the rest of the search. The following possibilities exist to specify a location step:

- **<string>** A simple string that cannot be resolved otherwise is taken to be the literal identifier of a JavaScript property of the current object. So a locator step of `mytoolbar` will signify a JavaScript property named `mytoolbar` on the current object.

```
qxh=mytoolbar
```

- **qx. ...** A string starting with qx. is taken to be a qooxdoo classname, e.g. qx.ui.basic.Label. It signifies a child which is an instance of the given class.

```
qxh=qx.ui.form.Button
```

- **child[N]** Signifies the Nth child of the object returned by the previous step.

```
qxh=child[3]
```

- **[@attrib{=value}]** Selects a child that has a property *attrib* which has a value of *value*. The specification of a value is optional. "Property" here covers both qooxdoo as well as generic JavaScript properties.

```
qxh=[@label=".*Label$"]
```

As for the values, only string comparisons are possible, but you can specify a RegExp as value as the comparisons will be RegExp matches.

- The special token * is a wildcard operator. It covers the semantics of XPath's // and *descendant-or-self* constructs. The wildcard can span zero to multiple levels of the object hierarchy. This saves you from always specifying absolute locators, e.g.

```
qxh=*/[@label="My Button"]
```

This will recursively search from the first level below the search root for an object with a label property that matches the string "My Button". As you might expect, these recursive searches take more time than other searches, so it is good advice to be as specific in your locator as possible. To that end, you can use multiple wildcards in the same locator, like

```
qxh=*/[@label="Section 3"]/[@page]/*/[@label="First Button"]
```

This will search recursively from the root for an object with label "Section 3" and then, assuming it is a ButtonView which has a page property, navigate to the corresponding page, where it again searches recursively for an item with label "First Button". This is much more effective than searching the entire object space with "*/[@label="First Button"]".

- **app:** Three special operators at the beginning of a locator specify which object space you want to search:
  - *app:* signifies the object space down from `qx.core.Init.getInstance().getApplication()`
  - *inline:* signifies the object space down from the root widget of a "qooxdoo isle" in an inline application. See this article for details.
  - *doc:* (or anything else for that matter, including nothing) signifies the object space down from the application's root widget, i.e. `qx.core.Init.getApplication().getRoot()`.

As with all Selenium locators, there are no set-valued results (as with generic XPath), and each locator has to come up with at most one result element. Therefore, for each location step, the first match wins, i.e. if there are multiple children that match the current specification, the first child is taken as the root for the rest of the search. Backtracking is only done for wildcard (*) searches.

qxhv Locator: Search visible widgets only

The `qxhv=` locator works just like `qxh=`, except that for each step, only qooxdoo widgets with the "visibility" property set to "visible" are considered. This means that no descendants of invisible container widgets will be found. In some cases, this can lead to unexpected results. For example, in many qooxdoo applications, the root folder of a qx.ui.tree.Tree is set to be invisible. In that case, the `qxhv` locator would never find the root node's descendants, even though they are visible in the GUI.

qxidv Locator: Search visible widgets using HTML IDs

The `qxidv=` locator searches for an HTML element with the given ID and looks at the qooxdoo widget it belongs to. Only if the widget is visible is the element returned, otherwise the locator will fail.

qxhybrid locator: Combine locator strategies

The `qxhybrid=` locator allows you to combine different locator strategies. It consists of multiple sub-locators separated by double ampersands (&&), each of which is applied to the DOM element returned by the previous locator. The first sub-locator can be of any supported type (qx* or any of Selenium's built-in locator types) while the following steps can be either qx* or XPath locators.

The primary use case for this strategy is testing applications where HTML IDs have been assigned to container widgets but not to child widgets such as e.g. list items (that may be generated during the application's runtime).

An example: Suppose an application contains a list widget (`qx.ui.form.List`) with the HTML ID "options". This is easy to find using Selenium's default ID locator:

```
options
```

Now in order to find a list item which has the label text "Foo", the following hybrid locator could be used:

```
qxhybrid=options&&qxh=[@label=Foo]
```

8.5 Code Organisation

8.5.1 Code Organisation Introduction

From a conceptual point of view there are only two broad categories in qooxdoo's programming model, **libraries** and **applications**.

Libraries are basically containers that hold resources of any kind, class files, JS code, images, html and translation files, you name it. In this sense, the framework class library and its resources is nothing more than a big library. *Applications* are artefacts that are built from the resources of these libraries. They are the "deliverables" that can be deployed, can be run under some runtime environment like a browser or Node.js, or are shipped to be consumed elsewhere. Libraries provide the "parts", applications are the "products" made from these parts.

What constitutes a library is its *Manifest.json* file which provides the main meta-data, and paths on disk which hold class code and resources. That's it, and this is exactly what most application *skeletons* create. So once you've run *create-application.py* the result can immediately be used as a library. (The fact that it has a main class which can be run as an application doesn't matter).

In contrast to libraries which hold the majority of all the files you deal with (hence this little saying that in qooxdoo *"everything is in a library"*), applications, which are basically generated artefacts, are related only with two standard files, `config.json` and `generate.py`, or more abstractly build configuration and build tool interface. That means you can put a qooxdoo configuration file anywhere on your file system, enter some paths to existing libraries and some build options, and invoking *tool/bin/generator.py* create a qooxdoo application right away. Bang! But for convenience these files are also included with the skeletons, making each skeleton a library (Manifest.json) and a build environment (config.json) at the same time [1].

8.5.2 Custom Libraries

Once your application has grown beyond a certain size, or when you start a second application that could re-use some of the code of the first, you start thinking about factoring code out into separately manageable units. This is when you create dedicated libraries.

In qooxdoo *all code* is organized in *libraries*. Also the code tree that holds your application's main class is, conceptually, a library. So even in the simplest skeleton you are already working *in* a library (the skeleton), *with* a library (the framework classes). Creating and using further libraries is only a repetition of that.

Creating a Custom Library

Just run *create-application.py*. The default application type ("desktop") is good enough for this purpose. If you have existing code that you want to put into the library, just move the files over to their new location under the *source/class/<namespace>* path. Don't forget to adapt the class name as given in the call to e.g. *qx.Class.define*. The name passed in this call has to match the path suffix of the class file, like *"<namespace>.Foo"*.

[1] *In addition to referring to a generated artefact that can e.g. run in a browser we sometimes speak about an "application" and mean the library which contains the main class, the one that will be used to start the entire application at runtime.*

If you don't plan to develop a small demo application along with the library classes, you could put away with the *Application.js* file that is part of every skeleton by default. But you could just as well keep this file, as it allows you to build an application in your library directly (also see further).

Using the Library

In an existing application, to use your new library you have to do two things.

Make it known to the Generator

You need to make the new library known to the existing application so it knows where to look for resources. In principle this means that every job that evaluates libraries (like *source*, *build*, etc.) needs to be informed about it through the *library* configuration key.

To make it easier for you, so you don't have to add the new library to each and every job individually, there is the *libraries* job. If you override this one, all standard jobs that use the *library* key will automatically inherit it:

```
"libraries" : [
  {
    "manifest": "path/to/new/library/Manifest.json"
  }
]
```

It suffices that you enter the new library, since other default libraries will be added automatically.

Use it in your Code

Now all you have to do is just to reference resources from the new library, e.g. a library class, in your code:

```
var c = new mylib.Foo();
```

"Building" the library itself

This was what you have to do to use the library in *another* application. But there is nothing to stop you from creating a little demo application in the library itself. This is quite useful as it helps you to develop your library API further without the need to test it in other (potentially more complex) applications which include it. Just keep the default *Application.js* class around and use it to instantiate and exercise classes from the library. You don't have to change anything in the library's *config.json*, as the "local" library is always included.

Without the main *Application.js* there is not much sense in running the application-generating build jobs of the tool chain, like "source" or "build", in the library directly. You can still run other jobs that do not create an application from your code, like "api", "test" or "lint".

Sharing a Namespace

You can share a common namespace prefix across libraries. This is especially interesting if you split up a large application into multiple libraries that can be developed independently. But it is important that every library has its own, individual namespace.

Let's illustrate that with an example. Imagine you have been developing your application to quite some size. You have already organized the classes in subdirectories of the namespace root, e.g. like this

```
source/class/myapp
               /model
                 Foo.js
               /view
                 Bar.js
               Application.js
```

Now you want to factor out the *model* and *view* components into their own libraries. In a suitable path you create two new skeletons:

```
$ create-application.py -n my_model -s myapp.model
$ create-application.py -n my_view  -s myapp.view
```

Now you can move *Foo.js* to the first library, into its *source/class/myapp/model/* path, and *Bar.js* to the second, into its *source/class/myapp/view/* path. So together with your initial application you now have three libraries, with namespaces *myapp*, *myapp.model* and *myapp.view*, respectively. The namespaces are all distinct, but share the common prefix *myapp*.

Mind that in the original situation *Foo*'s class id was *myapp.model.Foo*. This hasn't changed! The class id is the same in the new library, so you don't have to edit the class itself (i.e. its call to *qx.Class.define*), nor do you have to adapt any location referencing *Foo* in other code (like in *"var c = new myapp.model.Foo();"*). But strictly speaking the class was formerly allocated in a namespace *myapp* with a path of *model/Foo.js*, while now it is allocated in a namespace *myapp.model* with a path of *Foo.js*.

Speed up Cold-Cache Compile Time

Once you have settled in using an own library and the library's code is stable you can speed up usage of the library classes by running the *dependencies* job. This will create a file with dependency information for the library which can be used to compile your main application. (The SDK comes with such a file pre-compiled for the framework classes.) You can then work in your main application, even run *clean* and *distclean* jobs but the dependency information for your library will pertain.

The file will not be used, though, if you again modify code in the library, to make sure the information is always current. But you can re-run the *dependencies* job after a while when the code has stabilized.

8.5.3 qooxdoo-contrib

qooxdoo-contrib is qooxdoo's infrastructure for third-party code that is useful for other users building qooxdoo projects. A lot of those contributions take the form of qooxdoo libraries ranging from small helper classes to full-blown and complex widgets and themes. But you may also find server-side implementations for RPC's, translation files or simple auxiliary stuff. It is community-provided content, and is also used as an incubator area for the framework itself. Some contributions are actively maintained, others are rather stale, so you may find there code of any stage of maturity (and consequently, immaturity).

With qooxdoo 3.0 a new contribution infrastructure was introduced. The old contrib platform was *repository-based*, meaning that all contributions had to be in a certain source repository on SourceForge to be recognized as contributions. The new platform is *catalog-based*, meaning that it doesn't require that the contribution is in any particular data store or version control system. The catalog includes links where each specific contribution can be downloaded.

This page deals specifically with library-style contributions as they can be included in app development.

Library-style Contributions

There are basically two aspects to contributions

- the *user view*, meaning how to use a particular contribution in application development
- the *maintainer view*, meaning how to provide and maintain a particular contribution

User View

Contributions can be included in a configuration like any other libraries: You add an appropriate entry in the `library` array of your configuration. Like other libraries, the contribution must provide a *Manifest.json* file with appropriate contents.

If the contribution resides on your local file system, there is actually no difference to any other library. Specify the relative path to its Manifest file and you're basically set.

The really new part comes when the contribution resides online, and needs to be downloaded to be used. This is directly supported by the Generator. With running a compile job (e.g. *source*, *build*) the Generator will now query the catalog for that version of the contribution, evaluate the corresponding Json file, and access the download value. The corresponding contribution will be downloaded to the local disk and used as a library as usual.

In such a case you use a special syntax to specify the location a catalog Manifest file that pertains to the contrib's particular version. It is URL-like with a `contrib` scheme and will usually look like this:

`contrib://<ContributionName>/<Version>/<ManifestFile>`

The contribution source tree will then be downloaded from the repository, the generator will adjust to the local path, and the contribution is then used just like a local library. The local path where the contribution is placed is a subdirectory of the *cache/downloads* config key, which you can adapt.

When re-running the build job, the Generator will check if the contribution has changed, and will re-download it if that is the case.

Putting it all together here is an sample *config.json* snippet:

```
"jobs" : {
  "libraries" : {
    "library" : [{
      "manifest": "contrib://UploadMgr/0.5/Manifest.json"
      }
    ]
  }
  ...
}
```

(The wrapping in the predefined *libraries* includer job makes it easily available to build jobs).

Mind that this is **not** the Manifest file that is part of the library, but the catalog entry. Though they can be almost identical, the catalog Manifest will only be searched for the *info/download* key, and a few others related to downloading the contribution. The Manifest in the actual contribution library is then searched for e.g the *provides/class* key, to find the class path in the library.

contrib:// URIs and Internet Access As contrib libraries are downloaded from an online location you need Internet access to use them. Here are some tips on how to address offline usage and Internet proxies.

Avoiding Online Access If you need to work with a contrib offline, it is best to download it to your hard disk, and then use it like any local qooxdoo library. The simplest way to do this to download it using its *contrib://* URL once, then move the entire contribution from the download cache (use *generate.py info* to locate this) to some other path, and then adjust your *config.json* to match the new local path on disk. Moving it away from the download cache is so that it is not deleted when you run *generate.py distclean*.

Alternatively, you can download the archive directly. To find its download URL you go to the catalog repo, locate the catalog Manifest for the contrib's version, and pick the *info/download* URL from it. Then download and unpack the archive on your local disk, and adjust the *config.json* to reflect its path.

In any case you are now using the contribution like a local library. The only thing you are missing this way is the automatic online check for updates, where a newer version of the contrib would be detected and downloaded. You need to do this by hand, re-checking when you can, and re-downloading a newer version if there is one.

Accessing Online from behind a Proxy If you are sitting behind a proxy, here is what you can do. The generator uses the *urllib* module of Python to access web-based resources. This module honors proxies:

- It checks for a *http_proxy* environment variable in the shell running the generator. On Bash-like shells you can set it like this:

```
http_proxy="http://www.someproxy.com:3128"; export http_proxy
```

- If there is no such shell setting on Windows, the registry is queried for the Internet Options.
- On MacOS, the Internet Config is queried in this case.
- See the module documentation for more details.

The remainder of this chapter now details the maintainer view, or how to provide a contribution.

The Catalog - A Github Repo

The central piece of the contrib infrastructure is the catalog, it is like the index of known contributions. To make maintenance of the catalog simple and straight-forward, we decided to implement it as a Github repository. It will basically have the same directory structure you might know from the Sourceforge qooxdoo-contrib repo. Under a root path,

- the *contribution names* are top-level
- beneath each contribution there is a set of directories with *version names*, and potentially a general readme file.
- in each version directory is a *Manifest.json* file that applies to this particular version of the contribution

The Manifest.json file is exactly the Manifest file you know from qooxdoo libraries. The intent is that you can copy it straight over from your project to the catalog repo. You need to make sure, though, that all necessary fields in it will be filled, particularly the *info/download* field. A Generator job, *validate-manifest*, will help you with that.

In practice that means that maintaining your contribution in the catalog will require you to fork the catalog repo, make suitable changes like adding or updating the information about a contribution, and then issue a pull request. (This obviously also means you will need a Github account to be a contribution maintainer, but we hope this requirement to be trivial.) As soon as the request is merged into the main repo, using your contribution from an application's config.json will work.

Providing a Contribution

This was the general approach, now to the nitty-gritty.

Contributions come as Archives

The actual contribution code, i.e. the code somebody would download and use, needs to be provided through the Manifest's *info/download* URL. The value should be a HTTP(S) URL to an archive (like zip or tar.gz) ready to be downloaded.

The archive should contain a single root folder with arbitrary name, and beneath that the contents of the contribution. I.e. for a standard qooxdoo library the second level should contain its Manifest.json.

A SHA-1 checksum must then be calculated over the archive file, and the result be entered in the catalog's *Manifest.json/info/checksum* field (At this point the catalog's and the contrib's Manifest.json necessarily deviate from each other). This checksum is used to verify the downloaded archive later on the client side, and also to check for updates of the contribution.

Here are the corresponding Manifest.json entries for some Github-hosted contribution:

```
"info" : {
  "download" : "https://github.com/myuid/mycontrib/archive/master.tar.gz",
  "checksum" : "e3241b1e1c44c3620b07972411a15cf3f05cfa4c"
  ...
}
```

Supported Archive Formats The following archive formats/extensions are supported:

- .zip
- .tar
- .tar.gz
- .tgz
- .tar.bz2

Sourceforge-based Contributions For the time being we will support an exception from the above. If the contribution is still hosted at the old Sourceforge qooxdoo-contrib SVN repository, the download URL need not end in an archive name, but in the standard SVN URL for this contribution's version. (The current Sourceforge SVN interface doesn't support archive downloads anymore). The Generator will then use the old Web spidering to download the contribution to the client side. Here is an example:

```
"info" : {
  "download" : "http://svn.code.sf.net/p/qooxdoo-contrib/code/trunk/qooxdoo-contrib/SkeletonWidget/0
  ...
}
```

The *checksum* for such a contribution is not used. Rather, the SVN revision number from SourceForge will be used to detect updates.

Further manual keys

We added a *info/category* field to the Manifest file which allows you to label your contrib with one or more of these supported categories:

- theme
- widget
- drawing
- tool
- backend

We will use this information to categorize the contribs in a future web interface. If you provide more than one category, the first one will be regarded as primary category.

So an example would be:

```
"info" : {
  "category" : ["theme"],
  ...
}
```

Maintainer's Workflow

So the basic workflow for an author having a new revision of his contribution's version is:

- Create an *archive* containing the contribution and put it *online*.
- Edit the contribution's Manifest.json to contain the *download* location and a SHA-1 *checksum* over the archive.
- Copy this Manifest.json to the appropriate path in the *catalog* repo.
- Send a *pull request* for the catalog.

For an author choosing Github to host his contribution all this can be quite easily achieved (except for the checksum thing) by maintaining contribution versions as Git *branches* and exploiting the archive downloads that Github offers. You just use an URL like

`https://github.com/<user>/<contrib>/archive/<branch_name><archive_suffix>`

as the Manifest's download URL, with e.g. *branch_name* being *master* and *suffix* being *.zip*.

Future Work: Web Interface to the Catalog

We're planning to also have a web interface to the catalog that might be a bit nicer than using Github's code browsing facility, maybe together with searching and sorting capabilities.

8.6 Parts

8.6.1 Parts and Packages Overview

Note: This is an advanced feature. While it has been put to good use in various applications it requires special care when being deployed.

Motivation

Packages are a concept that allows you to partition your application physically. The idea is to spread the entire application over multiple JavaScript files, in order to optimize download and startup behaviour. On page load only the essential first part of the application is loaded (commonly called the *boot* part), while others remain on the server and will only be loaded on demand. As a consequence, the initial code part is smaller, so it's faster to download, consumes less bandwidth and starts up faster in the browser. Other parts are then loaded on demand during the user session. This incurs a bit of latency when the user enters a certain application path for the first time and the corresponding part has to be loaded. On the other side, parts that pertain to a certain application path (e.g. an options dialogue) never have to be downloaded if this application path is not entered during the running session.

Development Model

In order to realize this concept, you have the option to specify *parts* of your application, while the build process takes care of mapping these (logical) parts to physical packages that are eventually written to disk. At run time of your application, the initial package will contain loader logic that knows about the other parts.

There are two different but related terms here: You as the developer define **parts** of your application. These are logical or visual related elements, like all elements that make up a complex dialogue, or the contents of an interactive tab pane. The build process then figures out all the dependencies of these parts and collects them into **packages**, which eventually map to physical files on disk. Since some parts might have overlapping dependencies, these are optimized so that they are not included twice in different packages. Also, you might want to specify which parts should be collapsed into as few packages as possible, how small a package might be, and so forth. So you define the logical partitioning of your application and specify some further constraints, and the build process will take care of the rest, producing the best physical split of the entire app under the given constraints.

Loading Parts

In your application code, you then load the defined parts at suitable situations, e.g. when the user opens a dialogue defined as a part, using qooxdoo's PartLoader API. The PartLoader keeps track of which parts have already been loaded, and provides some further housekeeping. But it is your responsibility to "draw in" a given part at the right moment.

Consequently, the configuration of your application allows you to specify those logical parts of your application, by giving a suitable name to each and listing the top-level classes or class patterns for each. You are using these part names with the PartLoader in your application code. Further config keys allow you tailor more specifics, as mentioned above. See the *packages key* reference section for the config key nitty-gritty.

8.6.2 Using Parts

Basic Usage

Parts allow you partition your application into multiple Javascript files.There is an initial part, the *boot* part, that is loaded at application start-up. All other parts have to be loaded explicitly in your application code.

To use parts in your application, you have to do two things:

- declare the parts in your application's *config.json* configuration file
- load each part other than the boot part explicitly at suitable situations in your application code

Here is an example:

Suppose you have a settings dialog in your application that is only needed occasionally. You want to save the memory footprint of the involved classes, and only load the dialog on demand when the user hits an "Open Settings Dialog" button during a session. If the user doesn't invoke the dialog, the necessary classes are not loaded and the application uses less memory in the browser. In all cases, application start-up is faster since less code has to be loaded initially.

Add Parts to your Config

In your configuration file, add the following job entries (assuming you are using a standard GUI application with a name space of *custom*):

```
"my-parts-config":
{
  "packages" :
```

```
  {
    "parts"  :
    {
      "boot"     :
      {
        "include" : [ "${QXTHEME}", "custom.Application" ]
      },
      "settings" :
      {
        "include" : [ "custom.Settings" ]
      }
    }
  }
},

"source" :
{
  "extend" : [ "my-parts-config" ]
},

"build" :
{
  "extend" : [ "my-parts-config" ]
}
```

This will inject your part configuration into the standard build jobs (*source* and *build*), instructing the generator to generate JS files for the "boot" and the additional "settings" part (a single part may be made up of multiple JS files, depending on cross class dependencies with other parts). In the *boot* part, you are repeating the main *include* list of class patterns for you application (the example above mirrors this list of a standard GUI app). In the part you want to separate from the initial boot part, like *settings* above, you carve out some top-level classes or name spaces that constitute the part you want to specify. In our example, this is just the name of the top-level dialog class.

Add Part Loading to your Class Code

Next, you have to add code to your application to load any part other than the boot part. Carrying on with our example, at a suitable spot in your application code, you have to load the *settings* part, e.g. when some "Open Settings Dialog" button is pressed which is available from your main application class. We put the loading action in the click event listener of the button:

```
var settingsButton = new qx.ui.toolbar.Button("Open Settings Dialog");

settingsButton.addListener("execute", function(e)
{
  qx.io.PartLoader.require(["settings"], function()
  {
    // if the window is not created
    if (!this.__settingsWindow)
    {
      // create it
      this.__settingsWindow = new custom.Settings();
      this.getRoot().add(this.__settingsWindow);
    }

    // open the window
    this.__settingsWindow.center();
    this.__settingsWindow.open();
```

```
  }, this);

}, this);
```

The main thing to note here is that upon pressing the "Open Settings Dialog" button *qx.io.PartLoader.require* is invoked to make sure the *settings* part will be loaded (It doesn't hurt to invoke this method multiple times, as the PartLoader knows which parts have been loaded already).

The first argument to the *require* method is a list containing the parts you want to be loaded (just *"settings"* in our example). The second argument specifies the code that should be run once the part is successfully loaded. As you can see, the *custom.Settings* class which is loaded with this part is being instantiated.

This section also shows that you cannot run the same application with and without parts. In order to use parts, you have to "instrument" your application code with calls to *qx.io.PartLoader.require*, and currently there is no way these calls can fail gracefully. You have to make a decision.

These are the essential ingredients to set up and use parts in your application. For full details on the *packages* configuration key, see the *configuration reference*. For some additional usage information relating to this key, see this *article*. For a complete application that uses parts, check the Feedreader sources.

In Depth: Configuring the "include" Key of your Parts

The most crucial and at the same time most difficult aspect of using parts is configuring the parts in your *config.json*. More specifically, the definition of the *include* key for each part requires thought and consideration to get right. This section tries to give you a set of technical guidelines to help you with that.

"include" lists must be free of overlap Don't list classes in the *include* list of one part which also appear in another. This becomes less obvious when you use wildcards in your *include* lists: `[ "foo.bar.*" ]` overlaps with `[ "foo.bar.baz" ]`, and with `[ "foo.*" ]`! So think of what these expressions will expand to. The generator will complain should two *include* lists overlap.

Don't put load dependencies of one part in the "include" list of another This is even less obvious. The base line is that you must not have classes in the *include* list of one part that are needed by classes of another part at load time. (Mind that this is **not** only referring to the *include* list of the other part, but to all its classes!). A good criterion to follow is: Stick to classes that are only used in some **member method** of another class. Then you are usually on the safe side, and are only using classes for your part definition that are required by others at run time, not load time. (Counter examples would be classes that are used as super classes by others (they show up in their *extend* entry), or are used in the *defer* section of another class, or are used to directly initialize a map entry, like an attribute, of another class definition). The generator will complain if load dependencies of one part are listed in the definition of another.

Don't group classes "physically" That means: Don't think about how classes are organized in terms of libraries or name spaces. This is not a good defining principle for parts. Try to think in terms of **logical** or **visual** components, and let the generator figure out which classes from which libraries and name spaces need to go into that part. Visual or logical components usually map to *execution paths* in your running app. A dialog, a window, a certain tab view that are only reached when the user makes some specific interactions with your application, thus following a specific execution path in your code, those are good candidates for defining a part. Of course, e.g. when you are using a library or contribution in your application which exhibits one class as its published API and which you instantiate at one specific point in your application, this might also make for a good part, but would be merely coincidental.

Don't define parts with framework classes This is just a concrete example of the previous point, but happens so often that it merits its own mentioning. It is generally a bad idea to use framework classes to define a part. Framework classes should be free to be added where they are needed *by your classes' dependencies*. And although there are high-level widgets in the framework, like the DateChooser or the HtmlArea, you always have application code wrapped around them. Then it's good practice to forge this code into its own custom class, and make this class the entry point for a part.

Advanced Usage: Part Collapsing

This section reflects part collapsing, i.e. the merging of one package into another which reduces the number of packages a part depends on.

Motivation and Background

You as the application developer define *parts* to partition your application. qooxdoo's build system then partitions each part into *packages*, so that each part is made up of some of the set of all packages. Each package contains class code, and maybe some more information that pertains to it. So the classes making up a part are spread over a set of packages. Several parts can share one or more packages.

This way we obtain maximum flexibility for loading parts in your application. Whenever a part is requested through the *PartLoader* it checks which packages have already been loaded with earlier parts, and loads the remaining packages that complete the requested part. No class is loaded twice, and no unnecessary classes are loaded with each part.

The upper limit for the number of packages which are initially constructed from the definition of the parts is **(2 ^ number_of(parts)) - 1** (That is two to the power of the number of parts, minus one). E.g. if you have defined 3 parts, the initial number of packages can be 7. (This is due to the fact that each package is defined by the set of classes that are required by the same parts). But there are situations where you might want to give up on this optimal distribution of classes across packages:

- when packages become **too small**; sometimes packages derived with the basic procedure turn out to be too small, and the benefit of loading no unnecessary classes is outweigh by the fact that you have to make an additional net request to retrieve them.
- when you know the **order** in which parts are loaded during run time in advance; then it makes sense to be "greedy" in retrieving as many classes as possible in a single package, as other parts needing the same classes of the (now bigger) package, but are known to load later, can rely on those classes being loaded already, without being affected by the extra classes that get loaded.

These are situations where *part collapsing* is useful, where packages are merged into one another. This is discussed in the next sections.

How Packages are Merged

(This is a more theoretical section, but it is kept here for the time being; if you are only looking for how-to information, you can skip this section).

During what we call part collapsing, some packages are merged into others. That means the classes that are contained a source package are added to a target package, and the source package is deleted from all parts referencing it.

Obviously, it is crucial that the target package is referenced in all those parts where the source package was referenced originally, so that a part is not loosing the classes of the source package. This is taken care of by the selection process that for any given source package picks an appropriate target package. (Target packages are searched for in the set of already defined packages, and there are no new packages being constructed during the collapsing process).

After the source package has been merged into the target package, and has been removed from all parts, there are two cases:

- For parts that referenced both (source and target) package initially, there is no difference. The same set of classes is delivered, with the only difference that they come in one, as opposed to two, packages.
- Parts that only reference the target package now reference more classes then they really need. But this should be acceptable, as either negligible (in the case of merging packages by size), since the additional weight is marginal; or as without negative effect (in the case of merging by load order), since the "overladen" package is supposed to be loaded earlier with some other part, and will already be available when this part is loaded.

Collapsing By Package Size

Collapsing by package size is straight forward. You can specify a minimal package size (in KB) that applies to all packages of your application. If a package's size, and it is its *compiled* size that matters here, is beneath this threshold the package will be merged into another. This avoids the problem of too much fragmentation of classes over packages, and trades optimally distributing the classes (to always load only necessary classes) for minimizing net requests (when loading packages for a part).

Collapsing by size is disabled by default. You enable it by specifying size attributes in your parts configuration:

```
"packages" :
{
  "sizes"    :
  {
    "min-package" : 20,
    "min-package-unshared" : 10
  },
  ...
}
```

The *min-package* setting defines a general lower bound for package sizes, the *min-package-unshared*, which defaults to *min-package* if not given, allows you to refine this value specifically for those packages which pertain to only one part.

Collapsing By Load Order

Collapsing by load order is always useful when you know in advance the order of at least some of your parts, as they are loaded during the app's run time. This is e.g. the case when you have a part that uses other parts to do its work (a big dialogue that has sub-controls like a tabview). The enclosing part is always loaded before its sub-parts can be used. Or there is a part that is only accessible after it has been enabled in another part. These situations can be captured by assigning a load order to (some of) your parts in your configuration.

```
"packages" :
{
  "parts"  :
  {
    "boot" :
    {
      "include"   : [ "${QXTHEME}", "app.Application" ]
    },
    "some-part" :
    {
      "include"   : [ "app.Class1", "app.Class2" ],
      "expected-load-order" : 1
    },
    "other-part" :
    {
      "include"   : [ "app.Class3", "app.Class4" ],
      "expected-load-order" : 2
    },
    ...
  },
  ...
}
```

The *boot* part has always the load index 0, as it is always loaded first. The other parts that have a load index (1 and 2 in the example) will be collapsed with the expectation that they are loaded in this order. Parts that don't have an

expected-load-order setting are not optimized by part collapsing, and there are no assumptions made as to when they are loaded during run time.

The important thing to note here is that the load order you define is **not destructive**. That means that parts are still self-contained and will continue to function *even if the expected load order is changed during run time*. In such cases, you only pay a penalty that classes are loaded with a part that are actually not used by it. But the overall functionality of your application is not negatively affected.

8.6.3 Further Resources

- *Generator Configuration*
- qooxdoo API

8.7 Internationalization

8.7.1 Internationalization

We define internationalization (a.k.a. *"I18N"*) as composed of two distinct areas:

Localization Adapting software to suit regional customs regarding date, time and number formatting, names for time units, countries, languages and so forth.

Translation Translating user-visible strings in software, like labels on buttons, pop-up messages, headings, help texts, and so forth.

Localization largely relies on approved standards that are in use in any given regional and/or cultural area, and can therefore take advantage of standardized data and information. Translation is much more application-specific, and the relevant strings of an application have to be translated in any target language individually.

Localization

Localization is the effort of displaying data in a way that conforms to regional and/or cultural habits. This mostly affects data of everyday life: monetary currencies, names and display formats used in dates and time, number formats and naming conventions in general (e.g. names of countries and languages in the world), to list the most common use cases. Writing a date as 01/31/1970 rather than 1970/01/31, or starting the week with Sunday rather than Monday fall in this category.

A coherent set of these conventions taken together is usually referred to as a locale, and they are signified by a country code or some derivative thereof. *en*, *en_US* and *en_UK* for example signify three distinct locales that are used in English speaking countries. The understanding is that there is a sort of inheritance relation between more general and more specific locales, so that e.g. *en_US* only needs to specify the items in which it deviates from the more general *en* locale, and relies on the *en* settings for all other on which they agree. For historical reasons there is a common "ancestor" to all locales which is called *C*. If not specified all locale settings fall back to those given in *C* (which is mostly a copy of *en*). qooxdoo supports this fall-back chain of locale settings by looking up a specific item e.g first in *en_US* (if that were the current locale), then *en* and then in *C*.

To support such regional settings, qooxdoo uses data from the CLDR project, the *"Common Locale Data Repository"*, which collects data for known locales in a set of XML files. See the project's home page and terms of use.

Translation

While translating a sentence from one human language into another is still a task mostly done by humans, qooxdoo tries to provide tools to help in managing this process. This section describes how to translate either a new or an existing qooxdoo-based application. It shows how to *prepare* the application, *extract* the messages that shall be translated, and finally *update* and *run* the translated application.

Prepare the Application

To translate an application, all translatable strings must be marked using one of the following functions:

- `this.tr()`: translate a message
- `this.trn()`: translate a message that supports a plural form
- `this.trc()`: translate a message and providing a comment
- `this.marktr()`: mark a string for translation, but do not perform any translation

You can use these methods right away for your own classes if they are derived from `qx.ui.core.Widget` or `qx.application.AbstractGui`. If that's not the case you have to include the mixin `qx.locale.MTranslation` manually:

```
qx.Class.define("custom.MyClass",
{
  extend : qx.core.Object,
  include : [qx.locale.MTranslation],
  ...
});
```

Example Change original code like this:

```
var button = new qx.ui.form.Button("Hello World");
```

to:

```
var button = new qx.ui.form.Button(this.tr("Hello World"));
```

Following, the four methods are explained in more detail:

tr Example:

```
var button = new qx.ui.form.Button(this.tr("Hello World"));
```

tr marks the string `"Hello World"` for translation (This string is often referred to as the *message id*, as it serves as the lookup key for any provided translation). This means that the string itself will be extracted when the appropriate generator job is run (see *further*). During application run time, *tr* returns the translation of the given string *under the current locale*. That means, the actual string you get at this point in time depends on the locale in effect. If, on the other hand, the environment setting *qx.dynlocale* is set to "true", *tr* returns an instance of `qx.locale.LocalizedString`. The `toString()` method of the returned object performs the actual translation based on the current locale. This has the advantage that later changes to the locale (see *further*) are immediately reflected in the widgets using this object, as most know how to handle and re-evaluate LocalizedString's. But you only need that setting if you plan to support locale switching during run time.

If the string given to *tr* does not have a translation under the current locale, the string itself will be returned.

There is one exception to the simple rule that all strings can just be replaced by wrapping them in an appropriate `this.tr()` function call: If init values of *dynamic properties* are meant to be localizable, the init value has either

to be set in the class constructor using `this.tr()`, or `qx.locale.Manager.tr()` has to be used inside the property declaration. See documentation on *Defining an init value* for details.

trn Example:

```
var n = 2;
var label = new qx.ui.basic.Label(this.trn("Copied one file.", "Copied %1 files.", n, n));
```

Like *tr*, translates a message but takes differences between singular and plural forms into account. The first argument represents the singular form while the second argument represents the plural form. If the third argument is 1 the singular form is chosen, if it is bigger than 1 the plural form is chosen. All remaining parameters are the inputs for the format string.

trc Example:

```
var label = new qx.ui.basic.Label(this.trc("Helpful comment for the translator", "Hello World"));
```

Translates the message as the *tr* method, but provides an additional comment which can be used to add some contextual information for the translator. This meaningful comment should help the translator to find the correct translation for the given string.

marktr Sometimes it is necessary to mark a string for translation but not yet perform the translation. Example:

```
var s = this.marktr("Hello");
```

Marks the string `Hello` for translation and returns the string unmodified.

Format Strings Since sentences in different languages can have different structures, it is always better to prefer a format string over string concatenation to compose messages. This is why the methods above all support format strings like `Copied %1 files` as messages and a variable number of additional arguments. The additional arguments are converted to strings and inserted into the original message. `%` is used as an escape character and the number following `%` references the corresponding additional argument.

Extract the Messages

After the source code has been prepared, the desired languages of the application may be specified in `config.json`, in the `LOCALES` macro within the global `let` section, for example

```
"let" :
  {
    // ...
    "LOCALES"       : ["de", "fr"]
  },
```

This would add a German and a French translation to the project. For a more exhaustive list of available locales see here.

A run of

```
generate.py translation
```

will generate a `.po` file for each configured locale, with all translatable strings of the application (These files are usually stored in the `source/translation` folder of the application).

If a specified translation does not yet exist, a new translation file will be created. In this example two files, `source/translation/de.po` and `source/translation/fr.po`, would be created.

If such a file already exists, the newly extracted strings will be merged with this file, retaining all existing translations. Therefore, you can re-run `generate.py translation` as often as you want. You should re-run it at least whenever you introduced new translatable strings into the source code, so they will be added to the .po files (see *further*).

Translate the Messages

These `.po` files are the actual files you - or your translator ;-) - would have to edit. Since qooxdoo internally uses well-established tools and formats for internationalization (GNU gettext via polib), any "po"-aware editor or even a simple text editor can be used.

Some of the programs that support manipulation of `.po` files are:

- Poedit (Windows, Mac OS X, Linux)
- LocFactory Editor (Mac OS X)
- Lokalize (Linux)
- Gtranslator (Linux)

If you want to know more about the details of `.po` files, see *The Format of PO Files*.

Update the Application

After editing and saving the `.po` files, the next `generate.py source` run integrates the translations into your application's source version. To get the effect of the new translations it can simply be reloaded in your browser.

If the source code changes, e.g. by adding, removing or changing translatable strings, it can be merged with the existing translation files just by calling `generate.py translation` again. Moreover, each `generate.py source` - or `generate.py build` if you are about to deploy your application - will pick up all current translatable strings from the source files and will merge them on the fly with the information from the .po files, using the result for the corresponding build job. This way, the generated application always contains all current translatable strings (But of course only those from the .po files can have actual translations with them).

Run the translated Application

By default qooxdoo tries to use the browser's default language as its locale. You can change the language of the application by using `qx.locale.Manager`. For example, the following sets the language of the application to French:

```
qx.locale.Manager.getInstance().setLocale("fr");
```

The qooxdoo widgets are supposed to update their contents on a locale change. Custom widgets may have to be modified to allow for an update on locale change. To inform the application of a language change, qooxdoo fires a `changeLocale` event.

A widget that needs custom update logic may listen to this event:

```
qx.locale.Manager.getInstance().addListener("changeLocale", this._update, this);
```

- *PO File Cheat Sheet*

8.8 Documenting Code

8.8.1 Writing API Documentation

For documenting the qooxdoo API special comments in the source code (so-called "doc comments") are used. The doc comments in qooxdoo are similar to JSDoc comments or Javadoc comments. To account for some qooxdoo specific needs there are certain differences to the two systems mentioned above. For a complete treatment of the syntax see the *JSDoc reference*.

An introductory example

Doc comments are specially formatted comment blocks enclosed by `/**` and `*/`. A typical use case is to put them in front of a method definition. You start with a general description of the method, and then add sections that start with `@` followed by a special key that describes e.g. a parameter or the return type of the method. Here is an example:

```
/**
 * Shows a message to the user.
 *
 * @param text {string} the message to show.
 */
showMessage : function(text) {
  ...
}
```

The `@param` attribute entry describes the parameter `text`. Description texts may also include markup for highlighting and structure.

Here is a longer example that covers an entire class file:

```
/**
 * General class description.
 */
qx.Class.define("mypackage.MyClass",
{
  extend : blubb.MySuperClass,

  /**
   * Constructor description.
   *
   * @param param1 {Integer} description of first parameter\
   */
  construct : function(param1) {
    ...
  }
});

properties :
{
  /** Property definitions. */
  "myProperty" :
   {
      check : "Number",
      init : 0
   }
},
```

```
members :
{
  /** Method description */
  myMethod : function(bla, blubb)
  {
    ...
  }
},

statics :
{
  /** Static method description */
  myStaticMethod : function(bla, blubb)
  {
    ...
  },

  /** Constant description */
  MY_CONSTANT : 100
},
```

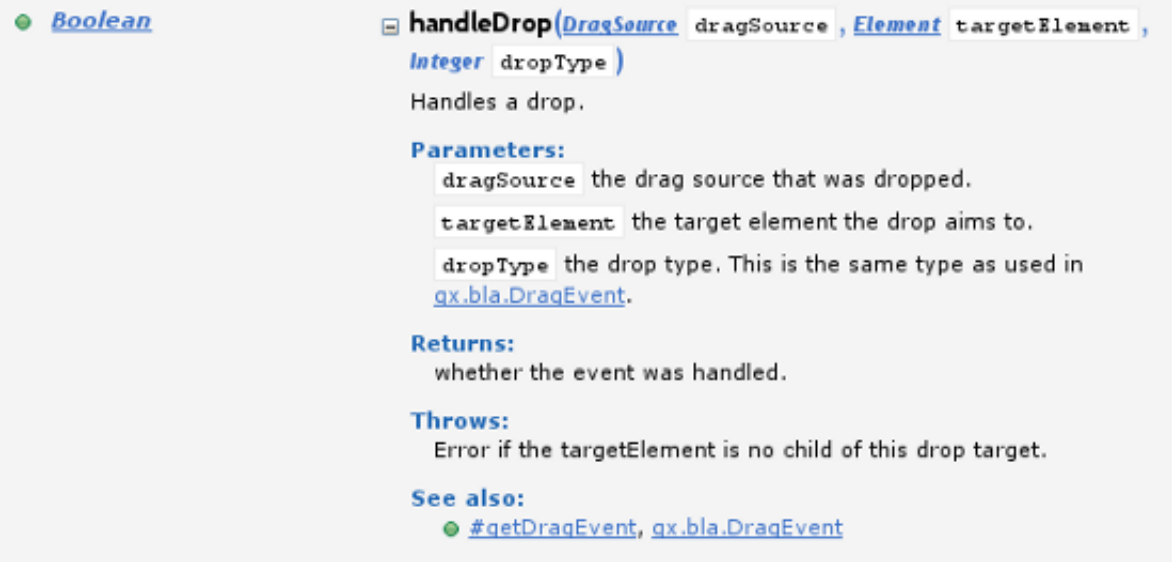
The class description is taken as the first comment in the file which starts with `/**`. Therefore if you have a comment at the start of the file which has a first line of `/**********`, that will be taken as the class description, overriding any comment above the class itself. Therefore use `/* *********` or `/* ==========` etc.

Advanced Doc Comments

Here is a more advanced example of a method documentation block that uses more `@` keys to provide structured information about the method.

```
/**
* Handles a drop.
*
* @param dragSource {qx.bla.DragSource} the drag source that was dropped.
* @param targetElement {Element} the target element the drop aims to.
* @param dropType {Integer ? null} the drop type. This is the same type
*        as used in {@link qx.bla.DragEvent}.
* @return {Boolean} whether the event was handled.
* @throws {Error} if the targetElement is no child of this drop target.
*
* @see #getDragEvent
* @see qx.bla.DragEvent
*/
handleDrop : function(dragSource, targetElement, dropType) {
  ...
}
```

This will render in the Apiviewer similarly to this:



As mentioned above the *JSDoc reference* has the complete list of possible section keys and markup possibilities.

Package documentation

While documenting a class files where JSDoc comments are interleaved with the class code seems straight forward, this is not so obvious if you want to provide documentation for a *package*, i.e. a collection of classes under a common namespace (like *qx.ui.core*, *qx.util*, etc.).

In order to fill this gap you can add a `__init__.js` file to the package. This file should contain only a single JSDoc comment that describes the package as a whole. These files are then scanned during a `generate.py api` run and the documentation is inserted at the package nodes, together with a list of classes of the corresponding package, in the documentation tree. See the API documentation for the framework packages as examples.

8.8.2 JSDoc Reference

The declarative language used in JSDoc-like comments in qooxdoo has grown including specific extensions, maybe in some cases deviating from the official implementation, so it makes sense to summarize the supported constructs.

Overall JSDoc Structure

A doc comment appears right before the structure (class, property, method or constant) it describes. It begins with `/**` and ends with `*/`. The rows in between start with a `*` followed by the text of the particular row. Within this frame there is a description text at the beginning. Afterwards attributes may follow, describing more aspects.

Description texts may also include HTML tags for a better structuring.

An example:

```
/**
* Handles a drop.
*
* @param dragSource {qx.bla.DragSource} the drag source that was dropped.
* @param targetElement {Element} the target element the drop aims to.
* @param dropType {Integer ? null} the drop type. This is the same type
*        as used in {@link qx.bla.DragEvent}.
* @return {Boolean} whether the event was handled.
```

```
* @throws if the targetElement is no child of this drop target.
*
* @see #getDragEvent(dragSource, elem, x, y)
* @see com.ptvag.webcomponent.ui.dnd.DragEvent
*/
handleDrop : function(dragSource, targetElement, dropType) {
  ...
};
```

Inline Markup

Running text can be formatted using inline markup which uses special characters around the target text:

- *strong* (will render as **strong**)
- __emphasis__ (will render as *emphasis*)

There is no escape character, so in order to e.g. enter a literal "@" into the text, use the HTML entity equivalent ("*@*" in this case).

HTML

There is limited support for HTML markup. You should be able to use all of the character-level tags, like `<a>` or `<code>`, as well as paragraph-level tags like `<p>` or `<ul>`. `<pre>` is particularly suited for code snippets, as it allows you to add syntax highlighting for JavaScript with `<pre class="javascript">`.

Attributes / Documentation Tags

After the general description text there may follow any number of attributes or "documentation tags" (as the JSDoc3 spec calls them). They all have a common general syntax:

```
'@' <key> <key_data>
```

That is they all start with an at-sign, `@`, as the first thing on a line within the JSDoc comment block. Then follows a special key from a pre-defined set of keys, like *param*, *return*, *throws* and the like. The key data is then key-specific and varies a bit. There might be keys that have no data at all. Some use a parenthesized syntax to indicate arguments (like *"@ignore(foo)"*), other use a more verb-like syntax (like *"@deprecated {3.0} use bar instead"*). Many of them allow free comment text at the end. See the Section Reference for a full list of supported attributes and their individual syntaxes.

A new attribute entry or the end of the JSDoc comment terminate an attribute specification. Attributes may stretch across multiple lines. Lines following an attribute key are logically appended to the first line (i.e. the effect is as if you had written one long line).

You can **comment out** an attribute by just prefixing it with another `@`, like

```
@@ignore(foo)
```

Then this attribute will simply be ignored.

The following sections before the reference list of supported attributes give some general information that apply to some of them.

Handling of Data Types

Because JavaScript has no strong typing, the types of the parameters accepted by a method may not be read from the method's definition. For showing the accepted types in the API documentation the data type may be specified in the doc attributes `@param` and `@return`.

The following type indicators are accepted:

Primitive	`var`, `void`, `undefined`
Builtin classes	`Object`, `Boolean`, `String`, `Number`, `Integer`, `Float`, `Double`, `Regexp`, `Function`, `Error`, `Map`, `Date`, `Element`
Other classes	Here the full qualified name is specified (e.g. `qx.ui.core.Widget`). If the referenced class is in the same package as the currently documented class, the plain class name is sufficient (e.g. `Widget`).
Lists	Homogenous lists are indicated by adding one or more `[]` to the type, e.g. `String[]`, `Integer[][]`.

Syntax of a Type Specification

Here is the full syntax for a type specification as used in concrete doc attributes:

```
'{' [ Type1 '|' Type2 '|' ... [ '?' [<default_value]]  ] '}'
```

That is, between curly braces an optional list of type indicators (as described above), separated by `|`, following an optional `?` to indicate the entire parameter is optional, followed by an optional default value (the last two for `@param` attributes).

For a parameter description the meaning is: The expected parameter can be of Type1 or Type2 or ..., is optional, i.e. can be left out, and will default to *<default_value>*.

Example

```
{String|Integer ? null}
```

Matching of Names in Code

Many of the JSDoc keys take some sort of symbol names as parameters, e.g. the `foo` in `@ignore(foo)`, which are then matched against names found in the code. These parameters include global variables, built-in functions, function arguments, namespaces, and the like. It is important that you are aware of the semantics of those parameters, i.e. the way they are used to establish a match with a name actually found in the code. The left arrow in the schematics, `->`, can be read as "matches".

- **Exact Match**

  The name matches the parameter exactly. Some keys restrict themselves to exact matches, e.g. the *alert* in `@lint ignoreDeprecated(alert)` will only match the global symbol *alert* in the code, neither *aler* nor *alerty* nor *alert.foo*.

  ```
  foo (parameter) -> foo (name)
  ```

  The following match types include exact match, but also allow other kinds of matches. Non-exact matches always honor object boundaries (not just simple string prefixes), so e.g. `foo` might match `foo.bar` but will never match `foobar`.

- **Prefix Match**

The name matches a prefix of the parameter. Some keys regard the name from the code as a (pot. complete) prefix of their parameters. E.g. if you use `foo.bar.baz` as a parameter, `foo`, `foo.bar` and `foo.bar.baz` will be matched.

```
foo.bar (parameter) -> foo (name)
```

- **Extension Match**

  The parameter matches a prefix of the name. Some keys regard the parameter as a prefix of the name from the code, again usually restricting it to object boundaries. In that case, a name `foo.bar` will match a parameter of `foo`, while the name `foozy` will not.

  ```
  foo (parameter) -> foo.bar (name)
  ```

- **Wildcard Match**

  Some keys need an explicit, glob-style wildcard at the end to support extension matches. In that case you need to provide a parameter like `foo.*`, in order to match a name of `foo.bar` from the code . Again, a match has to honor object boundaries. In the case of a wildcard like `foo.*`, a simple `foo` will also be matched, so the exact match (without dot and wildcard) is included.

  ```
  foo.* (parameter) -> foo.bar (name)
  ```

The individual tags should make it clear which of those match semantics they use when checking actual code names. Many keys will allow not only one parameter, but a list of parameters. Matching is then applied to each parameter in turn, and if one of them matches the key applies.

Section Reference

A JSDoc comment consists of different sections, where a section is either a leading text, the description, or an entry starting with an `@` attribute. Here is a complete list of the supported sections.

Overview

API Documentation	• Description • @abstract • @childControl • @deprecated • @internal • @link • @param • @protected • @return • @see • @signature • @throws • @type
Lint Checking	• @lint
Compiler	• @cldr • @asset • @attach • @attachStatic • @ignore • @require • @use
Extra	• @tag

Description

Description

General description of the item the JSDoc comment refers to.

Syntax

Free text, without any leading `@` attribute, containing HTML and/or markup, and some `@` attributes that may be embedded in text (see further). If given must be the first section in the doc comment.

@abstract

Scope

methods

Description

Used to signify abstract methods in regular classes.

Syntax

```
@abstract
```

@childControl

Scope

class

Description

In a class description of a widget that is composed of various sub-widgets the `@childControl` entry informs about those sub-widgets. This is relevant for users that want to apply a *custom theme* to the widget (the name is the default appearance ID), or implement *own widgets* that derive from this.

Syntax

```
@childControl <name> { <type> } [<description>]
```

Parameters

name	An identifying name for the child control
type	The *type specification* of the child control widget
description	*(opt.)* What the child control is used for in the context of this widget

Example

```
@childControl title {qx.ui.basic.Label} caption of the window
```

@param

Scope

functions

Description

Describes a parameter. `@param` is followed by the name of the parameter. Following that is the type in curly brackets (Example: `{Integer}`), followed by the description text.

Syntax

```
@param <name> { <type> } [<description>]
```

Parameters

name	Name of formal parameter to function
type	A *type specification* like `{Boolean	Integer ? 0}`
description	*(opt.)* Descriptive text of the parameter

Example

```
@param foo {Integer} The main factor
```

@protected

Scope

functions

Description

Marks the method as protected. This is helpful if for some reason a protected method name cannot start with "_" (single underscore). With this attribute the Apiviewer can still classify the method as protected.

Syntax

```
@protected [<description>]
```

Parameters

description	*(opt.)* Descriptive text of the parameter

Example

```
@protected
```

@type

Scope

Data

Description

`@type` is usually used to document data items, esp. when the type is not immediately apparent in the code. This is for example the case when a class member is initialized with `null` and a value of some other type is then assigned in the constructor, so as to not share a single data value across multiple instances.

Syntax

```
@type { <type> } [<description>]
```

Parameters

type	A *type indicator* like `Map`
description	*(opt.)* Descriptive text of the type

Example

```
@type {Map}
```

@return

Scope

functions

Description

Describes the return value.

Syntax

```
@return { <type> } [<description>]
```

Parameters

type	The *type* of the return value.
description	*(opt.)* Descriptive text

Example

```
@return {Integer} The sum of the arguments
```

@throws

Scope

Functions

Description

Describes in which cases an exception is thrown.

Syntax

```
@throws { <type> } [<description>]
```

Parameters

type	The *type* of the exception
description	*(opt.)* Descriptive text under which circumstances this exception is thrown.

Example

```
@throws {Error} If the parameter 'X' is out of range.
```

@see

Description

Adds a cross reference to another structure (class, property, method or constant).

Syntax

```
@see <class_item> [<link_text>]
```

Parameters

class_item	A class item is either a class name, or a class name followed by a `#`, followed by the name of a class attribute like property, method or constant. If you refer to a structure within the same class, then the class name may be omitted. If you refer to a class in the same package, then the package name before the class may be omitted. In all other cases you have to specify the fully qualified class name (e.g. `qx.ui.table.Table`). Some examples: • `qx.ui.form.Button` refers to the class `Button` in the package `qx.ui.form`. • `qx.constant.Type#NUMBER` links to the constant `NUMBER` of the class `qx.constant.Type`. • `qx.core.Init#defineMain` refers to the method `defineMain` in the class `qx.core.Init`
link_text	An optional display text for the link. If missing `<class_item>` is shown.

Example

```
@see qx.constant.Type#NUMBER the NUMBER types
```

@link

Scope

Embedded in descriptive text, Description.

Description

The `@link` attribute is similar to the @see attribute, but it is used for linking within description texts. Unlike the other attributes, the `@link` attribute is not standalone, but in curly brackets and within the main description text or a description text of another attribute.

Syntax

```
{ @link <class_item> [<link_text>] }
```

Parameters

See @see.

Example

```
You will find more information about NUMBER types {@link
qx.constant.Type#NUMBER here}.
```

@signature

Scope

Functions

Description

Sometimes the API documentation generator is not able to extract the method signature from the source code. This for example is the case when the method is defined using a `qx.core.Environment` selection, or if the method is assigned from a method constant like `qx.lang.Function.returnTrue`. In these cases the method signature can be declared inside the documentation comment using the `@signature` attribute. You can also add individual parameter names to the signature, but then need to provide `@param` entries for each of them.

Syntax

```
@signature function ( <param>, ...  )
```

Parameters

param	Names for parameters; must match potential `@param` sections.

Example

```
members :
  {
    /**
     * Always returns true
     *
     * @return {Boolean} returns true
     * @signature function()
     */
    sayTrue: qx.lang.Function.returnTrue;
  }
```

With parameters:

```
members :
  {
    /**
     * Always returns false, but takes some parameters.
     *
     * @return {Boolean} returns false
     *
     * @signature function(foo, bar, baz)
     * @param foo {String} ...
     * @param bar {Integer} ...
     * @param baz {Map} ...
     */
    sayFalse: function() {
      ...
    }
  }
```

@internal

Scope

Class, function

Description

Mark the given entity as internal, i.e. not part of the library's public API. A method marked internal will be hidden in the Apiviewer. A class marked internal is still shown in the Apiviewer, but is highlighted as internal. Classes marked internal should not be instantiated in code using the library, internal methods should not be called from outside of it.

Syntax

```
@internal
```

Example

```
@internal
```

@deprecated

Scope

Class, function

Description

Mark the given entity as deprecated, i.e. library users should no longer use this entry. It will be removed over time.

Syntax

```
@deprecated { <since_version> } [<description>]
```

Parameters

since_version	qooxdoo version with which the corresponding item was deprecated
description	*(opt.)* Descriptive text of the deprecation

Example

```
@deprecated {2.1} Please use Object.keys instead
```

@lint

Description

Taylor warning messages for the source code. This attribute is evaluated at compile time, and influences the warnings issued by the generator. It has no relevance for the API documentation of the code. The general idea is to switch off warnings for certain situations in the code, mostly related to the identifiers used.

Within one JSDoc comment, the same subkey can appear multiple times.

Syntax

```
@lint <subkey> ( <name> ,...  )
```

Parameters

subkey	**The following subkeys are supported:** • **environmentNonLiteralKey** Don't warn about calls to qx.core.Environment methods without a literal key argument (as such calls cannot be optimized). With no argument, applies to all calls to *qx.core.Environment.(get|select)* in the scope. If given arguments, only the calls using the corresponding variables as keys are exempted. • **ignoreDeprecated** Use of deprecated globals (like `alert`). • **ignoreNoLoopBlock** Don't warn about loop or condition statements which don't have a block (`{...}`) as body. Takes no argument. • **ignoreReferenceField** A class map member that is initialized with a reference value (object, array, map, ...), as those will be shared among class instances. • **ignoreUndefined** *(Deprecated)* This key is deprecated for the more general *@ignore* hint. • **ignoreUnused** Scoped variables (function parameters, function expression's identifier, or variables declared with `var`) which are never used. • **ignoreJsdocKey** *[Not yet implemented]* JSDoc @ keys which are either unknown (i.e. not documented on this page) or do not comply with the syntax given here.
name	The identifier which the lint subkey should be applied to.

Example

To turn off warnings for a global symbol `foo` that is not known to the generator, but will be available at runtime of the code, use

```
@lint ignoreUndefined(foo)
```

To silence warnings for non-literal key arguments in Environment calls use

```
@lint environmentNonLiteralKey()
```

To apply this only to calls using a specific key argument `foo` use

```
@lint environmentNonLiteralKey(foo)
```

@cldr

Scope

Class

Description

This hint indicates that the class needs CLDR data (e.g. names of months or week-days). It takes no arguments.

Syntax

```
@cldr()
```

Example

```
@cldr()
```

@asset

Scope

Class

Description

Request resources, like images, that this class uses to be included in a build.

You can also use `*` as a wildcard character, to request entire resource namespaces: `@asset(foo/*)` will request all resources found under the "foo/" namespace.

Syntax

```
@asset ( <resource_id> , [<resource_id>] )
```

Parameters

resource_id	The resource ID or resource pattern to be added.

Example

```
@asset(custom/test.png)
```

This will add the image `custom/test.png` to the build.

```
@asset(custom/*)
```

Add all resources under the `custom` name space to the build.

@attach

Scope

Function

Description

Attach the function to the *members* section of the given class, using the opt. second parameter as the member name.

Syntax

```
@attach { <class> , [<feature_name>] }
```

Parameters

class	Class ID where the function should be attached.
feature_name	*(opt.)* Feature name under which the function should be attached; if missing, the original function name is used.

Example

```
@attach{foo.MyClass, bar}
```

This will attach the given function to the class `foo.MyClass` as a member function, under the name `bar`, so you can call it like `f=new foo.MyClass(); f.bar()`.

@attachStatic

Scope

Function

Description

As with @attach above, but attach the function to the *statics* section of the given class, using the opt. second parameter as the statics' name.

Syntax

```
@attachStatic { <class> , [<feature_name>] }
```

Parameters

class	Class ID where the function should be attached.
feature_name	*(opt.)* Feature name under which the function should be attached; if missing, the original function name is used.

Example

```
@attachStatic{foo.MyClass, bar}
```

This will attach the given function to the class `foo.MyClass` as a static function, under the name `bar`, so you can call it like `foo.MyClass.bar()`.

@require

Scope

File

Description

Enforce the inclusion of a required class *before* the current code. Use this only if the generator cannot determine the dependency automatically.

There is one special name, `feature-checks`, which is reserved for internal use and shouldn't be used in normal application code. This will add all known feature check classes as load time dependencies to the current class.

Syntax

```
@require ( <name> ,...  )
```

Parameters

name	Class name to include.

Example

```
@require(qx.core.Object)
```

@use

Scope

File

Description

Enforce the inclusion of a required class. Use this only if the generator cannot determine the dependency automatically.

There is one special name, `feature-checks`, which is reserved for internal use and shouldn't be used in normal application code. This will add all known feature check classes as run time dependencies to the current class.

Syntax

```
@use ( <name> ,...  )
```

Parameters

name	Class name to include.

Example

```
@use(qx.core.Object)
```

@ignore

Scope

File, class, function

Description

Ignore the occurrence of global symbols. This @ hint has two implications:

- Don't warn about it if the symbol is unknown (i.e. is not in any known library or a known built-in), i.e. it influences the lint system.
- Don't include the symbol in the build, i.e. it influences the compiler system which then also doesn't follow the symbol's dependencies.

There are two special names that may be used in application code:

- **auto-require** : Ignore all load time dependencies detected by the automatic analysis; they will not be added to the class' load dependencies. *This effectively turns off the automatic processing of load time dependencies for this class*.
- **auto-use** : Ignore all run time dependencies detected by the automatic analysis; they will not be added to the class' run dependencies. *This effectively turns off the automatic processing of run time dependencies for this class*.

You can also use `*` as a wildcard character, to ignore entire class APIs or namespaces: `@ignore(foo.*)` will ignore "foo" and any symbol starting with "foo.". Otherwise, matches are exact so *@ignore(foo)* will only ignore "foo", but not "foo.bar".

Syntax

```
@ignore ( <name> ,...  )
```

Parameters

name	Class name to include. The name can include trailing wildcards, to ignore entire class APIs or namespaces, e.g. `qx.dev.Debug.*` or `qx.dev.unit.*`.

Example

```
@ignore(qx.dev.unit.TestSuite)
```

See

Special section on *@ignore*.

@tag

Scope

any

Description

The `@tag` entry allows to do arbitrary tagging on the entity that is being documented (class, method, ...). This allows for pre-processing of the source code with custom programs, e.g. to extract those tags and make them available to the application at runtime (see the *Demobrowser* application for an example of this).

Syntax

```
@tag <text>
```

Parameters

text	Arbitrary text, usually short or composed tag names

Example

```
@tag noPlayground
@tag single value binding
```

8.8.3 @ignore

@ignore is a very powerful construct that probably deserves a bit elaboration on the reference information.

Variadic Arguments

Like many @-hints @ignore is capable of a variable number of arguments. So instead of writing

```
@ignore(foo)
@ignore(bar)
```

you can write

```
@ignore(foo, bar)
```

to the same effect. (Of course you can also have two separate @ignore entries if you prefer that).

Double Relevance

More importantly, @ignore has relevance both as a compiler hint but also for the lint checker. Using @ignore means

- don't warn about this symbol if you cannot resolve it (for the lint checker)
- don't include this symbol and its dependencies in the build (whether it is known or not – for the compiler)

Silence Lint Only

So *@ignore* will affect both lint and compile jobs, which is usually what you want. You only want lint not to warn you about a symbol in your code if you know you don't need to take any action to provide it when the application is created. (Otherwise you would want to be alerted about that by lint). But that effectively means that the symbol can be left out from the build, and the compiler can safely skip it.

But if you actually have symbols in your code that are provided by another contribution or library which are not known to the *lint* job, it is not a good idea to simply add `@ignore(...<symbols>...)` in the affected classes, as then you would also skip those symbols when building the application, which might result in a broken app.

Rather, to just cover the *lint* behavior modify the configuration for the `lint` job in your *config.json* by adding the missing top-level symbols:

```
"jobs" : {
  "lint" : {
    "lint-check" : {
      "allowed-globals" : [
        /* add symbols here that lint should ignore */
      ]
    }
  }
}
```

Name Globbing

@ignore supports globbing in a rather strict way. Already the old #ignore supported globs like *#ignore(foo.*)* to ignore entire namespaces, but also did some automatic globbing when it thought that *foo* was actually a class and not a namespace. The effect was that *#ignore(foo)* would also ignore *foo.getBar* when this looked like an attribute reference on a class object. (As you can imagine the problem lies in the term "looked like". This decision could be safely made for known classes but not for unknown symbols. In an unknown *foo.bar*, is *bar* a nested namespace or a class attribute?!).

@ignore(foo) will ignore *foo* and only *foo*. If you also want *foo.getBar* be ignored either list it explicitly (as in *@ignore(foo, foo.getBar)*) or use a wildcard (as in *@ignore(foo.*)*) which will ignore both.

Scoped Application

Most importantly, @ignore is *lexically scoped*. This was a major requirement, and one reason to integrate compiler hints with the JSDoc system. When people used an unknown symbol in one method, they wanted to ignore that specifically for that method and not globally for the whole file. As a consequence, using the same symbol in a sibling method you would again get an "Unknown global symbol" warning which was desired. This was not available with the old #ignore.

So if an unknown name is found in a particular line of code, a lookup happens to the next enclosing lexical scope if this name should be ignored. If there is no such information in the enclosing JSDoc comment the search is repeated upwards, e.g. in the JSDoc preceding the class definition. If necessary this is repeated all the way up to the top-most

JSDoc, which effectively takes the place of the old #ignore hint. So the old functionality is covered by a simple replacement of the different comment blocks, but the new system also allows a much finer control.

This scoped look up is not the case for other compiler hints like e.g. @require or @use which still scope over the entire class file.

8.9 Miscellaneous

8.9.1 Image clipping and combining

qooxdoo integrates the support for clipped and combined images in the framework where both features are heavily used, mainly in the different themes like *appearance or decoration themes*.

Configuration

Note: To be able to use image clipping and combining you need a locally installed *ImageMagick* package. The latest version known to work is 6.6.1.

To use the two features you have to configure dedicated generator jobs. the generator to clip or combine images. You can add those jobs to your standard `config.json` file, or, as the configuration for these tasks is fairly self-contained, put them in an own file like `image.json`, as we do in the framework.

Here is the general layout for the image manipulating jobs configuration:

```
{
  "jobs" :
  {
    "common" :
    {
      "let" :
      {
         "RESPATH" : "./source/resource"
      },

      "cache" :
      {
         "compile" : "../../cache"
      }
    },

    "image-clipping" : { ... },

    "image-combining": { ... }
  }
}
```

The `common` job is used to set up the basic settings which are shared between the specific jobs `image-clipping` and `image-combine`, described in the following sections.

Image clipping

Clipping images is needed whenever you have a base image, e.g. a complete image for your button with rounded borders, and want to cut it into several parts. A common use case in the framework is to use such images for `grid`

decorators.

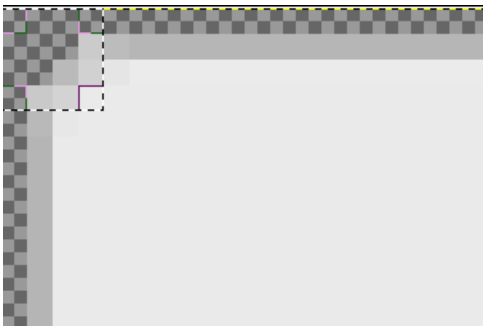
```
"image-clipping" :
{
   "extend" : ["common"],

   "slice-images" :
   {
      "convert-cmd" : "convert %(infile)s -crop \
          %(xoff)sx%(yoff)s+%(xorig)s+%(yorig)s +repage %(outfile)s",
      "images" :
      {
         "${RESPATH}/custom/image/source/groupBox.png" :
         {
            "prefix" : "../../clipped/groupBox",
            "border-width" : 4
         }
      }
   }
}
```

(Mind that you cannot split a string across lines in Json, so the `\` in the value of `convert-cmd` is only for better readability here in the manual.) Each entry in the `images` block represents one source image to clip.

- The key has to be the path to the *source* image.
- The `prefix` entry will set the base file path for all the result images. The resulting file paths will follow the rule `prefix + imagepart + extension` where imagepart will specify the spacial location from which the clip has been taken, e.g. `tl` for top-left or `br` for bottom-right etc. So one result image will be *"../../clipped/groupBox-tl.png"*.
- The entry `border-width` defines how deep from the border into the image the cut will run. If you look at your source image you can determine the border-width by selecting a rectangle (which your graphic tool) which encloses the corner of the image completely. The edge of the rectangle is your border-width (see further).

See the *slice-images reference* for all configuration details.

Visual example Here is an example illustration for the border-width case.



The selection rectangle has the size of 4 x 4 pixels (a single pixel is indicated by the embedded square at the bottom-right corner), thus the `border-width` value is 4. Differing border width values for each of the four sides are also supported. In that case, the value for border-width must be an array containing the four values in the order: top, right, bottom, left.

Image combining

Complementary to image clipping image combining takes multiple images as sources and generates a single image out of them. The result image is like a box that contains the input images side by side. Here is a configuration sample:

```
"image-combine" :
{
   "extend" : ["common"],

   "combine-images" :
   {
      "montage-cmd" : "montage @%(tempfile)s -geometry +0+0 -gravity \
        NorthWest -tile %(orientation)s -background None %(combinedfile)s",
      "images" :
      {
         "${RESPATH}/custom/image-combined/combined.png":
         {
            "prefix" : [ "${RESPATH}" ],
            "layout" : "vertical",
            "input"  :
            [
              {
                "prefix" : [ "${RESPATH}" ],
                "files" : [ "${RESPATH}/custom/image/clipped/groupBox*.png" ]
              }
            ]
         }
      }
   }
}
```

(Mind that you cannot split a string across lines in Json, so the `\` in the value of `montage-cmd` is only for better readability here in the manual.) Basically the structure is the same as for the `image-clipping` job. Let's take a look at the details.

- The key has to be the path of the *result* image.
- The `layout` key takes the two possible values "horizontal" or "vertical" and determines the alignment of the source images inside the combined image.
- `files` is an array which takes several input images that share the same path prefix. (This is relevant as the `prefix` will be stripped from the index which is also generated together with the output image. The individual files in the index are only identified by their paths *after* the prefix.)

The layout depends on the sizes of the source images and their intended purpose. Combining images of same sizes saves white space "noise" in the result image, thus decreasing transfer size. If the combined image contains images that need to be stretched *horizontally* by the browser, the images need to be aligned *vertically*, and vice versa. If you are free in this respect the horizontal layout is usually the better choice

For more information see the *combine-images* reference section.

Running Image Jobs

If you are finished with the definition of your images to clip and/or to combine you can use the `generator` to actually let them created for you.

```
./generate.py -c image.json image-clipping
```

```
./generate.py -c image.json image-combine
```

If you include the following job in your `image.json` jobs list

```
"images" :
{
   "run" : [ "image-clipping", "image-combine" ]
},
```

the execution of

```
./generate.py -c image.json images
```

will run both jobs at once.

Benefits

There are several benefits for setting up the image clipping and combining.

- Fewer HTTP requests mean better performance when using combined images.
- Widgets using the `grid` decorator are easier to use. If you do not use the tool-based clipping you have to slice the source image and name the parts manually.
- State changes are faster with combined images as the browser does not have to change the source of the displayed image. Instead it only changes the value of the CSS property `background-position` to display the desired part of the combined image.

8.9.2 Reporting Bugs

Note: Please see the general document on How to report bugs

8.9.3 An Aspect Template Class

Here is a code template which you may copy to your application namespace and adapt it to implement aspects in your qooxdoo application. For a far more advanced sample look at qx.dev.Profile.

```
/**
 * AspectTemplate.js -- template class to use qooxdoo aspects
 *
 * This is a minimal class template to show how to deploy aspects in qooxdoo
 * applications. For more information on the aspect infrastructure see the API
 * documentation for qx.core.Aspect.
 *
 * You should copy this template to your application namespace and adapt it to
 * your needs. See the comments in the code for further hints.
 *
 * To enable the use of your aspect class, some extra settings need to be done
 * in your configuration file.
 *   * Add a require of your aspects class to qx.Class
 *   * Set the environment setting qx.aspects to true
 *   * Set the environment setting qx.enableAspect to true
 *
 */
```

```
/**
 *
 * @require(qx.core.Aspect)
 * @ignore(auto-require)
 */

/** Adapt the name of the class */
qx.Bootstrap.define("your.namespace.YourAspectClass", {

  /** The class definition may only contain a 'statics' and a 'defer' member */
  statics :
  {

    __counter : 0,  // Static vars are possible

    /**
     * This function will be called before each function call.
     *
     * @param fullname {String} Full name of the function including the class name.
     * @param fcn {Function} Wrapped function.
     * @param type {String} The type of the wrapped function (static, member, ...)
     * @param args {Arguments} The arguments passed to the wrapped function.
     */
    atEnter: function(fullName, fcn, type, args)
    {
      console.log("Entering "+fullName);  // Adapt this to your needs
    },

    /**
     * This function will be called after each function call.
     *
     * @param fullname {String} Full name of the function including the class name.
     * @param fcn {Function} Wrapped function.
     * @param type {String} The type of the wrapped function (static, member, ...)
     * @param args {Arguments} The arguments passed to the wrapped function.
     * @param returnValue {var} return value of the wrapped function.
     */
    atExit: function(fullName, fcn, type, args, returnValue)
    {
      console.log("Leaving "+fullName);  // Adapt this to your needs
    }

  },

  defer : function(statics)
  {
    /**
     * Registering your static functions with the aspect registry. For more
     * information see the API documentation for qx.core.Aspect.
     *
     * @param fcn {Function} Function from this class to be called.
     * @param position {String} Where to inject the aspect ("before" or "after").
     * @param type {String} Which types to wrap ("member", "static", "constructor",
     *                         "destructor", "property" or "*").
     * @param name {RegExp} Name(pattern) of the functions to wrap.
     */
    qx.core.Aspect.addAdvice(statics.atEnter, "before", "*", "your.namespace.*");
    qx.core.Aspect.addAdvice(statics.atExit, "after",  "*", "your.namespace.*");
```

```
  }

});
```

A job in your configuration could look something like this:

```
"source" :
      {
        "require" :
        {
          "qx.Class" : ["aspects.Aop"]
        },

        "environment" :
        {
          "qx.aspects" : true,
          "qx.enableAspect" : true
        }
      }
```

If you need some more information on configuring the generator, take a look at the *Generator Config Keys*.

8.9.4 Internet Explorer specific settings

This page describes all settings which are used/implemented by qooxdoo to workaround/solve IE-specific issues.

Document Mode in IE8

qooxdoo uses *Internet Explorer 8 standard mode* as the default for all generated applications. This is achieved by setting a XHTML 1.2 Doctype to all *index.html* files provided by the framework.

Using alpha-transparent PNGs

IE7 and IE8 have built-in support for loading alpha-transparent PNGs. qooxdoo however does use the AlphaImageLoader for all IE versions whenever a PNG image has to be loaded. This has several reasons:

- Performance issues in IE8 - native alpha PNG support is slower when running IE8 standards mode
- Rendering bug in IE - reported at Bug #1287

URL-Rewriting under HTTPS

Every IE version does show a *Mixed Content* warning whenever a resource (image, script, etc.) is loaded with a regular HTTP request when the containing page runs under HTTPS. However, this useful warning is also appearing in situations it is not acceptable, e.g. for relative paths like *./path/to/my/resource*. In order to solve these issues every URL of a resource managed by qooxdoo is rewritten in IE under HTTPS to an absolute URL to prevent the warning. See Bug #2427 for more details.

CHAPTER

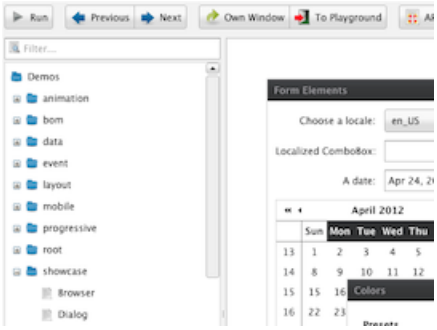
NINE

STANDARD APPLICATIONS

qooxdoo comes with a set of web applications that showcase various features of qooxdoo, cover different application types and scenarios, or provide helpful tools for application development.

9.1 Demo Applications

9.1.1 Demobrowser

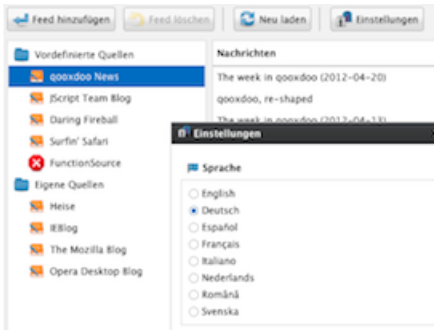


Demobrowser is a runner frame application that hosts nearly 250 sample applications. All those applications are full, stand-alone qooxdoo applications. They cover a wide range, from simple layout test apps to more full-featured form applications. But the focus is usually to exercise a particular widget or feature of the qooxdoo class library. So while they might be simple visually, they are good resources to see how a specific feature can be used in an app. As they are generated in three variants, one for each of qooxdoo's standard themes, you can get an impression how the same application looks under the different themes.

To navigate these demo applications, the runner frame organizes them in a navigation tree that groups applications by main feature (like data binding, layouts, events, etc.). It also allows you to search for demo titles and qooxdoo classes used in the demos, so you can e.g. search for all demos that deploy qooxdoo's List widget (qx.ui.form.List). For each rendered app you can inspect the JavaScript source to see how it is done.

> Contains many examples and tests for widgets, layouts and other framework functionality.
>
> Online demo

9.1.2 Feedreader

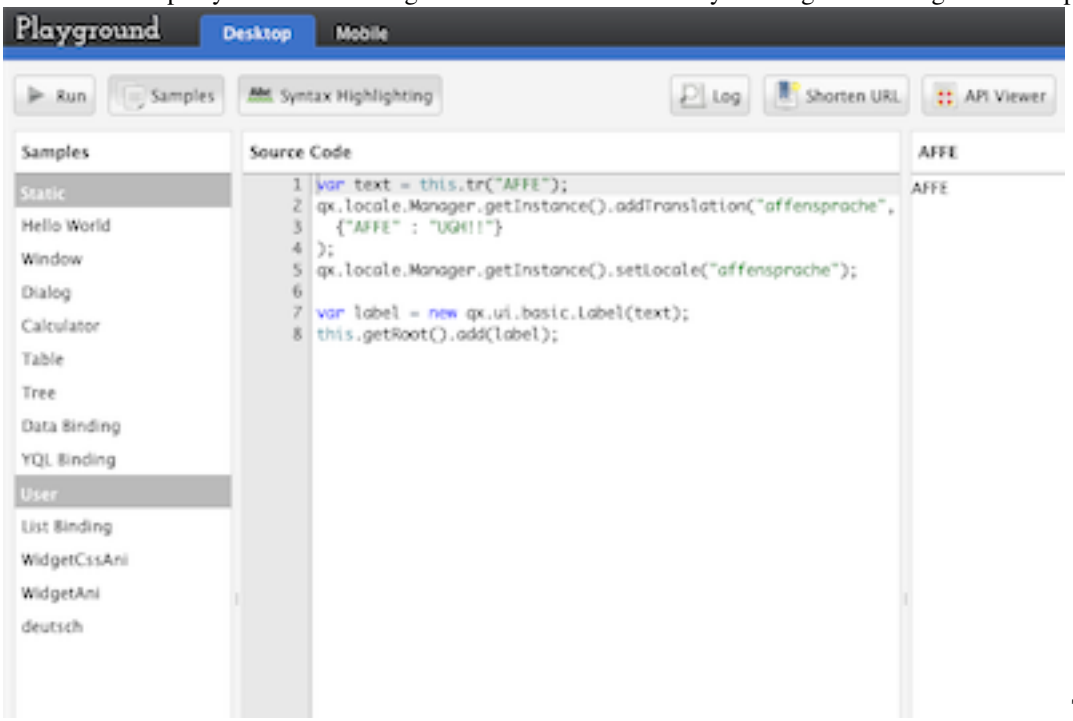


Feedreader is a browser-based RSS feedreader. It allows you to read posts of pre-defined feeds, but you can also add other feeds in a session. The individual feeds are retrieved using YQL queries. It also showcases switching the language for an application, offering seven languages to choose from. As it uses internet access, internationalization and is organized in parts on the code level, it shows several features of prototypical RIA applications.

> A typical rich internet application (RIA) for displaying RSS feeds.
>
> Online demo

9.1.3 Playground

The Playground application allows you to play with code in an edit pane, and see the result of running that code in a preview pane. It comes with a set of pre-defined code samples, but many more are available and can be saved in the playground. Code can also be bookmarked and the links saved and re-run, to re-create the sample you were working on. This allows for easy sharing of running code samples with others.



The scope of the code you can enter in the edit pane is restricted to what you can do in the `main()` method of a standard qooxdoo application class.

The app features two different modes, one for creating RIA apps and one for creating mobile apps (webkit browser required).

Bookmarklet

Note: experimental

```
javascript:(function(s){try{s=document.selection.createRange().text}catch(e){s=window.getSelection()
```

Explore qooxdoo programming interactively: edit qooxdoo code in one pane, and see the result running in another.

Online demo

9.1.4 ToDo

The ToDo application is a simple but yet powerful demonstration on how qooxdoo can be used to write a website, based on HTML and CSS. The app uses data binding, the offline store, a controller and templating to get the best out of the website specific features of qooxdoo.

A DOM-oriented application using data binding and CSS styling.

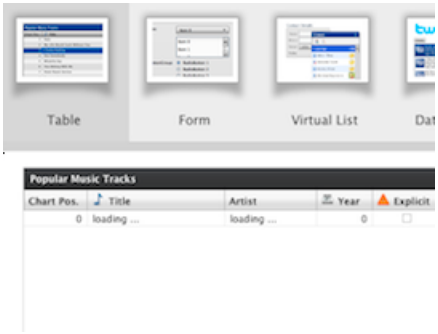
Online demo

9.1.5 Tutorial

The tutorial app is dedicated for absolute qooxdoo beginners. It offers small tutorials taking care of exactly one feature. This includes a simple Hello-World sample but also stuff like from validation or data binding. It offers two types of tutorial: qx.Desktop and qx.Mobile.

> A online tutorial application which contains mobile and desktop tutorial.
>
> Online demo

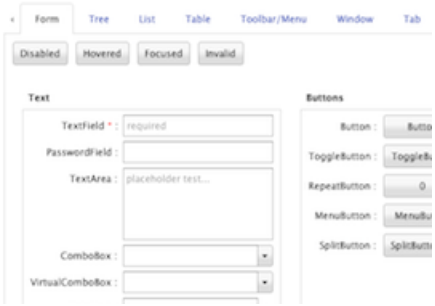
9.1.6 Showcase



The Showcase application contains a number of feature "applets" that are actually parts of a single qooxdoo application. A thumbnails bar allows you to switch between the different demo apps. The topics covered include tabling, themes, internationalization and data binding. With each app there comes instructions and background information, how to exercise them, links to further demos and documentation.

> A page-style application embedding a number of small showcase applications to highlight specific topics like tables, theming or internationalization.
>
> Online demo

9.1.7 Widgetbrowser



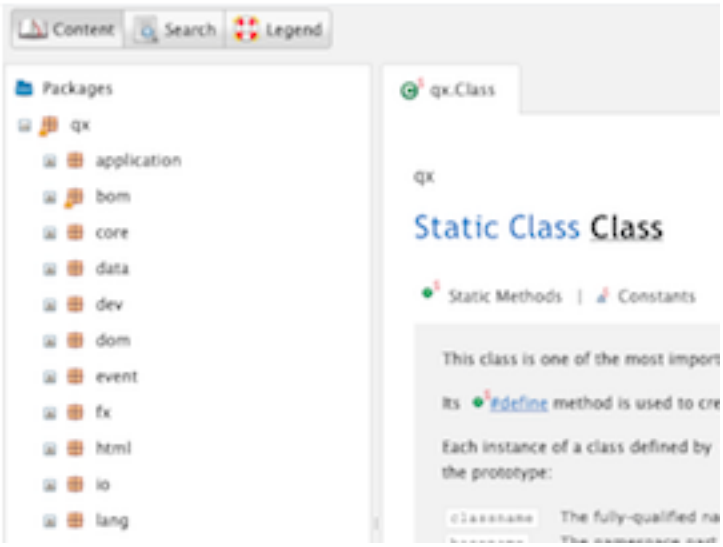
The Widgetbrowser application shows the widgets and themes available in qooxdoo. Apart from giving an overview of the widgets and themes available, the application is especially useful for theme authors.

Features the widgets and themes available in qooxdoo.

Online demo

9.2 Developer Tools

9.2.1 API Viewer



The API Viewer displays class API reference for one or more libraries. The tree view pane offers the typical class hierarchy, organized by name spaces. Each package (intermediate name space) has an overview description and links to the sub-packages or classes it contains. Descriptions usually contain cross links to relevant packages or classes. The entire reference is searchable through the search tab.

The actual API descriptions are generated from *JSDoc-style comments* in the class code, and can be generated for custom applications as well, so you can browse the API of your own classes.

Advanced Search

Search results can be filtered by type (Methods, Properties, etc.) and restricted to given namespaces. **Regular Expressions** are supported for both the item name and the namespace. Note that if a search term contains one or more

capital letters, the search will be **case-sensitive**.

Class Item Toggles

The visibility of various class items can be toggled using the buttons on the right hand side of the tool bar:

- **Properties**: Toggles *generated property methods*
- **Includes**: Members inherited from super classes and included from *Mixins* can be toggled separately
- **Protected/Private/Internal**: Separate toggles for each type of *non-public member*

Linking Source Files

The API Viewer can show links to the source code, typically provided by the web interface of a source code management system, for classes, methods and static functions. To add these links for your own libraries, define the key `info/sourceViewUri` in `Manifest.json`, e.g.:

```
"info" :
{
  "name" : "Custom Application",
  "version" : "trunk",
  "qooxdoo-versions": ["trunk"],
  //[...]
  "sourceViewUri" : "https://github.com/someuser/custom/blob/master/source/class/%{classFilePath}#L%
},
```

The following placeholders are supported:

- `%{classFilePath}` will be replaced with the fully qualified name of the class converted to a file path, e.g. `custom.model.OrderData` would become `custom/model/OrderData.js`
- `%{lineNumber}` will be replaced by the line number where an item (member or static method) is defined in the original source file.

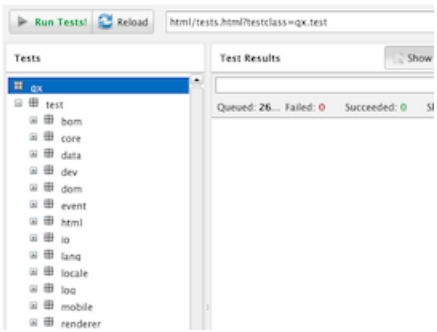
API Doc Verification

The Generator checks API documentation for completeness while building the API Viewer. Errors, such as members with missing doc comments or undocumented parameters will be displayed in the GUI: Affected name spaces and classes will have an exclamation mark on their icon in the tree view, while the detail view will display an error message for the affected class item.

Searchable API reference of the qooxdoo framework.

Online demo

9.2.2 Testrunner



Testrunner is a runner frame application for unit tests. Unit tests can be written using framework classes from the `qx.dev.unit.*` name space. They follow the general scheme of JSUnit. Test class are then gathered into a dedicated test application (the "Application under Test"). This test application is loaded into the runner frame, which discovers and displays the contained tests, and allows you to run them all or individually. Results and log entries are displayed in dedicated panes.

The online Testrunner loads qooxdoo's own framework unit tests (approx. 2,400 unit tests currently), but a custom testrunner can be created for each custom application, to run that application's unit tests.

See the dedicated page for more information:

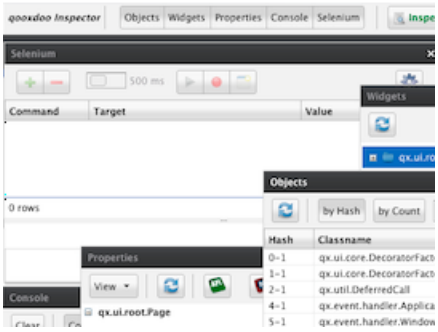
The qooxdoo Test Runner

Integrated unit testing framework similar to (but not requiring) JSUnit.

Online demo

9.2.3 Inspector

qooxdoo Inspector is a powerful development tool perfectly suited for *live* debugging and modifying qooxdoo applications.



See it in action, debugging the qooxdoo feedreader demo application.

If you know the Firebug extension for Firefox, you will be familiar with most of Inspector's capabilities. But it is much more than that: Since it is a qooxdoo application itself, it runs in *all* major browsers, including IE, Firefox, Opera, Safari and Chrome. And it allows for truly *qooxdoo-specific* debugging, including displaying the UI hierarchy and modifying the properties of qooxdoo widgets.

Usage

There are two ways to use the inspector (explained in more detail below):

- The first way is to run a simple generator job to create a local inspector instance for your custom application. (See: *Running the inspector job*)
- Generate the build version of the inspector and open it in a (local) web server. (See: *Running inspector with an HTTP server*)

Individual inspector from file system

First of all, make sure you've created a source version of your application. Then create the inspector:

```
generate.py inspector
```

Once the job is finished, you can open the `index.html` file from the created inspector application. You will find the file in the newly generated inspector folder (`inspector\index.html`).

Shared inspector over a web server

To generate the build version of the inspector, change to the inspector home directory (in the SDK in folder `SDK\component\inspector`). Then run its `build` job:

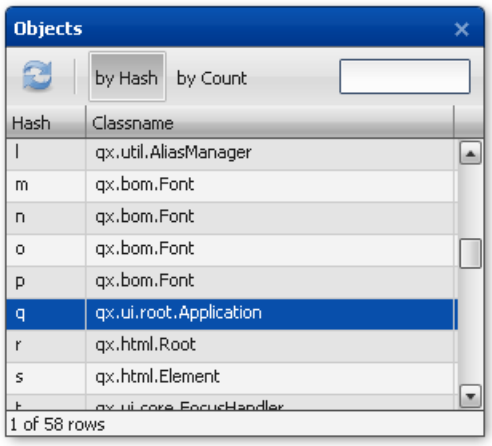
```
generate.py build
```

Once the build job is finished you can access the inspector through your HTTP server to inspect different qooxdoo applications. If you don't already have an HTTP server like Apache installed or you don't want to configure it, you can startup a simple Python-based web server locally:

```
python -m CGIHTTPServer
```

Note: Make sure the qooxdoo SDK (inspector) and the custom applications to debug are accessible from the document root! You can achieve this by starting up the Python command above from a directory that has both directories as subdirectories.

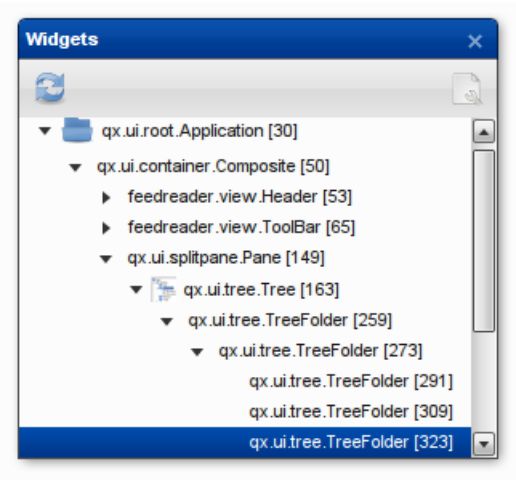
Objects Window



The objects window lists all qooxdoo objects created by your app in a table. The inspector has full access to the internal object registry of your application. Of course, the inspector's objects are excluded from the display so they

won't interfere with debugging your app. The objects can be sorted by hash, count or name and filtered by name. To select an object listed in the table and to update the other views accordingly, simply click on its list entry.

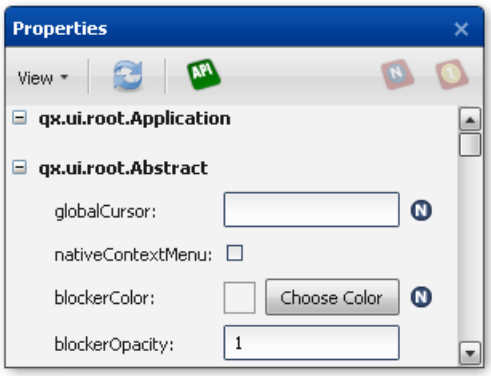
Widgets Window



The widgets window displays the hierarchical structure of your application's GUI as a tree. Each widget which was added to the document (or into any deeper widget hierarchy) will be shown. Again, a simple click on a widget in the tree selects it. Most of the widgets have a specific icon (corresponding to their type) in order to identify the widgets in the tree faster. The name of the widget's class and its hash value are shown as identifiers in the tree.

The widgets window has two display modes: By default, the application's "public" widget hierarchy is displayed, i.e. only those widgets that were explicitly added by the application developer using the parent widget's "add" method. Sub-widgets that are added by the parent widget itself ("child controls") are hidden in this mode. That's why it's possible to select a widget using the "Inspect widget" button or the Objects window without the Widgets tree displaying it. In that case, use the button in the top right corner to switch to the internal widget hierarchy display mode and click the "reload" button. After that, all sub-widgets including child controls will be displayed in the window.

Properties Window



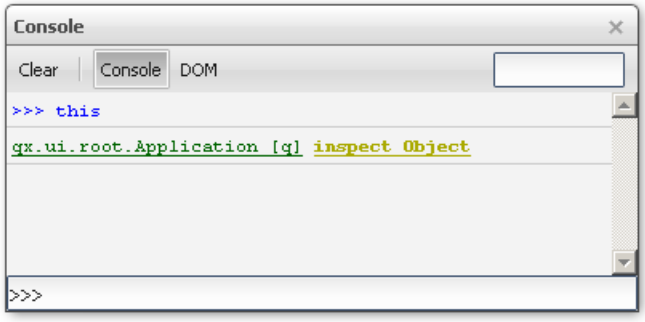
The properties window is one of two windows whose main focus is on actually *working* with a previously selected object. It shows all properties of the currently selected object. There are two different ways to sort the properties.

But it is not only about displaying properties, it also allows editing: To make this as convenient and least error-prone as possible, form elements are chosen according to the property's type. For instance, in many cases it is as easy as using

a checkbox (for a boolean value), a drop-down menu (for pre-defined values) or a color picker (for a color value). For properties that support a wider range of values, regular text input fields are used.

If you want to know more about a certain property, select it and click the API button to open up the API documentation for the selected property.

Console

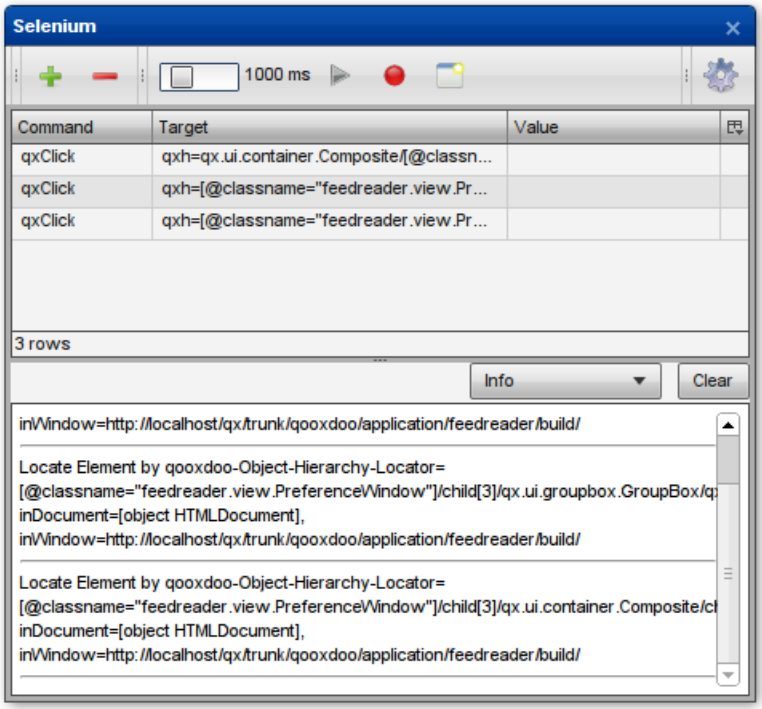


The console is probably the most powerful Inspector window, as it allows viewing and modifying instances similar to the properties window, but it also gives the developer a virtually unrestricted environment for debugging a qooxdoo app.

One part of the console is a generic JavaScript console, familiar to most Firebug users. At the prompt you can enter arbitrary JavaScript code which is executed after pressing enter. The keyword "this" refers to the currently selected object. That way it is very easy to inspect and modify the currently selected widget instance. To make it even more convenient, auto-completion while entering code is available. This allows you to select one of the suggested methods that are available for a specific object. Hit the CRTL+Space keys to display a list of available instance members.

Another part of the console window is a DOM browser, named as in Firebug. This browser allows you to inspect an object interactively. You can "dive into" an object, down to arbitrary depth, following property values that refer to data structures within the current object or pointing to ones within other objects.

Selenium Window



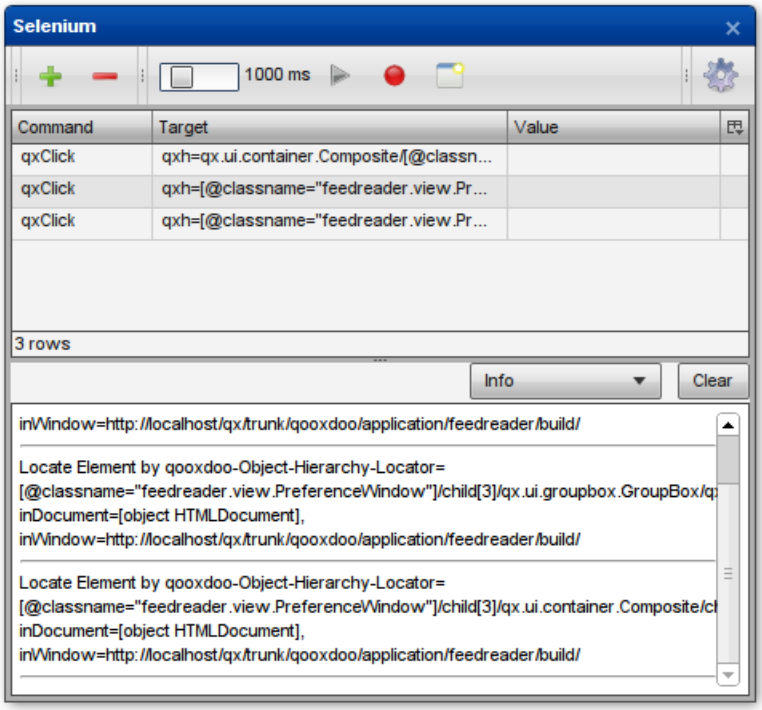
The Selenium window's purpose is to help test developers in writing simulated interaction tests which will then be run using the Selenium testing framework and qooxdoo's *Simulator component* or the Simulator contribution it is based on. Similar to the Selenium IDE Firefox plugin, it can be used to determine a locator string for any element (qooxdoo widget in this case) and supports playback of test commands against the inspected application.

There is a dedicated page with extensive descriptions that demonstrates how to create a test case using the Selenium window:

Using the Inspector to write Selenium tests

qooxdoo's Inspector is not only a very useful tool for application developers, it can also help you write Selenium tests.

The Selenium window The Inspector's Selenium window duplicates some of the functionality of the Selenium IDE Firefox extension, with a qooxdoo twist. It can generate locator strings for any qooxdoo widget and run Selenium commands against the inspected application. The result is a simple Selenium test case that can be exported in the "Selenese" HTML format.



Configuration The Selenium window must load **Selenium Core** (the JavaScript part of Selenium RC) from an external source. This location can be configured in the options window, which is opened by clicking the rightmost button in the Selenium window.

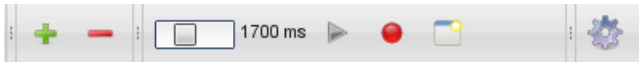
If the Inspector is loaded over HTTP, the required scripts can be loaded directly from their online repository on Google Code. Just click the "Use default URI" button.

If you can't access the Selenium repository or you're loading the Inspector from the local file system, you can manually download and extract Selenium Core:

- Download the 1.0.2 release of Selenium RC
- Open the downloaded archive and extract the file `/selenium-remote-control-1.0.2/selenium-server-1.0.2/s`
- From the .jar file, extract the `core` directory.
- In the Options window, enter the path to the **parent directory** of `core`. Use a file system URI (`file:///...`) if you're loading the Inspector from the file system. If you're loading the Inspector from a web server, use an HTTP URI. In this case, Same Origin Policy restrictions do **not** apply, so the script directory needn't be on the same server as the Inspector itself. If it is, a relative path can be used.

Click "OK" after configuring the paths. The rest of the Selenium window's GUI will be activated once the external scripts are loaded. The configured URI is saved in a cookie so this step is only necessary once per browser.

Controls

Toolbar 

Pressing the **plus button** will add a new line to the test case. This consists of a default command (`qxClick`) and a `qxh` locator pointing to the widget currently selected in the Inspector.

The **minus button** removes the currently selected lines from the test case.

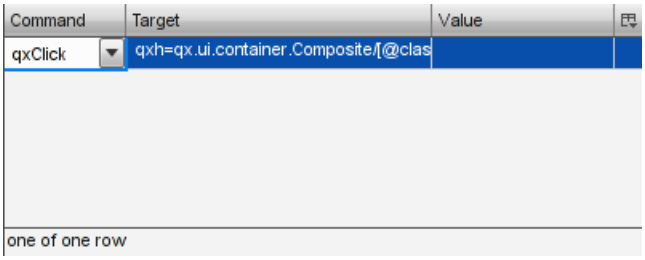
The **slider** controls the delay between individual commands when playing back a test case. In some cases, e.g. clicking a button that opens a new window, it will be necessary to set this to a higher value to make sure the application finishes rendering before the next command executes.

The **play button** executes selected test commands. If no commands are selected, the will all be run.

While the **record button** is active, a new line will be added whenever a new widget is selected in the Inspector.

The **import/export button** opens a new window containing the current test case in Selenese format. To import a Selenese test case, paste it into the text field and click `Import`.

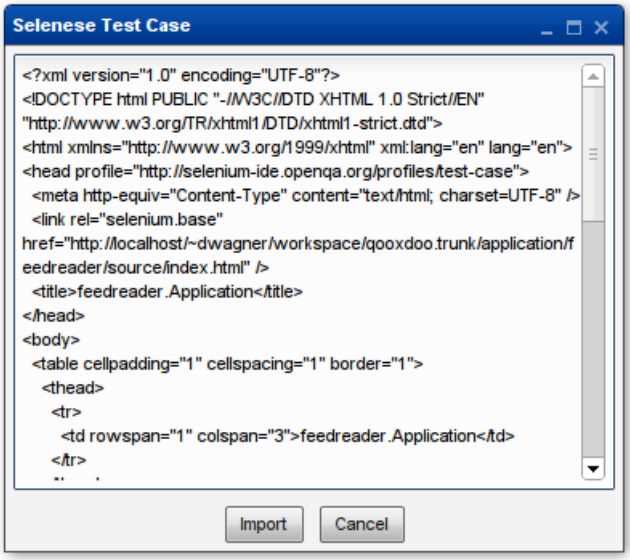
The **options button** opens a dialog where external script paths can be configured.



Test Commands

The table underneath the toolbar lists the commands in the current test case. Select one or more rows to execute their commands using the play button. Commands, locators and parameters can be edited by double clicking. Editing commands will display a combo box listing all commands supported by Selenium Core.

Log The log area displays any messages generated by Selenium Core while running commands.



Selenese window

Opened by clicking the Import/Export button in the toolbar, the Selenese window displays the current test case in Selenese format. This can be copied and pasted into a file, e.g. to be run by Selenium RC. Selenese import is also supported by pasting the contents of a Selenese file in the text area and clicking `Import`. This will replace any commands in the current test case with those from the pasted Selenese.

Tutorial To demonstrate the Selenium window, let's write a small test case for the qooxdoo Feed Reader: We'll automate the procedure of adding a new user-defined feed.

For this we'll need both the Feed Reader itself and the Inspector, of course: Generate both by running `generate.py source,inspector` in the `application/feedreader` directory of your qooxdoo SDK or SVN checkout, then open `application/feedreader/inspector/index.html` in your favorite browser.

Now configure the external scripts as described above.

Time to start automating: Click the **Inspect Widget** button in the Inspector's toolbar, then click the Feed Reader's **Add Feed** button. `qx.ui.toolbar.Button[xy]` should now be listed as the inspected widget. If you clicked the button's icon or label, that's fine too.

Click the **plus button** and a new line is added to the test case. Select that line and press **play** and the Add Feed window should open. You might need to move some Inspector windows around to see it.

Now click the **record** button, select **Inspect widget** again and click the upper text field in the Add Feed window. The new command will be added immediately. Select **Inspect Widget** again and click the second text field, then repeat the process for the **Add** button. We're done adding commands, so you can deactivate the **record** button and then close the Add Feed window.

Of course we want to type in the text fields instead of clicking them, so we need to change the commands: Double click the first column of the second row that currently says `qxClick`. Open the dropdown menu that appears and select `qxType`. Now double click this command's `value` cell and enter a title for the new feed to be added, e.g. "Selenium Blogs".

Repeat this step for the next row to define the new feed's URL, e.g. "http://feeds.feedburner.com/Selenium".

That's all the steps we need, so let's watch Selenium work. Set the slider to something around 1.5 seconds, select all four commands in the table and press the **play** button. If all went according to plan, we can click the **export** button to get a Selenese version of our test case to save.

> A debugging tool to inspect a qooxdoo application, featuring an interactive console, an object and widget finder, and a property editor.
>
> Online demo

9.2.4 Simulator

Overview

The purpose of the Simulator component is to help developers rapidly develop and run a suite of simulated user interaction tests for their application with a minimum amount of configuration and using familiar technologies, e.g. qooxdoo-style JavaScript. To do so it uses a combination of qooxdoo's own toolchain, Mozilla's Rhino JavaScript engine and Selenium Remote Control.

Feature Highlights

The Simulator enables developers to:

- Define Selenium test cases by writing qooxdoo classes
- Use the JUnit-style setUp, test*, tearDown pattern
- Define test jobs using the qooxdoo toolchain's configuration system
- Utilize the standard Selenium API as well as qooxdoo-specific user extensions to locate and interact with qooxdoo widgets
- Capture and log uncaught exceptions thrown in the tested application
- Use Selenium Server to run tests in many different browser/platform combinations

- Write custom log appenders using qooxdoo's flexible logging system

How it works

Similar to *unit tests*, Simulator test cases are defined as qooxdoo classes living in the application's source directory. As such they support qooxdoo's OO features such as inheritance and nested namespaces. The setUp, testSomething, tearDown pattern is supported, as well as all assertion functions defined by qx.core.MAssert.

The main API that is used to define the test logic is **QxSelenium**, which means the DefaultSelenium API plus the Locator strategies and commands from the qooxdoo user extensions for Selenium.

As with qooxdoo's unit testing framework, the Generator is used to create a test runner application (the Simulator). User-defined test classes are included into this application, which extends qx.application.Native and uses a simplified loader so it can run in Rhino.

A separate Generator job is used to start Rhino and instruct it to load the Simulator application, which uses Selenium's Java API to send test commands to a Selenium server (over HTTP, so the server can run on a separate machine). The Server then launches the selected browser, loads the qooxdoo application to be tested and executes the commands specified in the test case.

Setting up the test environment

The following sections describe the steps necessary to set up Simulator tests for an application based on qooxdoo's GUI or Inline skeleton.

Required Libraries

The Simulator needs the following external resources to run:

- Java Runtime Environment: Version 1.6 is known to work.
- Selenium Server and Java Client Driver: Version 1.0.3 or later. All versions up to and including 2.26.0 are known to work. Newer versions should generally be OK as long as the Selenium API remains stable.
- Mozilla Rhino: Versions 1.7R1 through 1.7R3 are supported. **Version 1.7R4 does not work!**

The Java archives for the Selenium client driver and Rhino must be located on the same machine as the application to be tested. For Rhino, this means js.jar. Older versions of Selenium provide a single archive (selenium-java-client-driver.jar), while newer ones are split up into the actual driver (selenium-java-<x.y.z>.jar) and several external libraries found in the "libs" folder of the ZIP archive.

The Selenium Server (selenium-server.jar, or selenium-server-standalone.jar for newer releases) can optionally run on a physically separate host (see the Selenium RC documentation for details). The qooxdoo user extensions must be located on the same machine as the server (see below).

Generator Configuration

Unlike other framework components, the Simulator isn't ready to run out of the box: The application developer needs to specify the location of the required external libraries (Selenium's Java bindings and Mozilla Rhino). This is easily accomplished by redefining the *SIMULATOR_CLASSPATH* macro (in the application's config.json file; be sure to heed the *general information about paths* in config files):

```
"let" :
{
  "SIMULATOR_CLASSPATH" :
  [
    "../selenium/selenium-java-2.22.0.jar",
    "../selenium/libs/*",
    "../rhino/js.jar"
  ]
}
```

The "environment" section of the "simulation-run" job configures where the AUT is located and how to reach the Selenium server that will launch the test browser and run the test commands. The following example shows the minimum configuration needed to launch a Simulator application that will test the source version of the current application in Firefox 3 using a Selenium server instance running on the same machine (localhost):

```
"simulation-run" :
{
  "let" :
  {
    "SIMULATOR_CLASSPATH" :
    [
      "../selenium/selenium-java-2.22.0.jar",
      "../selenium/libs/*",
      "../rhino/js.jar"
    ]
  },

  "environment" :
  {
    "simulator.testBrowser" : "*firefox",
    "simulator.selServer" : "localhost",
    "simulator.selPort" : 4444,
    "simulator.autHost" : "http://localhost",
    "simulator.autPath" : "/${APPLICATION}/source/index.html"
  }
}
```

See the *job reference* for a listing of all supported settings and their default values. Additional runtime options are available, although their default settings should be fine for most cases. See the *simulate job key reference* for details.

Writing Test Cases

As mentioned above, Simulator test cases are qooxdoo classes living (at least by default) in the application's **simulation** name space. They inherit from simulator.unit.TestCase, which includes the assertion functions from qx.core.MAssert. Simulator tests look very similar to qooxdoo unit tests as they follow the same pattern of **setUp**, **testSomething**, **tearDown**. Typically, each test* method will use the QxSelenium API to interact with some part of the AUT, then use assertions to check if the AUT's state has changed as expected, e.g. by querying the value of a qooxdoo property.

Locating Elements

In order to simulate interaction with a qooxdoo widget, Selenium needs to locate it first. This is accomplished by using one or more of the locator strategies described on this page:

- *Locating elements*

Simulating Interaction

In addition to Selenium's built-in commands, a number of qooxdoo-specific methods are available in the simulator.QxSelenium and simulator.Simulation classes. Run **generate.py api** in the *component/simulator* directory of the qooxdoo SDK to create an API Viewer for these classes.

Test Development Tools

Selenium IDE

This Firefox plugin allows test developers to run Selenium commands against a web application, making it a very useful to debug locators and check if commands produce the expected results. In order to use Selenium IDE with the qooxdoo-specific locators and commands, open the Options menu and enter the path to the qooxdoo extensions for Selenium in the field labeled *Selenium Core extensions*, e.g.:

```
C:\workspace\qooxdoo-3.0-sdk\component\simulator\tool\user-extensions\user-extensions.js
```

Inspector

qooxdoo's *Inspector component* can provide assistance to test developers by automatically determining locators for widgets.

Generating the Simulator

The "simulation-build" job explained above is used to generate the Simulator application (in the AUT's root directory):

```
generate.py simulation-build
```

Note that the Simulator application contains the test classes. This means that it must be re-generated whenever existing tests are modified or new ones are added.

Starting the Selenium server

The Selenium server must be started with the *-userExtensions* command line option pointing to the qooxdoo user extensions for Selenium mentioned above:

```
java -jar selenium-server-standalone-2.22.0.jar -userExtensions <QOOXDOO-TRUNK>/component/simulator/t
```

Running the Tests

Once the Simulator application is configured and compiled and the Selenium server is running, the test suite can be executed using the "simulation-run" job:

```
generate.py simulation-run
```

The Simulator's default logger writes the result of each test to the shell as it's executed. The full output looks something like this:

```
================================================================================
    EXECUTING: SIMULATION-RUN
================================================================================
>>> Initializing cache...
```

```
>>> Running Simulation...
>>> Load runtime: 360ms
>>> Simulator run on Thu, 02 Dec 2010 15:57:30 GMT
>>> Application under test: http://localhost/~dwagner/workspace/myApplication/source/index.html
>>> Platform: Linux
>>> User agent: Mozilla/5.0 (X11; U; Linux i686; en-US; rv:1.9.2.12) Gecko/20101026 Firefox/3.6.12
>>> PASS  myapplication.simulation.DemoSimulation:testButtonPresent
>>> PASS  myapplication.simulation.DemoSimulation:testButtonClick
>>> Main runtime: 11476ms
>>> Finalize runtime: 0ms
>>> Done
```

Testing multiple browser/OS combinations

General

Since the Simulator uses Selenium RC to start the browser and run tests, the relevant sections from the Selenium documentation apply. Due to the special nature of qooxdoo applications, however, some browsers require additional configuration steps before they can be tested.

Firefox, Chrome

Firefox and Chrome are generally well supported by Selenium, just make sure to use a Selenium version that isn't (much) older than the browser you intend to use for testing.

Internet Explorer 6, 7, 8 and 9

Starting the server When testing with IE, the Selenium server **must** be started with the *-singleWindow* option so the AUT will be loaded in an iframe. This is deactivated by default so two separate windows are opened for Selenium and the AUT. IE restricts cross-window JavaScript object access, causing the tests to fail.

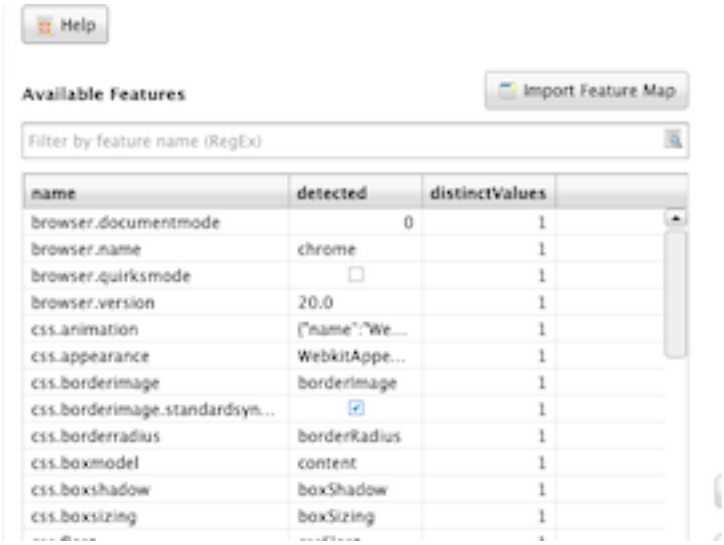
```
java -jar selenium-server-standalone.jar -singleWindow -userExtension [...]
```

Launching the browser To launch IE, the **iexploreproxy* launcher should be used. The **iexplore* launcher starts the embedded version of IE which in some ways behaves differently from the full-blown browser.

```
"simulation-run" :
{
  "environment" :
  {
    "simulator.testBrowser" : "*iexploreproxy",
    [...]
  }
}
```

A framework to develop simulated interaction tests, using Selenium.

9.2.5 Feature Configuration Editor



A tool designed to help developers create configurations for browser-specific builds. Detected feature sets from multiple clients can be imported and compared to find common values. The selected features are displayed in JSON format and can be pasted straight into the application's `config.json`.

Browser-specific builds

By predefining environment keys that correspond to certain browser-specific features, builds can be tailored towards certain clients. For example, legacy Internet Explorer versions (6,7 and 8) have very similar sets of features that are highly unlikely to change. Due to their comparatively poor JavaScript performance, they also particularly benefit from cutting down the size of the code that needs to be evaluated and the number of runtime feature checks, making them prime candidates for a custom build.

Generator configuration

Regardless of the usage scenario, developers need to make sure to carefully choose the environment settings to be hard-wired so as not to accidentally remove code needed by one of the target clients. The Feature Configuration Editor was designed to facilitate this process by allowing developers to compare the feature sets of multiple browsers and create an environment configuration for common features.

The following job config example shows how to create an application variant customized for IE 6, 7 and 8.

Please keep in mind that the environment map shown here is only an example and may be outdated. Make sure you always use environment values from the Feature Configuration Editor of the SDK you are using!

```
"build-script-legacyie" :
{
  "extend" : ["build-script"],

  "environment" :
  {
    "browser.name":"ie",
    "css.animation": null,
    "css.animation.requestframe": null,
    "css.appearance": null,
    "css.borderimage": null,
```

```
"css.borderimage.standardsyntax": null,
"css.borderradius": null,
"css.boxmodel": "content",
"css.boxshadow": null,
"css.float": "styleFloat",
"css.gradient.filter": true,
"css.gradient.legacywebkit": false,
"css.gradient.linear": null,
"css.gradient.radial": null,
"css.inlineblock": "inline-block",
"css.opacity": false,
"css.overflowxy": true,
"css.placeholder": false,
"css.rgba": false,
"css.textShadow": false,
"css.textShadow.filter": true,
"css.textoverflow": "textOverflow",
"css.transform": null,
"css.transform.3d": false,
"css.usermodify": null,
"css.userselect": null,
"css.userselect.none": null,
"ecmascript.array.every": false,
"ecmascript.array.filter": false,
"ecmascript.array.foreach": false,
"ecmascript.array.indexof": false,
"ecmascript.array.lastindexof": false,
"ecmascript.array.map": false,
"ecmascript.array.reduce": false,
"ecmascript.array.reduceright": false,
"ecmascript.array.some": false,
"ecmascript.date.now": false,
"ecmascript.error.stacktrace": null,
"ecmascript.function.bind": false,
"ecmascript.object.keys": false,
"ecmascript.string.trim": false,
"engine.name": "mshtml",
"event.help": true,
"event.pointer": false,
"event.touch": false,
"html.audio": false,
"html.audio.aif": "",
"html.audio.au": "",
"html.audio.mp3": "",
"html.audio.ogg": "",
"html.audio.wav": "",
"html.canvas": false,
"html.classlist": false,
"html.dataset": false,
"html.element.compareDocumentPosition": false,
"html.element.contains": true,
"html.element.textcontent": false,
"html.filereader": false,
"html.geolocation": false,
"html.image.naturaldimensions": false,
"html.storage.userdata": true,
"html.stylesheet.addimport": true,
"html.stylesheet.createstylesheet": true,
```

```
    "html.stylesheet.deleterule": false,
    "html.stylesheet.insertrule": false,
    "html.stylesheet.removeimport": true,
    "html.svg": false,
    "html.video": false,
    "html.video.h264": "",
    "html.video.ogg": "",
    "html.video.webm": "",
    "html.vml": true,
    "html.webworker": false,
    "html.xpath": false,
    "html.xul": false,
    "io.ssl": false,
    "runtime.name": "ie",
    "xml.attributens": false,
    "xml.createelementns": false,
    "xml.createnode": true,
    "xml.domparser": false,
    "xml.domproperties": true,
    "xml.getelementsbytagnamens": false,
    "xml.getqualifieditem": true,
    "xml.implementation": false,
    "xml.selectnodes": true,
    "xml.selectsinglenode": true
  },

  "compile-options" :
  {
    "paths":
    {
      "file" : "build/script/${APPLICATION}_ie.js"
    }
  }
}
```

By also running the default `build-script` job, an additional generic version of the application that makes no assumptions about client features can be generated whenever `build` is run:

```
"build" :
{
  "run" :
  [
    "build-resources",
    "build-script",
    "build-script-legacyie",
    "build-files"
  ]
}
```

Loading a specific variant

Finally, the application's `index.html` file must make sure the correct application variant is loaded based on the browser, e.g. by performing a simple user agent check:

```
<!DOCTYPE html>
<html xmlns="http://www.w3.org/1999/xhtml" xml:lang="en">
<head>
```

```
  <meta http-equiv="Content-Type" content="text/html; charset=utf-8" />
  <title>customapp</title>
  <script type="text/javascript">
    var suffix = "";

    if (/MSIE (6|7|8)\.0/.exec(navigator.userAgent)) {
      suffix = "_ie";
    }

    var scriptPath = "script/customapp" + suffix + ".js";
    document.write('<script type="text\/javascript" src="' + scriptPath + '"><\/script>');
  </script>
</head>
<body></body>
</html>
```

Editing tool for environment configurations used for browser-specific builds.

Online demo

CHAPTER

TEN

TOOLING

qooxdoo's tool chain comes with the SDK and comprises tools that help you create and maintain your JavaScript applications. They fall into two broad categories:

- command-line tools
- browser-based tools

Command-line tools are tools that run on your operating system's command shell, like *bash* for MacOSX and Linux, or *cmd* or *PowerShell* for Microsoft Windows. They generally require a Python installation on your system. Two important examples of this category are *create-application.py*, sort of an application wizard which you use to create a new application, and *generate.py* which you use during your development activities (and referred to as the "generator"), e.g. to build a running application from your source code.

Browser-based tools run in a web browser. Among them are the Apiviewer, which provides an interactive API reference, the Testrunner, which allows running your unit test in a GUI, or the Inspector, which allows to inspect the visual elements of your application and manipulate their properties.

As the browser-based applications are mostly described elsewhere, this section deals mainly with the command-line tools. It also provides a general introduction into the qooxdoo SDK and its structure.

10.1 Introduction

10.1.1 Introduction to the SDK

While the *Hello World* tutorial shows you how to use it, this page walks you through the basic structure of the qooxdoo SDK itself.

The SDK, when unpacked to your disk, is simply a structure of files and folders under a common root directory. Main ingredients include the qooxdoo class library, sample and helper applications for the browser, and the scripts, modules and data files of the tool chain.

- In the SDK's root directory there is - besides *readme.txt* and *license.txt* - an *index.html* that gives you an overview over and access to most of the SDK's browser-based applications and components. Just be aware (as mentioned on that page) that all of them need a `generate.py build` first in their respective directories. Only few like the Apiviewer for the framework are shipped pre-built and can be invoked immediately.
- The *physical structure* of the SDK gives you a high-level view of its files and folders. As you can see there the SDK has four main components represented through the subdirectories *application*, *component*, *framework* and *tool*. Three of them, *application*, *component* and *framework* contain (either directly or in further subdirectories) qooxdoo applications or libraries that follow the general scheme for a *qooxdoo application*.

- In each you will find a *Manifest.json* file which signifies the adherence to the skeleton scheme. They also all contain a *generate.py* script which offers all or a subset of the standard *qooxdoo jobs* that you can run on a library, like *source*, *build*, *test* or *api*.
- The fourth component, *tool*, comprises the tool chain and its various parts. You shouldn't need to worry about those files since you interact with the tool chain through its executable programs, like *generate.py* or *create-application.py*.

10.1.2 SDK Requirements

qooxdoo offers a platform-independent and user-friendly tool chain, in form of an SDK. It comes with the *qx.Desktop* and *qx.Mobile* downloads. For those components you use it for *creating and developing* a qooxdoo application. It is not needed for *running* the application. For the *qx.Website* and *qx.Server* components there are pre-build libraries to download, so you don't need the SDK.

Python

The tool chain only requires a Python installation. Use a standard **Python 2.x** release, version 2.5 or above. Python 3 is currently not supported. (If in doubt you can query the version of your local Python installation by running the command `python -V`). As a qooxdoo user you do not need any Python knowledge, it is merely a technology used internally for the tools. Python comes either pre-installed on many systems or it can be installed very easily:

Windows

It is trivial! Just download and install the excellent ActivePython package. Its default settings of the installation wizard are fine, there is nothing to configure. You can as well use the Windows package from Python.org, but this might require additional manual *configuration*.

Windows Shells Interop A word concerning various shells available under Windows and how they interoperate. We are testing the SDK with Windows cmd and occasionally PowerShell. Both should work equally well, and you should be able to freely switch between them (e.g. running *create-application.py* in cmd shell, and then change to PowerShell and run *generate.py source* in the skeleton, or vice versa).

If you mix your development efforts between native Windows shells and Cygwin (see next section), things will get more complicated. While working entirely under Cygwin should incur no problems (apart from being slower than under a native Windows setup), even when using a Windows installation of Python, creating an application with Cygwin and then building it with cmd or the other way round might or might not work as expected.

Other environments are available on Windows that provide a command shell, like MinGW and git bash . The latter has seen increased popularity with the growing distribution of the Git version control system. We would not recommend mixing SDK usage with git bash, as it (at the time of checking) uses a file system interface that is neither like Windows nor Cygwin (but rather reminiscent of an old Cygwin interface, using drive letters and forward slashes like `c:/foo/bar`). It's unclear whether using only git bash would work for qooxdoo projects, and we wouldn't be able to provide support for any issues that might arise.

Cygwin

Cygwin can be used as an optional free and powerful Unix-like environment for Windows. You won't need a native Python installation, just make sure to include Cygwin's **built-in** Python as an additional package when using Cygwin's setup program.

Mac

Python is **pre-installed** on Max OS X. No additional software needs to be installed, but on older systems it might need an update.

Linux

Python often comes **pre-installed** with your favorite distribution, just make sure they're still using a Python 2.x version. If not, simply use your package manager to install a suitable package.

Disk Space

The unpacked SDK will require around **110 MB** disk space (a big part of this is due to media files like images).

During runtime the tool chain also uses a subdirectory in your system's `TMP` path, to cache intermediate results and downloaded files. Depending on your activities this cache directory can become between **0.5** and **1.5 GB** in size. If the default cache path does not suite you, you can change it in your configuration.

Installation and Setup

Installation of the SDK is just going to the download section and grab the package suitable for your purpose. Choose either the *Desktop* or *Mobile* download, which both come as an SDK archive. Unzip it to a suitable path on your hard disk. The archive contains a single top-level folder, which in turn contains all the SDK's files and sub-folders.

This is all as far as the SDK is concerned. As an additional convenience you might want to add the `<sdk-root-path>/tool/bin` directory to your system environment `PATH` variable. This is a prerequisite for invoking the executable programs of the tool chain without the need to address them with their path.

Installation Troubleshooting

SDK Installation Troubleshooting

Python Installation

Python 3.0 Please make sure that you use a regular **Python 2.x** release (v2.5 or above). **Python 3.0 is currently not supported**.

Execute `python -V` in a console to get the installed Python version.

Windows

Making the interpreter available

Note: The following is only required when installing the Windows package from Python.org. When installing the preferred ActivePython this installation step is conveniently handled within its graphical installation wizard.

After your successful *Python installation*, you need to add the installation folder to the so-called `PATH` environment variable, which contains a list of directories that are searched for executables.

Suppose you installed Python to its default location `C:\Python26`, open a Windows command shell (choose menu `Start -> Run...` and type `cmd`). The following command prepends the installation folder to the value of `PATH`, separated by a semicolon:

```
set PATH=C:\Python26;%PATH%
```

When you now execute `python -V`, it should print out its version number.

The modification of the `PATH` variable as described above is only *temporary*. In order not to repeat the command each time you open a new command shell, modify the `PATH` variable permanently: in `Start -> Preferences -> System` choose `Environment variables` under the `Advanced` tab. Edit the system variable `Path` by prepending `C:\Python26;`.

File association

Note: The following is only required when installing the Windows package from Python.org. When installing the preferred ActivePython this installation step is conveniently handled within its graphical installation wizard.

In a standard Python installation on Windows, the `.py` file extension gets associated with the Python interpreter. This allows you to invoke .py files directly. You can check that in the following way at a command prompt:

```
C:\>assoc .py
.py=Python.File
```

If this doesn't work, you can add a file association through `Windows Explorer -> Extras -> Folder Options -> File Types`.

If for any reason you cannot use a file association for .py files, you can still invoke the Python interpreter directly, passing the original command line as arguments. In this case, make sure to provide a path prefix for the script name, even for scripts in the same directory, like so (this will be fixed later):

```
python ./generate.py source
```

Windows Vista To run qooxdoo's Python-based tools without problems, it is important to have Python installed as an administrator "for all" users.

Administrators installing Python "for all" users on Windows Vista *either* need to be logged in as user `Administrator`, *or* use the runas command, as in:

```
runas /user:Administrator "msiexec /i <path>\<file>.msi"
```

Windows 7 It has been reported that you need to use the PowerShell that comes with Windows 7 for the tools to work properly. The simple command shell doesn't seem to be sufficient. To launch the PowerShell, hit the *WIN+R* keys and enter `powershell`.

Mac OS X Older Macs (e.g. 10.4) may need an update of the pre-installed Python. See the following comment from the Python on Mac page : "Python comes pre-installed on Mac OS X, but due to Apple's release cycle, it's often one or even two years old. The overwhelming recommendation of the "MacPython" community is to upgrade your Python by downloading and installing a newer version from the Python standard release page."

If the generator is very slow on your Mac, it may be due to Spotlight or more precisely it's indexing daemon `mds`. `mds` can end up in an infinite loop resulting in very high disk load. While this is a general Mac issue, the generator can trigger this behaviour. To end the infinite loop:

```
# Delete Spotlight cache
sudo rm -r /.Spotlight-V100
```

10.1.3 Hello World

This tutorial is a fast-paced, high-level *tour de force*, to get you acquainted with working with the SDK. For that purpose we will create a minimal Desktop application.

Set up the Framework

To follow this, make sure your computer meets the requirements for the SDK as outlined on the *SDK Requirements* page. Go to the download page and grab the latest stable Desktop component. After downloading, all you have to do is to unzip the archive to a suitable path on your hard drive.

Create your Application

It is easy to setup your own application using the platform-independent script `create-application.py` in the *tool/bin* path of the SDK. It will create a skeleton application in a directory you specify, that is automatically configured to work with your version of the qooxdoo framework.

To create a new skeleton with `create-application.py` you will need to follow some initial *platform-dependent* steps - even when the rest of your development is independent of the platform. Please see the appropriate section below for *Windows* , *Cygwin* or *Mac , Linux*

Note: If you have any problems setting up the qooxdoo tool chain, please see some additional help for *troubleshooting*.

Windows

Open a command shell like `cmd` or `PowerShell`. Let's create an application named `custom` in the current directory, with the qooxdoo SDK available at `C:\qooxdoo-3.0-sdk`:

```
C:\qooxdoo-3.0-sdk\tool\bin\create-application.py --name=custom
```

Cygwin

Open a command shell like `bash`. To create your application `custom` in the current directory, with the qooxdoo SDK available at `C:\qooxdoo-3.0-sdk`, call the script as follows:

```
/cygdrive/c/qooxdoo-3.0-sdk/tool/bin/create-application.py --name=custom
```

Mac , Linux

Open a command shell like `bash`. To create an application `custom` in the current directory, with a qooxdoo SDK available at `/opt/qooxdoo-3.0-sdk`, call the script as follows:

```
/opt/qooxdoo-3.0-sdk/tool/bin/create-application.py --name=custom
```

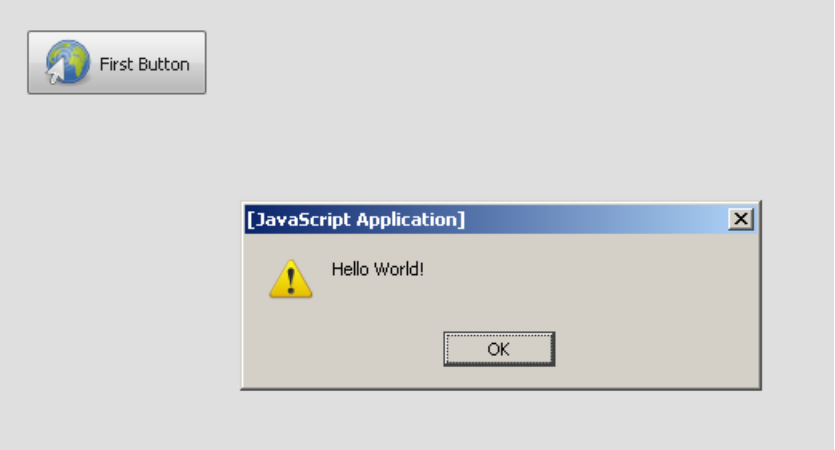
Run your Application

Now that your application is set up, let's generate a version that can be opened in your browser. Change to the newly created application directory and kick off the automatic build process:

```
cd custom
generate.py source-all
```

Under non-Windows systems you might have to prefix the command with the local directory, i.e. execute `./generate.py source-all` instead.

Now that the application has been generated, open the `source/index.html` file in your web browser to run your application and click the button:



As you go on with your application development it might be advantageous to run your application through a web server. So alternatively to opening `source/index.html` in the browser directly, you can start a local mini- web server by issuing the following command on the shell

```
generate.py source-server
```

Watch the output of the command, it will tell you the URL under which your source application is available over the web server (Just copy-paste it to the location field of your web browser). Once you're done hit `Ctrl-C` in the shell window to terminate the server process.

Write Application Code

The folder `source/class` contains all application classes. When starting with a newly created application, there is only a single file for application logic, `custom/Application.js`. Open it in your favorite editor or IDE.

The method `main()` contains the entire code of your little skeleton app. Even if you haven't done any qooxdoo programming before, you should be able to figure out what the code does. Get familiar with the code and change it, e.g. modify the label of the button, move the button to another position or add a second button.

To see the changes, you just have to refresh your document in the browser, e.g. by hitting `F5`. During development there usually is no need to re-generate this so-called "source" version of your app. Only if you later introduce new classes or if dependencies between classes change, you would have to re-generate your app. To do so, execute `generate.py source-all` (to include all source classes) or `generate.py source` (to only include the required classes) before refreshing your browser.

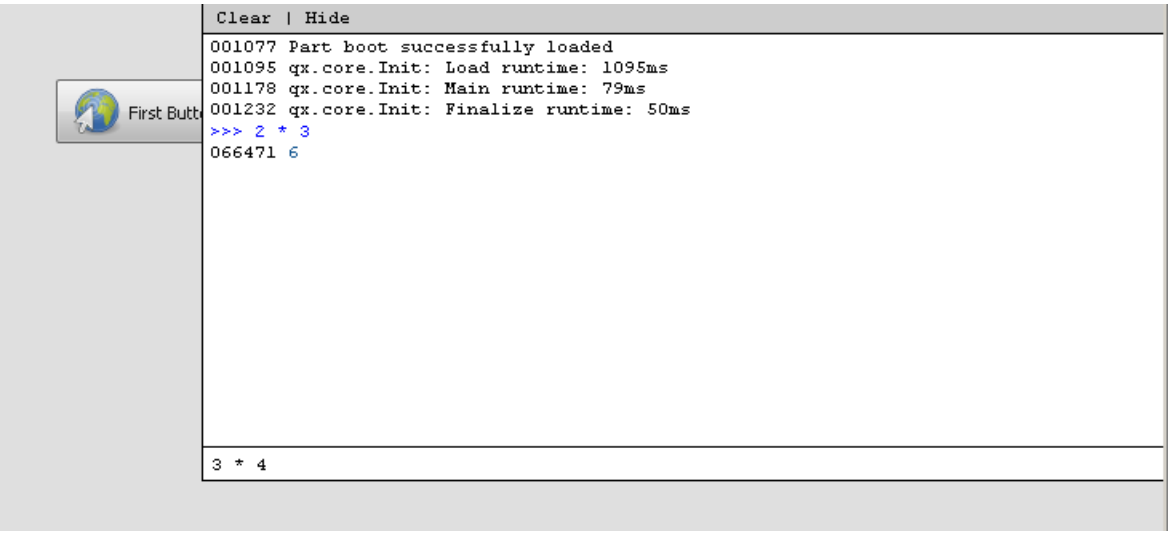
Debugging

In your newly created application you should have noticed the following code:

```
if (qx.core.Environment.get("qx.debug"))
{
  qx.log.appender.Native;
  qx.log.appender.Console;
}
```

This code turns on two different ways of "logging", i.e. capturing and printing out information about the operation of your application.

`qx.log.appender.Native` uses the native logging capabilities of your client if available, e.g. Firebug in Firefox (use `F12` to toggle). If your browser doesn't come with developer-friendly logging, `qx.log.appender.Console` provides such a feature for *all* browsers: the console prints out the log messages in an area inside your browser window. It also includes an interactive JavaScript shell (use `F7` to toggle):



The reason for enclosing the two logging classes in a so-called "debug" variant is explained in more detail in the next section. It ensures that logging is only turned on in the development version (i.e. "source" version) of your app. It will automatically be turned off in the final version of your app that is to be deployed.

Deployment

The development version of a qooxdoo app is called the "source" version, the deployment version of an app is called "build" version. The latter is similarly created by executing

```
generate.py build
```

After successful completion let the browser open `index.html` from the newly created `build` folder. Although you probably won't see a difference between this deployment version of your app and the previous "source" version, it should have started up faster.

Unlike the "source" version, with its numerous unmodified JavaScript files, the "build" version only has to load a single, optimized JavaScript file.

Manually creating such a "custom build" from your application class (or classes) would have been a very tedious and complex job. In fact most other JavaScript libraries do provide built-in support to automate this task. Building your app strips off unneeded whitespaces and comments, optimizes and reorganizes your code, uses a JS linker to only include classes that your application needs, and many more refinements and optimizations as well.

A lot of debugging code is also removed when a "build" is generated that would only be useful during development of your application, e.g. printing out informative warnings or coding hints. Just like the logging code in the section above, you can put arbitrary code into such "variants", which may then be automatically removed during "conditional compilation" of the build process. This lets you receive information on your app when you're developing it, but removes this for your final code, so your end users don't see it.

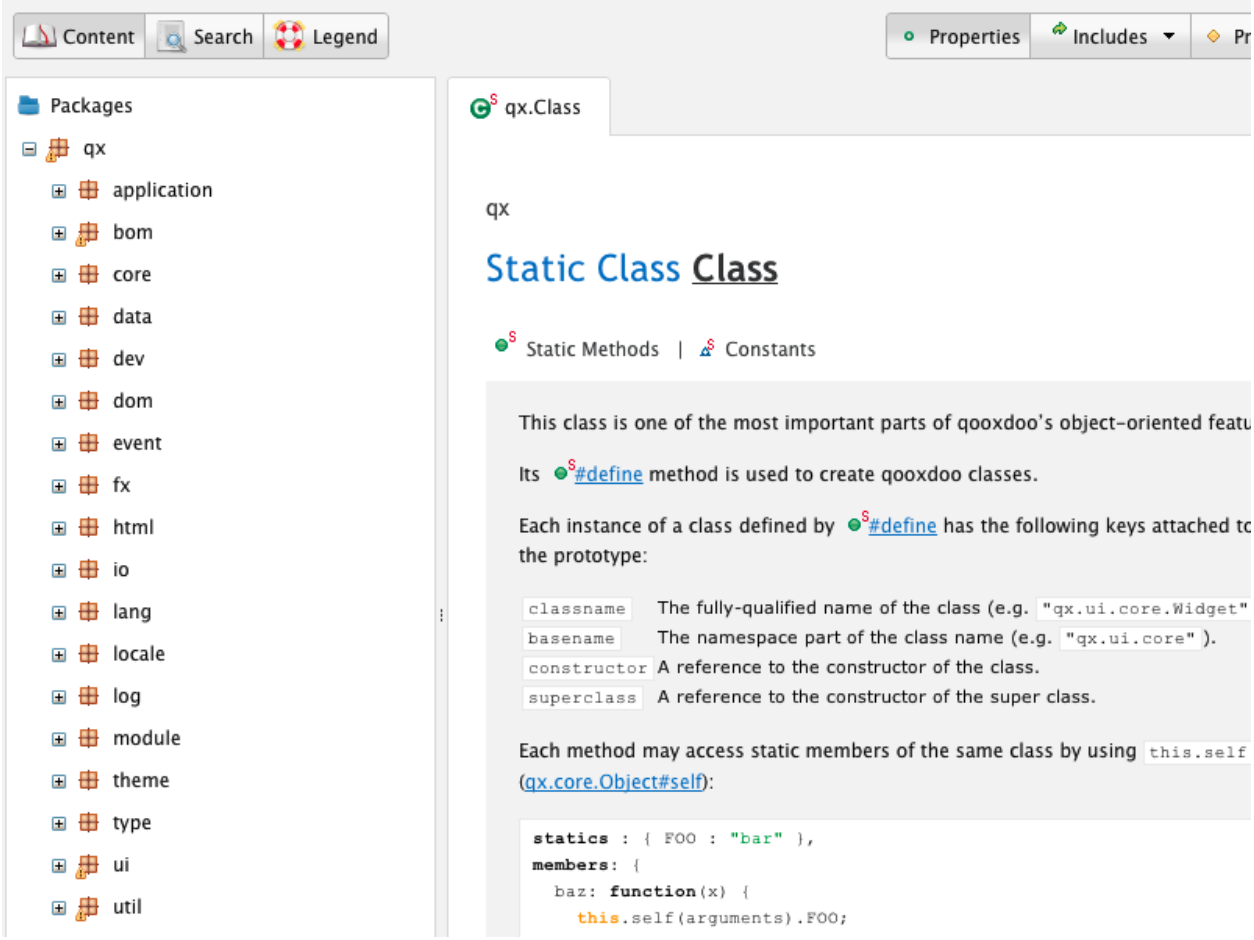
API Reference

qooxdoo supports inline comments that are similar to Javadoc or JSDoc comments. They allow for JavaScript and qooxdoo specific features, and look like `/** your comment */`.

From those comments a complete, interactive API reference can be generated:

```
generate.py api
```

To start the *API Viewer application*, open `index.html` from the newly created `api` folder in your browser. It includes fully cross-linked and searchable documentation of your application classes as well as the framework classes.

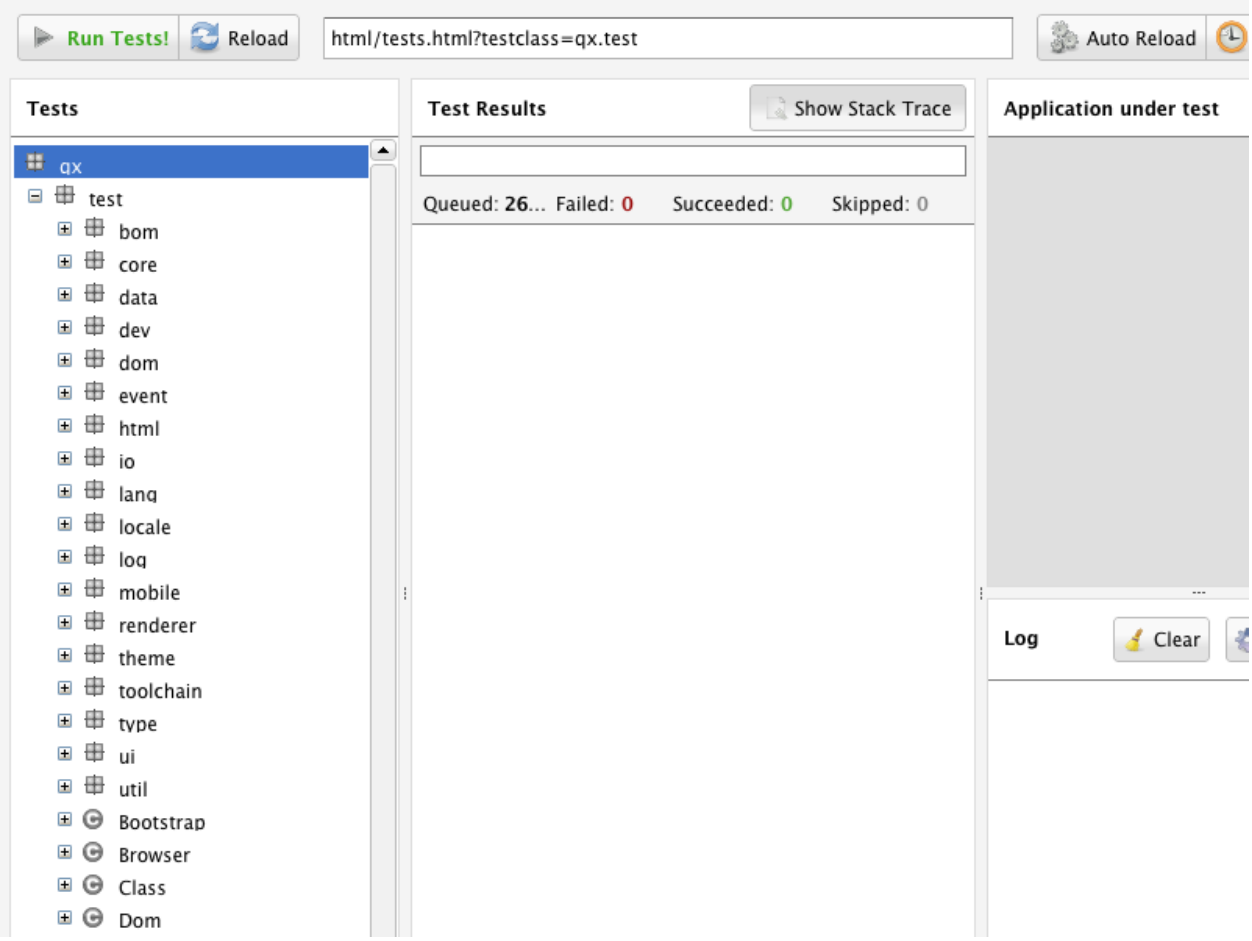


Unit Testing

You might have noticed the `test/DemoTest.js` file in the `source/class` folder of your application. This class demonstrates how to define "unit tests" for your application. qooxdoo comes with its own unit testing framework, it does not require any additional software installation. Simply execute the following command:

```
generate.py test
```

Open `index.html` from the newly created top-level `test` folder in your browser. The *Testrunner application* allows you to select and run the tests under your application namespace:



You may skip the rather advanced topic of unit tests while continuing to extend your custom application code. In case you are interested in test-driven development and creating your own unit tests, please see the corresponding *Unit Testing* documentation.

10.1.4 SDK Structure

When exploring the SDK tree, the following overview will give you an idea about the file structure of qooxdoo:

readme.txt - a quick information

license.txt - qooxdoo's license information

index.html - an overview over and access to most of the SDK's applications. Mind that in order to use them, you might need to run a `generate.py build` in their respective directories first.

application/

- *sample and demo applications* and interactive tools (for end users) in their respective subfolders, like `demobrowser`, `feedreader` or `playground`

component/

- *helper applications and libraries* (used internally), like `apiviewer`, `testrunner` or `simulator`.

documentation/ - documentation files

- `manual` - the user manual

framework/ - qooxdoo's class library

- `source`
  - `class` - JavaScript classes
  - `resource`
    - `qx` - resources need to be namespaced, here it is `qx`
      - `decoration` - images for the decorations, `Modern` and `Classic`
      - `icon` - icon themes that come with qooxdoo, `Oxygen` and `Tango`
      - `static` - other common resources like `blank.gif`
    - `source` - contains original resources
  - `translation` - language-specific data as `po` files

tool/ - tool chain of the framework

- `bin` - executable scripts are located here, most importantly `generator.py`
- `data` - lots of data to be used by different tools, e.g. for localization, migration, etc.
- `pylib` - Python modules used by the tool chain

10.1.5 Application Structure

Structural Overview

A qooxdoo application has a well-organized file structure. For an application named `custom`, everything is located within the application folder `custom`. Indentation denotes file system nesting:

- `source` - this folder always exists, as it contains the *development version* of your app
  - `index.html` - usually the only HTML file a qooxdoo application needs. Typically it hardly includes any markup, as the entire qooxdoo application is available as an external JavaScript file
  - `class` - all JavaScript classes
    - `custom` - this is the top-level namespace of your classes, often identical to the application name
  - `resource` - any static resources like images, etc. belong into this folder
    - `custom` - resource handling requires all files to be organized in folders that correspond to namespaces. Typically, the resources of your app are stored in a folder of the same name as the top-level namespace of your application classes
      - `test.png` - sample resource
  - `script` - this folder is created and/or updated for each development version of your app when executing `generate.py source` (or one of the other *source-** jobs)
    - `custom.js` - this JavaScript file is included from `index.html`. It is a loader script that includes all required files one-by-one.
  - `translation` - if you choose to develop your app for multiple languages, translation files will be put into this directory

        * `en.po` - and the other `.po` files for the languages your app supports. The respective locale is used as a file name, e.g. `it.po`, `pt_BR.po`, etc.

- `build` - this folder is created and/or updated for each *deployment version* of your app using `generate.py build`
  - `index.html` - identical to the one of the `source` version
  - `script` - contains the generated JavaScript code of your application
    * `custom.js` - this JavaScript file is included from `index.html`. In the *build* version this file contains the loader plus JavaScript code your application requires, in a compressed and optimized form. If you are developing a large-scale application, you can split it into so-called parts that can be loaded on demand.
  - `resource` - if your application classes contain appropriate *compiler hints*, those resources are automatically copied to this target folder. Your application is then self-contained and may be transferred to an external hosting environment.
- `api` - contains a searchable *API viewer* specific to your application, created by running the command `generate.py api`. As it is self-consistent, it may be copied anywhere and run offline.
- `test` - a standalone *Test runner* for unit tests you may create for your app, created by running `generate.py test`.
- *Manifest.json* - every qooxdoo app has such a Manifest file for some meta information
- *config.json* - configuration file for the build process and all other integrated developer tools
- *generate.py* - use this script for all kinds of tasks and tools, most importantly to generate the development and the deployment versions of your app.

Description

Here is a bit more prose regarding this structure. Of the basic structure, every application/library must contain a *config.json* and a *Manifest.json* file in its top-level directory (In theory, you can deviate from this rule, but it's much easier to stick with it). From this directory, a *source/class* subdirectory is expected, which contains a name space subdirectory and some class files therein. All other subdirectories in the top directory are then created during generator runs ('build', 'api', 'test', ...).

The most important of these sudirectories is of course *source* since it contains your source code. Aside from the *class/<name space>* subdirectory it has to have a *resource* subdir (for icons, style files, flash files, etc.) and a *translation* subdir (for string translation files). All these are mandatory, but might be empty. During a *'generate.py source'* a *source/script* directory is created which contains the generator output (basically a Javascript file that references all necessary class files, icons, etc.). This one has to be referenced from the application's index.html (usually *source/index.html*).

The *build* dir (created with *'generate.py build'*) has a very similar structure as the *source* dir, with *script*, and *resource* subdirs. The main difference is that everything that is necessary for your application to run is copied under this common root, and that the generator output script(s) in *build/script* contains the actual class definitions, not just references to their source files. The *build* dir is therefore self-contained, and doesn't have references that point outside of it.

Create some vanilla skeleton apps with *create-application.py* located in *tool/bin* and look at their initial file structure, to get a feel for it. Tailor the *source/class/<namespace>/Application.js* as the main application class, add further classes to your needs, and let the tool chain take care of the rest. You will have to run `generate.py source` initially and whenever you use further classes in your code. You can try out your app by opening *source/index.html* directly in your browser. You simply reload to see changes in the code. If you are comfortable with that, run a `generate.py build` and open *build/index.html* in your browser. If that is fine, copy the whole `build` tree to your web server.

10.1.6 Manifest.json

qooxdoo's Manifest files serve to provide meta information for a library in a structured way. Their syntax is in JSON. They have a more informational part (keyed `info`), which is more interesting for human readers, and a technical part (named `provides`) that is used in the processing of generator configurations. Here is a brief sample with all the possible keys:

Manifest files are referenced in application's *config.json* files (in the *library* key), to identify the library they stand for.

Reference

This is a sample file:

```
{
  "info" :
  {
    "name" : "Custom Application",

    "summary" : "Custom Application",
    "description" : "This is a skeleton for a custom application with qooxdoo.",

    "keywords" : ["custom"],
    "homepage" : "http://some.homepage.url/",

    "license" : "SomeLicense",
    "authors" :
    [
      {
        "name" : "First Author (uid)",
        "email" : "first.author@some.domain"
      }
    ],

    "version" : "trunk",
    "qooxdoo-versions": ["trunk"],
    "sourceViewUri" : "https://github.com/someuser/custom/blob/master/source/class/%{classFilePath}#1
  },

  "provides" :
  {
    "namespace"   : "custom",
    "encoding"    : "utf-8",
    "class"       : "source/class",
    "resource"    : "source/resource",
    "translation" : "source/translation",
    "type"        : "application"
  }
}
```

Description of Keys:

- **info**: All entries in this section are optional.
  - **name**: Name of the library.
  - **summary**: Short summary of its purpose.

  - **description**: Descriptive text.
  - **keywords**: List of keywords, tags.
  - **homepage**: Homepage URL of the library.
  - **license**: License name(s) of the library.
  - **authors**: Author(s) of the library. A list of maps, each map containing the following fields:
    * **name** : Author name.
    * **email** : Author email address.
  - **version**: Version of the library.
  - **qooxdoo-versions**: List of versions of the qooxdoo framework this library is compatible with.
  - **sourceViewUri**: URL to view the library's class code online. This URL will be used in generated API documentation. It has a special syntax and allows for placeholders (e.g. for the class name and the source line number). See the *Apiviewer documentation* for details.
- **provides**: Entries in this section are mandatory.
  - **namespace**: Library namespace (i.e. the namespace elements all class names in this library are prefixed with, e.g. `foo` for a main application class with name `foo.Application`).
  - **encoding**: File encoding of source code files (should be utf-8).
  - **class**: Path to the library's class code relative to the Manifest.json file, up to but not including the root namespace folder (e.g. `source/class`).
  - **resource**: Path to the library's resources relative to the Manifest.json file, up to but not including the root namespace folder (e.g. `source/resource`).
  - **translation**: Path to the library's translation files relative to the Manifest.json file (e.g. `source/translation`).
  - **type**: One of [`library`, `application`].

10.1.7 Code Structure

Outline

This is how a single source file should look like. Ahead of the detailed listing here are some general rules to follow when you write your own classes:

- Define **one** class per file.
- The base **class name** (like "Application" in *"custom.Application"*) has to match the **file name** (e.g. *"Application.js"*).
- The class **name space** (like "custom" in *"custom.Application"*) has to match the **directory path** of the file under the `source/class` root (like e.g. *"custom/Application.js"*).
  - This applies recursively for sub-directories. E.g. a class in the file *"custom/foo/Bar.js"* has to be named *"custom.foo.Bar"*.

Details

- **UTF-8 encoding** : All source files have to be encoded in UTF-8.
- **Header** *(optional)* : A comment holding author, copyrights, etc.

- **Compiler Hints** *(optional)* : Enclosed in a *JSDoc* comment you can have any number of the following @ attributes that serve as hints to the compiler:
  - *@use*
  - *@require*
  - *@ignore*
  - *@asset*
  - *@cldr*

  See their respective descriptions on the JSDoc page for details. Currently, *@use*, *@require*, *@asset* and *@cldr* are interpreted global to the file (So actually no matter where you place those hints within the file they will scope over the entire file. Hence, it's good practice to put them at the beginning). Only *@ignore* will scope over the construct it precedes, as the JSDoc reference explains.
- **Single Definition** : One call to a *define()* method, such as qx.(*Class*|*Theme*|*Interface*|*Mixin*|...).define().

Example:

```
/* ************************************************************************

   Copyright:

   License:

   Authors:

************************************************************************ */

/**
 * My wonderful class.
 *
 * @asset(custom/*)
 * @ignore(foo)
 */

qx.Class.define("custom.Application",
{
  ...
});
```

10.2 Generator

10.2.1 Generator Overview

This is a high-level overview of some important generator features. There is also a more comprehensive *feature overview*.

Quick links:

- *Generator Usage*
- *Configuration file details*

Configuration

- Load project configuration from JSON data file
- Each configuration can define multiple so named jobs
- Each job defines one action with all configuration
- A job can extend any other job and finetune the configuration
- Each execution of the generator can execute multiple of these jobs

Cache Support

- Advanced caching system which dramatically reduces the runtime in repeated calls.
- The cache stores data on the disk using the `pickle` Python module.
- Invalidation of cache files happens through a comparison of modification dates.
- Cache filenames use hash keys to keep them short and unique.
- Among the information which is being cached by the generator there are
  - class meta data
  - syntax trees
  - code dependencies
  - compiler results
  - api data
  - localization data

Class Selection

- Use include/exclude lists to define the set of classes to use.
- Allows simple wildcards, e.g. `qx.*`.
- By default, prerequisite classes are added to the class set, except those specified by an exclude.
- This can be toggled using a = prefix. This switches to a mode where exactly the classes listed in the config are included.
- As a fallback all known classes will be added when no includes are defined.

Variants

- From a single code base multiple variants can be created.
- This is controlled by *environment* variables, the values of which can be queried in the code.
- Given a set of environment bindings, code parts that are never executed as a consequence, can be pruned from the final application, saving code size.
- It is possible to generate multiple variant combinations. This means that a single job execution can create multiple files at once using different sets of environment bindings ("variant sets").
- Variants are combinable and all possible combinations are automatically created. For example: gecko+debug, mshtml+debug, gecko+nodebug, mshtml+nodebug.

API Data

- Creation of split API data which loads incrementally as needed.
- Creation of a searchable index containing all relevant names of the API (e.g. classes, properties, functions, events, ...)

Internationalisation

- Creation and update of "po" files based on marked strings in the class files.
- Inclusion of translation information in the generated application.
- Dynamic creation of localization data based on the standardized information available at unicode.org. The "main" package of CLDR which is used, is locally mirrored in the SDK.

Parts

- Each part can be seen as a logical or visual component of the application.
- Each part may result in multiple packages (script output files).
- The number of packages could be exponential to the number of parts (but through the optimization this is often not the case).
- Packages are merged given some constraints (e.g. minimal size), to reduce their overall number.
- The parts are defined in the application configuration, using a similar include key like the class selection.
- There is one signified initial part, named 'boot', that is loaded automatically at application startup, and contains the initial set of functionality.
- Other parts are loaded explicitly by the application code, using a specific `PartLoader` API of the framework.

10.2.2 Generator Features

This is a functional overview over the feature areas of the Generator, answering the question "What can I achieve with the Generator?".

Application Generation

Code Dependency Analysis

The Generator automatically detects dependencies between classes. These dependencies are explored recursively, so only the minimal set of start classes needs to be provided, in order to create a full application consisting of many classes. Except for rare cases, no explicit "requiring" of other classes is necessary in application code.

Code Selection

Depending on dependency information the classes necessary for an application are selected from all classes provided by the involved libraries.

Variant Builds

You can create variants of your application, where in each of them only code is contained that complies with a specific set of values that can be defined in configuration. Those values may pertain to browser features, runtime settings, or user-defined properties. A common application is to remove debug code from optimized builds, or to specialize code for a specific rendering engine like Gecko or Webkit.

Code Optimization

Besides variant generation (that optimizes by removing dead code) various optimizations and compressions can be applied to class code, to make script files smaller and execution faster. Those optimizations include variable shortening, partial evaluation, call inlining, or constant folding (the latter for environment queries).

Script and Loader Generation

All the code that eventually goes into the application needs to be sorted, so that symbols are available in the JavaScript interpreter when they are referenced. This is achieved by generating sorted script files, and generating a loader script that loads them in the right order. The loader script is the single entry point for the hosting HTML page to load the qooxdoo application.

Zip Compression

Script files can optionally be gzipped.

Application Environment

An open set of key-value bindings can be established in the generator configuration. Those bindings are evaluated by the Generator at compile time (e.g. in the form of partial evaluating access to them), as well as at runtime.

File Inclusion

You can add arbitrary .js and .css files to your application that will be loaded ahead of any qooxdoo code.

Contribution Inclusion

Online hosted qooxdoo contributions can be included like local libraries.

Lazy-Loading Parts

You can define parts of your application that are generated as distinct units that can be loaded on demand during runtime. This reduces network and memory footprint when the main application is loaded, and the overall footprint when the optional part is not needed over the app's life cycle.

Deployment Builds

The deployment build creates an optimized version of the application, together with all its static resources like images, translation strings, Css files, into a self-contained directory tree. This tree can then be copied to arbitrary locations and will run there out of the box.

File Watching

TBD [Watching files or directory trees for changes, and take a predefined action like re-generating an application, compile Less to Css files, or run a documentation generator.]

Application Development

Inspector Console

The Generator allows the creation of an inspector that can load the actual application and provides various console views to inspect and tweak it. E.g. it exposes the object hierarchy of qooxdoo classes, gives access to each class' properties, etc.

Code Maintenance

Lint Checking

You code can be inspected for flaws and potential pitfalls, beyond it being syntactically correct.

Whitespace Fixing

Irregular whitespace can be an annoyance, like tab width differences or the inclusion of unusual Unicode whitespace characters (e.g. BOM). The Generator can fix this.

Pretty-Printing

Your code can be re-formatted to comply to some rules of regularity, which are customizable through configuration.

Resource Handling

Resource Selection

From a rich set of application resources like images only those are chosen that are required by the classes that are selected for the application. This reduces the size footprint of the application.

Image Slicing and Combining

The Generator provides a high-level interface to the ImageMagick tool suite, in order to slice a complex image in smaller parts (e.g. border, edges and the central part), or to combine a set of images into a combined image.

Base64 Combined Images

A special case of image combining, the generator can create Base64 representations of a set of images into a single file. These images can then be used with `data:` URLs.

CSS Compression

Css files can be compressed.

Documentation

API Data

From class code JSDoc comments can be extracted, and fed into one of the Apiviewer instances to be viewed in the browser.

Testing

Unit Tests

An "Application Under Test" can be generated, combining application test classes and classes from qooxdoo's unit testing framework into a runnable application. To control the testing, both command-line as well as browser-based runners are available.

GUI Tests

qooxdoo supports testing browser applications with Selenium. The generator can generate the necessary client driver scripts from dedicated application and framework classes that can then be run with e.g. Node.js.

Internationalization

PO Files

The Generator allows you to extract tagged strings from class code and place them in PO files which can then be translated by translators.

Runtime Support

For a given list of locales message keys with their translations will be extracted from the PO files and included with the application. Locales can then be switched a runtime, or be lazily loaded on demand.

File System

File Copying

Various files can be copied, especially for the deployment version of the application.

Artefacts Cleanup

Clean jobs can be deployed to remove generated artefacts and cached content.

Migration

Application Code Migration

The Generator supports automatic migration of application code across several qooxdoo versions.

Logging and Reporting

Dependency Logging

Dependency relations between classes can be logged in several formats, json, flare, graphviz/dot or formatted text.

Library Classes

Unused classes of a library can be logged during application build.

Library Translations

The Generator can which and how much PO entries of a library are translated.

Installation Information

A general 'info' job gathers information about the installed qooxdoo version, the current cache, Python version, asf. This is helpful for debugging client problems.

Miscellaneous

Shell Commands

Arbitrary shell commands can be issued through the Generator, allowing to bind in other child processes in the build system.

10.2.3 Generator Usage

The generator is a command-line utility which serves as the single entry front-end for all qooxdoo tool chain functions (nearly; there are a few functions that are available through other programs, but these really serve special purposes).

The generator is started to execute various jobs. Those jobs represent the feature set of the tool chain. This page is about how to invoke the generator.

Files and Folder Structure

The qooxdoo SDK has a dedicated `tool` folder that contains all elements that make up the tool chain. The general structure is like this:

```
tool
   |- app    -- helper apps
   |- bin    -- stand-alone programs and scripts
   |- data   -- various data files
   |- pylib -- Python modules
```

The generator is actually the program `tool/bin/generator.py`.

generate.py

To make it easier to invoke the generator, each library in the SDK (framework, applications, components) contains a `generate.py` script that is really just a proxy for the generator itself. It is also part of each project created by the *create-application.py* wizard. The aim is to hide the actual path to the generator program. You can omit using it if you add *<QOOXDOO_PATH>/tool/bin* to your PATH environment variable.

Command-line Options

Since the generator is nearly completely driven by its configuration files, there are rather few command-line options:

```
shell> generator.py -h
Usage: generator.py [options] job,...

Arguments:
  job,...               a list of jobs (like 'source' or 'copy-files',
                        without the quotes) to run
  x                     use 'x' (or some undefined job name) to get a
                        list of all available jobs from the configuration file

Options:
  -h, --help            show this help message and exit
  -c CFGFILE, --config=CFGFILE
                        path to configuration file containing job definitions
                        (default: config.json)
  -q, --quiet           quiet output mode (extra quiet)
  -v, --verbose         verbose output mode of job processing
  -w, --config-verbose  verbose output mode of configuration processing
  -l FILENAME, --logfile=FILENAME
                        log file
  -s, --stacktrace      enable stack traces on fatal exceptions
  -m KEY:VAL, --macro=KEY:VAL
                        define/overwrite a global 'let' macro KEY with value
                        VAL
  -I, --no-progress-indicator
                        suppress animated progress indication
```

The most important options are the path of the config file to use (*-c* option), and the list of jobs to execute. The *-m* option allows Json-type values, scalars like strings and numbers, but also maps *{...}* and lists *[...]* [1].

[1] Caveat: The latter two might push you to the brink of your shell's quoting capabilities :-) .

Configuration Files

The single most important way to control the actions of the generator is through specialized configuration files. These files have a JSON syntax and contain the definitions for the various jobs the generator is supposed to execute. There is a *whole section* in this manual dedicated to these config files.

Usage Patterns

As a few quick hints on how you would invoke the generator, here are the most common use cases. All these examples name a single job to run, and rely on the availability of the default config file `config.json` in the current directory:

- `generate.py source` – when you just started to create your application and every time you have added new classes to it.
- `generate.py build` – when you have completed your application and/or want to create an optimized, deployable version of it.
- `generate.py api` – when your application is getting complex and/or you want to have a local version of the standard Apiviewer application that includes the documentation of all of your application classes.
- `generate.py test` – when you have created unit test classes for your application and want to run them in the Testrunner frame application.

The *Helloworld* tutorial will give the complete steps how to start a project and get going.

Default Jobs

Arguments like `source` or `api`, as shown in the previous section, are so called *jobs* in qooxdoo lingo. If you are working on a skeleton-based application you automatically get a whole list of such pre-defined jobs to work with. For a quick overview, invoke the generator script with an undefined job argument, like

```
generate.py X
```

This gives you a list of all jobs available through your current config file, many of them with a few words of explanation about what they do:

```
- api          -- create api doc for the current library
- build        -- create build version of current application
- clean        -- remove local cache and generated .js files (source/build)
- distclean    -- remove the cache and all generated artefacts of this library...
- fix          -- normalize whitespace in .js files of the current library ...
- inspector    -- (since 0.8.2) create an inspector instance in the current library
- lint         -- check the source code of the .js files of the current library
- migration    -- migrate the .js files of the current library to the current ...
- pretty       -- pretty-formatting of the source code of the current library
- profiling    -- includer job, to activate profiling
- source       -- create source version of current application
- source-all   -- create source version of current application, with all classes
- test         -- create a test runner app for unit tests of the current library
- test-source          -- create a test runner app for unit tests (source...
- translation          -- create .po files for current library
```

For an exhaustive reference of these default jobs, see the *default jobs page*.

10.2.4 Generator Script Optimizations

When creating the JavaScript output for an application, the generator supports several optimizations. These optimizations can be enabled in the generator configuration using the *code/optimize* key, a subkey of *compile-options*. The best way to set this key is by setting the *OPTIMIZE* macro in your config's global *let* section. What the individual optimizations do is described here in detail.

basecalls

Calls to *this.base()*, which invoke the corresponding superclass method, are inlined, i.e. the superclass method call is inserted in place of the this.base() call.

comments

The *comments* optimization is automatically included in any of the other optimizations, so really only makes a difference when given as the only optimization key for the given build. In that case, comments are stripped from the source code, and the resulting text is passed to the script output, also retaining (most of the) white space of the source version. What you get is a near-source code version in the running application that allows you to focus on the code, and is lighter in terms of transfer size.

privates

This is less an optimization in space or time, but rather a way to enforce privates. Private members of a class (those beginning with "__") are replaced with generated names, and are substituted throughout the class. If some other class is accessing those privates, these references are not updated and will eventually fail when the access happens. This will lead to a runtime error.

There is a caveat with privates optimization: Apart from identifier references to the private, also **string references** in the class code will be replaced. That means if a string literal contains of the exact sequence of characters as the private key, the contents of the string will also be replace. This only affects complete matches, not partly matches in a larger string.

```
__foo : function () {
  this.debug("__foo");
  this.debug("__foo called");
}
```

If `__foo` is replaced by, say, `__a` by the private optimization, the code will look like this after the optimization:

```
__a : function () {
  this.debug("__a");
  this.debug("__foo called");
}
```

The reason for this behaviour is that members, including private members, of a class are sometimes referenced by their name string, particularly in definitions of *properties*, and as arguments to *dispose methods*, as used in the `destruct` member of a class. Here is a longer code fragment to show where name references to members can be used:

```
properties : {
  myprop : {
    apply : "__myapply",
    validate : "__myvalidate"
  }

},
```

```
members : {
  __foo : ...,
  __myapply : function () {...},
  __myvalidate : function () {...}
}
...
destruct : function () {
  this._disposeObjects("__foo");
}
```

For more details where string references can occur, see e.g. the *class* and *property* quick refs.

strings

With the string optimization, strings are extracted from the class definition and put into lexical variables. The occurrences of the strings in the class definition is then replaced by the variable name. This mainly benefits IE6 and repetitive references to the same string literal.

statics

(experimental)

The statics optimization tries to remove unused ("dead") code, namely the code of methods of static classes. The reason for this is that static methods are often invoked with their complete class name, e.g. as `qx.bom.Cookie.get()`, which is easy to detect. Often, an application would only call a single method of a static class, so the other methods of this class are unused, and can be removed.

As removing a method reduces the dependencies this method has to other classes, those dependencies are checked themselves. If there are no other dependents, the dependent class feature can be removed as well. This pattern is applied recursively until no more code can be removed. Classes which are no longer used at all are removed entirely. (Technically, the generator uses reference counting to track the "usage count" of a class feature, and eventually constructs a reachability graph to remove entire trees of classes and their dependencies if they are not reachable by the main application classes).

In the context of a dynamic language this is a very aggressive optimization, and the problem is the occurrence of false positives. I.e. methods are judged as "not used" when in fact they are. This hinges on the highly dynamic nature of JavaScript where methods can be aliased, passed around as parameters to other functions, stored as map values, and so forth, all of which is hard to detect at compile time.

The cure is to add `@require` hints to force the inclusion of those methods that you know are used, although the generator cannot detect this. E.g. in a class that has an undetected runtime dependency on `qx.bom.Cookie.get()` you should add an appropriate hint in the this class:

```
/*
@require(qx.bom.Cookie#get)
*/
```

Warning: The statics optimization is highly experimental, and is not for use in normal application development. If you use it, you should expect manual work and multiple iterations to get your classes working again. You best provide a good test coverage in advance so you can convince yourself that all classes are indeed working when this optimization is enabled.

variables

Local variable names are made short. Scoped variables (those declared with a *var* statement in a function) are replaced by generated names that are much shorter (1-2 characters on average). Depending on the original code, this can result in significant space savings.

variants

With giving the *variants* optimization key, code will be removed that is not relevant for the current build. The decision about relevance is based on the settings given in the job configuration's *environment* key. Often, these settings will be queried in class code to select a certain code branch. If the value of the setting is known at compile time, the correct branch can be selected right away, and all other branches be removed. This allows to omit code that wouldn't be executed at run time anyway ("dead code removal").

The way environment settings are queried in class code is through certain APIs of the qx.core.Environment class. These API calls are searched for, and depending on context safe optimizations are applied. Here are the different calls and how they are treated.

.get()

qx.core.Environment.get() references the environment key as its first parameter. If this parameter is a literal, i.e. a string, representing a known environment key, the call can be replaced by the environment key's value. This is applied in all situations, and saves the method call at run time:

```
var a = qx.core.Environment.get("myapp.foo");
```

If the value of the environment key is `"bar"`, the expression is thus reduced to a simple assignment, where `a` is assigned the value `"bar"`:

```
var a = "bar";
```

If the call happens inside the condition of an `if` statement, and the call is the only expression, it is evaluated and the whole *if* statement is replaced by either its *then* or its *else* branch, depending on the truth value of the environment key.

```
if (qx.core.Environment.get("myapp.foo")) {
  // some code if mayapp.foo evaluates to true
} else {
  // some code if myapp.foo evalutates to false
}
```

The same holds true if the call to *qx.core.Environment.get()* is not the only expression in the *if* condition, but is part of a simple compare where

- the condition operator is one of ==, ===, !=, !===
- the other operand is a literal value (like `"foo"`, `3`, or `true`)

```
if (qx.core.Environment.get("myapp.foo") == "bar") {
  ...
} else {
  ...
}
```

Again, the branch of the *if* statement is chosen according to the outcome of the comparison. If the condition evaluates to false and there is no *else* branch, the *if* statement is removed.

.select()

With qx.core.Environment.select() you can choose an expression from a set of expressions according to the current value of an environment key. The first parameter to the call is again the environment key, the second is a map that maps possible values to arbitrary expressions.

Again, if the key is a literal string and can be found in the environment settings known to the generator, the whole *qx.core.Environment.select()* expression is replaced by the corresponding expression from the map parameter.

```
var a = qx.core.Environment.select("myapp.foo", {
  "bar" : function (x) { return x+3;},
  "baz" : 24
}
```

Depending on the value of `myapp.foo`, the variable `a` will be assigned a function, or the number literal *24*.

You can include the special key **"default"** in the map parameter to *.select()*. Its expression will be chosen if the value of the environment key does not match any of the other concrete map keys. If the generator comes across a *.select()* call where the environment value does not match any of the map keys *and* there is no *"default"* key, it will raise an exception.

.filter()

Similar to `.select()`, qx.core.Environment.filter() takes a map. But this time the map keys are different environment keys (not possible values of a single key).

```
include : qx.core.Environment.filter({
  "module.databinding" : qx.data.MBinding,
  "module.logger"      : qx.core.MLogging,
  "module.events"      : qx.core.MEvent,
  "module.property"    : qx.core.MProperty,
  "qx.debug"           : qx.core.MAssert
}),
```

Each key is checked, and if its value resolves to a true value, the corresponding map value is added to an array. At the end, this array is returned. That means, `.filter()` turns a set of environment keys into a list of corresponding expressions. For the generator, this means that if an environment value is known to be false at compile time, its entry can be safely removed from the filter map. The benefit of this is that code dependencies that are in the map values are removed, again saving dependencies that would never be used at runtime.

Note: Mind, though, that `variants` optimization somewhat conflicts with the `qx.allowUrlSettings` environment key. See *there* for more information.

---

whitespace

Whitespace (spaces, tabs, newlines) is removed. Semi-colons are inserted where necessary.

10.2.5 Adding Dependency Information Manually

When the automatic dependency analysis misses dependencies, e.g. because a method is instantiating a class that has been passed in as a formal parameter, or you are calling a method on one class that is attached to it from another class dynamically, you need to inform the Generator about these dependencies explicitly. There are different ways to achieve that.

In the class file

You can declare dependencies at the top of the class file using the *require* and *use* compiler hints. They are embedded in specific comments and don't interfere with normal JavaScript syntax. For example

```
/**
 * @require(qx.module.Animation)
 * @use(qx.module.Cookie)
 */
```

Mind the difference between `require` and `use`. `use` should be preferred as it only says that the required class has to be available "eventually" at runtime. `require` imposes a stronger constraint as it demands that the required class is loaded *ahead* of the current class, and should only be used when the required class is used at load-time of the current class (e.g. in the *defer* method).

In the configuration

You can specify dependencies in the configuration of the jobs that create your application. The corresponding configuration keys are (not surprisingly) *require* and *use*. Here is an example:

```
"source-script" :
{
  "require" :
  {
    "myapp.ClassA" : ["qx.module.Animation"]
  },
  "use" :
  {
    "myapp.ClassA" : ["qx.module.Cookie"]
  }
}
```

Remember that source and build jobs are independent from each other so you usually want to add this configuration also to the `build-script` job to have the dependencies available in both build types.

Passing dependency information via configuration is interesting when you don't want to hard-wire this information into the class file. E.g. if you are building variants of your application where you want to inject variant-specific classes as dependencies, the configuration method is preferable.

10.2.6 Configuration

Generator Configuration File

Overview

The configuration file that drives the generator adheres to the JSON specification. It has the following general structure:

```
{
  "name" : ...,
  "include : ...,
  "jobs" :
  {
    "job1" : { ... },
    "job2" : { ... },
    ...
    "jobN" : { ... }
```

```
  }
}
```

The top-level keys `name`, `include` and `jobs` are pre-defined, the only mandatory being *jobs*. Jobs are the core of each configuration file (much like targets in a Makefile). The job names `job1`, ..., `jobN` are freely chooseable names but must form a valid key. JavaScript-style comments (`/*...*/` and `//...`) are allowed.

Example

Here is an example of a minimal config file that defines a single job to create the source version of an application:

```
{
  "jobs" :
  {
    "source" :
    {
      "let" :
      {
        "QOOXDOO_PATH" : "../..",
        "APPLICATION" : "custom"
      },

      "library" :
      [
        {
          "manifest"     : "${QOOXDOO_PATH}/framework/Manifest.json"
        },
        {
          "manifest"     : "./Manifest.json"
        }
      ],

      "compile-options" :
      {
        "paths" :
          {
            "file" : "./source/script/${APPLICATION}.js"
          }
      },

      "compile" : { "type" : "source" },

      "require" :
      {
        "qx.log.Logger" : ["qx.log.appender.Native"]
      },

      "environment" :
      {
        "qx.application" : "${APPLICATION}.Application"
      },

      "cache" :
      {
        "compile" : "../../cache2"
      }
    }
```

```
    }
}
```

Syntax

The basic syntax of the configuration files is JSON, but on top of that a schema further restricts which keys and values can appear in which locations in the structure, see further for details. Additionally to the described keys you can place = in front of job and key names, to indicate that this feature should prevail as specified when configs get merged. See *a special section* for more details on that. The config system also allows the use of *macros*, details of which can again be found *in a dedicated section*. If you use keys outside those listed here in your configuration, you will be warned about them, and they will be ignored in the processing.

Valid Job Keys

As mentioned before jobs are the main contents in any configuration file. Each job has a name which is freely chooseable. Its value is a map where the keys are **not** freely chooseable, but are predefined.

Those job keys (i.e. keys used in a job definition) can be grouped into several categories:

- `structure-changing` - Keys that influence the configuration itself, e.g. the contents or structure of jobs, the job queue, or the config file as a whole (e.g. *extend, include (top-level), run*).
- `actions` - Keys that if present trigger a certain action in the generator, which usually results in some output (e.g. *compile, api, localize*).
- `input/output-setting` - Keys that specify input (e.g. classes or ranges of classes to deal with) and output (e.g. packaging, variants) options (e.g. *library, require, include*).
- `runtime-settings` - Keys pertaining to the working needs of the generator (e.g. *cache*).
- `miscellaneous` - Keys that don't fall in any of the other categories (e.g. *desc*).

First, here is an overview table, to list all possible keys in a job (if the key has a different context, this is explicitly noted). Below that, you'll find a structured listing of all possible configuration keys in their respective context, with links to further information for each.

Action Keys	Description
api	Triggers the generation of a custom Apiviewer application.
clean-files	Delete files and directories from the file system.
collect-environment-info	Prints various info about the qooxdoo environment (version etc.)
combine-images	Triggers creation of a combined image file that contains various images.
compile	Triggers the generation of a source or build version of the app.
copy-files	Triggers files/directories to be copied.
copy-resources	Triggers the copying of resources.
fix-files	Fix white space in source files.
lint-check	Check source code with a lint-like utility.
migrate-files	Migrate source code to the current qooxdoo version.
pretty-print	Format source files.
provider	Collects classes, resources and dependency info in a directory tree.
shell	Triggers the execution of one or more external command(s).
simulate	Triggers the execution of a suite of integration tests.
slice-images	Triggers cutting images into regions.
translate	Triggers updating of .po files.

Continued on next page

Table 10.1 – continued from previous page

validation-config	Validate a configuration file.
validation-manifest	Validate the Manifest.json.
watch-files	Execute a job when some files change.
web-server	Start a mini web-server to serve the current app.
web-server-config	Generate a configuration snippet (e.g. for Apache), for the current app.
Structure-changing Keys	**Description**
default-job (top-level)	Default job to be run.
export (top-level)	List of jobs to be exported to other config files.
extend	Extend the current job with other jobs.
include (top-level)	Include external config files.
jobs (top-level)	Define jobs.
let	Define macros.
let (top-level)	Define default macros.
run	Define a list of jobs to run.
Input/Output-setting Keys	**Description**
add-css	Include arbitrary CSS URIs to be loaded by the app.
add-script	Includes arbitrary script URIs to be loaded by the app.
asset-let	Defines macros that will be replaced in @asset hints.
compile-options	Various options that tailor the *compile* action.
dependencies	Fine-tune dependency processing.
exclude	Exclude classes from processing of the job.
include	Include classes to be processed in the job.
library	Define libraries to be taken into account for this job.
packages	Define packages for this app.
require	Define prerequisite classes (load time).
environment	Define key:value pairs for the app.
use	Define prerequisite classes (run time).
Runtime-setting Keys	**Description**
cache	Define the path to the cache directory.
config-warnings (experimental)	Suppress warnings relating to configuration.
log	Tailor log output options.
Miscellaneous Keys	**Description**
desc	A descriptive string for the job.
name (top-level)	A descriptive string for the configuration file.

Listing of Keys in Context

This shows the complete possible contents of the top-level configuration map. Further information is linked from the respective keys.

- *name* A name or descriptive text for the configuration file.
- *include* Include external config files. Takes a list of maps, where each map specifies an external configuration file, and options how to include it. (See special section on the *include key*)
- *let* Define default macros. Takes a map (see the description of the job-level 'let' further down). This let map is included automatically into every job run. There is no explicit reference to it, so be aware of side effects.
- *export* List of jobs to be exported if this config file is included by another.

- *default-job* The name of a job to be run as default, i.e. when invoking the generator without job arguments.
- *config-warnings (experimental)* Suppress warnings about configuration aspects which you know are ok.
- *jobs* Map of jobs. Each key is the name of a job.
  - **<jobname>** Each job's value is a map describing the job. The describing map can have any number of the following keys:
    - *add-css* A list of CSS URIs that will be loaded first thing before the app starts.
    - *add-script* A list of URIs that will be loaded first thing before the app starts.
    - *api* Triggers the generation of a custom Apiviewer application.
    - *asset-let* Defines macros that will be replaced in @asset hints in source files. (See special section on the *"asset-let" key*).
    - *cache* Define the path to cache directories, most importantly to the compile cache. (See special section on the *"cache" Key* key).
    - *clean-files* Triggers clean-up of files and directories within a project and the framework, e.g. deletion of generated files, cache contents, etc.
    - *collect-environment-info* Collects various information about the qooxdoo environment (like version, cache, etc.) and prints it to the console.
    - *combine-images* Triggers creation of a combined image file that contains various images.
    - *compile* Triggers the generation of a source or build version of the application.
    - *compile-options* Define various options that influence compile runs (both source and build version).
    - *config-warnings (experimental)* Suppress warnings from configuration aspects which you know are ok.
    - *copy-files* Triggers files/directories to be copied, usually between source and build version.
    - *copy-resources* Triggers the copying of resources, usually between source and build version.
    - *dependencies* Fine-tune the processing of class dependencies.
    - *desc* A string describing the job.
    - *environment* Define key:value pairs for the application, covering settings, variants and features.
    - *exclude* List classes to be excluded from the job. Takes an array of class specifiers.
    - *extend* Extend the current job with other jobs. Takes an array of job names. The information of these jobs are merged into the current job description, so the current job sort of "inherits" their settings. (See the special section on *"extend" semantics*).
    - *fix-files* Fix white space in source files.
    - *include* List classes to be processed in the job. Takes an array of class specifiers.
    - *let* Define macros. Takes a map where each key defines a macro and the value its expansion. (See the special section on *macros*).
    - *library* Define libraries to be taken into account for this job. Takes an array of maps, each map specifying one library to consider. The most important part therein is the "manifest" specification. (See special section on *Manifest files*).
    - *lint-check* Check source code with a lint-like utility.
    - *log* Tailor log output of job.
    - *migrate-files* Migrate source code to the current qooxdoo version.

* *packages* Define packages for the application. (See special section on *packages*).
* *pretty-print* Triggers code beautification of source class files (in-place-editing). An empty map value triggers default formatting, but further keys can tailor the output.
* *provider* Collects classes, resources and dependency information and puts them in a specific directory structure under the `provider` root.
* *require* Define prerequisite classes needed at load time. Takes a map, where the keys are class names and the values lists of prerequisite classes.
* *run* Define a list of jobs to run in place of the current job. (See the special section on *"run" semantics*).
* *shell* Triggers the execution of one or more external command(s).
* *simulate* Triggers the execution of a GUI test (simulated interaction) suite.
* *slice-images* Triggers cutting images into regions.
* *translate* (Re-)generate .po files from source classes.
* *use* Define prerequisite classes needed at run time. Takes a map, where the keys are class names and the values lists of prerequisite classes.
* *validation-config* Validate a given configuration file against the configuration schema.
* *validation-manifest* Validate the Manifest.json against the manifest schema.
* *watch-files* Execute an action when some files on disk change.
* *web-server* Start a simple web server that serves the current application (default: source version).
* *web-server-config* Generate a small configuration file that can be used to export the current application (source version) through a pre-installed web server, like Apache.

Configuration Usage

The Generator's actions are driven by so called "jobs" (think of Make or Ant "tasks"), and all it does depends on which jobs you pass to it on the command line and how these jobs are defined. Jobs are defined in configuration files. The qooxdoo SDK comes with a whole slew of pre-defined jobs which are ready to run, but you are also free to define entirely new jobs using the same building blocks as the pre-defined ones. More often, though, if you are not entirely satisfied with the pre-defined jobs you will want to work on a middle ground and tweak or adapt existing jobs so they suit you better.

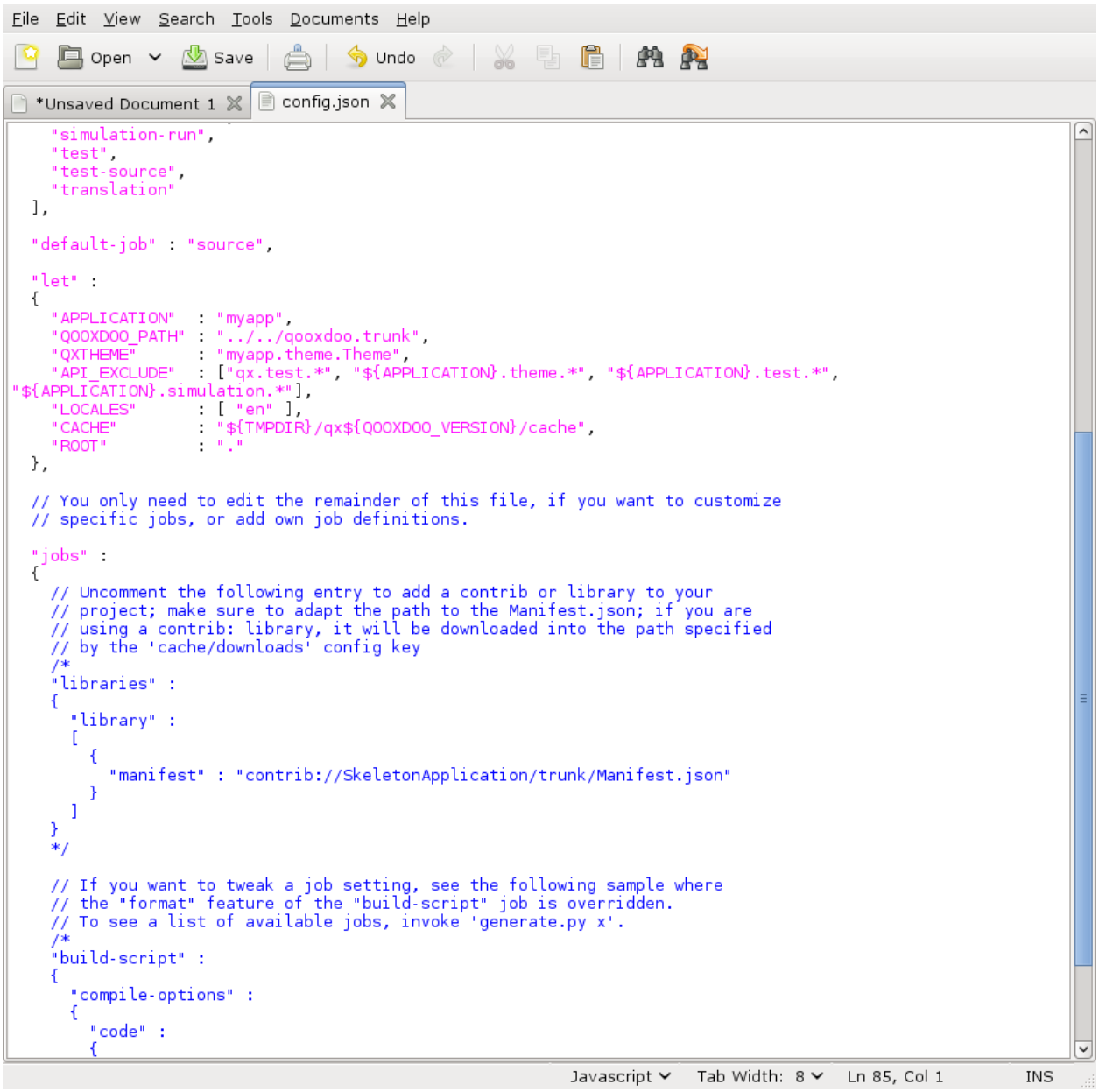
This page tells you more about the inner workings of the configuration system and how to use it.

Skeleton Configuration

When you create an application skeleton, a basic configuration file, `config.json`, is created along the way. With this config file you have access to all the standard jobs that are available for this type of skeleton. Usually, you will just run these jobs and be done with it, so there might never be a need for you to actually look inside the config file. The Generator will read the configuration file when invoked, analyze its contents and perform the job(s) you gave on the command line using the definitions provided through the configuration.

If you do, though, you will find that it doesn't contain much. The important part is that it includes job definitions from a system configuration file (like `application.json`). The other important item is a global `"let"` entry which gives you a first hold into customizing jobs. We'll get back to this later.

Moreover, there is a `"jobs` section which is mostly empty except for some comments that aim to guide you to fill it up should you find the need to do so.



Mechanisms of the Configuration System

Here are the fundamental mechanisms the configuration system works with.

File Import You can import the job definitions of one configuration file into another (using the top-level include key). Mind that you are only importing job definitions.

Job Definitions Job definitions are the main "meat" of every configuration. Job definitions make use of the basic configuration keys provided by the config system, this is how they achieve their effect.

Jobs can *extend* each other. Think of "extending" as one job inheriting the properties of the job it is extending. This way you can "subclass" jobs to customize them, or "abstract" common properties into jobs that are extended by several

others.

There are two basic mechanisms of job extension. One is explicit, using the `extend` keyword in the job definition. The other is implicit, by defining a job in your configuration file that has the *same name* as a job you are importing from another file.

In the *extend* key you refer to other jobs by name. The resolution of such names is done *late*. That means, if you are importing a job "foo" from another file, which in turn extends a job "bar" then if you have a local job "bar" this one will be used. Otherwise, the job "bar" from the imported file will be used.

Macros Macros allow you to define values, and then refer to those values in other places of the configuration, by referring to the macro's name. Values can basically be any allowed JSON value type (strings, numbers, boolean, ...). Macros can only be defined with the *let* configuration key. It takes a map, the map keys are the macro names, each key's value is the macro value.

To reference a macro, surround it with curly braces and put a `$` in front. Referencing macros is *always done in string literals* (otherwise you would break JSON syntax). If the macro's value is itself a string, this value will be interpolated into the string it is referenced. An example:

```
"let" : {
  "foo" : "bar"
},
"descr" : "This is the ${foo} job"
```

If the macro has some other value the reference to it must be the only contents of the string:

```
"let" : {
  "foo" : true
},
"compile-options" : {
  "uris" : {
    "add-nocache-param" : "${foo}"
  }
}
```

The resolution of macros is *late*. That means, a job is first expanded as much as possible ("extend" and "run" keys resolved), before the macros that are used in it definition will be evaluated. Only macro definitions from the job's own "let" are considered at this stage.

Macros are single-assignment only. In the process of expanding a job definition, the precedence for macros is:

- Macros defined directly in the job have highest priority.
- Then macros defined in the global "let" section of the enclosing configuration file.
- Then macros included in the job definition by incorporating other job definitions (e.g. through extending), in the order the jobs are incorporated (e.g. are listed in the "extend" key).

Tweaking Configurations

So what if you find that the existing jobs do not suffice for you to achieve what you want? There is usually a layered approach of steps you can take, going from simple (but less powerful) to advanced (but more challenging). These steps are:

- Adapt macros.
- Extend existing jobs.
- Define new jobs.

We will look at each of these steps in turn.

Macros

Macros are simple named placeholders that are used in Generator configuration files. They make it easy to define values that are used in multiple jobs in a single place (e.g. the application name), or expose a value in a specific job so this value can be customized (e.g. a list of packages to ignore when building an application-specific Apiviewer). One way to change a macro is to edit the *config.json* file of your application. Start your favorite text editor and load the configuration file.

Let's suppose you want to add support for additional locales to your application. Then locate the `"let"` entry in the configuration map. The *let* key lets you define macros. Locate the macro named *"LOCALES"*, and add two more locales so the value looks something like this: *["en", "fr", "de"]*. With the next run of the command *generate.py translation* files *fr.po* and *de.po* will be added to your *source/translation* directory.

There is also the possibility to pass a macro definition on the command line when you invoke the Generator:

```
generate.py source --macro  CACHE:/tmp/cache
```

This tells the Generator to use the path */tmp/cache* for its caching. Passing macros in this manner allows you to change a macro on a per-invocation basis. The command-line value will take precedence over a potential existing definition in config.json.

Overriding Existing Jobs

The second approach that goes beyond just modifying a macro is to override an existing job. The default *config.json* comes with a commented-out sample for this. Let's suppose you want to add some extra newlines that are sprinkled throughout the build version of your app. In the *"jobs"* section of the config you find a job entry named *"build-script"*. It has a sub-key *compile-options/code/format* (the "/" indicates nesting in the Json maps) which is set to false (the default). Just uncomment this job, set the *format* value to true, run generate.py build again, and you'll find newlines added to the generated code. This illustrates the general principle:

1. **Identify the job you are not contempt with.** This might require that you look at the Generator output, or consult the basic configuration file, *tool/data/config/base.json*, as some jobs which you can invoke with the Generator are broken down into sub-jobs.
2. **Add an entry of the same name in your config.json.** The Generator, once you run it the next time, will indicate this by issuing a hint in the console output that the respective job has been shadowed.
3. **Add those keys to the job entry that you want to change, with suitable values.** Use the default job's definition to find out which config key you need to tweak. To achieve this you can look at the job's definition, e.g. in `base.json`, or run the Generator with the `-w` command line flag; this will print the full job definition before the job is run.

As mentioned above, on the next time you run the Generator it will indicate that you have successfully overridden a predefined job. The message will be something like this:

```
- Warning: ! Shadowing job "build-script" with local one
```

(This is also helpful to prevent you from accidentally overriding an existing job with a custom job that is supposed to be new).

Custom Jobs

Custom jobs are jobs that you freely define in your config.json. You add them to the `jobs` section just as in the previous step, but making sure you are **not** using an existing name for them (check the Generator console output when

you run the job to make sure). The challenge with a custom job is that you have to build it up from scratch, and it might take you through some trial-and-error until you come up with a job definition that is fully functional. To help you with that, many basic configuration entries that almost any job would need are available in dedicated job definitions of their own (like "cache" or "libraries"), and we recommend using them. (This gives you another hint at the configuration system of the tool chain: Jobs need not do anything useful; they can also just be containers for configuration snippets that can be included in other jobs to make their definition more modular or compliant). Here is a simple custom job that just copies two files to the build path of the application:

```
"myjob" :
{
  "extend" : ["cache"],
  "copy-files" :
  {
    "files"  : ["foo1.txt", "foo2.txt"],
    "source" : "/home/myhome/tmp",
    "target" : "./build"
  }
}
```

Don't forget to add the entry *"myjob"* in your config's "export" list, so it is available on the command line.

Further Resources

- If you want to embark on the effort of creating custom jobs you're well advised to make yourself familiar with the *general Generator configuration overview*, and
- the *reference of configuration keys* that can be used.
- Also, there is an example configuration file in *tool/data/config/example.json* to look at.
- The basic configuration file, *tool/data/config/base.json*,
- and the configuration files for the Testrunner (*component/testrunner/testrunner.json*)
- and Apiviewer (*component/apiviewer/api.json*) also provide good examples to learn from.

Generator Configuration Details

This page contains various special sections related to the Generator configuration system. They are mostly linked to from other, more general pages so you might want to just follow their *"special section"* links if you want more information about a specific item rather than wading through this material linearly.

Path Names

A lot of entries in a config file take path names as their values (top-level "include", "manifest" keys of a library entry, output path of compile keys, asf.). Quite a few of them, like the top-level include paths, are interpreted **relative** to the config file in which they appear, and this relation is retained no matter from where you reference the config file.

This might not hold true in each and every case, though. For some keys you might have to take care of relative paths yourself. The authoritative reference is always the corresponding documentation of the *individual config keys*. If a key takes a path value it will state if and how these values are interpreted. Please check there.

A good help when dealing with paths is also to use macros, if you need to abstract away from a value appearing multiple times. E.g.

```
"let" : {"MyRoot": ".", "BUILD_PATH" : "build"}
"myjob" : { ... "build_dir" : "${MyRoot}/${BUILD_PATH}" ... }
```

This should make it more intuitive to maintain a config file.

Paths with Spaces Most file systems allow spaces in directory and file names these days, a notorious example of this being the `C:\\Documents and Settings` path on Windows. To enter such paths safely in your configuration Json structure, you need to escape the spaces with back-slash (\). As the back-slash is also a meta-character in Json, it needs to be escaped as well. So a path with spaces would look like this in your config: `"...\foo\dir\\ with\\ spaces\bar\file\\ with\\ spaces.html"`.

Nota bene: As the configuration files are processed by Python, and Python is allowing forward-slash on Windows, the initial example can more easily be given as `"c:/Documents\\ and \\Settings"` (rather than the canonical `"C:\\\\Documents\\ and\\ Settings"`).

Note: To Implementors:

The configuration handler (`generator/config/Config.py`) handles relative paths in the obvious cases, like for the `manifest` entries in the `library` key, or in the top-level `include` key. But it cannot handle all possible cases, because it doesn't know beforehand which particular key represents a path, and which doesn't. In a config entry like `"foo" : "bar"` it is hard to tell whether `bar` represents a relative file or directory. Therefore, part of the responsibility for relative paths is offloaded to the action implementations that make use of the particular keys.

Since each config key, particularly action keys, interpret their corresponding config entries, they know which entries represent paths. To handle those paths correctly, the `Config` module provides a utility method `Config.absPath(self, path)` which will calculate the absolute path from the given path relative to the config file's location.

File Globs

Some config keys take file paths as their attributes. Where specified, *file globs* are allowed, as supported by the underlying Python module. File globs are file paths containing simple metacharacters, which are similar to but not quite identical with metacharacters from regular expressions. Here are the legal metacharacters and their meanings:

Metacharacter	Meaning
*	matches any string of zero or more characters (regexp: .*)
?	matches any single character (regexp: .)
[]	matches any of the enclosed characters; character ranges are possible using a hyphen, e.g. [a-z] (regexp: <same>)

Examples Given a set of files like `file9.js, file10.js, file11.js`, here are some file globs and their resolution:

File Glob	Resolution
file*	file9.js, file10.js and file11.js
file?.js	file9.js
file1[01].js	file10.js and file11.js

Class Data

Besides code a qooxdoo application maintains a certain amount of data that represents some sort of resources. This might be negligible for small to medium size applications, but becomes significant for large apps. The resources fall roughly into two categories,

- **Internationalization (I18N) Data** This comprises two kinds of data:
  - translated strings
  - locale information (also CLDR data, such as currency, date and time formats, asf.)
- **File Resources**
  - static files like PNG and GIF graphics, but also HTML and CSS files, sound and multimedia files, asf.

Many of these resources need an internal representation in the qooxdoo app. E.g. translated strings are stored as key:value pairs of maps, and images are stored with their size and location. All this data requires space that shows up in sizes of application files, as they are transfered from server to browser.

Packaging of Class Data Resource information is packaged up by the tool chain, and they are kept together with the code that uses them. Generally, they go together with a package, which is a bunch of code that will be loaded simultaneously. Alternatively, you can configure the Generator to place all internationalization data in **dedicated I18N parts** (see further).

In the former case resource data including *all* locales is placed together so it can be loaded with the classes using this data. If you support a lot of different languages in your application that might mean that e.g. all translations for a set of keys are always loaded, although a client might only use one of them. Your app is hence wasting bandwidth and memory transfering all data. But if you allow locale switches at runtime these would be fast as all the necessary translations are already loaded.

In the second case, I18N resources (translations, CLDR data) are forked out into dedicated parts (and consequently, packages), one for each locale (see *packages/i18n-as-parts*). The advantage is that you only load exactly those resources which you need for a specific locale, leaving all others on the server. On the downside, like with other parts those parts have to be actively loaded by the application (using qx.io.PartLoader.require), and switching the locale at runtime requires another server roundtrip for the new locale.

So the build system allows you to tailor where resource information is stored so you can optimize on your network consumption and memory footprint. Here is an overview of the possible packaging:

- **source** version:
  - **default**: all class data is stored in separate file(s) (one for each defined part)
  - **with I18N parts**: class data is in dedicated I18N packages (one for each locale)
- **build** version:
  - **default**: class data is stored together with code, in the first file of each package
  - **with I18N parts**: class data is in dedicated I18N packages (one for each locale)

In the build version without dedicated I18N parts (case 2.1), those class data is stored as is needed by the code of the package. This may mean that the same data is stored in multiple packages, as e.g. two packages might use the same image or translated string. This is to ensure optimal independence of packages among each other so they can be loaded independently, and is resolved at the browser (i.e. resource data is stored uniquely in memory).

"cache" Key

Compile cache The main payload of the *cache* key is to point to the directory for the compile cache. It is very recommendable to have a system-wide compile cache directory so cache contents can be shared among different projects and libraries. Otherwise, the cache has to be rebuilt in each environment anew, costing extra time and space.

The default for the cache directory is beneath the system TMP directory. To find out where this actually is either run `generate.py info`, or run a build job with the `-v` command line flag and look for the *cache* key in the expanded job definition, or use this snippet.

The compile cache directory can become very large in terms of contained files, and a count of a couple of thousand files is not unusual. You should take care that your file system is equipped to comply with these demands. Additionally, disk I/O is regularly high on this directory so a fast, local disk is recommendable. Don't use a network drive :-) .

"let" Key

Config files let you define simple macros with the `let` key. The value of a macro can be a string or another JSON-permissible value (map, array, ...). You refer to a macro value in a job definition by using `${<macro_name>}`.

```
"let": {"MyApp" : "demobrowser"}
  ...
  "myjob" : { "environment" : {"qx.application" : "${MyApp}.Application"}}
```

If the value of the macro is a string you can use a reference to it in other strings, and the macro reference will be replaced by its value. You can have multiple macro references in one string. Usually, these macro references will show up in map values or array elements, but can also be used in map keys.

```
"myjob" : {"${MyApp}.resourceUri" : "resource"}
```

If the value of the macro is something other than a string, things are a bit more restrictive. References to those macros can not be used in map keys (for obvious reasons). The reference has still to be in a string, but the macro reference has to be **the only contents** of that string. The entire string will then be replaced by the value of the macro. That means, you can do something like this:

```
"let" : {"MYLIST" : [1,2,3], ...},
  "myjob" : { "joblist" : "${MYLIST}", ...}
```

and the "joblist" key will get the value [1,2,3].

A special situation arises if you are using a **top-level let**, i.e. a *let* section on the highest level in the config file, and not in any job definition. This *let* map will be automatically applied to every job run, without any explicit reference (so be aware of undesired side effects of bindings herein).

When assembling a job to run, the precedence of all the various *let* maps is

```
local job let < config-level let < 'extend' job lets
```

With imported jobs top-level definitions will take precedence over any definitions from the external config file (as if they were the 'first' let section in the chain).

OS Environment Variables as Configuration Macros *(experimental)*

On startup, the generator will read the operating system environment settings, and provide them as configuration macros, as if you had defined them with *let*. This can be handy as an alternative to hard-coding macros in a configuration file, or providing them on the generator command line (with the *-m* command-line option).

Here is an example. Suppose in your *config.json* you have section like this:

```
"jobs" : {
  "myjob" : {
    "environment" : {
      "myapp.foosetting" : ${FOOVALUE}
    }
  }
}
```

then you can provide a value for *FOOVALUE* by just providing an environment setting for it. E.g. if you are using *bash* to invoke the generator, you could something like this:

```
bash> env FOOVALUE=17 ./generate.py myjob
```

which will result in *myapp.foosetting* getting the value 17.

A few things are important to note in this respect:

- The generator includes all the environment settings that the operating system provides. There is no filtering of any kind. This can lead to surprises when you are not aware which settings are available and which not. If in doubt use your operating system's facilities to list the environment settings in effect when you launch the generator.
- In the parsing of config files and the expansion of generator jobs, the environment settings have high priority. They will take precedence over all settings giving in the configuration files given with *let* keys. Only macro settings passed through the generator command-line option *-m* will take higher precedence, and will override environment keys.

"log" Key

Logging is an important part of any reasonably complex application. The Generator does a fair bit of logging to the console by default, listing the jobs it performs, adding details of important processing steps and reporting on errors and potential inconsistencies. The *log* key lets you specify further options and tailor the Generator console output to your needs. You can e.g. add logging of unused classes in a particular library/name space.

"extend" Key

Job resolution `extend` and `run` keywords are currently the only keywords that reference other jobs. These references have to be resolved, by looking them up (or "evaluating" the names) in some context. One thing to note here is that job names are evaluated **in the context of the current configuration**. As you will see (see section on *top-level "include"s*), a single configuration might eventually contain jobs from multiple config files, the local job definitions, and zero to many imported job maps (from other config files), which again might contain imported configs. From within any map, only those jobs are referenceable that are **contained** somewhere in this map. Unqualified names (like "myjob") are taken to refer to jobs on the same level as the current job, path-like names (containing "/") are taken to signify a job in some nested name space down from the current level. Particularly, this means you can never reference a job in a map which is "parallel" to the current job map. It's only jobs on the same level or deeper.

This is particularly important for imported configs (imported with a top-level "include" keyword, see further *down*). Those configs get attached to the local "jobs" map under a dedicated key (their "name space" if you will). If in this imported map there is a "run" job (see the *next section*) using unqualified job names, these job names will be resolved using the imported map, not the top-level map. If the nested "run" job uses path-like job names, these jobs will be searched for **relative** to the nested map. You get it?!

Extending jobs Now, how exactly is a job (let's call this the primary job) treated that says to "extend" another job (let's call this the secondary job). Here is what happens:

- The primary job provides sort of the master definition for the resulting job. All its definitions take precedence.
- The secondary job is searched in the context of the current "jobs" map (see above).
- Keys of the secondary job that are **not** available in the primary job are just added to the job definition.
- Keys of the secondary job that are already present in the primary job and have a scalar value (string, number, boolean) are **discarded**.
- Keys of the secondary job that are already present in the primary job and have a list or map value are **merged**. The extending rules are applied on the element level recursively, i.e. scalar elements are blocked, new elements are added, composed element are merged. That means, those keys accumulate all their inner keys over all jobs in the transitive hull of all extend jobs of the primary job.
- There is a way of **preventing** this kind of merge behaviour: If you prefix a job key with an equal sign (=) no subsequent merging will be done on this key. That means all following jobs that are merged into the current will not be able to alter the value of this key any more.
- Obviously, each secondary job is extended itself **before** being processed in this way, so it brings in its own full definition. As stated before it is important to note that this extending is done in the secondary job's **own** context, which is not necessarily the context of the primary job.
- If there are more than one job in the "extend" list, the process is re-applied **iteratively** with all the remaining jobs in the list. This also means that the list of secondary jobs defines a precedence list: Settings in jobs earlier in the list take precedence over those coming later, so order matters.

Important to note here: **Macro evaluation** takes place only **after** all extending has been done. That is, macros are applied to the fully extended job, making all macro definitions available that have accumulated along the way, with a 'left-to-right' precedence (macro definitions in the primary job take precedence over definitions in secondary jobs, and within the list of secondary jobs, earlier jobs win over subsequent). But in contrast to job names that also means that macros are explicitly **not** evaluated in the original context of the job. This makes it possible to tweak a job definition for a new environment, but can also lead to surprises if you wanted to have some substitution taking place in the original config file, and realize it doesn't.

Job Shadowing and Partial Overriding Additionally to the above described features, with the configuration system you can

- create jobs in your local configuration with *same names* as those imported from another configuration file. The local job will take precedence and "shadow" the imported job; the imported job gets automatically added to the local job's `extend` list.
- extend one job by another by only *partially specifying* job features. The extending job can specify only the specific parts it wants to re-define. The jobs will then be merged as described above, giving precedence to local definitions of simple data types and combining complex values (list and maps); in the case of maps this is a deep merging process. Here is a sample of overriding an imported job (`build-script`), only specifying a single setting, and relying on the rest to be provided by the imported job of same name:

```
"build-script" : {
  "compile-options" : {
    "code" : {
      "format" : true
    }
  }
}
```

You can again use = to control the merging:

- *selectively block* merging of features by using = in front of the key name, like:

```
...
  {
    "=open-curly" : ...,
    ...
  }
...
```

- override an imported job *entirely* by guarding the local job with = like:

```
"jobs" : {
  "=build-script" : {...},
  ...
}
```

"run" Key

"run" jobs are jobs that bear the `run` keyword. Since these are kind of meta jobs and meant to invoke a sequence of other jobs, they have special semantics. When a `run` keyword is encountered in a job, for each sub-job in the "run" list a new job is generated (so called *synthetic jobs*, since they are not from the textual config files). For each of those new jobs, a job name is auto-generated using the initial job's name as a prefix. As for the contents, the initial job's definition is used as a template for the new job. The `extend` key is set to the name of the current sub-job (it is assumed that the initial job has been expanded before), so the settings of the sub-job will eventually be included, and the "run" key is removed. All other settings from the initial job remain unaffected. This means that all sub-jobs "inherit" the settings of the initial job (This is significant when sub-jobs evaluate the same key, and maybe do so in a different manner).

In the overall queue of jobs to be performed, the initial job is replaced by the list of new jobs just generated. This process is repeated until there are no more "run" jobs in the job queue, and none with unresolved "extend"s.

"asset-let" Key

The `asset-let` key is basically a *macro* definition for `@asset` compiler hints, but with a special semantics. Keys defined in the "asset-let" map will be looked for in *@asset* hints in source files. Like with macros, references have to be in curly braces and prefixed with `$`. So a "asset-let" entry in the config might look like this:

```
"asset-let" :
  {
    "qx.icontheme" : ["Tango", "Oxygen"],
    "mySizes" : ["16", "32"]
  }
```

and a corresponding *@asset* hint might use it as:

```
@asset(qx/icon/${qx.icontheme}/${mySizes}/*)
```

The values of these macros are lists, and each reference will be expanded into all possible values with all possible combinations. So the above asset declaration would essentially be expanded into:

```
@asset(qx/icon/Tango/16/*)
@asset(qx/icon/Tango/32/*)
@asset(qx/icon/Oxygen/16/*)
@asset(qx/icon/Oxygen/32/*)
```

"library" Key and Manifest Files

The *library* key of a configuration holds information about source locations that will be considered in a job (much like the CLASSPATH in Java). Each element specifies one such library. The term "library" is meant here in the broadest sense; everything that has a qooxdoo application structure with a *Manifest.json* file can be considered a library in this context. This includes applications like the Showcase or the Feedreader, add-ins like the Testrunner or the Apiviewer, contribs from the qooxdoo-contrib repository, or of course the qooxdoo framework library itself. The main purpose of any *library* entry in the configuration is to provide the path to the library's "Manifest" file.

Manifest files Manifest files serve to provide meta information for a library in a structured way. Their syntax is again JSON, and part of them is read by the generator, particularly the `provides` section. See *here* for more information about manifest files.

"manifest" values The most important key in each *library* entry is *manifest*. This section gives some examples and background on the possible values of this key.

Local path The simplest value is just a path on your local machine. It must lead to the library root directory and end in the library's *Manifest.json*:

```
../../mylib/utils/Manifest.json
```

Like in this example paths can be relative, and will be calculated from the configuration file they appear in. The Generator will search the Manifest file especially for the *provides* keys, e.g. *provides/class* which points to the library's class path.

The other possible values are concerned with network-base libraries.

contrib:// URL If the value starts with `contrib://` there will be a lookup in the *contribution catalog* for the given contribution and version. For example:

```
contrib://UploadWidget/0.4/Manifest.json
```

will look in the catalog for a contribution named "UploadWidget" and below that for a version named "0.4". This must contain a file "Manifest.json" that contains a download link to an archive, and some other entries to assist in downloading.

The archive will be downloaded and unpacked, and then used by the Generator like a local library.

http(s):// URL If the value starts with `http://` or `https://` there are two cases:

- Either it points to a file that has an archive extension (like *.zip* or *.tar.gz*), it will be downloaded and unpacked, just like with a contribution archive. Example:

  ```
  http://example.com/foo/bar/my-contrib-0.3.tar.gz
  ```

- Or it points to a file that has a *.json* extension. Then it will be evaluated like a catalog entry-style *Manifest.json* file and the download information therein will be used to get to the archive. Example:

  ```
  http://example.com/foo/bar/MyContrib-0.3.catalog.json
  ```

Mind that for network-based libraries the JSON files pointed to by a URL is searched for the *download* information for the archive, while the downloaded archive itself needs to contain a *Manifest.json* file (literally) which is searched for information about the actual library contents (e.g. classes). See the *contribution page* for details.

URI handling URIs are used in a qooxdoo application to refer from one part to other parts like resources. There are places within the generator configuration where you can specify *uri* parameters. What they mean and how this all connects is explained in this section.

You will rarely need to set the `uri` attribute of a library entry. This is only necessary if the relative path to the library (which is automatically calculated) does not represent a valid URL path when running the **source** version of the final app. (This can be the case if your try to run the source version from a web server that requires you to set up different document roots). It is not relevant for the *build* version of your app, as here all resources from the various libraries are collected under a common directory. For more on URI handling, see the next section.

Where URIs are used The first important thing to note is:

Note: All URI handling within qooxdoo is related to libraries.

Within qooxdoo the *library* is a fundamental concept, and libraries in this sense contain all the things you are able to include in the final Web application, such as class files (.js), graphics (.gif, .png, ...), static HTML pages (.htm, .html), style sheets (.css), and translation files (.po).

But not all of the above resource types are actually referenced through URIs in the application. Among those that are you find in the **source** version:

- references to class files
- references to graphics
- references to static HTML
- references to style sheet files

The **build** version uses a different approach, since it strives to be a self-contained Web application that has no outgoing references. Therefore, all necessary resources are copied over to the build directory tree. Having said that, URIs are still used in the build version, yet these are only references confined to the build directory tree:

- JS class code is put into the (probably various) output files of the generator run (what you typically find under the *build/script* path). The bootstrap file references the others with relative URIs.
- Graphics and other resources are referenced with relative URIs from the compiled scripts. Those resources are typically found under the *build/resource* path.
- Translation strings and CLDR information can be directly included in the generated files (where they need not be referenced through URIs), or be put in separate files (where they have to be referenced).

So, in summary, in the *build* version some references might be resolved by directly including the specific information, while the remaining references are usually confined to the build directory tree. That is why you can just pack it up and copy it to your web server for deployment. The *source* version is normally used directly off of the file system, and employs relative URIs to reference all necessary files. Only in cases where you e.g. need to include interaction with a backend you will want to run the source version from a web server environment. For those cases the following details will be especially interesting. Others might want to skip the remainder of this section for now.

Although the scope and relevance of URIs vary between *source* and *build* versions, the underlying mechanisms are the same in both cases, with the special twist that when creating the *build* version there is only a single "library" considered, the build tree itself, which suffices to get all the URIs out fine. These mechanisms are described next.

Construction of URIs through the Generator So how does the generator create all of those URIs in the final application code? All those URIs are constructed through the following three components:

```
to_libraryroot [1]  + library_internal_path [2] + resource_path [3]
```

So for example a graphics file in the qooxdoo framework might get referenced using the following components

- [1] *"../../qooxdoo-3.0-sdk/framework/"*
- [2] *"source/resource/"*

- [3] *"qx/static/blank.gif"*

to produce the final URI *"../../qooxdoo-3.0-sdk/framework/source/resource/qx/static/ blank.gif"*.

These general parts have the following meaning:

- **[1]** : URI path to the library root (as will be valid when running the app in the browser). If you specify the *uri* parameter of the library's entry in your config, this is what gets used here.
- **[2]** : Path segment within the specific library. This is taken from the library's *Manifest.json*. The consumer of the library has no influence on it.
- **[3]** : Path segment leading to the specific resource. This is the path of the resource as found under the library's resource directory.

Library base URIs in the Source version Part *[1]* is exactly what you specify with the *uri* subkey of an entry in the *library* key list. All *source* jobs of the generator using this library will be using this URI prefix to reference resources of that library. (This is usually fine, as long as you don't have different autonomous parts in your application using the same library from different directories; see also further down).

If you don't specifying the *uri* key with your libraries (which is usually the case), the generator will calculate a value for *[1]*, using the following information:

```
applicationroot_to_configdir [1.1] + configdir_to_libraryroot [1.2]
```

The parts have the following meaning:

- **[1.1]** : Path from the Web application's root to the configuration file's directory; this information is derived from the *paths/app-root* key of the *compile-options* config key.
- **[1.2]** : Path from the configuration file's directory to the root directory of the library (the one containing the *Manifest.json* file); this information is immediately available from the library's *manifest* key.

For the **build** version, dedicated keys *uris/script* and *uris/resource* are available (as there is virtually only one "library"). The values of both keys cover the scope of components [1] + [2] in the first figure.

Since [1.2] is always known (otherwise the whole library would not be found), only [1.1] has to be given in the config. The properties of this approach, compared to specifying just [1], are:

- *The application root can be specified individually for each compile job.* This means you could have more than one application root in your project, e.g. when your main application offers an iframe, into which another application from the same project is loaded; qooxdoo's Demobrowser application takes advantage of exactly this.
- *Relative file system paths have to match with relative URIs in the running application.* So this approach won't work if e.g the relative path from your config directory to the library makes no sense when the app is run from a web server.

From the above discussion, there is one important point to take away, in order to create working URIs in your application:

Note: The generator needs either the library's *uri* parameter ([1]) or the URI-relevant keys in the compile keys ([1.1]) in the config.

While either are optional in their respective contexts, it is mandatory to have at least *one* of them for the URI generation to work. Mind though, that qooxdoo provides sensible defaults for the URIs in compile keys.

Overriding the 'uri' settings of libraries Libraries you specify in your own config (with the *library* key) are in your hand, and you can provide `uri` parameters as you see fit. If you want to tweak the *uri* setting of a library entry that is added by including another config file (e.g. the default *application.json*), you simply re-define the library entry of that particular library locally. The generator will realize that both entries refer to the same library, and your local settings will take precedence.

Specifying a "library" key in your config.json You can specify `library` keys in your own config in these ways:

- You either define a local job which either shadows or "extends" an imported job, and provide this local job with a `library` key. Or,
- You define a local `"libraries"` job and provide it with a `library` key. This job will be used automatically by most of the standard jobs (source, build, etc.), and thus your listed libraries will be used in multiple jobs (not just one as above).

"packages" Key

For a general introduction to parts and packages see this separate *document*. Following here is more information on the specifics of some sub-keys of the *packages* config key.

parts/<part_name>/include The way the part system is currently implemented has some caveats in the way *parts/*/include* keys and the general *include* key interact:

1. The general *include* key provides the "master list" of classes for the given application. This master list is extended with all their recursive dependencies. All classes given in a part's *include*, including all their dependencies, are checked against this list. If any of those classes is not in the master list, it will not be included in the final app.

   Therefore, you cannot include classes in parts that are not covered by the general *include* key. If you want to use e.g. *qx.bom.** in a part, you have to add `"qx.bom.*"` to the general *include* list. Otherwise, only classes within *qx.bom.** that actually derive from the general include key will be actually included, and the rest will be discarded. Motto:

   "The general include key is a filter for all classes in parts."

2. Any class that is in the master list that is never listed in one of the parts, either directly or as dependency, will not be included in the app. That means you have to **actively** make sure that all classes from the general *include* get - directly or indirectly - referenced in one of the parts, or they will not be in the final app. Motto:

   "The parts' include keys are a filter for all classes in the general include key."

   Or, to put both aspects in a single statement: The classes in the final app are exactly those in the **intersection** of the classes referenced through the general *include* key and all the classes referenced by the *include* keys of the parts. Currently, the application developer has to make sure that they match, i.e. that the classes specified through the parts together sum up to the global class list!

   There is another caveat that concerns the relation between *include*'s of different parts:

3. Any class that is listed in a part's *include* (file globs expanded) will not be included in another part. - But this also means that if two parts list the same class, it won't be included in either of them!

   This is e.g. the case in a sample application, where the *boot* part lists *qx.bom.client.Engine* and the *core* part lists *qx.bom.** which also expands to *qx.bom.client.Engine* eventually. That's the reason why *qx.bom.client.Engine* would not be contained in either of those parts, and hence would not be contained in the final application at all.

i18n-as-parts Setting this sub-key to *true* will result in I18N information (translations, CLDR data, ...) being put in their own separate parts. The utility of this is:

- The code packages get smaller, which allows for faster application startup.
- Data is not loaded for *all* configured locales when a package is loaded (which is usually not necessary, as you are mostly interested in a single locale across all packages). Rather, you can handle I18N data more individually.

Here are the details:

- By default, I18N data, i.e. translations from the .po files and CLDR data, is integrated as Javascript data with the application packages (either as part of the first .js file of a package, or in its own .js file). This package-specific data will encompass the data for all configured locales needed in this package (Think: Data cumulated by package).
- Setting *packages/i18n-as-parts: true* removes this data from the packages. Rather, data for *each individual locale* (en, en_US, de, de_DE, ...) will be collated in a dedicated *part*, the part name being that of the respective language code (Think: Data cumulated by locale). As usual, each part is made up of packages. In the case of an I18N part, these are the corresponding data package plus fall-back packages for key lookup (e.g. [”C”, “en”, “en_US”] for the part *en_US*). Each package is a normal qooxdoo package with only the data section, and without the code section.

So far, so good. With the config key set to *true*, this is the point where the application developer has to take over. The application will not load the I18N parts by itself. You have to do it using the usual part loading API (e.g. `qx.io.PartLoader.require(["en_US"])`). You might want to do that early in the application run cycle, e.g. during application start-up and before the first translatable string or localizable data is to be displayed. After loading the part, the corresponding locale is ready to be used in the normal way in your application. The Feedreader application uses this technique to load a different I18N part when the language is changed in its *Preferences* dialog.

“include” Key (top-level) - Adding Features

Within qooxdoo there are a couple of features that are not so much applications although they share a lot of the classical application structure. The APIViewer and TestRunner are good examples for those. (In the recent repository re-org, they have been filed under *component* correspondingly). They are applications but receive their actual meaning from other applications: An APIViewer in the form of class documentation it presents, the TestRunner in the form of providing an environment to other application’s test classes. On their own, both applications are “empty”, and the goal is it to use them in the context of another, self-contained application. The old build system supported make targets like ‘api’ and ‘test’ to that end.

While you can always include other applications’ *classes* in your project (by adding an entry for them to the *library* key of your config), you wouldn’t want to repeat all the necessary job entries to actually build this external app in your environment. So the issue here is not to re-use classes, but *jobs*.

Re-using jobs So, the general issue we want to solve is to import entire job definitions in our local configuration. The next step is then to make them work in the local environment (e.g. classes have to be compiled and resources be copied to local folders). This concepts is fairly general and scales from small jobs (where you just keep their definition centrally, in order to use them in multiple places) to really big jobs (like e.g. creating a customized build version of the Apiviewer in your local project).

Practically, there are two steps involved in using external jobs:

1. You have to *include* the external configuration file that contains the relevant job definitions. Do so will result in the external jobs being added to the list of jobs of your local configuration. E.g. you can use

   ```
   generator.py ?
   ```

   to get a list of all available jobs; the external jobs will be among this list.

2. There are now two way to utilize these jobs:

- You can either invoke them directly from the command line, passing them as arguments to the generator.
- Or you define local jobs that *extend* them.

In the former case the only way to influence the behaviour of the external job is through macros: The external job has to parameterize its workings with macro references, you have to know them and provide values for them that are suitable for your environment (A typical example would be output paths that you need to customize). Your values will take precedence over any values that might be defined in the external config. But this also means you will have to know the job, know the macros it uses, provide values for them (e.g. in the global *let* of your config), resolve conflicts if other jobs happen to use the same macros, and so forth.

In the latter case, you have more control over the settings of the external job that you are actually using. Here as well, you can provide macro definitions that parameterize the behaviour of the job you are extending. But you can also supply more job keys that will either shadow the keys of the same name in the external job, or will be extended by them. In any case you will have more control over the effects of the external job.

Add-ins use exactly these mechanisms to provide their functionality to other applications (in the sense as 'make test' or 'make api' did it in the old system). Consequently, to support this in the new system, the add-in applications (or more precisely: their job configuration) have to expose certain keys and use certain macros that can both be overridden by the using application. The next sections describe these build interfaces for the various add-in apps. But first more practical detail about the outlined ...

Add-In Protocol In order to include an add-in feature in an existing app, you first have to `include` its job config. On the top-level of the config map, e.g. specify to include the Apiviewer config:

```
"include" : [{"path": "../apiviewer/config.json"}]
```

The include key on this level takes an array of maps. Each map specifies one configuration file to include. The only mandatory key therein is the file path to the external config file (see *here* for all the gory details). A config can only include what the external config is willing to *export*. Among those jobs the importing config can select (through the `import` key) or reject (through the `block` key) certain jobs. The resulting list of external job definitions will be added to the local jobs map.

If you want to fine-tune the behaviour of such an imported job, you define a local job that extends it. Imported jobs are referenced like any job in the current config, either by their plain name (the default), or, if you specify the `as` key in the include, by a composite name `<as_value>::<original_name>`. Suppose you used an `"as" : "apiconf"` in your include, and you wanted to extend the Apiviewer's `build-script` job, this could look like this:

```
"myapi-script" :
{
  "extend" : ["apiconf::build-script"]
  ...
}
```

As a third step, the local job will usually have to provide additional information for the external job to succeed. Which exactly these are depends on the add-in (and should eventually be documented there). See the section specific to the *APIViewer* for a concrete example.

API Viewer For brevity, let's jump right in into a config fragment that has all necessary ingredients. These are explained in more detail afterwards.

```
{
  "include" : [{"as" : "apiconf", "path" : "../apiviewer/config.json"}],
  "jobs" : {
    "myapi" : {
```

```
        "extend" : ["apiconf::build"],
        "let" : {
            "ROOT"  :  "../apiviewer",
            "BUILD_PATH" : "./api",
            "API_INCLUDE" : ["qx.*", "myapp.*"],
            "API_EXCLUDE" : ["myapp.tests.*"]
            },
        "library" : { ... },
        "environment" : {
            "myapp.resourceUri" : "./resource"
            }
        }
    }
}
```

The `myapi` job extends the `build` job of APIViewer's job config. This "build" job is itself a run job, i.e. it will be expanded in so many individual jobs as its `run` key lists. All those jobs will get the "myapi" job as a context into which they are expanded, so all other settings in "myapi" will be effective in those jobs.

In the `let` key, the ROOT, BUILD_PATH, API_INCLUDE and API_EXCLUDE macros of the APIViewer config are overridden. This ensures the APIViewer classes are found, can be processed, and the resulting script is put into a local directory. Furthermore, the right classes are included in the documentation data.

The `library` key has to at least add the entry for the current application, since this is relevant for the generation of the api documentation for the local classes.

So in short, the `ROOT`, `BUILD_PATH`, `API_INCLUDE` and `API_EXCLUDE` macros define the interface between the apiviewer's "run" job and the local config.

"environment" Key

Variant-specific Builds The *environment* configuration key allows you to create different variants from the same code base. Variants enable the selection and removal of code from the build version. A variant is a concrete build of your application with a specific set of environment values "wired in". Code not covered by this set of values is removed, so the resulting script code is leaner. We call this code *variant-optimized*. But as a consequence, such a variant usually cannot handle situations where other values of the same environment keys are needed. The generated code is *variant-specific*. The generator can create multiple variants in one go. Variants can be used to implement feature-based builds, or to remove debugging code from the build version. It is comparable to conditional compilation in C/C++.

For any generation process of a build version of an app, there is a certain set of environment settings in effect. If variant optimization is turned on, code is variant-optimized by looking at certain calls to qx.core.Environment that reference an environment key that has an existing setting. See the *optimization section* for details about that.

How to Create Multiple Variants in One Go The above section mentions the optimization for a single build output, where for each environment key there is exactly one value. (This is also how the qooxdoo run time sees the environment). The generator configuration has an additional feature attached to environment settings. If you specify **more than one** value for an environment key (in a list), the generator will automatically generate multiple output files. Each of the builds will be created with one of the values from the list in effect. Here is an example for such a configuration:

```
"environment" : {
  "foo" : [13, 26],
  "bar" : "hugo",
  "baz" : true
}
```

The environment set for producing the first build output would be `{foo:13, bar:"hugo", baz:true}`, the set for the second `{foo:26, bar:"hugo", baz:true}`.

For configurations with multiple keys with lists as values, the process is repeated for any possible combination of values. E.g.

```
"environment" : {
  "foo" : [13, 26],
  "bar" : ["a", "b"],
  "baz" : true
}
```

would result in 4 runs with the following environment sets in effect:

1. `{foo:13, bar:"a", baz:true}`
2. `{foo:13, bar:"b", baz:true}`
3. `{foo:26, bar:"a", baz:true}`
4. `{foo:26, bar:"b", baz:true}`

Caveat The special caveat when creating multiple build files in one go is that you need to adapt to this in the configuration of the **output file name**. If you have just a single output file name, every generated build script will be saved over the previous! I.e. the generator might produce multiple output files, but they are all stored under the same name, so what you get eventually is just the last of those output file.

The cure is to hint to the generator to create different output files during processing. This is done by using a simple macro that reflects the current value of an environment key in the output file name.

```
"build-script" :
{
  "environment" : {
    "myapp.foo" : ["bar", "baz"]
  },
  "compile-options" : {
    "paths": {
      "file" : "build/script/myapp_{myapp.foo}.js"
    }
  }
}
```

This will two output files in the *build/script* path, `myapp_bar.js` and `myapp_baz.js`.

Browser-specific Builds By predefining select environment keys, builds can be tailored towards specific clients. See the *Feature Configuration Editor article* for instructions.

Branching in Configuration Files

In general there is no way of conditional branching in the *configuration DSL* of the tool chain. qooxdoo configuration files are JSON-based and have no *"if"* construct of any kind. So there is no way of directly expressing e.g. *"If the value of this macro is true include this list of classes, otherwise include a different list"*. But you can achieve much of the same by using the values of macros in references to other job names. Here is how to do that.

Includer Jobs

In qooxdoo configurations the general way to inject settings into a job is by using the extend key. So if you want settings from one job to propagate into another job you make the second job extend the first:

```
"jobA" : {
  "environment" : { "foo" : "bar" }
},

"jobB" : {
  "extend" : [ "jobA" ],
  ... // more job settings
}
```

So now *jobB* will get the environment setting from *jobA* as if you had written them into *jobB* directly (There is some conflict resolution going on if *jobB* already has an *environment* key). This of course makes more sense if you want to have more than one job inherit these settings, like when you substitute "jobB" with "source" and "build". It's a common way in qooxdoo configs to maintain multiply used settings in a single place. As in this example the job names in the *extend* key can refer to jobs that do nothing on their own and are just provided to hold some setting to be used in other jobs (often referred to as *"includer jobs"*).

Using Macros in Job Names

What's also interesting here is that the names in the *extend* key can contain macros. This allows you to select a job according to the value of some macro.

```
"jobA1" : {
  "environment" : { "foo" : "bar" }
},

"jobA2" : {
   "environment" : { "foo" : "xyz" }
},

"jobB" : {
  "extend" : [ "job${JobSuffix}" ]
  ...
}
```

By setting the value of the *JobSuffix* macro to either "A1" or "A2" you now select which job is being included into the extending job, and by that select the configuration keys and values that come with it. In this example you could either specify the concrete value of *JobSuffix* in the global "let" section of the configuration file

```
"let" : {
  "JobSuffix" : "A1"     // or "A2"
}
```

or you could provide it on the command line when invoking the generator:

```
generate.py -m JobSuffix:A2 ...
```

Pairs of Includers

Often you will create pairs of includer jobs like in the above example for the same set of settings, to provide alternative values. To pick up the example from the beginning, to provide two different include lists to a source job you could write:

```
"oneInclude" : {
  "=include" : [ "foo.ClassA", "foo.theme.ThemeA" ]
},

"otherInclude" : {
  "=include" : [ "foo.ClassB", "foo.theme.ThemeB" ]

"source" : {
  "extend" : [ "${IncJob}Include" ]
}
```

(Don't worry about the equal sign in `"=include"` for the moment). Now you only have to provide the value for the *IncJob* macro, either `"one"` or `"other"`, and your *source* job will use the corresponding include lists. This basically is it, you can now construct different jobs by just assigning different values to macros. Mind that this kind of selecting includer jobs will only work with values of macros, and only if those values are strings. This also means you cannot e.g. refer to the value of a specific *environment* setting. But in many cases you can work the other way round and make the value of an environment setting part of an includer job which is then selected by the value of a macro.

Generator Configuration - Under the Hood

This page gives some background information about how the configuration system is deployed in the SDK. It is interesting if you want to understand some of the inner workings and how things play together. *It is not necessary to know these details if you just want to use the configuration system.*

Cascading Configurations

The configuration system of qooxdoo is fairly generic and versatile, and it allows you to write stand-alone configuration files from scratch, with just the configuration documentation at hand. But since a lot of configuration options are boilerplate, have to be re-used in various parts of a config, and are applicable to a broad range of applications and libraries, a significant effort has been put into making configuration settings re-usable, and shipping common configuration settings with the SDK. The two major tools in this regard are including one config file from another (through the top-level *include* key), and re-using jobs (through *run* and *extend* keys).

If you create a new application with *create-application.py* you'll find a pre-configured *config.json* in the application directory that is ready to run. When you look into it, you'll find that it provides - besides a handful of macro definitions - only an *include* key to the SDK's central application configuration file, *application.json*.

application.json and base.json The configuration infrastructure of qooxdoo 3.0 is based on two main configuration files, both in the *tool/data/config* folder, *application.json* and *base.json*.

base.json defines all the basic jobs that a normal application would want to deploy. Most significant are the *source* and *build* jobs that create the source and build version of an application, respectively. Other jobs contained here are concerned with cleaning up (*clean* and *distclean*), creating translation files (*translate*) or formatting the Javascript code (*pretty*). It is also basic in the sense that it doesn't rely on any other config file.

But there is a distinct class of jobs missing from *base.json*, those that create helper applications for the current project and rely on additional libraries. Currently, this class is represented by the *api* and *test* jobs.

This is where *application.json* comes into play. *application.json* creates a superset of the jobs from *base.json* by including it, so all of its jobs are available also through *application.json*. The added value of *application.json* is that it also integrates the core configuration files of the *Apiviewer* and the *Testrunner*. These applications export jobs that can be run in the context of other applications, in order to build customized Apiviewer and Testrunner applications, within the respective project.

In order to achieve this, *application.json* tailors those component jobs to e.g. include the classes from the deploying application. All applications including *application.json* in their config get access to all of these jobs.

Why splitting all those jobs into two configuration files? The answer is to disentangle the base jobs from the component jobs. This way the components that provide jobs to *application.json*, and are therefore included with it, can still use *base.json* for their own configuration, without worrying too much about cyclic inclusions. That's it.

Naturally, all these standard jobs are tailored with some sensible defaults. These defaults should be fine for all but a few custom applications. But of course the configuration system has to provide ways to deviate from the standard settings, and without too much repetition. (These different needs of applications are even mirrored in the SDK itself, where some applications are contempt with the default settings like the *Feedreader*, while others need more specific settings, as is the case e.g. with the *Demobrowser*. See their configuration files for more details).

The Use of Macros

Within the configuration system, macros (defined with *let* keys) serve a couple of purposes:

- to keep the use of a specific value consistent within a configuration file (this is how macros are used in many languages)
- to customize settings of imported jobs so they can be controlled by the importing configuration
- to pass parameters into jobs

The last usage is probably the most delicate. Jobs provided by external components or libraries to the deploying application need to learn certain facts about this application, in order to do their job well. As a consequence some components require dedicated macros to be set by the application, e.g the *API_INCLUDE* and *API_EXCLUDE* macros that are required for the *api* job. This is a way of parameterizing jobs. Unfortunately, since every job winds up with a flat set of macros that are available to it (you can think of it as a job having a "global name space" for macros), macros have to be globally unique within the set of configuration files that is used for the particular application.

Application Startup

While this is not particularly a generator config topic, it has some implications on configuration issues just as well.

An "application" as seen from the qooxdoo point of view is just a set of classes that are run on top of what could be called the qooxdoo runtime system. (In that respect qooxdoo is similar to other object-hosting frameworks, e.g. the Perl Object Environment (POE) with the main difference being that POE can host multiple applications and switch between them).

When the application is loaded, qooxdoo first establishes and starts a runtime environment. This comprises of things as divers as defining a handful of global variables and data structures, to setting up its object system, to creating instances of system classes e.g. for logging or event handling.

Once this is established, the qooxdoo runtime starts the *main()* method of the main application class (made known to it through the *qx.application* setting). From there, the application classes take over and create the application, through instantiating further classes (like IO classes or GUI widgets), setting properties and invoking methods on them.

Config Processing

This is an account of the principles that rule the processing of config files.

When the Config File is Read

- The Json data structure is parsed into an internal data structure; this is standard Json processing.

- If the config file contains a global *let* section these macros are expanded among themselves (for macros referencing other macros) temporarily. This intermediate *let* map is then used for other top-level keys, to expand potential macros and finalize their values. E.g. a global *include* key might use macros to encode paths to other config files. Then these macros are resolved with the local knowledge to derive real paths. The *jobs* key and the *let* key itself are explicitly not expanded, to allow for later (re-) evaluation in another config file.
- If there is a global *include* key, the listed config files are included (next section).

When another Config File is Included

- The external config file is processes like the original file (previous section); i.e. the initial parsing and including process is applied recursively. The process is checked for cyclic references.
- Then, every job in the *jobs* key of the external config file is processed in the following manner.
- For each external job, a new job for the current config file is created. This is to apply a local *let* section, so it can take preference over the external's job *let* settings. This is done next.
- A potential global *let* section is included into the new job, as if this was a normal *let* key of the job.
- Then, the external job is merged into the new job (see next section).
- A reference to the external config is added to the new job; this way, the original context is retained. This can be important to resolve references to other jobs in the right context.
- For the new job a job name is constructed: * If the external config is included without *"as"* parameter, the original name is used. If it is included with *"as"* parameter, its value is prepended to the original name. * If no job of the same name already exists in the config, nothing further is done. * If, on the other hand, a job of such name already exists, a new, conflict-free name is generated for the new job, and this name is added to the conflicting job's *extend* key, so the existing job will inherit the new job's features.
- Finally, the new job is added to the current config's list of jobs.

When Jobs are Merged

- When two jobs are merged, which happens during *extend* and *run* expansion, and config file inclusion, there is a *source* job, which is merged into the *target* job, so there are distinct roles and a direction of the merging.
- The basic principle is that the target job takes preference over the settings in the source job, like with OO inheritance where child classes can override parent features.
- If a key of the source job is missing in the target job, it is added to the target job.
- If a key of the source job is present in the target job, and has a "=" leading the key name, then the source key is discarded, and is not taken into account for the merging.
- If a key of the source job is present in the target job, and is not protected by the "=" sigil, the following happens:
  - If the key value is a scalar value (string, number, boolean), the target value takes precedence and the source value is discarded.
  - If the key value is a reference value (list or map) then
    - in the case of a list, the elements of the source list are uniquely appended to the target list, i.e. duplicates are omitted in the process.
    - in the case of a map, the merge process is applied recursively.

The Job Expansion Process

- After all include files have been processes, the list of jobs in this config is final. At this stage it can be decided whether the requested jobs (the jobs that are passed as arguments to the generator) are among them and can be run.
- Each job in the list of requested jobs (the "agenda" if you will) is expanded in the following way.
- Then, a potential *run* key has to be processed: * For each job in the *run* a new job is created ("synthetic jobs"). This is so they can inherit stuff. The definition of the original job is used - with the *run* key stripped - as the template for all of these jobs, so they have all the original job features. * Each job from the original *run* key is then added to the *extend* key of its corresponding synthetic job, so they inherit from their run jobs. * The list of synthetic jobs is now added to the agenda in place of the original job that had the *run* key.
- A potential *extend* key has to be processed: * For each element in the *extend* key, the corresponding job is searched (see special section below). * Each of those jobs are merged into the current one, in the order they appear in the list. This also means that features of each job in the list take precedence over those of jobs that come right to it.
- The last two steps are repeated until no more jobs are on the agenda that have unresolved *extend* or *run* keys.
- Now each job has found its final job definition, and is run by the Generator.

How Job References are Resolved

- *extend* and *run* keys in a job reference other jobs by name. These names have to be resolved to their actual job definitions, in order to complete the expansion of the referencing job.
- When name resolution has to be done, there are two contexts in which the referenced name is looked for:
  - the current config
  - the config in which the job was originally defined; this may be different from the current config, since the job might have been obtained by inclusion of an external configuration file.
- The last point is interesting since a job in the current config might be referencing a job "foo" which might not be present in the current config, e.g. due to filtering this job during import (there are various ways to do this). So the job has to be looked for in one of the external config files. The original config file is chosen since there might be more the one imported config file, and each of those might be defining a "foo" job.

How to add a new Component

qooxdoo comes with a set of helper applications, so called "components", that can be custom-build for any standard application. Examples are the Apiviewer, Testrunner and Inspector. Suppose we had a new such component, how would this be made available as a standard job to skeleton-based applications? This section provides an implementation view to the more end-user oriented introduction *here*.

Basics Usually, you simply want to run a job already defined for the component, such as the *build* job that creates an optimized version of it. But in virtually all cases such a component needs to be passed information about the application that tries to build it. This ranges from simple things like the output path, where a script is stored, over the information which class libraries the application uses (think of the application's test classes for the *Testrunner*), up to arbitrary modification of job settings (variants, compile options, ...). So, generally speaking, you need to pass some information to, or *parameterize*, the component job. These kinds of modifications are discussed in this section.

The answer to the question how to pass information into a job is generally two-fold:

- **Macros in global let sections**
- **Other Jobs**

Macros in global *let* sections are included automatically into jobs within the current configuration file; they are directly integrated into a job's own *let* key. Jobs themselves can be related to each other, but for this you have to be aware of a general property of jobs in the configuration system:

Note: Within the generator's configuration system, there is only a **single mechanism** how two jobs can pass information between - and thus influence - each other: **Through Job Extending.**

That means one job has to extend the other, either directly or indirectly (via intermediate "extend" jobs), in order to share information between the jobs.

This also means that the question which job extends which (the *extension order*, if you will) is crucial, as the settings in the extending job always take precedence over those of any extended job. The extending job also has some possibilities to control which keys are being modified by the extended jobs. Within the "extend" list of jobs, those to the left take precedence over those on the right.

Preparing the component On that basis we will look at concrete ways to apply this when invoking a component job. The job of the component that is to be run is often referred to as the *"remote job"*, as it is defined remotely to the invoking application, which will be referred to as the *"invoking context"*.

Using the basic principles outlined above, there are **two practical ways** how component jobs can receive information from the invoking context:

- **Macros**
- **Includer Jobs**

In both cases, it is essential that both the invoking environment (custom application) and the providing component agree on the way how information is passed. In clear terms this means, it has to be part of the documentation of the component how it allows its job to be tailored. (This documentation for the existing component jobs of qooxdoo is available from the *list of default jobs*).

Parameterizing a remote job through Macros Macros are a simple way to pass information around. The component job uses a macro in a place that should be parameterized, e.g. a part in a path.

A typical example is the BUILD_PATH macro. The component job stores its output in a file like this:

```
"outfile" : "${BUILD_PATH}/job_output.js"
```

The component will usually provide a sensible default for the macro, e.g.

```
"BUILD_PATH" : "./script"
```

The invoking context can now tailor the output path by overriding the BUILD_PATH macro:

```
"BUILD_PATH" : "my/other/path"
```

and running the component job with this macro binding will cause the output be written in the alternate directory. Of course you have to make sure the new macro binding is in effect when the component job is being run (see also further down for this). In the simplest case you just put the macro definition in the *global let section* of the application *config.json*. As these let bindings are included in every job of the config, also to the jobs that are imported from other configs, these bindings apply to effectively every job that is accessible through this config. As it is applied very early, the binding in this let section take precedence over bindings of the same macros defined in imported jobs. Thus it is possible to pass the new binding into a job defined in another configuration file.

If you want a more fine-grained control over the scope of a specific macro, you can add a new job definition into your config of the *same name* as the job you want to tweak (but mind any name spacing of names introduced through the *as* key in *include* keys, see further). Through automatic inheritance the remote job will become a parent of the local

job. If you give the local job a *let* section with the required macro, this binding will only take effect for the named job (and those extending it), but not for others.

Parameterizing a remote job through Includer Jobs A more powerful but also more complex way to tailor a remote job is through an *includer job*, a job that is included by others to add additional configuration to them. Used to parameterize another job includer jobs are akin to dependency injection in programming languages.

The component job would *extend* the includer job in its own definition:

```
"extend" : [ "includer-job" ]
```

Again, the component would usually provide an *includer-job* of its own, with sensible defaults.

The invoking context can then tailor the remote job by tailoring the includer job:

```
"includer-job" :
    {
       "library" : { ... },
       "environment" : { ... },
       "compile-options" : { ... },
       ...
    }
```

Supplying a job with the name of the includer job will make the component's worker job use this definition for its own extend list (through *job shadowing*). As with macros, the invoking application and the component have to agree about the name of the includer job. After that, you can essentially pass all kinds of job keys into the remote job. There is virtually no limit, but usually you will only want to set a few significant keys (Again, this is part of the protocol between application and component and should be stated clearly in the component's documentation). You should also bear in mind the general rules for job extending, particularly that the main job's settings (the component job in our case) will take precedence over the settings of the includer job, and that the main job can choose to block certain keys from being modified by included jobs.

Adding a new job So how would you typically use these mechanisms to a new default job for qooxdoo that will build the new component in a custom application? Here is a list of the steps:

- Split the component's *config.json* into two.This is usually helpful to keep config settings for the component that are just necessary to develop the component itself, from the definitions that are interesting to other applications that want to run the "exported" job(s) of that component. See e.g. the *Testrunner* application, where the configuration is split between the local *config.json* and the includeable *testrunner.json*.
- Include the export config of the component in *application.json*. This will usually be done with a dedicated name space prefix, like

  ```
  {
    "path" : "path/to/component/component.json",
    "as"   : "comp"   // something meaningful
  }
  ```

- Create a new job in *application.json*.Choose a name as you would want it to appear to the end user when he invokes `generate.py x`. Optionally, add a descriptive *"desc"* key that will appear next to the job's name in the listing.
- Make this job extend the component's job you want to make available, e.g. like

  ```
  "extend" : [ "comp::build" ] // "build" is the job you want in most cases
  ```

- Add further keys, like a *let* section with macros you want to override, or other job keys.

- If the component's job honors an includer job, define such a job in *application.json*. You will usually also need to prefix it with the component's "as" prefix you used above:

  ```
  "comp::<includer job name>" : { <includer job keys>... }
  ```

  The component's worker job will automatically include your includer job.

- Add the job to the *export* list in the skeletons that should support it.The skeletons' *config.json* usually contain an *export* key, to filter the list of jobs a user will see with *generate.py x* down to the interesting jobs. Adding the new job name will make sure the users sees it.

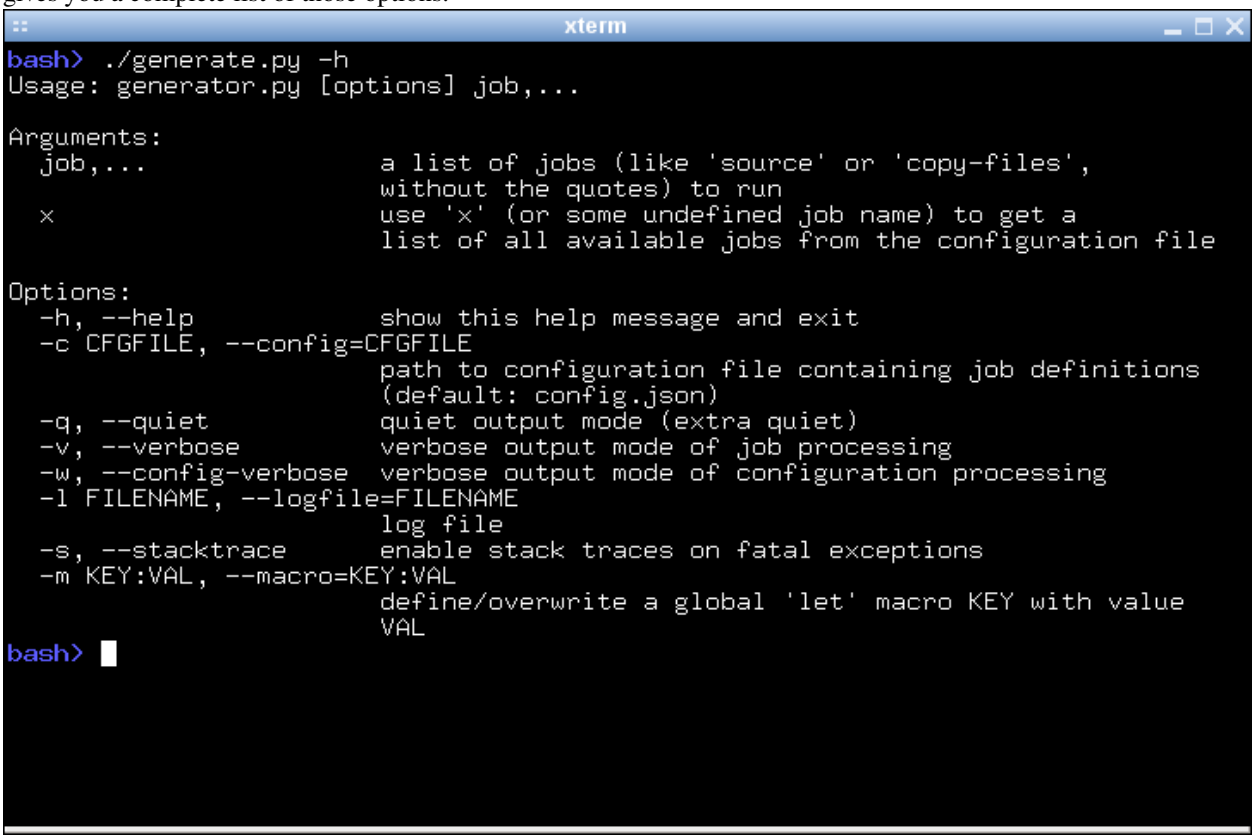
10.2.7 Tutorials

Tutorial: Basic Tool Chain Usage

In various introductions and tutorials you were using the qooxdoo tool chain casually along the way. Now it's about time to take a more systematical look. The main interface to invoke the tool chain is the *generate.py* script that is part of every skeleton, often colloquially referred to as "the Generator". In each qooxdoo library or application, it sits next to the library's *Manifest.json* and the default configuration file, *config.json*. The *Manifest.json* file is the main declaration file for any qooxdoo app, it's constitutional document if you will. *config.json* is the configuration file that steers the Generator and its actions. When invoked, the Generator looks for a file of this name in the current directory for default instructions, but you can supply an alternative configuration file with a command line option. Invoking

```
generate.py -h |--help
```

gives you a complete list of those options.

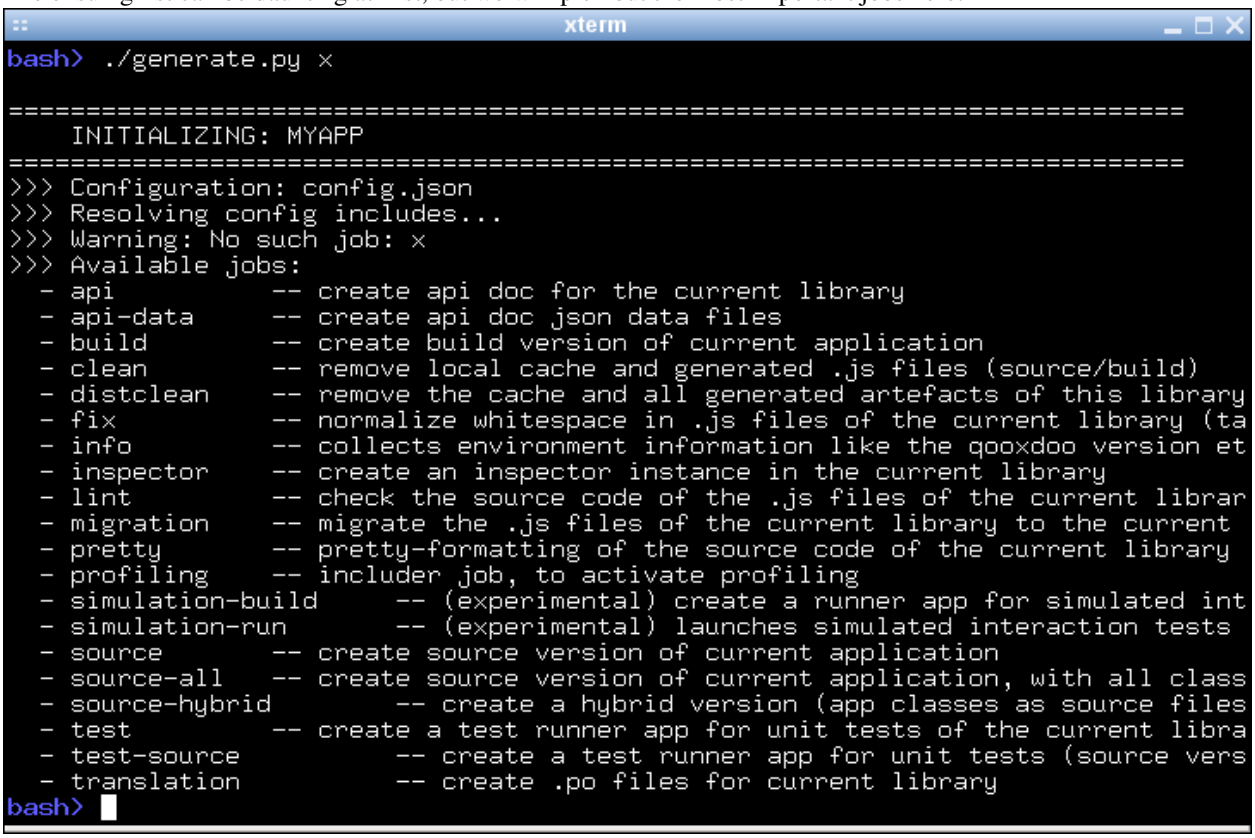


In the general case the Generator takes the name of a *job* to perform as its sole argument. You can even invoke it without any argument, and it will run the "default job" if the configuration defines one.

Supplying a non-existing job name will result in the Generator providing a list of known jobs which it can perform. You can try this by using a made-up job name like "*x*":

```
generate.py x
```

The ensuing list can be daunting at first, but we will pick out the most important jobs here.



Generating a Runnable App

The most important job of the Generator is to create a version of your application that you can run in the browser. This is surprising for many people at first. Why do I need to "generate" a working application, when I have written my JavaScript and have an index.html handy? Why not just load the app right away? The answer is that qooxdoo is not a prefabricated JS library that you just <*script*>-include in your HTML page. For each application exactly those classes are selected that are necessary to run it. This avoids any overhead of carrying unnecessary code with your app. To achieve this, an individual piece of JavaScript code is generated, the so-called *loader*. For any qooxdoo application, this loader is the first file to be loaded and evaluated in the browser, and it makes sure all necessary components of the application get loaded after it as well. Besides many other benefits that can be achieved, this is the central reason to have a generation step before a qooxdoo app can be run.

Use the Source, Luke

The tool chain is able to generate your application in various flavors. This is reflected by the available generation jobs, "source", "source-hybrid", "source-all" and "build". The most important for starting and building up your app, are the source jobs. Running

```
generate.py
```

will generate the so-called "source version" of your application in the default variant.

In general, the source version of an app is tailored towards development activities. It makes it easy to write code, run the application, test, debug and inspect the application code, fix issues, add enhancements, and repeat.

In the *source* job, all the classes of the app are in their original source form, and loaded from their original file paths on the file system. If you inspect your application in a JavaScript debugger like Firebug or Chrome Developer Tools, you can identify each of your custom files individually, read its code and comments, set breakpoints, inspect variables and so forth. This job is particular interesting when you want to debug classes outside your custom application, e.g. if you are debugging another library along the way.

You only have to re-run this Generator job when you introduce new dependencies, e.g. by instantiating a class you haven't used before. This changes the set of necessary classes for your application, and the Generator has to re-create the corresponding loader.

In the *source-hybrid* version, the Generator will concatenate class files into a bunch of script files, except for your application classes which are loaded directly from their original path on the file system. This allows for a reasonable loading speed of your application in the browser while still providing convenient debug access to your own class files.

With *source-all* all existing classes will be included, be they part of your application, the qooxdoo framework, or any other qooxdoo library or contribution you might be using. All those classes are included in the build, whether they are currently required or not. This allows you develop your code even more freely as you don't have to re-generate the application when introducing new dependencies. All classes are already there, after all. The down-side is that due to the number of classes your app loads slower in the browser, so it's a trade-off between development speed and loading speed.

So if you are just getting started with qooxdoo development, use the *source-all* version, which is the most convenient if you are not too impatient. If you are concerned about loading speed during development, but don't mind hitting the up and return keys in your shell window once in a while, go with the default *source-hybrid* job. If your emphasis on the other hand is on inspection, and you want to see exactly which class files get loaded into your app and which code they provide, the *source* version might be your preference.

A Deployment Build

On the other end of the spectrum there is the `build` version of you app. The "build" version is what you want to create at the end of a development cycle, when your app is stable and you want to deploy it into production. Running

```
generate.py build
```

will create a highly optimized version of your app. All necessary code is stripped, squeezed and compressed, and put into as few JS files as possible. Everything is geared towards small size, fast transport, fast loading and minimal memory footprint. Along with the code, all other required resources, such as icons and images, are collected together under a common root directory, usually named `build`. The good thing here is that this makes the contents of this directory self-contained so you can copy it to the document tree of a web server, zip it up and send it by mail, and so forth. All necessary content will be included, and the app will just run when the contained *index.hmtl* is loaded.

For an example let's suppose you have an application `myapp` and a web server instance running on a machine called `fooserv`. Then, given suitable network connection and setup, the following command will copy your build version to the web server:

```
scp -r build bar@fooserv:~/public_html/myapp
```

and you can load it in the browser with

```
http://fooserv/~bar/myapp/
```

Non-App-Generating Jobs

So now you know about the basic jobs to create a runnable application using the Generator. There is a whole bunch of jobs that is not concerned with creating a runnable version of your app, but do other things. One of those is addressed in the *tweets tutorial* which is concerned with internationalization of an application. The Generator job in this context is `translation`, and extracts translatable strings from your JavaScript source files into *.po* files. Here is a quick topical overview of those kinds of jobs:

Internationalization:

- `translation` – extract translatable strings into .po files

Source Code:

- `lint` – check source code for potential issues
- `fix` – fix white space in source code
- `pretty` – re-format source code

Development:

- `api` – create an application-specific instance of the Apiviewer
- `test` – create an application-specific instance of the Testrunner
- `inspector` – create an application-specific instance of the Inspector
- `simulation-build` – create a GUI testing application (to be used with Selenium)

Files:

- `clean` – clean up generated files for this app
- `distclean` – clean up generated files for this app, and delete the Generator cache

As mentioned before, for a full list of available jobs with short descriptions run `generate.py x`, or see the the list of *default jobs*.

Tweaking Jobs

For most people the jobs that come with qooxdoo are good enough to get all necessary work done. But not for all. Sometimes you want the output file be named differently; or the index.html that loads your qooxdoo app lives in some other part of your web space; or you want to get rid of a specific optimization in your build version. Fortunately, the tool chain of qooxdoo is very flexible and highly configurable. There is a set of built-in functionality that can be drawn upon by job definitions, and jobs can be freely defined or altered. The system is in fact so configurable that we have thought of means of limiting its flexibility, for the sake of an easier user interface. If you feel you want to change the way in which a particular Generator job works, or define one from scratch, see a *dedicated page* on this topic.

10.2.8 References

- *Default Action Jobs*
- *Default Includer Jobs*
- *Generator Config Keys*
- *Generator Config Macros*

10.3 Lint

10.3.1 Tutorials

Source Code Validation

qooxdoo includes its own Javascript validator, **Ecmalint**, which application developers can use to check their source files for errors. It is started by running the *lint* generator job in an application directory:

```
./generate.py lint
```

Critical Warnings

Use of undefined or global identifier This warning indicates that an unknown global variable is used. This can be caused by:

- The variable is not declared as local variable using `var`
- The variable name is misspelled
- It is OK to use this global but EcmaLint does not know about it. This can be fixed by passing the variable name as known variable to the EcmaLint call or by adding a `@lint ignoreUndefined(VARIABLE_NAME)` doc comment to the method's API doc comment

Unused identifier

Map key redefined

Data field has a reference value **Hint:** If data fields are initialized in the members map with reference values like arrays or maps they will be shared between all instances of the class. Usually it is better to set the value to 'null' and initialize it in the constructor

Use of deprecated identifier

Critical Warning (for framework)

Potentially non-local private data field **Hint:** You should never do this.

Protected data field **Hint:** Protected data fields are deprecated. Better use private fields in combination with getter and setter methods.

Comment: It appears that this isn't an issue that is generically to be solved as the hint suggest. See the corresponding bug report.

Undeclared private data field **Hint:** You should list this field in the members section.

Coding Style Warnings

The statement of loops and conditions must be enclosed by a block in braces

Multiply declared identifier

Explicitly ignoring messages

Here are some of the @ hints that can be used to explicitly suppress specific lint messages:

```
@lint ignoreUnused(x, y)
@lint ignoreDeprecated(alert)
@lint ignoreUndefined(button1, foo)
@lint ignoreReferenceField(field)
```

For a comprehensive list of possible @lint hints see the *JSDoc reference*. Before lint prints a warning it walks up the AST and looks for the next enclosing API doc comment. Usually these comments should be placed in method JsDoc comments or in the class comment.

There are additional warning for which there is currently no key to suppress them as they are deemed too important (e.g. duplicate map keys). On the other hand, there might be additional checks to be wanting which are currently not implemented (e.g. checking protected fields).

10.4 Application Wizard

10.4.1 Create Application

There is a command-line tool named `create-application.py`, available from both the SDK root and *tool/bin* directories, that helps you start a new application or library. It basically creates a folder structure with some essential files and values filled in. This basic setup already comprises a minimal working application which you can build and run, with no changes. But of course the intention is that you then go ahead and change the files' contents, particularly the JavaScript source files, add new classes, and evolve this skeleton into your desired application.

The same file structure is suitable to hold a library, i.e. a set of classes that you want to reuse in several applications. You can even have libraries that only hold images or other static resources, like CSS files.

You start it at the command prompt. The minimal set of options you have to provide is an application name (*-n*), and optionally an application type (*-t*). Other options let you select e.g. an output directory, a different application namespace, or a log file.

Here is a simple example:

```
$ create-application.py -n foo -t native
```

Several tutorials in this manual make use of *create-application.py*, e.g. the *Hello World* tutorial. There is also a dedicated page that describes the *various application types*.

For the most current information about the options please refer to the interactive help you get with `create-application.py --help`. Here is a sample capture:

```
$ create-application.py --help
Usage: create-application.py --name APPLICATIONNAME [--out DIRECTORY]
                             [--namespace NAMESPACE] [--type TYPE]
                             [-logfile LOGFILE] [--skeleton-path PATH]

Script to create a new qooxdoo application.

Example: For creating a regular GUI application 'myapp' you could execute:
  create-application.py --name myapp
```

```
Options:
  -h, --help            show this help message and exit
  -n APPLICATIONNAME, --name=APPLICATIONNAME
                        Name of the application. An application folder with
                        identical name will be created. (Required)
  -o DIRECTORY, --out=DIRECTORY
                        Output directory for the application folder. (Default:
                        .)
  -s NAMESPACE, --namespace=NAMESPACE
                        Applications's top-level namespace. (Default:
                        APPLICATIONNAME)
  -t TYPE, --type=TYPE  Type of the application to create, one of: ['basic',
                        'bom', 'contribution', 'gui', 'inline', 'mobile',
                        'native'].'basic' -- for non-browser run times like
                        Rhino, node.js; 'bom' -- can be used to build low-
                        level qooxdoo applications; 'contribution' -- is
                        suitable for qooxdoo-contrib ; 'gui' -- is a standard
                        qooxdoo GUI application; 'inline' -- is an inline
                        qooxdoo GUI application; 'mobile' -- is a qooxdoo
                        mobile application with full OO support and mobile GUI
                        classes; 'native' -- is a qooxdoo application with
                        full OO support but no GUI classes. (Default: gui)
  -l LOGFILE, --logfile=LOGFILE
                        Log file
  -p PATH, --skeleton-path=PATH
                        (Advanced) Path where the script looks for skeletons.
                        The directory must contain sub directories named by
                        the application types. (Default:
                        /home/thron7/workspace/qooxdoo.git/component/skeleton)
  --cache=PATH          Path to the cache directory; will be entered into
                        config.json's CACHE macro (Default:
                        ${TMPDIR}/qx${QOOXDOO_VERSION}/cache)
```

10.5 Migration

10.5.1 Migration Guide

Migrating from a previous qooxdoo version to a current release often requires nothing more than just running the `migration` job in your application. Yet, some changes between releases may involve manual modifications as detailed in the migration guide of each individual release. The following guide covers both cases.

Backup

You might want to create a backup of your application files first. The migration process changes source files in place, modifying your code base.

Configuration

- Then, after you have unpacked the new qooxdoo SDK on your system, change references to it in your `config.json` and possibly in `generate.py` to point to the new version (look for "QOOXDOO_PATH"). Make sure that the path ends in the root directory of the SDK (like *"../qooxdoo-3.0-sdk"*).

- Check the current release notes and those of previous releases between your current version and 3.0 for changes to the generator configuration, as they have to be done by hand. Make sure you apply them to your config.json as far as they affect you. For example, with 0.8.1 the config.json macro `QOOXDOO_PATH` does not include the trailing "framework" part anymore, so make sure to add that in references to the qooxdoo class library. E.g. if you list the qooxdoo framework Manifest.json explicitly in your config using QOOXDOO_PATH, it should read *"${QOOXDOO_PATH}/framework/Manifest.json"*.
- Alternatively, particularly if you config.json is rather small, create a *separate gui skeleton* elsewhere and copy its config.json over to your application, and port the config settings from your old configuration to this file. This might be the simpler approach.

Run Migration

Then change to your application's top-level directory and invoke the command

```
generate.py migration
```

- Answer the interactive questions during its progress. For more information about this script, see the *corresponding job description*.

Migration Log

- Check the `migration.log` which is created during the run of the migration script. Check all hints and deprecation warnings in the log and apply them to your code.

Release Notes

- Apply all the instructions from the "Migration" section of the release you are upgrading to, *and all intervening releases* between your old version and the target version, as far as they concern you.

Test

You now have an up-to-date source tree in your application. Run

```
generate.py source
```

to check that the generation process goes through and test your application in the browser. Use the browser console or qooxdoo's own console to see any more warnings and hints at runtime.

Special Issues

Compiler Hints

Compiler hints of the `#` form are deprecated with qooxdoo 3.0. Use `@` hints in *JSDoc comments* instead. This affects all of `#asset, #require, #use, #ignore` and `#cldr`. There is mostly a one-to-one translation of the arguments, with unchanged semantics:

- #asset*(<args>)* -> `@`asset*(<args>)*
- #require*(<args>)* -> `@`require*(<args>)*
- #use*(<args>)* -> `@`use*(<args>)*

- #ignore*(<args>)* -> @ignore*(<args>)* The semantics of *@ignore* are slightly different from *#ignore* in that there is no *implicit* globbing on symbol names anymore, so that you might need to append a `.*` to a few of the arguments to achieve the same effect.
- #cldr -> @cldr*()* Mind that *@cldr* requires a pair of empty parentheses (to make the syntax consistent with other @-hints).

Legacy Versions

If you are migrating from a legacy version of qooxdoo to 3.0, namely from a **0.8.2** or prior release, please do a *two-step* migration to 3.0. Firstly, migrate to qooxdoo 0.8.3, following the instructions in the corresponding manual. You will need a qooxdoo 0.8.3 SDK to go through the process, so fetch one from the download location. This is necessary as there have been major changes in qooxdoo which require the infrastructure of the intermediate version to bridge. Then, follow the remaining steps in this document.

10.6 Other Tools

Some of the tools that come with the SDK are described elsewhere in this manual. Here are some pointers:

- *API Viewer*
- *Test Runner*
- *Inspector*
- *Feature Configuration Editor*
- *Simulator*

CHAPTER

ELEVEN

REFERENCES

11.1 Core

11.1.1 Class Declaration Quick Ref

This is a quick reference for the various features of a qooxdoo class declaration. It uses an *EBNF-like syntax*.

Properties, a particular part of the class declaration, have quite an extensive sub-spec, and are therefore factored out to their *own page*.

```
class_decl      := 'qx.Class.define' '(' '"' <name.space.ClassName> '"' ','
                     '{' { feature_spec ',' } '}'
                   ')'

feature_spec    :=
                   'type'        ':' type_spec        |
                   'extend'      ':' extend_spec      |
                   'implement'   ':' implement_spec   |
                   'include'     ':' include_spec     |
                   'construct'   ':' construct_spec   |
                   'events'      ':' events_spec      |
                   'statics'     ':' statics_spec     |
                   'properties'  ':' properties_spec  |
                   'members'     ':' members_spec     |
                   'environment' ':' environment_spec |
                   'destruct'    ':' destruct_spec    |
                   'defer'       ':' defer_spec

type_spec       := 'static' | 'abstract' | 'singleton'

extend_spec     := <name.of.SuperClass>

implement_spec  := <name.of.Interface> |
                   '[' <name.of.Interface1> ',' <name.of.Interface2> ','
                       ... ']'

include_spec    := <name.of.Mixin> |
                   '[' <name.of.Mixin1> ',' <name.of.Mixin2> ',' ... ']'

construct_spec  := js_function_value

statics_spec    := c_map
```

```
properties_spec  := ? see separate properties quick ref ?

members_spec     := c_map

environment_spec := '{'
                     { '"' <environment_name> '"' ':'
                         ( js_primitive_value | js_reference_value ) ',' }
                    '}'

events_spec      := '{'
                     { '"' <event_name> '"' ':' '"' qx_event_type '"' ',' }
                    '}'

defer_spec       := js_function_value

destruct_spec    := js_function_value

c_map            := '{'
                     { <key> ':' ( js_primitive_value |
                                   js_reference_value |
                                   js_function_value  |
                                   js_function_call   ) ',' }
                    '}'

js_function_value   := ? Javascript anonymous function 'function (...)
                         {...}' ?
js_function_call    := ? Javascript function call 'foo(...)' ?
js_primitive_value  := ? any value from the Javascript primitive types ?
js_reference_value  := ? any value from the Javascript reference types ?
qx_event_type       := ? any qooxdoo event type class name, e.g.
                         'qx.event.type.DataEvent' ?
```

11.1.2 Interfaces Quick Ref

This is a quick reference for the various features of a qooxdoo interface declaration. It uses an *EBNF-like syntax*.

It is much like a class declaration, with a more limited set of features. Properties are just names with empty map values.

```
interface_decl  := 'qx.Interface.define' '(' '"' <name.space.InterfaceName> '"' ','
                     { feature_spec ',' }
                   ')'

feature_spec    := 'extend'     ':' extend_spec      |
                   'statics'    ':' statics_spec     |
                   'properties' ':' properties_spec  |
                   'members'    ':' members_spec     |
                   'events'     ':' events_spec

extend_spec     := <name.of.SuperInterface> |
                   '[' <name.of.SuperInterface1> ','
                       <name.of.SuperInterface2> ',' ... ']'

statics_spec    := '{'
                     { '"' <upper_case_key> '"' ':' js_primitive_value ',' }
                   '}'
```

```
properties_spec := '{'
                     { '"' <property_name> '"' ':' '{}' ',' }
                   '}'

members_spec    := c_map

events_spec     := '{'
                     { '"' <event_name> '"' ':' '"' qx_event_type '"' ',' }
                   '}'

c_map           := '{'
                     { <key> ':' ( js_primitive_value |
                                   js_reference_value |
                                   js_function_value  |
                                   js_function_call   ) ',' }
                   '}'

js_function_value   := ? Javascript anonymous function 'function (...)
                         {...}' ?
js_function_call    := ? Javascript function call 'foo(...)' ?
js_primitive_value  := ? any value from the Javascript primitive types ?
js_reference_value  := ? any value from the Javascript reference types ?
qx_event_type       := ? any qooxdoo event type class name, e.g.
                         'qx.event.type.DataEvent' ?
```

11.1.3 Mixin Quick Ref

This is a quick reference for the various features of a qooxdoo mixin declaration. It uses an *EBNF-like syntax*.

It is much like a class declaration, with a more limited set of features. Properties are documented on their *own page*.

```
mixin_decl      := 'qx.Mixin.define' '(' '"' <name.space.MixinName> '"' ','
                     { feature_spec ',' }
                   ')'

feature_spec    :=
                   'include'    ':' include_spec     |
                   'construct'  ':' construct_spec   |
                   'statics'    ':' statics_spec     |
                   'properties' ':' properties_spec  |
                   'members'    ':' members_spec     |
                   'events'     ':' events_spec      |
                   'destruct'   ':' destruct_spec

include_spec    := <name.of.Mixin> |
                   '[' <name.of.Mixin1> ',' <name.of.Mixin2> ',' ... ']'

construct_spec  := js_function_value

statics_spec    := c_map

properties_spec := ? see separate properties quick ref ?

members_spec    := c_map

events_spec     := '{'
                     { '"' <event_name> '"' ':' '"' qx_event_type '"' ',' }
```

```
                    '}'

destruct_spec    := '{'
                     { 'this._disposeFields'     '(' <fields_list> ')' ';' }
                     { 'this._disposeObjects'    '(' <fields_list> ')' ';' }
                     { 'this._disposeObjectDeep' '(' <deep_field> ')'      }
                     '}'

c_map            := '{'
                     { <key> ':' ( js_primitive_value |
                                   js_reference_value |
                                   js_function_value  |
                                   js_function_call   ) ',' }
                    '}'

js_function_value   := ? Javascript anonymous function 'function (...)
                         {...}' ?
js_function_call    := ? Javascript function call 'foo(...)' ?
js_primitive_value  := ? any value from the Javascript primitive types ?
js_reference_value  := ? any value from the Javascript reference types ?
qx_event_type       := ? any qooxdoo event type class name, e.g.
                         'qx.event.type.DataEvent' ?
```

11.1.4 Properties Quick Reference

This is a quick reference for the various property features available in qooxdoo.

Properties are declared in the constructor map of the class as a dedicated key-value pair (here called `properties_decl`). This is the quick reference for properties_decl (expressed in an *EBNF-ish* way):

```
properties_decl  := 'properties' ':' properites_map

properties_map   := '{' { prop_spec ',' } '}'
prop_spec        := '"' <property_name> '"' ':'
                        '{' { property_feature ',' } '}'

property_feature := nullable_spec      |
                    apply_spec         |
                    event_spec         |
                    init_spec          |
                    refine_spec        |
                    check_spec         |
                    themeable_spec     |
                    inheritable_spec   |
                    group_spec         |
                    mode_spec          |
                    validate_spec      |
                    dereference_spec

nullable_spec    := 'nullable'     ':' bool_val
apply_spec       := 'apply'        ':' '"' <FunctionName> '"'
event_spec       := 'event'        ':' '"' <EventName> '"'
init_spec        := 'init'         ':' <InitVal>
refine_spec      := 'refine'       ':' bool_val

check_spec       := 'check'        ':' '"' type_spec '"'       |
                                       '"' <ClassName> '"'     |
```

```
                                    '"' <InterfaceName> '"' |
                                    enum_spec               |
                                    inline_function         |
                                    '"' bool_expression '"'

validate_spec    := 'validate'     ':' '"' <FunctionName> '"'  |
                                    '<Function>'

dereference_spec := 'dereference'     ':' bool_val

themeable_spec   := 'themeable'    ':' bool_val
inheritable_spec := 'inheritable'  ':' bool_val
group_spec       := 'group'        ':' enum_spec
mode_spec        := 'mode'         ':' '"' 'shorthand' '"'

type_spec        := 'Boolean' | 'String' | 'Number' | 'Integer' | 'Float' |
                    'Double'  | 'Object' | 'Array'  | 'Map'     | 'Class' |
                    'Mixin'   | 'Interface'         | 'Theme'   | 'Error' |
                    'RegExp'  | 'Function'          | 'Date'    | 'Node'  |
                    'Element' | 'Document'          | 'Window'  | 'Event'

bool_val         := 'true' | 'false'
enum_spec        := '[' <val1>',' <val2> ',' ... ',' <valN> ']'
inline_function  := ? JavaScript anonymous function 'function (..)
                      { ... }' ?
bool_expression  := ? JavaScript expression evaluating to true/false ?
```

11.1.5 Array Reference

qooxdoo has a few classes that concern arrays. Some of them are special wrappers and others are extensions. Here is a list of all classes which have something to do with arrays in qooxdoo.

Data binding specific array

- qx.data.Array: The data array is a special array used in the data binding context of qooxdoo. It does not extend the native array of JavaScript but is a wrapper for it. All the native methods are included in the implementation and it also fires events if the content or the length of the array changes in any way. Also the *.length* property is available on the array.

Extension of the native array

- qx.type.BaseArray: This class is the common superclass for all array classes in qooxdoo. It supports all of the shiny 1.6 JavaScript array features like *forEach* and *map*. This class may be instantiated instead of the native Array if one wants to work with a feature-unified Array instead of the native one. This class uses native features wherever possible but fills all missing implementations with custom code.
- qx.type.Array: An extended array class which adds a lot of often used convenience methods to the regular array like *remove* or *contains*.

Utility methods

- qx.lang.Array: Provides static helper functions for arrays with a lot of often used convenience methods like *remove* or *contains*.

Extending the native array's prototype

- qx.lang.normalize.Array: Adds some methods to array to lift every browser to the same level. Check out the API doc for more details.

11.1.6 Framework Generator Jobs

This page describes the jobs that are available in the framework. Mainly this is just a reference list with short descriptions of what the jobs do. To find out more about predefined jobs for custom applications, see the *References*.

Framework Jobs

These jobs can be invoked in the *framework/* directory with the generator, as `generate.py <jobname>`.

api

Create api doc for the framework.

api-data

Create the api data for the framework. Can take individual class names as further arguments.

clean

Remove local cache and generated .js files.

distclean

Remove the cache and all generated artefacts of the framework (api, test, ...).

fix

Normalize whitespace in .js files of the framework (tabs, eol, ...).

images

Run the image clipping and combining of framework images.

lint

Check the source code of the frameworks .js files (except the tests).

lint-test

Check the source code of the test .js files of the framework.

qxoo-build

Creates a single file containing all the qooxdoo classes of the OO layer. This file can be used in non-browser environments.

qxoo-noopt

A non-optimized version of *qxoo-build*, for debugging.

test

Create a test runner app for unit tests of the framework.

test-source

Create a test runner app for unit tests (source version) of the framework.

test-inline

Create an inline test runner app for unit tests of the framework.

translation

Create the .po files of the framework.

11.2 GUI Toolkit

11.2.1 Widget Reference

Core Widgets

Widget, *Spacer*, *ScrollBar*

Content Widgets

Label, *Image*, *Atom*, *Tree*, *Table*

Container Widgets

Composite, *Scroll*, *Stack*, *SlideBar*, *Resizer*

Building Blocks

Toolbar, *TabView*, *SplitPane*, *GroupBox*, *MenuBar*

Popups

PopUp, *ToolTip*, *Menu*, *Window*

Embed Widgets

Canvas, *HTML Embed*, *Iframe*, *Flash*

Form Widgets

Button, *ToggleButton*, *RepeatButton*, *HoverButton*, *SplitButton*, *MenuButton*

TextField, *PasswordField*, *Spinner*, *DateField*, *TextArea*

ComboBox, *SelectBox*

CheckBox, *List*, *Slider*

Virtual Widgets

Virtual List, *Virtual ComboBox*, *Virtual SelectBox*, *VirtualTree*

Indicators

ProgressBar

Widget Reference List

Atom The Atom groups an image with a label with support for different alignments. It is a building block for many other widgets like Buttons or Tooltips.

Preview Image

Features

- Configurable spacing between icon and label
- Toggle display of “image” “label” or “both”
- Configurable icon position

Demos Here are some links that demonstrate the usage of the widget:

- A simple Atom demo

API

Here is a link to the API of the Widget:
qx.ui.basic.Atom

Button A Button widget is used to display plain text and/or an icon. The button supports mouse and key events.

Preview Image

Features

- Contain text and/or icon.
- Mouse and keyboard support.
- Ellipsis: If the label does not fit into the widget bounds an ellipsis ("...") is rendered at the end of the label.

Description The button widget is a normal widget for a GUI. The button supports plain text and icon. Also it is possible to handle user interactions with mouse and keyboard.

Demos Here are some links that demonstrate the usage of the widget:

- A button demo with differently configured buttons
- A window demo which using button

API

Here is a link to the API of the Widget:
qx.ui.form.Button

Canvas This widget embed the HTML canvas element.

Note: It does not work with Internet Explorer

Preview Image

Features Since this widget is embedding the HTML canvas element the core features of this widget are limited by the canvas element itself respective by the implementation of the different browsers. However, the widget offers these features on top:

- fires a `redraw` event whenever the dimensions of the canvas element has changed or the canvas element needs an update
- update method for the canvas element
- width and height of the canvas element as properties
- support for synchronized width and height coordinates

Description Taken from the WHATWG website: "The canvas element represents a resolution-dependent bitmap canvas, which can be used for rendering graphs, game graphics, or other visual images on the fly."

Demos Here are some links that demonstrate the usage of the widget:

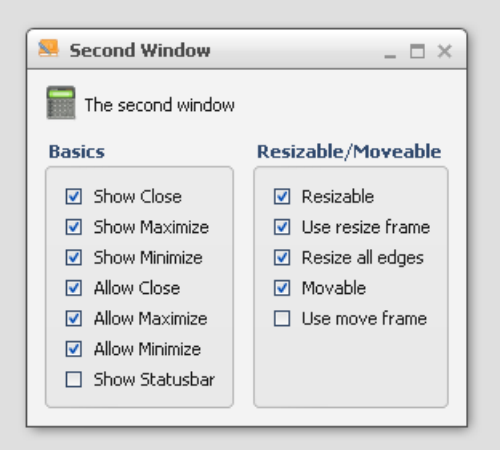
- Canvas demo

API

Here is a link to the API of the Widget:
Canvas API

CheckBox A CheckBox widget for Boolean values.

Preview Image



Features

- Mouse and keyboard control.
- Ellipsis: If the label does not fit into the widget bounds an ellipsis ("...") is rendered at the end of the label.

Description The CheckBox is a common widget found in many GUI applications. A CheckBox can be checked or not checked, either by mouse or keyboard. When the tri-state mode is enabled, there is an additional third state. The third state means that the CheckBox was neither checked nor unchecked, i.e. the state of the CheckBox is undetermined.

The CheckBox supports an optional plain text.

Also it is possible to combine a CheckBox with a TreeItem to construct a complex widget.

Demos Here are some links that demonstrate the usage of the widget:

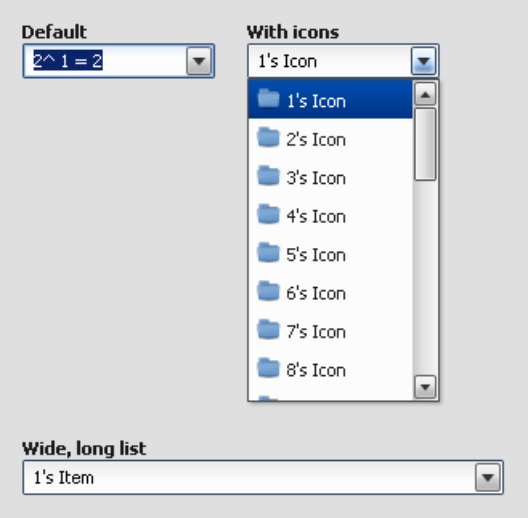
- CheckBoxes used in a GroupBox
- CheckBoxes used in a GroupBox to control a window
- A small dialog Demo
- ComboBox combined with a TreeItem

API

Here is a link to the API of the Widget:
qx.ui.form.CheckBox

ComboBox A ComboBox widget is used to select items from a list or allow customer input. The items in a ComboBox supports plain text and/or icons.

Preview Image



Features

- Mouse and keyboard support.
- Items with plain text and/or icons
- Ellipsis: If the label does not fit into the widget bounds an ellipsis ("...") is rendered at the end of the label.

Description A ComboBox is like a *TextField* with a drop down of predefined values. The main difference to the *SelectBox* is that the user can enter individual values or choose from the predefined ones. The items in the predefined list supports plain text and/or icons. The items which can be added to the list are `qx.ui.form.ListItem` items.

Please note that the ComboBox supports no auto- completion.

Demos Here are some links that demonstrate the usage of the widget:

- ComboBox demo
- Form demo

API

Here is a link to the API of the Widget:
qx.ui.form.ComboBox

Composite The Composite is a generic container widget. It exposes all methods to set layouts and to manage child widgets as public methods. Composites must be configured with a layout manager to define the way the widget's children are positioned.

Features

- Public methods to manage child widgets (add, remove, ...)
- Public `setLayout` method to define the Composite's layout manager

Description Composites are used to manually compose widgets. They are always used in combination with a layout manager. The general behavior of this widget is controlled by this layout manager.

Demos Any of the layout demos use Composites:

Here are some links that demonstrate the usage of the widget:

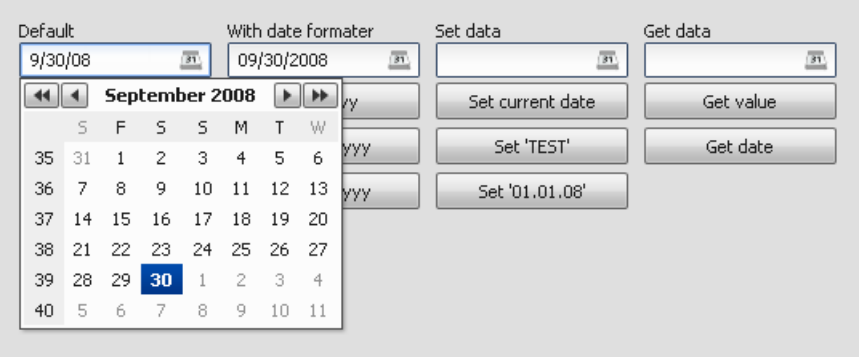
- The first layout demo. Any other layout demo uses Composites as well.

API

Here is a link to the API of the Widget:
qx.ui.container.Composite

DateField A DateField widget can be used for date input. The input can be done in to kinds. The first kind is to chose a date from a date chose, which is a part of the DateField. The second kind is to write the date direct in the input field. .. _pages/widget/datefield#preview_image:

Preview Image



Features

- Mouse and keyboard support.
- Own date format.

Description A DateField has a `qx.util.format.DateFormat` which is used to format the date to a string. The formatted string is show in the input field. The input can be edit directly in the input filed or selecting a date with the data chooser. The date chooser can be pop up by clicking the calender icon.

Demos Here are some links that demonstrate the usage of the widget:

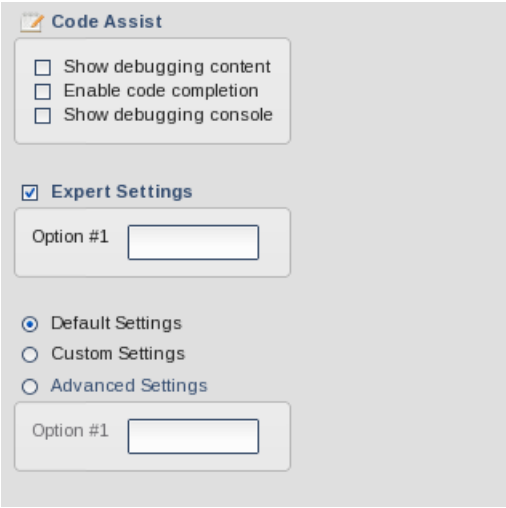
- DateField Demo
- Form demo

API

Here is a link to the API of the Widget:
qx.ui.form.DateField

GroupBox A Groupbox is a widget to group a set of form elements in a visual way.

Preview Image



Features

- Different legend types
- icon and text
- additional check boxes
- additional radio buttons

Description The GroupBox offers the possibility to visual group several form elements together. With the use of a legend which supports both text and icon it is easy label the several group boxes to give the user a short description of the form elements.

Additionally it is possible to use checkboxes or radio-buttons within the legend to enable or disable the connected groupBox (and their child elements) completely. This feature is most important for complex forms with multiple choices.

Demos Here are some links that demonstrate the usage of the widget:

- Demo showing all groupBox types

API

Here is a link to the API of the Widget:
qx.ui.groupbox.GroupBox

HoverButton The HoverButton is an *Atom*, which fires repeatedly execute events while the mouse is over the widget.

Preview Image

Features

- Contain text and/or icon.
- Ellipsis: If the label does not fit into the widget bounds an ellipsis ("...") is rendered at the end of the label.
- Event interval is adjustable.

Description The HoverButton is an *Atom*, which fires repeatedly execute events while the mouse is over the widget. The interval time for the HoverButton event can be configured by the developer.

Demos Here are some links that demonstrate the usage of the widget:

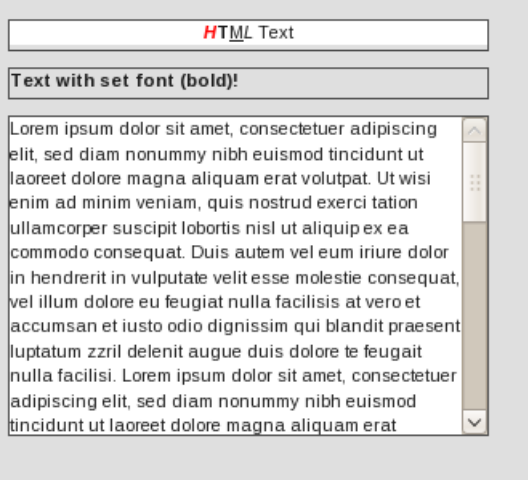
- Button demo with all supported buttons
- Form showcase demo

API

Here is a link to the API of the Widget:
qx.ui.form.HoverButton

HTML Embed The Html widget embeds plain HTML code into the application.

Preview Image



Features

- displays any valid HTML code
- CSS class support
- control whether the content is focusable
- control whether the content is selectable
- overflow support
- data event `changeHtml` is dispatched whenever content changes

Description The HTML embed can display any valid HTML code and implements some useful features like focus- and selection-control on top of it.

If you want to display a large amount of HTML code you can additionally use the overflow control to prevent the widget from eating up too much space within your application. This makes the seamless integration as easy as possible.

If you want to manipulate the styling of the displayed HTML code you can easily set a CSS class name to have the full control of the HTML.

Demos Here are some links that demonstrate the usage of the widget:

- HTML embed demo

API

Here is a link to the API of the Widget:
HTML Embed API

Iframe Container widget for internal frames (iframes). An iframe can display any HTML page inside the widget.

Preview Image

Features

- can display any HTML page
- fires a `load` event when the page fully loaded
- integrates a blocker element to prevents the iframe to handle key or mouse events

Description The iframe is a container widget for displaying any HTML page. It integrates seamlessly in your application though it can be styled like any other qooxdoo widget and offers an `load` event to control the page that's loaded within the widget. And the built-in blocker element prevents the native iframe element to handle any key or mouse event to ensure that e.g. the user navigates away by clicking a hyperlink.

Demos Here are some links that demonstrate the usage of the widget:

- Iframe demo

API

Here is a link to the API of the Widget:
API for Iframe

Flash Container widget for Flash.

Preview Image

Description A flash movie can be controlled to a certain extent directly from JavaScript with a number of commands.

These commands do not cover all Flash commands, so if you need more functionality you have to fuse an ActionScript with the Flash movie and start using the ExternalInterface to communicate.

To be able to use the JavaScript commands, three conditions must be full-filled:

1. the flash object must have been loaded to the DOM tree
2. the flash object must have received an id
3. the flash movie or document must have been enough loaded

To implement this functionality in qooxdoo we have added three events: “loading”, “loaded” and “timeout”. When the event “loading” is fired the three conditions have not been full-filled, and therefore the commands can’t be used.

If you wanna make sure the flash object is fully loaded and ready to be used listen to the "loaded" event. When the "loaded" event is fired you can start communicating directly with the Flash object. A "timeout" event is fired when the flash objects fails to load. You can also use the method isLoaded() in code to make sure that the Flash object is actually loaded.

Here's an example that shows how you can control changing to previous frame of a flash movie.

```
var flashWidget = new qx.ui.embed.Flash("/flash.swf");

flashWidget.addListener("loaded", function() {
  var flashFE = flashWidget.getFlashElement();

  var currentFrame = flashFE.CurrentFrame();
  var totalFrames = flashFE.TotalFrames();

  var newFrame = parseInt(currentFrame) - 1;

  if(totalFrames > 0 && newFrame >= 0)
  {
    flashFE.GotoFrame(newFrame);
  }
});
```

Demos Here are some links that demonstrate the usage of the widget:

- Embeded Flash in qooxdoo

API

Here is a link to the API of the Widget:
qx.ui.embed.Flash

Image As the name suggest, the Image widget is used to display image files.

Preview Image

Features

- Scaling the image
- Image clipping (combine multiple images into one single image)
- Auto sizing
- Configurable second image for the disabled state
- Support for PNG files with alpha transparency in all browsers (including IE6)
- Support for a loading event (only available for images loaded externally)

Demos Here are some links that demonstrate the usage of the widget:

- Image demo

API

Here is a link to the API of the Widget:
qx.ui.basic.Image

Label The Label widget is used to display either plain text or rich text with HTML markup.

Preview Image

Features

- Auto sizing
- Ellipsis: If the label does not fit into the widget bounds an ellipsis ("...") is rendered at the end of the label. (Only in text mode)
- "height for width": If the widget's width is too small to display the text in one line the text is wrapped and a new size hint is calculated. (Only in HTML mode)
- Configurable fonts, text colors and text alignment

Description The Label supports two different modes. The text and the HTML mode. The mode can be set by using the `rich` property. Which mode to use depends on the required features. If possible the text mode should be preferred because in this mode the text size calculation is faster.

Demos Here are some links that demonstrate the usage of the widget:

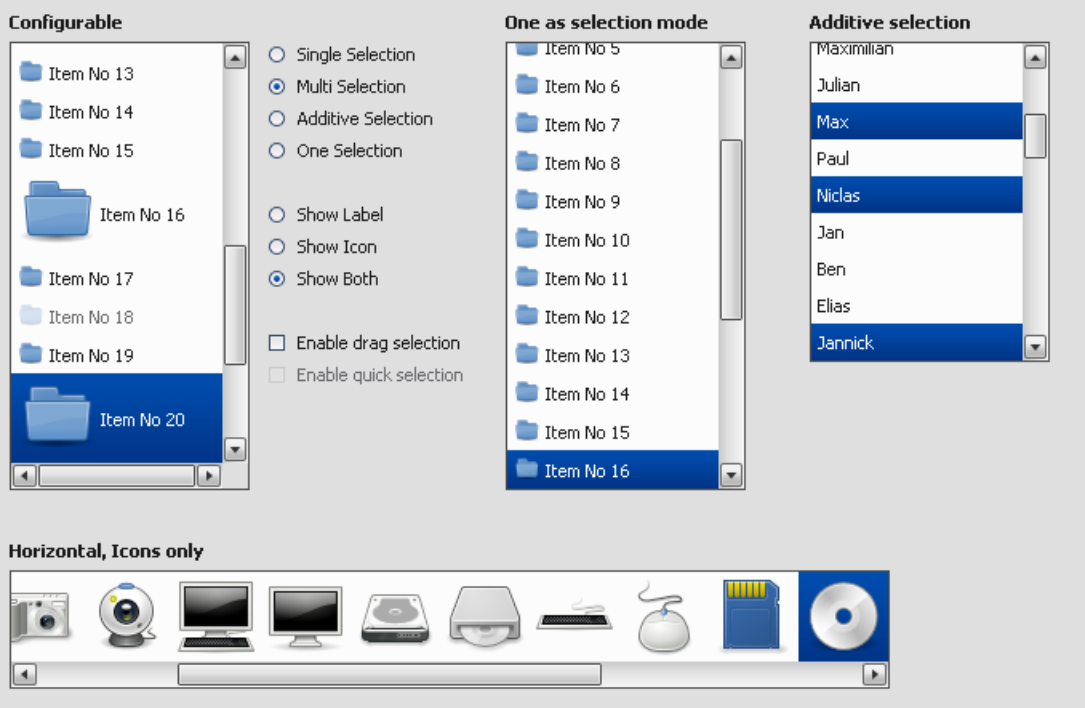
- A label demo with differently configured labels
- Height for width demo
- Label reflow

API

Here is a link to the API of the Widget:
qx.ui.basic.Label

List A List widget has items with plain text and/or icon.

Preview Image



Features

- Horizontal and vertical orientation.
- Single selection.
- Multi selection.
- Additive selection.
- One selection.
- Drag selection.
- Quick selection.
- Items with plain text and/or icon.
- Context menu support.

Description A List widget can be used to show a list of items. These items could selected in different modes:

- `single`: Only one or none could be selected.
- `multi`: One, more or none could be selected.

- `additive`: The same selection like `multi`, but each item, which the user clicked on it is added or removed to the selection.
- `one`: The same selection like `single`, but one must selected.

The item which are added to the list are `ListItem`. For more details see: ListItem.

Demos Here are some links that demonstrate the usage of the widget:

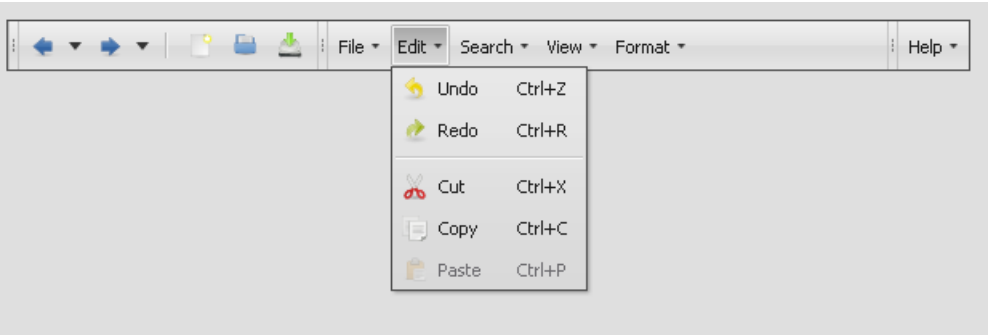
- List Demo
- Lists with Drag and Drop
- List with re-size support

API

Here is a link to the API of the Widget:
qx.ui.form.List

Menu The Menu is a widget that contains different widgets to create a classic menu structure. The menu is used from different widget, that needs a menu structure e.q. MenuBar.

Preview Image



Features

- On demand scrolling if the menu doesn't fit on the screen
- Menu items with text and/or icon.
- Each menu item can have a command for keyboard support.
- Menu items can have submenus.

The menu can contain different item types:

- Normal buttons
- CheckBox buttons
- RadioButtons
- Separators

Description The Menu widget is used in combination with other widgets. The other widgets has an instance from the menu and it's shown by user interactions. Each item in a menu can get an command key, that is used to get keyboard support for the user.

Here a some widgets that use a menu for user interaction:

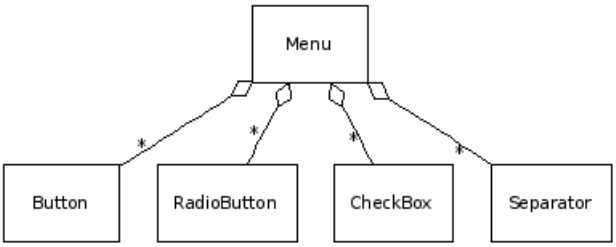
- *MenuBar*
- *Toolbar*
- *MenuButton*
- *SplitButton*
- *List*

The package `qx.ui.menu` has a collection of needed classes for creating a menu structure. The `qx.ui.menu.Menu` class is the container class for the menu structure and has items as child. Here are some item that can be used to create the structure:

- Button
- CheckBox
- RadioButton
- Separator

To create a submenu structure, each item (but not separator) can contain a menu to realize the submenu structure.

Diagram



Demos Here are some links that demonstrate the usage of the widget:

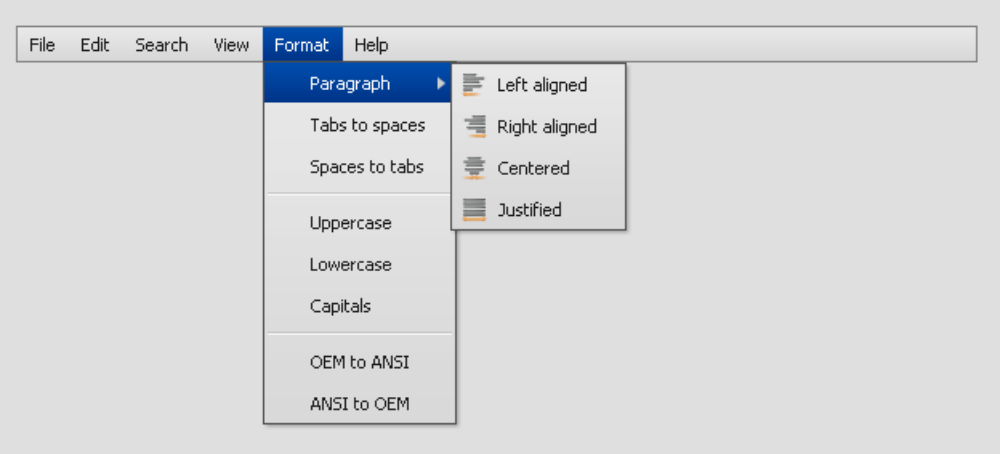
- Some different widgets that use the menu functionality
- Menus used in a MenuBar

API

Here is a link to the API of the Widget:
qx.ui.menu.Menu

MenuBar The MenuBar is a Widget to create a classic menu bar for an application.

Preview Image



Features

- Buttons as menu items with label and/or icon.

Description The MenuBar contains items `qx.ui.menubar.Button` to open a submenu `qx.ui.menu.Menu` that can handle user interactions. For more information about menus see *Menu*.

Demos Here are some links that demonstrate the usage of the widget:

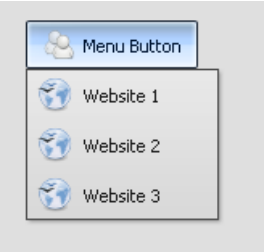
- MenuBar with all features

API

Here is a link to the API of the Widget:
qx.ui.menubar.MenuBar

MenuButton The MenuButton looks like a normal button, but it opens a menu when clicking on it.

Preview Image



Features

- Contain text and/or icon.
- Mouse support.
- Ellipsis: If the label does not fit into the widget bounds an ellipsis ("...") is rendered at the end of the label.
- Menu support.

Description The MenuButton looks like a normal button, but it opens a menu when clicking on it.

For using a menu see: *Menu*

Demos Here are some links that demonstrate the usage of the widget:

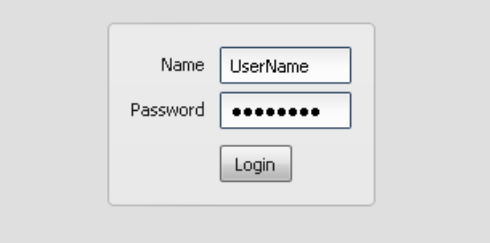
- Menu demo that contains a MenuButton
- Form demo

API

Here is a link to the API of the Widget:
qx.ui.form.MenuButton

PasswordField The PasswordField widget is a special TextField witch show the input hidden.

Preview Image



Features

- Hide password
- Mouse and keyboard control.
- Set maximum input length.
- Read only support.

Description The PasswordField is a special TextField for password input. The PasswordField hide the text input.

The act is the same like the TextField, for more details see: *TextField*

Demos Here are some links that demonstrate the usage of the widget:

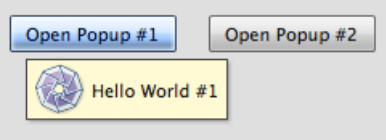
- Login dialog
- Show a form demo

API

Here is a link to the API of the Widget:
qx.ui.form.PasswordField

PopUp Popups are widgets, which can be placed on top of the application.

Preview Image



Features

- Auto hide property

Description Popups are automatically added to the application root and are used to display menus, the lists of combo or select boxes, tooltips, etc.

Demos Here are some links that demonstrate the usage of the widget:

- Simple example for the PopUp widget

API

Here is a link to the API of the Widget:
qx.ui.popup

ProgressBar The progress bar is an indicator widget.

Preview Image

Description The Progress bar is designed to simply display the current % complete for a process. It fires 2 events. When the % changes or when the process is complete.

The Value is limited between 0 and Maximum value. It's not allowed to set a Maximum value of 0. If you set a Maximum value bigger than 0, but smaller than Value, it will be limited to Value.

Here's an example. We create a default progress bar (value is 0, and the maximum value is 100). We then listen to change event and complete event. The change event is fired every time the % complete is changed, so we can see the new value. If the process is 100% complete the complete event is fired.

```
var pb = new qx.ui.indicator.ProgressBar();
this.getRoot().add(pb, { left : 20, top: 20});

pb.addListener("change", function(e) {
  this.debug(e.getData()); // % complete
  this.debug(pb.getValue()); // absolute value
});

pb.addListener("complete", function(e) {
  this.debug("complete");
});

//set a value
pb.setValue(20);
```

Demos Here are some links that demonstrate the usage of the widget:

- Simple example for the ProgressBar widget

API

Here is a link to the API of the widget:
qx.ui.indicator.ProgressBar

RepeatButton The RepeatButton is a special button, which fires an event, while the mouse button is pressed on the button.

Preview Image

Features

- Contain text and/or icon.
- Mouse support.
- Ellipsis: If the label does not fit into the widget bounds an ellipsis ("...") is rendered at the end of the label.
- Event interval is adjustable.

Description The RepeatButton is a special button, which fires an event, while the mouse button is pressed on the button. The interval time for the RepeatButton event can be configured by the developer.

Demos Here are some links that demonstrate the usage of the widget:

- Button demo with all supported buttons
- Form showcase demo

API

Here is a link to the API of the Widget:
qx.ui.form.RepeatButton

Resizer The Resizer is a resizable container widget.

Preview Image

Features

- Configurable whether all four edges are resizable or only the right and bottom edge
- Live resize or resizing using a resize frame (like in the screen shot)
- Sensitivity configurable i.e. The number of pixels on each side of a resize edge, where the resize cursor is shown.

Description The Resizer is a generic container just like a *Composite*, which can be resized by using the mouse. Either all edges or only the right and bottom edge can be configured to be resizable.

Demos Here are some links that demonstrate the usage of the widget:

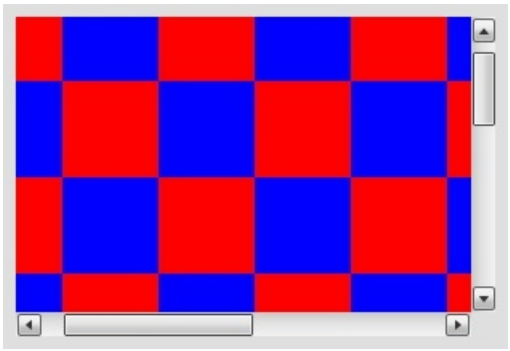
- Resizer demo

API

Here is a link to the API of the Widget:
qx.ui.container.Resizer

Scroll `Scroll` is a container, which allows vertical and horizontal scrolling if the content is larger than the container.

Preview Image



Features

- Themeable scroll bars
- Scroll bar visibility can be set independently for the X- and Y-axis. Possible values are `auto` (default), `on` and `off`

Description This widget can be used if the container's content is larger than the container itself. In this case vertical or horizontal scroll bars are displayed as needed.

Note that this class can only have one child widget and no configurable layout. The layout is fixed and cannot be changed.

Demos Here are some links that demonstrate the usage of the widget:

- A simple scroll container demo
- After resize the content matches the size of the scroll container.
- Content and container size can be changed. Display of scroll bars configurable.
- Content and container size can be changed. Display of scroll bars configurable.

API

Here is a link to the API of the Widget:
qx.ui.container.Scroll

ScrollBar The scroll bar widget exists as a custom qooxdoo scroll bar and a native browser scroll bar widget.

Which one is used as default can be controlled by the `qx.nativeScrollBars` setting.

Scroll bars are used e.g. by the *Scroll* container. Usually a scroll bar is not used directly.

Preview Image

Features

- Fully themable scroll bar (qooxdoo scroll bar)
- Size of the scroll bar knob can be adjusted

Demos Here are some links that demonstrate the usage of the widget:

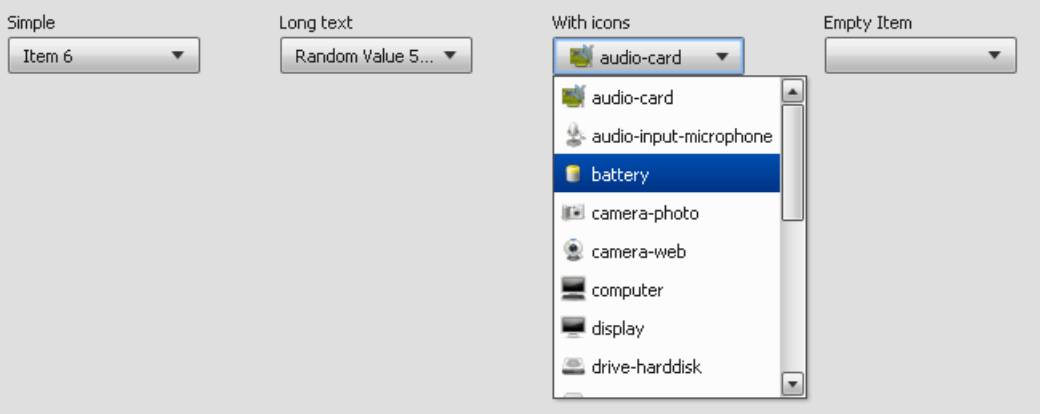
- Scroll bar demo
- A simple scroll container demo

API

Here is a link to the API of the Widget:
qx.ui.core.ScrollBar
qx.ui.core.NativeScrollBar

SelectBox The SelectBox has the same act like the ComboBox, but the SelectBox doesn't allow user input only selection is allowed.

Preview Image



Features

- Mouse and keyboard support.
- Items with plane text and/or icons
- Ellipsis: If the label does not fit into the widget bounds an ellipsis ("...") is rendered at the end of the label.

Description The SelectBox has the same act like the ComboBox, but the SelectBox doesn't allow user input only selection is allowed.

For more details about ComboBox see: *ComboBox*

Demos Here are some links that demonstrate the usage of the widget:

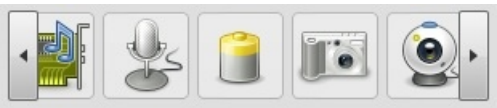
- SelectBox demo
- Other SelectBox demo
- Form demo

API

Here is a link to the API of the Widget:
qx.ui.form.SelectBox

SlideBar The SlideBar is a container widget, which provides scrolling in one dimension (vertical or horizontal).

Preview Image



Features

- Supports `vertical` and `horizontal` orientation
- Hides the scroll buttons if the content fits into the scroll container

Description The SlideBar widget can be used as a replacement for a *Scroll* container if scrolling is only needed in one direction. In contrast to the Scroll container the SlideBar uses *RepeatButtons* instead of scroll bars to do the scrolling. It is used e.g. in *tab views*.

Demos Here are some links that demonstrate the usage of the widget:

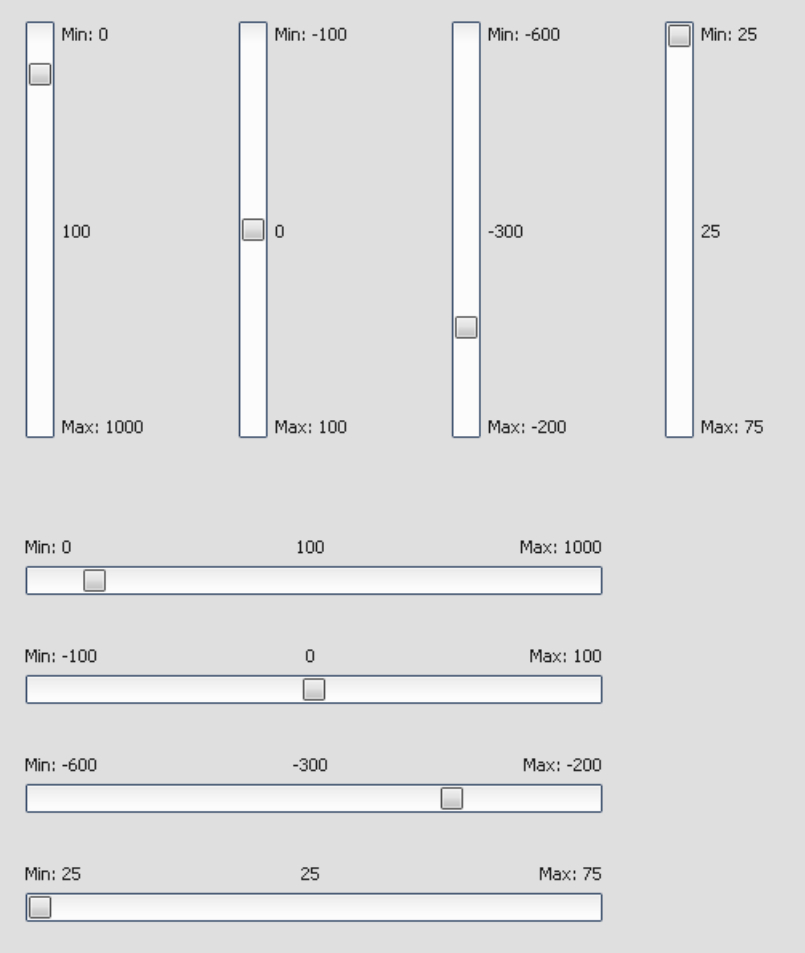
- SlideBar demo

API

Here is a link to the API of the Widget:
qx.ui.container.SlideBar

Slider The Slider widget is the classic widget for controlling a bounded value.

Preview Image



Features

- Mouse support.
- Horizontal and vertical orientation.
- Configurable steps.

Description The Slider widget is the classic widget for controlling a bounded value. It lets the user move a slider handle along a horizontal or vertical groove and translates the handle's position into an integer value within the defined range.

Demos Here are some links that demonstrate the usage of the widget:

- Slider demo
- Form demo

API

Here is a link to the API of the Widget:
qx.ui.form.Slider

Spacer A Spacer is a "virtual" widget, which can be placed into any layout and takes the space a normal widget of the same size would take.

Features

- Spacers are invisible and very light weight because they don't require any DOM modifications

Demos Here are some links that demonstrate the usage of the widget:

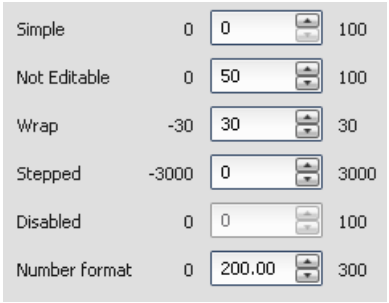
- This demo shows how spacers can be used to configure vraiable spacing in a grid.
- This demo shows how spacers can be used to configure vraiable spacing in a box layout.

API

Here is a link to the API of the Widget:
qx.ui.core.Spacer

Spinner A Spinner widget is a control that allows you to adjust a numerical value, typically within an allowed range e.g.: month of a year (range 1 – 12).

Preview Image



Features

- Mouse support.
- Configurable steps.
- Supports number format.

Description A spinner widget has a field to display the current value and controls such as up and down buttons to change that value. The current value can also be changed by editing the display field directly, or using mouse wheel and cursor keys.

An optional NumberFormat allows you to control the format of how a value can be entered and will be displayed.

Demos Here are some links that demonstrate the usage of the widget:

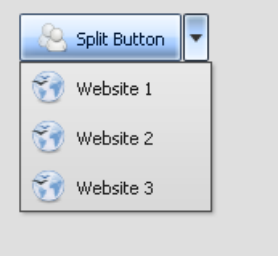
- Spinner demo
- Form demo

API

Here is a link to the API of the Widget:
qx.ui.form.Spinner

SplitButton The SplitButton acts like a normal button, but it opens a menu when clicking on the arrow.

Preview Image



Features

- Contain text and/or icon.
- Mouse and keyboard support.
- Ellipsis: If the label does not fit into the widget bounds an ellipsis ("...") is rendered at the end of the label.
- Menu support.

Description The SplitButton acts like a normal button, but it opens a menu when clicking on the arrow. The menu could contain a history list or something similar.

For using a menu see: *Menu*

Demos Here are some links that demonstrate the usage of the widget:

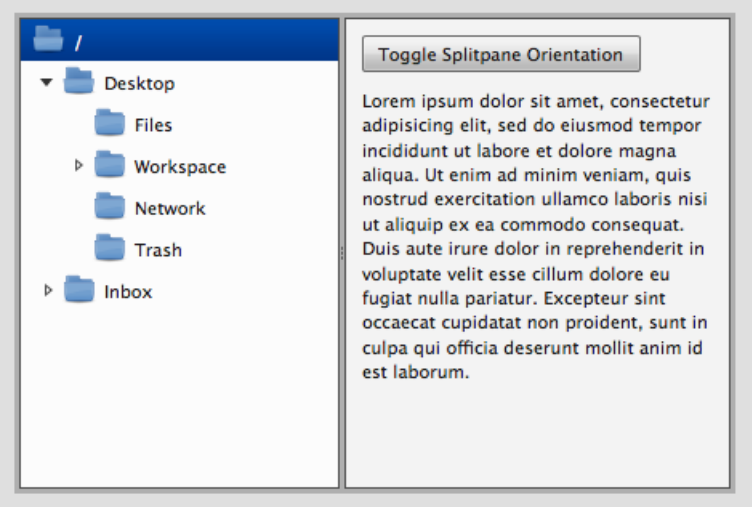
- Menu demo that contains a SplitButton
- Form demo

API

Here is a link to the API of the Widget:
qx.ui.form.SplitButton

SplitPane A SplitPane is used to divide two Widgets. These widgets can be resized by clicking the splitter widget and moving the slider. The orientation property states if the widgets should be aligned horizontally or vertically.

Preview Image



Features

- Orientation
  - vertical
  - horizontal
- Autosizing with static or flex values

Description The most important class (and the class you will use mainly) inside the `qx.ui.splitpane` package is the `Pane`. One can add two widgets (of any type) to it. Besides these two widgets a `Pane` also contains a `Splitter` between them. By clicking on it (and holding down the mouse button), a `Slider` will appear and follow the mouse to indicate where the `Splitter`'s will be placed when the mouse button is released. Once the mouse button is released the available space inside the `Pane` is redivided to both widgets according to the `Splitter`'s new position.

Demos Here are some links that demonstrate the usage of the widget:

- SplitPane that can toggle its orientation and hide/show panes

API

Here is a link to the API of the Widget:
qx.ui.splitpane

Stack The stack container is a container widget, which puts its child widgets on top of each other and only the topmost widget is visible.

Features

- Two size hint modes.
  - `dynamic:true`: The stack's size is the preferred size of the visible widget
  - `dynamic:false`: The stack's size height is the to the height of the tallest widget and the stack's width is set to the width of the widest widget

Description The stack is used if exactly one out of a collection of many widgets should be visible. This is used e.g. in the tab view widget. Which widget is visible can be controlled by using the `selected` property.

Demos Here are some links that demonstrate the usage of the widget:

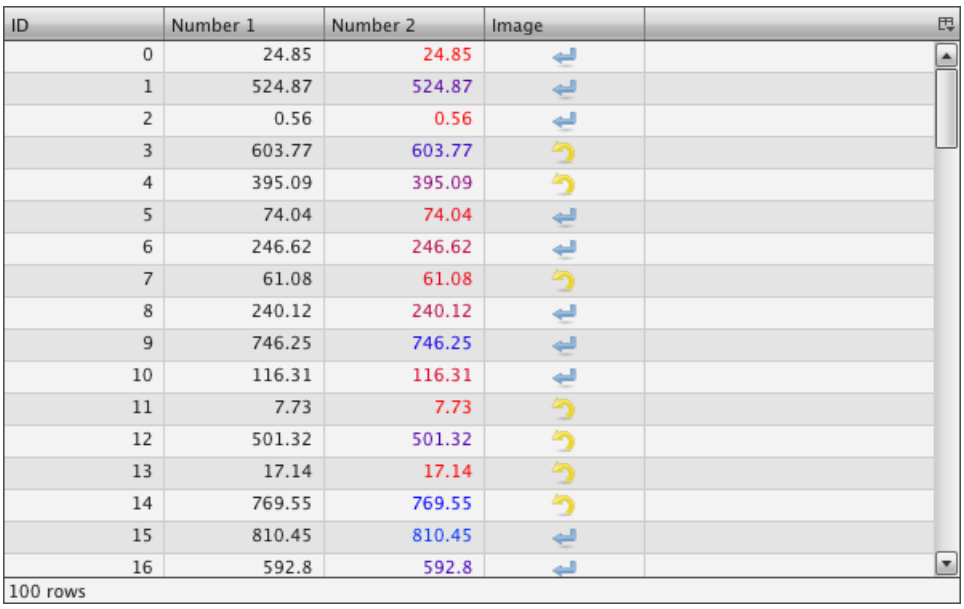
- Two stack containers. The first not dynamic, the second dynamic.

API

Here is a link to the API of the Widget:
qx.ui.container.Stack

Table The table package contains classes that allow you to build up virtual tables for showing data in a grid like view.

Preview Image



Description A `Table` is a widget to show a set of data in a column based view. It is based on the idea of virtual rendering. This means that only the visible rows will be rendered, which increases the performance of the widget and makes the table capable of displaying thousands of rows. But it is important to know that the table has only virtual rows, not columns. Having a huge number of columns can still decrease performance.

Features

Column Feature	Description
Display grid data	Takes an array containing an array for each row. The data in the row can be of almost any type.
Set custom header	Pre-built header renderer for icons and labels. Can be easily extended to supply a custom header cell renderer.
Column sorting	Built-in sorting accessible to the user by a click on the table header.
Reorganizing of columns	Columns can be reorganized by the user via Drag&Drop.
Change the visibility of columns	A special column visibility menu is included. It offers the user a way to show / hide single columns.
Content menu support	The table supports content menus for each cell.
Meta Columns	You can define one or more column which have a separate scrolling if any. E.g. you could have the first column always visible, while the other columns scroll out of view.
Resizable columns	The user can resize each column individually.

Row Feature	
Render for different kinds of data types	Special renderer for boolean, dates, HTML content, numbers, passwords and strings.
Conditional rendering for individual table cells	A conditional renderer is available which can render the data in different ways dependent on the content, like applying a red text colors to negative numbers.
Row filtering	Filtering for specific data can be done with a filter method.
Virtual rendering for rows	Only the rows visible will be rendered which increases the speed of the table.
Highlight color for hovered row	The currently hovered row can be highlighted.

General Feature	
Capable of remote data gathering	A remote data model can fetch data from the server. It fetches only the current visible data which means not the whole data needs to be transfered to the client on startup.
Different selection modes	The table offers single and multi selection in different variants.
Editable cells	The cells can be set to editable. Build in editors are CheckBox, ComboBox, PasswrodField, SelectBox and TextField.
Focus indicator	The currently selected cell can have a focus indicator.
Statusbar	The table has a status bar to show the number of rows and/or custom text.

Examples

Simple The most simple table can be build in five lines of code, as you can see in this example:

```
// table model
var tableModel = new qx.ui.table.model.Simple();
tableModel.setColumns(["ID", "A number"]);
tableModel.setData([[1, 12.23],[3, 849759438750],[2, -2]]);

// table
var table = new qx.ui.table.Table(tableModel);
this.getRoot().add(table);
```

One of the important parts of the table is the table model. The first line creates a simple table model. In the second

and third line, we configure the table model with some column names and data. With that model, we can create a table and add it to our application, as the example shows in the last two lines.

Editable Column Making for example the second column of our simple example editable can be done in one line:

```
// make second column editable
tableModel.setColumnEditable(1, true);
```

The first parameter here is the column (column numbering starts with 0), and the second one is to change the editable state.

Sorting Also adding a default sort order for the table is easy in one single line:

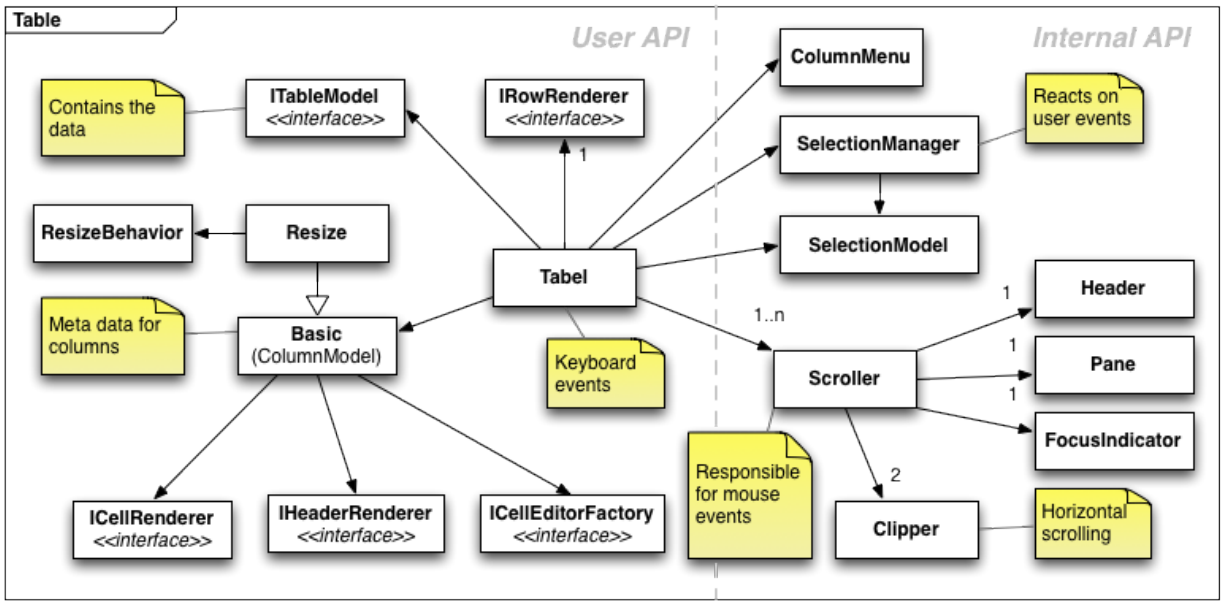
```
// sort the table on startup
tableModel.sortByColumn(0, true);
```

Again, the first argument is the column. The second argument is responsible for the sort order, `true` for ascending.

Conditional Cell Rendering As a last addition to our example we build something more complex. We want to render all negative numbers in red and all positive numbers in green:

```
// conditional rendering
var newRenderer = new qx.ui.table.cellrenderer.Conditional();
newRenderer.addNumericCondition(">", 0, null, "green");
newRenderer.addNumericCondition("<", 0, null, "red");
table.getTableColumnModel().setDataCellRenderer(1, newRenderer);
```

For that purpose, qooxdoo has a built-in conditional renderer. In the first line, we create such a renderer. The second and third line set up our conditional rules. The last line tells the table column model to use that renderer for the column with the index 1.



UML Diagram This diagram shows how the table uses the different kinds of classes you can find in the table namespace. The diagram is divided in two sides. The left side is interesting for the user if he wants to extend the table

or wants to use its custom cell renderer for example. The right side is usually a set of internal classes the tables uses to get its general tasks done.

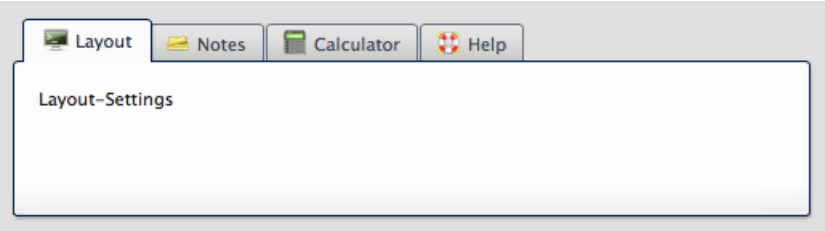
Further resources

- Table demos in the online Demobrowser.
- API documentation for qx.ui.table in the online APIViewer.

TabView The tab view stacks several pages above each other and allows to switch between them by using a list of buttons.

The buttons are positioned on one of the tab view's edges.

Preview Image



Features

- Tab positions: * top * bottom * left * right
- Overflow handling for tabs

Description A TabView widget consists of two parts:

- a `qx.ui.container.SlideBar` which contains a tab for every Page and can be positioned on every side of the TabView.
- a `qx.ui.container.Stack` which contains the Pages which can be added and removed at runtime.

A Page contains widgets to be shown in a TabView and usually has a label and icon to identify it.

Demos Here are some links that demonstrate the usage of the widget:

- Horizontal and vertical TabViews with a different amount of pages

API

Here is a link to the API of the Widget:
qx.ui.tabview

TextArea A TextArea some long text. The TextArea is classic GUI element.

Preview Image

Features

- Mouse and keyboard control.
- Configurable fonts and text alignment.
- Read only support.
- Automatic wrap around.

Description The TextArea is like a TextField, but for longer text input. So the TextArea supports a automatic wrap around which can be deactivated, when it is undesired.

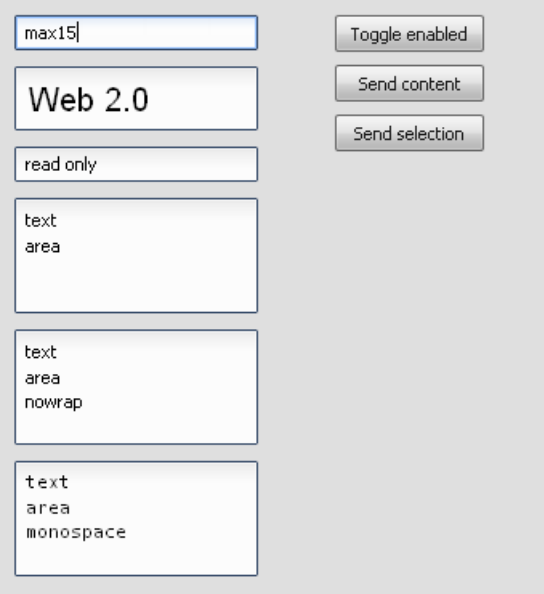
Demos Here are some links that demonstrate the usage of the widget:

- Shows different TextArea demos
- Shows a dialog demo with an TextArea
- Show a form demo

API

Here is a link to the API of the Widget:
qx.ui.form.TextArea

TextField The TextField widget is a classic GUI widget to edit text in a TextField.



Preview Image

Features

- Mouse and keyboard control.
- Configurable fonts and text alignment.
- Set maximum input length.
- Read only support.

Description The TextField widget has properties to set an alignment for the orientation and a Font for styling. Also is it possible to set the TextField read only and the maximum input length could be set.

Demos Here are some links that demonstrate the usage of the widget:

- Shows different TextField demos
- Shows a dialog demo with some TextFields
- Show a form demo
- Shows a browser demo

API

Here is a link to the API of the Widget:
qx.ui.form.TextField

ThemedIframe

Note: This widget is available since qooxdoo 0.8.3

Container widget for internal frames (iframes). An iframe can display any HTML page inside the widget.

Unlike `qx.ui.embed.Iframe`, which uses the browser's native iframe, ThemedIframe (particularly its scrollbars) can be visually modified according to the regular qooxdoo theming.

ToggleButton The ToggleButton widget is a classic GUI ToggleButton with to states: pressed or not pressed.

Preview Image

Features

- Contain text and/or icon.
- Mouse and keyboard support.
- Ellipsis: If the label does not fit into the widget bounds an ellipsis ("...") is rendered at the end of the label.

Description The button is a classic GUI element, that supports two states: pressed and not pressed. The state is changed by a mouse (click) or keyboard (enter or space) event. There is an additional third state when the tri-state mode is enabled. The third state means that the widget was neither pressed nor unpressed, i.e. the state of the button is undetermined.

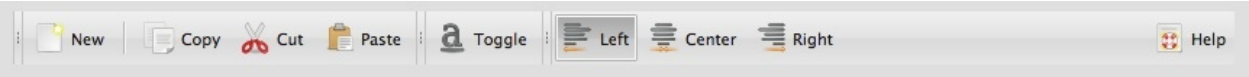
Demos Here are some links that demonstrate the usage of the widget:

- Button demo with all supported buttons
- Form showcase demo

API

Here is a link to the API of the Widget:
qx.ui.form.ToggleButton

Toolbar The ToolBar widget is responsible for displaying a toolbar in the application. Therefore it is a container for Buttons, RadioButtons, CheckBoxes and Separators.



Preview Image

Features

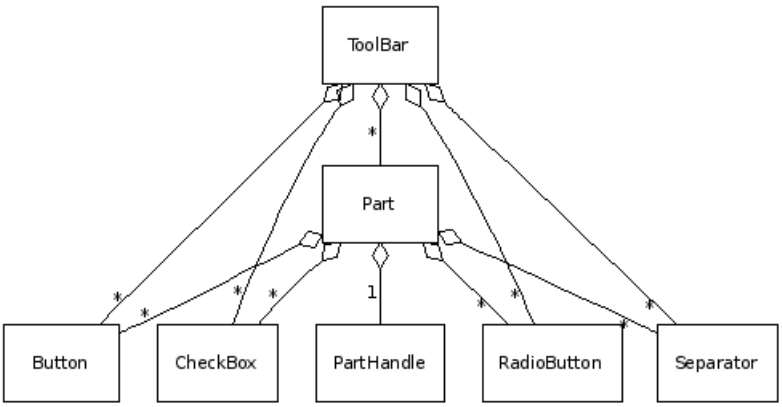
- Buttons
  - Regular
  - Radio
  - Toggle
  - Menu
- Icons and / or labels for all buttons
- Separation into parts
- Separator handles

Description The qx.ui.toolbar package, which contains all stuff needed for the toolbar widget, has the main class called ToolBar. The ToolBar class is the main container for the rest of the classes. If you want to group your buttons in the toolbar, you can do this with parts. The parts class acts as a subelement of the toolbar with almost the same functionality. To a part you can add buttons. There are some kinds of buttons in the toolbar package:

- Buttons
- Radio buttons
- CheckBox buttons
- MenuButtons
- SplitButtons

These buttons can also be added directly to the toolbar if no parts are needed. For further structuring in the toolbar, a Separator is available in the package which can be added.

Diagram



Demos Here are some links that demonstrate the usage of the widget:

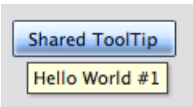
- Toolbar with all features
- Toolbar in a browser demo
- Toolbar with other menus

API

Here is a link to the API of the Widget:
qx.ui.toolbar

ToolTip A Tooltip provides additional information for widgets when the user hovers over a widget. This information can consist in plain text, but also include an icon and complex HTML code.

Preview Image



Features

- ToolTip can contain an icon
- ToolTip's label can contain HTML
- Show/hide delay

Description A ToolTip can be attached to one ore more widgets be creating a ToolTip and calling the `setToolTip()` method with the ToolTip as argument on the widget. The ToolTip will be shown as soon as the mouse overs the widget. A ToolTip can be configured to contain an icon and label and to be shown/hidden after a certain amount of time.

Demos Here are some links that demonstrate the usage of the widget:

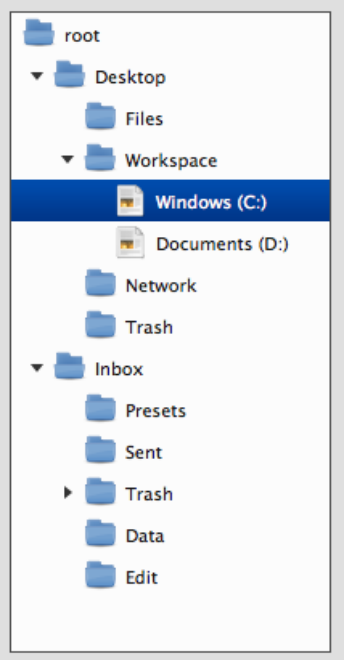
- Demonstrates regular and shared ToolTips

API

Here is a link to the API of the Widget:
complete package and classname

Tree The tree package contains classes that allow you to build up visual trees, like the ones you are familiar with e.g. for browsing your file system. Expanding and collapsing tree nodes is handled automatically by showing or hiding the contained subtree structure.

Preview Image

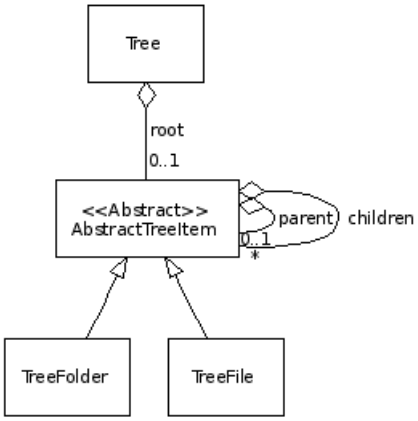


Features

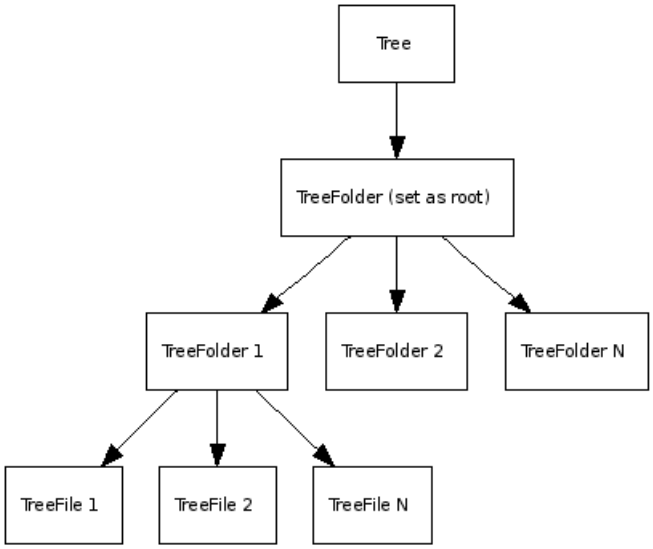
- Different open and selection modes
- Toggle-able tree root

Description A `Tree` contains items in an hierarchically structure. The first item inside a `Tree` is called the root. A tree always contains one single `TreeFolder` as the root widget which itself can contain several other items. A `TreeFolder` (which is also called *node*) can contain `TreeFolder` widgets or `TreeFile` widgets. The `TreeFile` widget (also called *leaf*) consists of an icon and a label.

UML Diagram



Dependencies



Demos Here are some links that demonstrate the usage of the widget:

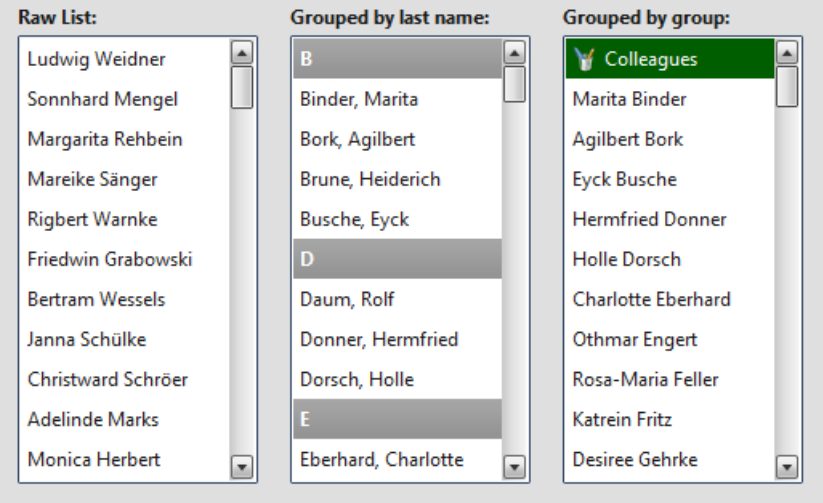
- Complex demo which shows many features of the tree
- A multi column tree

API

Here is a link to the API of the Widget:
qx.ui.tree

Virtual List The virtual List is a widget based on the framework's virtual infrastructure.

Preview Image



Description The `qx.ui.list.List` is based on the virtual infrastructure and supports filtering, sorting, grouping, single selection, multi selection, data binding and custom rendering.

Using the virtual infrastructure has considerable advantages when there is a huge amount of model items to render: Widgets are created only for visible items and reused. This saves both creation time and memory.

With the qx.ui.list.core.IListDelegate interface, it is possible to configure the list's behavior (item and group renderer configuration, filtering, sorting, grouping, etc.).

Note: At the moment we only support widget based rendering for list and group items, but we are planning to also support HTML based rendering in a future release.

Code Example Here's an example. We create a simple list example with 2500 items, sort the items (ascending), select the 20th item and log each selection change.

```
//create the model data
var rawData = [];
for (var i = 0; i < 2500; i++) {
  rawData[i] = "Item No " + i;
}
var model = qx.data.marshal.Json.createModel(rawData);

//create the list
var list = new qx.ui.list.List(model);

//configure the lists's behavior
var delegate = {
  sorter : function(a, b) {
    return a > b ? 1 : a < b ? -1 : 0;
  }
};
list.setDelegate(delegate);

//Pre-Select "Item No 20"
list.getSelection().push(model.getItem(20));

//log selection changes
list.getSelection().addListener("change", function(e) {
```

```
  this.debug("Selection: " + list.getSelection().getItem(0));
}, this);
```

Demos Here are some links that demonstrate the usage of the widget:

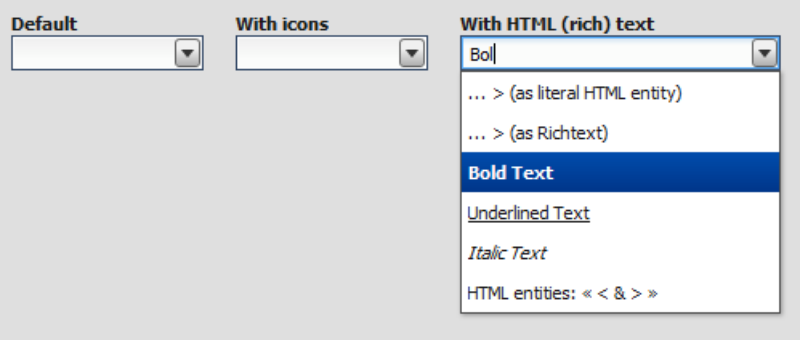
- Example for the virtual List widget
- Example showing the filtering feature
- Example showing the custom rendering
- Example showing the grouping feature

API

Here is a link to the API of the widget:
qx.ui.list.List

Virtual ComboBox The virtual ComboBox acts like the regular *ComboBox*, but is based on the framework's virtual infrastructure.

Preview Image



Features

- Mouse and keyboard support.
- Items with plain text and/or icons
- Ellipsis: If the label does not fit into the widget's bounds an ellipsis ("...") is rendered at the end of the label.
- Supports filtering, sorting, grouping, data binding and custom rendering like the *Virtual List*.

Mouse and keyboard behavior:

	keyboard	**open drop-down**	key down; key up;
		close drop-down	esc; enter
	mouse	**open drop-down**	click on arrow button
		close drop-down	click on item; click outside drop-down
drop-down closed	keyboard	**select next**	not possible
		select previous	not possible
		select first	not possible
		select last	not possible
	mouse	**select next**	not possible
		select previous	not possible
drop-down open	keyboard	**select next**	key down then enter
		select previous	key up then enter
		select first	page up then enter
		select last	page down then enter
	mouse	**select next**	click on item
		select previous	click on item
		wrap in list	no
		preselect	mouse over; key up; key down
		select drop-down item on open	yes, first item in the list which begins with value

Description The `qx.ui.form.VirtualComboBox` is based on the virtual infrastructure. The virtual SelectBox has both a *TextField* and a *Virtual List* drop-down. The drop-down can be used to predefine values which the user can select.

Using the virtual infrastructure has considerable advantages when there is a huge amount of model items to render: Widgets are created only for visible items and reused. This saves both creation time and memory.

The virtual ComboBox uses the same qx.ui.list.core.IListDelegate interface as the *Virtual List* to configure the ComboBox's behavior (item and group renderer configuration, filtering, sorting, grouping, etc.).

Note: At the moment we only support widget based rendering for list and group items, but we are planning to also support HTML based rendering in a future release.

Code Example Here's an example. We create a simple ComboBox example with 2500 items, sorting the items (ascending) and log each value change.

```
//create the model data
var rawData = [];
for (var i = 0; i < 2500; i++) {
  rawData[i] = "Item No " + i;
}
var model = qx.data.marshal.Json.createModel(rawData);

//create the SelectBox
var comboBox = new qx.ui.form.VirtualComboBox(model);

//configure the ComboBox's behavior
var delegate = {
  sorter : function(a, b) {
    return a > b ? 1 : a < b ? -1 : 0;
  }
};
comboBox.setDelegate(delegate);
```

```
//log value changes
comboBox.addListener("changeValue", function(e) {
  this.debug("Value: " + e.getData());
}, this);
```

Demos Here are some links that demonstrate the usage of the widget:

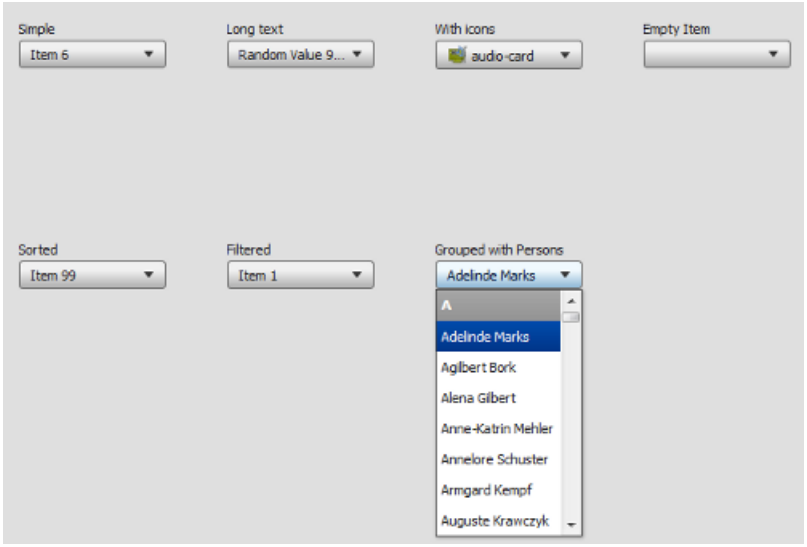
- ComboBox demo

API

Here is a link to the API of the widget:
qx.ui.form.VirtualComboBox

Virtual SelectBox The virtual SelectBox acts like the *SelectBox*, but is based on the framework's virtual infrastructure.

Preview Image



Features

- Mouse and keyboard support.
- Items with plain text and/or icons
- Ellipsis: If the label does not fit into the widget's bounds an ellipsis ("...") is rendered at the end of the label.
- Supports filtering, sorting, grouping, data binding and custom rendering like the *Virtual List*.

Mouse and keyboard behavior:

	keyboard	**open drop-down**	key down; key up; space; enter
		close drop-down	esc; enter
	mouse	**open drop-down**	click on widget
		close drop-down	click on item; click outside drop-down
drop-down closed	keyboard	**select next**	not possible
		select previous	not possible
		select first	not possible
		select last	not possible
	mouse	**select next**	not possible
		select previous	not possible
drop-down open	keyboard	**select next**	key down then enter
		select previous	key up then enter
		select first	page up then enter
		select last	page down then enter
	mouse	**select next**	click on item
		select previous	click on item
		wrap in list	no
		preselect	mouse over; key up; key down
		select drop-down item on open	yes

Description The `qx.ui.form.VirtualSelectBox` is based on the virtual infrastructure. It can be used to select one item and uses the *Virtual List* as a drop-down.

Using the virtual infrastructure has considerable advantages when there is a huge amount of model items to render: Widgets are created only for visible items and reused. This saves both creation time and memory.

The virtual SelectBox uses the same qx.ui.list.core.IListDelegate interface as the *Virtual List* to configure the SelectBox's behavior (item and group renderer configuration, filtering, sorting, grouping, etc.).

Note: At the moment we only support widget based rendering for list and group items, but we are planning to also support HTML based rendering in a future release.

Code Example Here's an example. We create a simple SelectBox example with 2500 items, sort the items (ascending), select the 20th item and log each selection change.

```
//create the model data
var rawData = [];
for (var i = 0; i < 2500; i++) {
  rawData[i] = "Item No " + i;
}
var model = qx.data.marshal.Json.createModel(rawData);

//create the SelectBox
var selectBox = new qx.ui.form.VirtualSelectBox(model);

//configure the SelectBox's behavior
var delegate = {
  sorter : function(a, b) {
    return a > b ? 1 : a < b ? -1 : 0;
  }
};
selectBox.setDelegate(delegate);
```

```
//Pre-Select "Item No 20"
selectBox.getSelection().push(model.getItem(20));

//log selection changes
selectBox.getSelection().addListener("change", function(e) {
  this.debug("Selection: " + selectBox.getSelection().getItem(0));
}, this);
```

Demos Here are some links that demonstrate the usage of the widget:

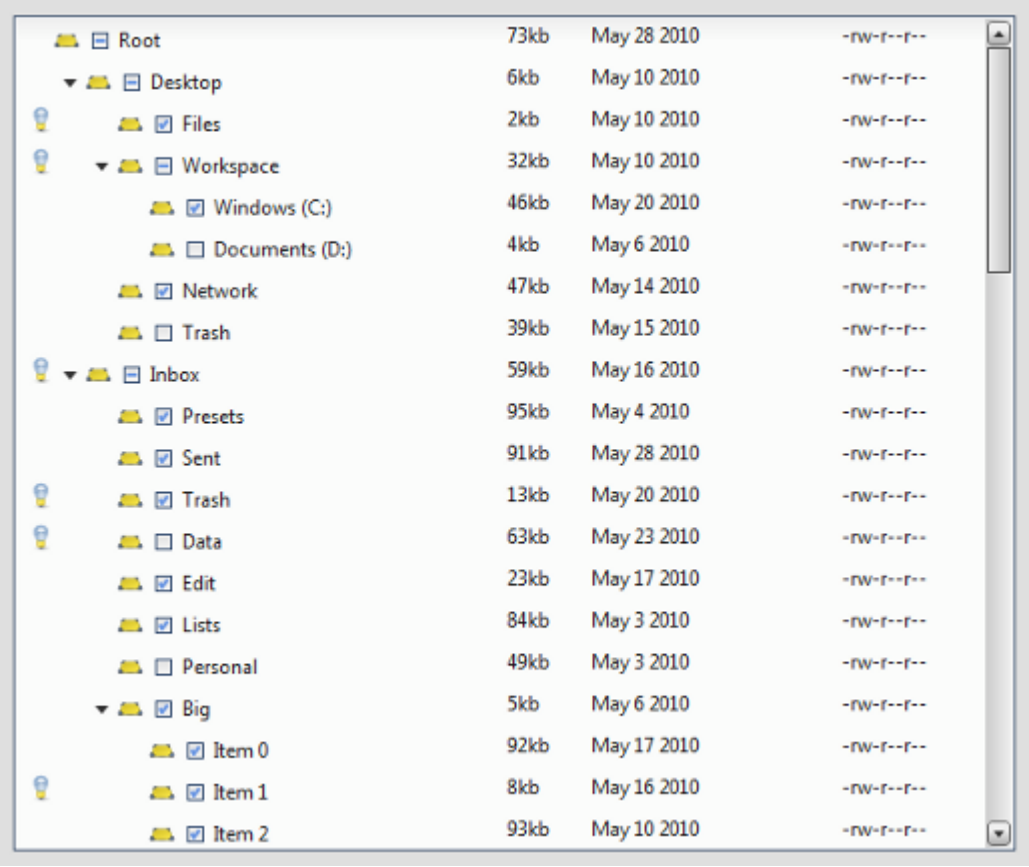
- SelectBox demo

API

Here is a link to the API of the widget:
qx.ui.form.VirtualSelectBox

VirtualTree The VirtualTree is a widget based on the framework's virtual infrastructure.

Preview Image



Description The `qx.ui.tree.VirtualTree` is based on the virtual infrastructure and supports single selection, multi selection, data binding and custom rendering.

Using the virtual infrastructure has considerable advantages when there is a huge amount of model items to render: Widgets are created only for visible items and reused. This saves both creation time and memory.

With the qx.ui.tree.core.IVirtualTreeDelegate interface it is possible to configure the tree's behavior (item renderer configuration, etc.).

Note: At the moment we only support widget based rendering for tree items, but we are planning to also support HTML based rendering in a future release.

Code Example Here's an example. We create a simple tree example with 2500 items and log each selection change.

```
//create the model data
var nodes = [];
for (var i = 0; i < 2500; i++)
{
  nodes[i] = {name : "Item " + i};

  // if its not the root node
  if (i !== 0)
  {
    // add the children in some random order
    var node = nodes[parseInt(Math.random() * i)];

    if(node.children == null) {
      node.children = [];
    }
    node.children.push(nodes[i]);
  }
}
// converts the raw nodes to qooxdoo objects
nodes = qx.data.marshal.Json.createModel(nodes, true);

// creates the tree
var tree = new qx.ui.tree.VirtualTree(nodes.getItem(0), "name", "children").set({
  width : 200,
  height : 400
});

//log selection changes
tree.getSelection().addListener("change", function(e) {
  this.debug("Selection: " + tree.getSelection().getItem(0).getName());
}, this);
```

Demos Here are some links that demonstrate the usage of the widget:

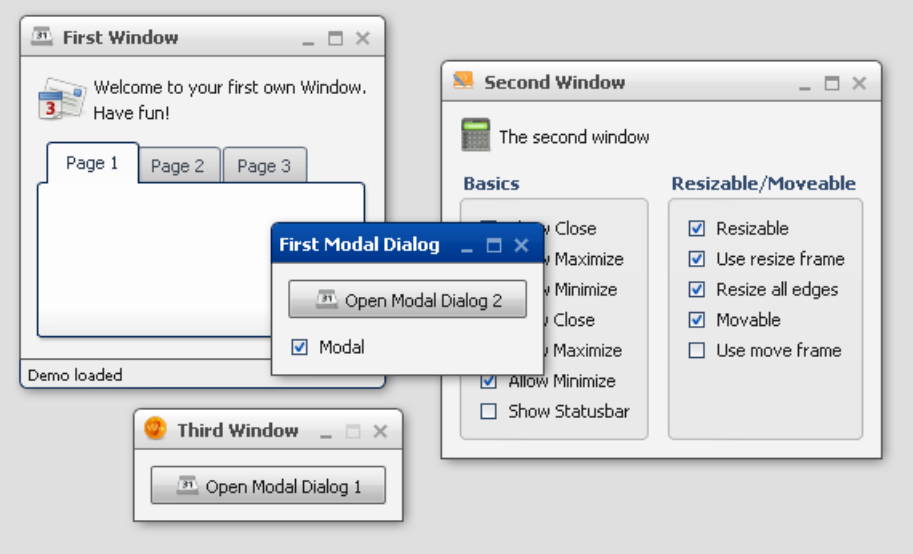
- Example for the VirtualTree widget
- Example with custom items as columns
- Example which loads items dynamically when a nodes is opened

API

Here is a link to the API of the widget:
qx.ui.tree.VirtualTree

Window The window widget is similar to Windows' MDI child windows.

Preview Image



Features

- Title support text and/or icon
- Support modal window
- Status bar support
- Minimize and maximize a window
- Open and close a window
- Resize a window

Description The window widget can be used to show dialogs or to realize a MDI (Multiple Document Interface) Application.

The widgets implements all known metaphors from a window:

- minimize
- maximize
- open
- close
- and so on

The package `qx.ui.window` contains two other classes that can be used to create a MDI Application:

- The Desktop can act as container for windows. It can be used to define a clipping region for internal windows.
- The Manager handle the z-order and modality blocking of windows managed the connected desktop.

Demos Here are some links that demonstrate the usage of the widget:

- Demonstrate different window types
- Windows with using a Desktop
- A window containing a table demo

- A calculator demo

API

Here is a link to the API of the Widget:
qx.ui.window.Window

11.2.2 Layout Reference

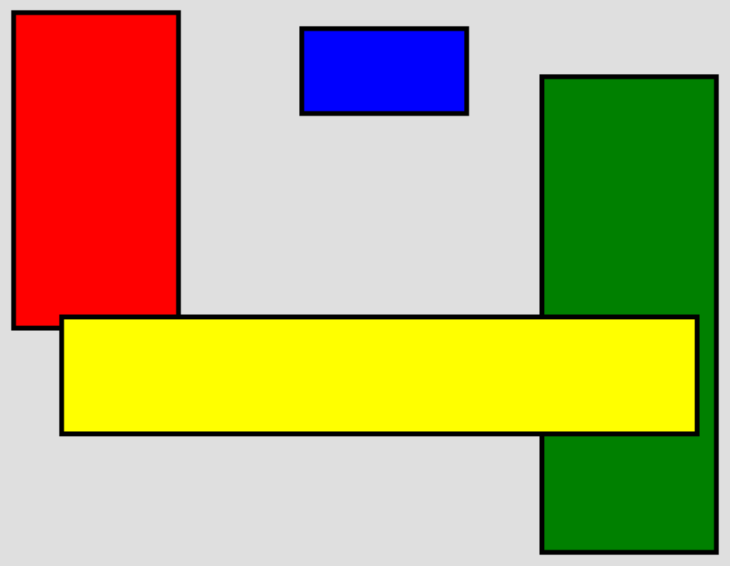
qooxdoo comes with some of the most common layout managers. The following layout managers are supported by qooxdoo:

The Basic layout is used to position the children at absolute top/left coordinates.

Basic

The Basic is used to position the children at absolute top/left coordinates.

Preview Image



Features

- Basic positioning using `left` and `top` layout properties
- Respects minimum and maximum dimensions without shrinking/growing
- Margins for top and left side (including negative margins)
- Respects right and bottom margins in the size hint
- Auto-sizing

Description

The basic layout positions each child at the coordinate given by the `left` and `top` layout properties.

The size hint of a widget configured with a Basic layout is determined such that each child can be positioned at the specified location and can have its preferred size and margin.

Margins for left and top will shift the widget position by this amount (negative values are possible). Margins for right and bottom are only respected while computing the size hint.

Layout properties

- **left**: The left coordinate in pixel (defaults to `0`)
- **top**: The top coordinate in pixel (defaults to `0`)

Alternative Names

- AbsoluteLayout (ExtJS)

Demos

Here are some links that demonstrate the usage of the layout:

- A demo of the Basic layout

API

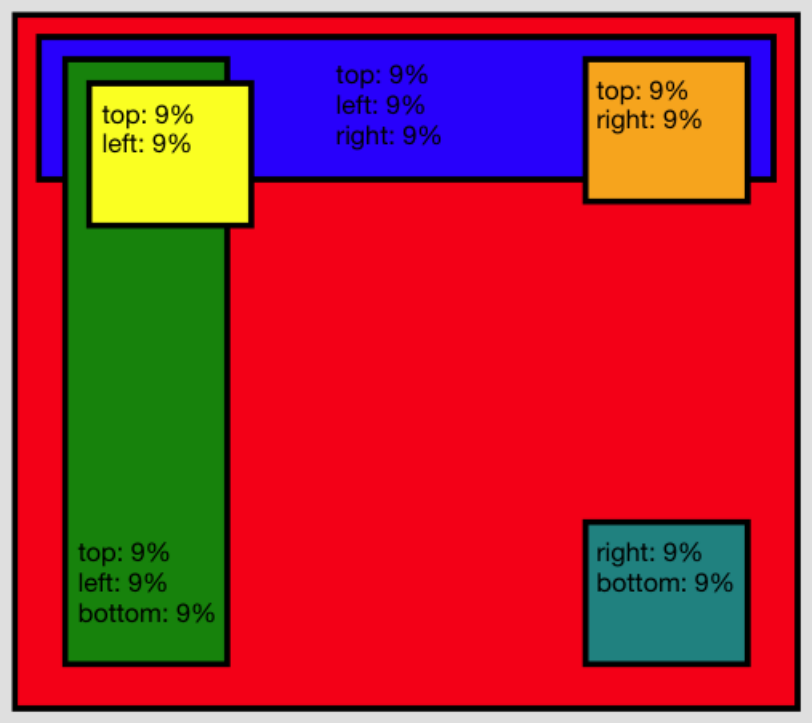
Here is a link to the API of the layout manager:
qx.ui.layout.Basic

The Canvas layout is an extended Basic layout. It is possible to position a widget relative to the right or bottom edge of the available space. The Canvas layout furthermore supports dimension and location measures in percent.

Canvas

The Canvas is an extended *Basic* layout. It is possible to position a widget relative to the right or bottom edge of the available space. The Canvas layout further has support for percent dimensions and locations.

Preview Image



Features

- Pixel dimensions and locations
- Percent dimensions and locations
- Stretching between left+right and top+bottom
- Minimum and maximum dimensions
- Children are automatically shrunk to their minimum dimensions if not enough space is available
- Auto sizing (ignoring percent values)
- Margins (also negative ones)

Description

In addition to the Basic layout the Canvas layout adds support for `right` and `bottom` layout properties. These allows to position a child in distance from the right or bottom edge of the available space. The canvas also adds support for *percent* locations and dimensions (layout properties `width` and `height`). Percents are defined as a string value (otherwise using the same layout property) with a "%" postfix.

It is possible to stretch a between the left and right edge by specifying layout properties for both `left` and `right`. The same is of cause true for `top` and `bottom`. To define a distance which is identically to each edge e.g. stretch a child to between all sides there is the `edge` property. This property accepts the same values are supported by the other location properties (including percents). Please keep in mind that often a Grow Layout might be the better choice when `edge` was planned to use in conjunction with a Canvas Layout.

The size hint of a widget configured with a Canvas layout is determined such that each child can be positioned at the specified location and can have its preferred size and margin. For this computation the layout ignores all widgets, which have a percent size or position, because These sizes depend on the actual rendered size and are not known upfront.

Layout properties

- **left** *(Integer|String)*: The left coordinate in pixels or as a percent string, e.g. `20` or `30%`.
- **top** *(Integer|String)*: The top coordinate in pixels or as a percent string, e.g. `20` or `30%`.
- **right** *(Integer|String)*: The right coordinate in pixels or as a percent string, e.g. `20` or `30%`.
- **bottom** *(Integer|String)*: The bottom coordinate in pixels or as a percent string, e.g. `20` or `30%`.
- **edge** *(Integer|String)*: The coordinate in pixels or as a percent string to be used for all four edges.
- **width** *(String)*: A percent width, e.g. `40%`.
- **height** *(String)*: A percent height, e.g. `60%`.

Demos

Here are some links that demonstrate the usage of the layout:

- Canvas with pixel positions
- Canvas with percent positions and dimensions
- Canvas showing left and right attachment of children
- Canvas with children having minimum and maximum dimensions

API

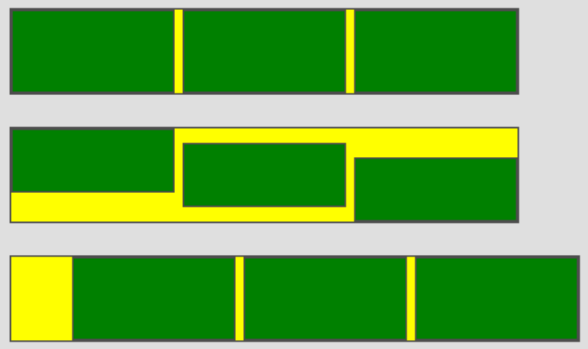
Here is a link to the API of the layout manager:
qx.ui.layout.Canvas

The Box layouts arranges their children back-to-back. The horizontal box layout arranges widgets in a horizontal row, from left to right, while the vertical box layout arranges widgets in a vertical column, from top to bottom.

HBox/VBox

The box layouts lay out their children one after the other. The horizontal box layout lays out widgets in a horizontal row, from left to right, while the vertical box layout lays out widgets in a vertical column, from top to bottom.

Preview Image



Features

- Respects Minimum and maximum dimensions
- Prioritized growing/shrinking (flex)
- Margins with horizontal (HBox) resp. vertical (VBox) collapsing)
- Auto sizing (ignoring percent values)
- Percent widths (not size hint relevant)
- Alignment (Children property {@link qx.ui.core.LayoutItem#alignX} is ignored)
- Horizontal (HBox) resp. vertical (VBox) spacing (collapsed with margins)
- Property to reverse children ordering (starting from last to first)
- Vertical (HBox) resp. horizontal (VBox) children stretching (respecting size hints)

Description

Both box layouts lay out their children one after the other. This description will discuss the horizontal box layout. Everything said about the horizontal box layout applies equally to the vertical box layout just with a vertical orientation.

In addition to the child widget's own preferred width the width of a child can also be defined as *percent* values. The percent value is relative to the inner width of the parent widget without any spacings. This means a horizontal box layout with two children of width `50%` and with a spacing will fit exactly in the parent.

The horizontal box layout tries to stretch all children vertically to the height of the box layout. This can be suppressed by setting the child property allowGrowY to false. If a child is smaller than the layout and cannot be stretched it will be aligned according to its alignY value. The alignX property of the layout itself defines the horizontal alignment of all the children as a whole.

The horizontal spacing can be defined using the property spacing. In addition to the spacing property each widget can define left and a right `margin`. Margins and the spacing are always collapsed to the largest single value. It for example the layout has a spacing of `10` pixel and two consecutive child widgets A and B - A with a right margin of `15` and B with a left margin of `5` - than the spacing between these widgets would be `15`, the maximum of these values.

The preferred height of an horizontal box layout is determined by the highest child widget. The preferred with is the sum of the widths of each child plus the spacing resulting from margins and the `spacing` property.

Layout properties

- **flex** *(Integer)*: Defines the flexibility (stretching factor) of the child (defaults to `0`)
- **width** *(String)*: Defines a percent width for the item. The percent width, when specified, is used instead of the width defined by the size hint. The minimum and maximum width still takes care of the elements limitations. It has no influence on the layout's size hint. Percents are mainly useful for widgets which are sized by the outer hierarchy.

Alternative Names

- QVBoxLayout (Qt)
- StackPanel (XAML)
- RowLayout (SWT)

Demos

Here are some links that demonstrate the usage of the layout:

- Simple HBox usage
- HBox with flex widths
- HBox with child margins
- HBox with percent widths
- HBox with switchable ''reversed" property
- HBox with separators
- HBox with vertical shrinking
- Simple VBox usage
- VBox with flex heights
- VBox with child margins
- VBox with percent heights
- VBox with switchable ''reversed" property
- VBox with separators
- VBox with horizontal shrinking

API

Here is a link to the API of the layout manager:

qx.ui.layout.HBox
qx.ui.layout.VBox

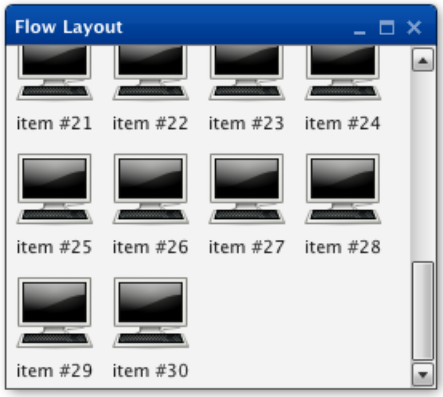
The Flow layout places widget next to each other from left to right. If the available width is not sufficient an automatic line break is inserted.

Flow

Note: This layout manager is available since qooxdoo 0.8.3.

A basic layout, which supports positioning of child widgets in a 'flowing' manner, starting at the container's top/left position, placing children left to right (like a HBox) until the there's no remaining room for the next child. When out of room on the current line of elements, a new line is started, cleared below the tallest child of the preceding line – a bit like using 'float' in CSS, except that a new line wraps all the way back to the left.

Preview Image



This image shows a gallery implemented using a Flow layout.

Features

- Reversing children order
- Manual line breaks
- Horizontal alignment of lines
- Vertical alignment of individual widgets within a line
- Margins with horizontal margin collapsing
- Horizontal and vertical spacing
- Height for width calculations
- Auto-sizing

Description

The Flow layout imitates the way text is rendered. Each child is placed horizontally next to each other. If the remaining space is too small a new line is created and the child is placed at the start of the new line.

It is possible to specify a horizontal alignment for all children. This is equivalent to `center`, `left` or `right` alignment of text blocks. Further it is possible to specify the vertical alignment of each child in a line.

This layout supports `height for width`, which means that given a fixed width it can calculate the required height.

Layout properties

- **lineBreak** *(Boolean)*: If set to `true` a forced line break will happen after this child widget.

Demos

Here are some links that demonstrate the usage of the layout:

- Flow layout demo

API

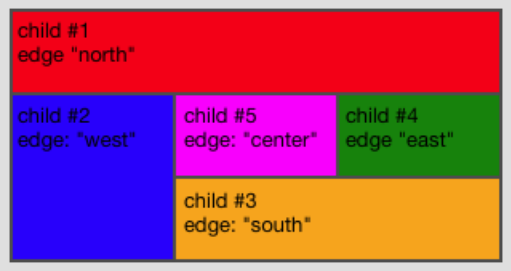
Here is a link to the API of the layout manager:
qx.ui.layout.Flow

A Dock layout attaches the children to the edges of the available space.

Dock

Docks children to one of the edges.

Preview Image



Features

- Percent width for left/right/center attached children
- Percent height for top/bottom/center attached children
- Minimum and maximum dimensions
- Prioritized growing/shrinking (flex)
- Auto sizing
- Margins and Spacings

- Alignment in orthogonal axis (e.g. alignX of north attached)
- Different sort options for children

Description

The `Dock` layout attaches the children to the edges of the available space. The space distribution respects the child order and starts with the first child. Every added child reduces the available space of the other ones. This is important because for example a left attached child reduces the available width for top attached children and vice-versa. This layout is mainly used for the basic application layout structure.

Layout properties

- **edge** *(String)*: The edge where the layout item should be docked. This may be one of `north`, `east`, `south`, `west` or `center`. (Required)
- **width** *(String)*: Defines a percent width for the item. The percent width, when specified, is used instead of the width defined by the size hint. This is only supported for children added to the north or south edge or are centered in the middle of the layout. The minimum and maximum width still takes care of the elements limitations. It has no influence on the layout's size hint. Percents are mainly useful for widgets which are sized by the outer hierarchy.
- **height** *(String)*: Defines a percent height for the item. The percent height, when specified, is used instead of the height defined by the size hint. This is only supported for children added to the west or east edge or are centered in the middle of the layout. The minimum and maximum height still takes care of the elements limitations. It has no influence on the layout's size hint. Percents are mainly useful for widgets which are sized by the outer hierarchy.

Alternative Names

- BorderLayout (Qt)
- DockPanel (XAML)
- BorderLayout (Java)
- BorderLayout (ExtJS)

Demos

Here are some links that demonstrate the usage of the layout:

- Simple docks
- Docks with auto sizing and spacings
- Docks with flex sizes (growing)
- Docks with flex sizes (shrinking)
- Docks with child margins
- Docks with percent sizes
- Docks with separators

API

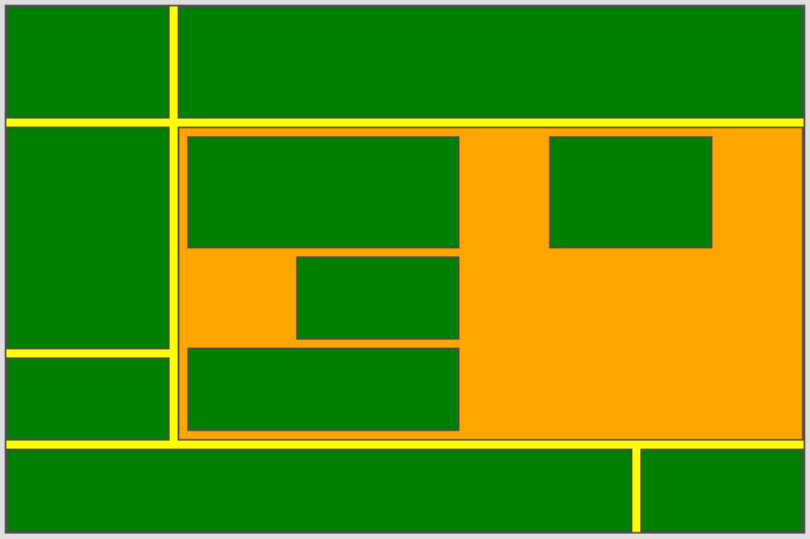
Here is a link to the API of the layout manager:
qx.ui.layout.Dock

The Grid layout arranges items in a two dimensional grid. Widgets can be placed into the grid's cells and may span multiple rows and columns.

Grid

The grid layout manager arranges the items in a two dimensional grid. Widgets can be placed into the grid's cells and may span multiple rows and columns.

Preview Image



This image show two nested grids with column and row spans.

Features

- Flex values for rows and columns
- Minimal and maximal column and row sizes
- Manually setting of column and row sizes
- Horizontal and vertical alignment
- Horizontal and vertical spacing
- Column and row spans
- Auto-sizing

Description

The grid arranges the child widgets in a two dimensional grid. Each child is associated with a grid `column` and `row`. Widgets can span multiple cells by setting the `colSpan` and `rowSpan` layout properties. However each grid cell can only contain one widget. Thus child widgets can never overlap.

The grid computes the preferred with/height of each column/row based on the preferred size of the child widgets. The computed column widths and row heights can be overridden by explicitly setting them using setColumnWidth and setRowHeight. Minimum and maximum sizes for columns/rows can be set as well.

By default no column or row is stretched if the available space is larger/smaller than the needed space. To allow certain rows/columns to be stretched each row/column can have a *flex* value.

Layout properties

- **row** *(Integer)*: The row of the cell the widget should occupy. Each cell can only contain one widget. This layout property is mandatory.
- **column** *(Integer)*: The column of the cell the widget should occupy. Each cell can only contain one widget. This layout property is mandatory.
- **rowSpan** *(Integer)*: The number of rows, the widget should span, starting from the row specified in the `row` property. The cells in the spanned rows must be empty as well. (defaults to `1`)
- **colSpan** *(Integer)*: The number of columns, the widget should span, starting from the column specified in the `column` property. The cells in the spanned columns must be empty as well. (defaults to `1`)

Alternative Names

- QGridLayout (Qt)
- Grid (XAML)
- TableLayout (ExtJS)

Demos

Here are some links that demonstrate the usage of the layout:

- Simple grids
- Complex grids
- A grid with different cell alignments
- An animated grid

API

Here is a link to the API of the layout manager:
qx.ui.layout.Grid

The Grow layout stretches all children to the full available size but still respects limits configured by min/max values.

Grow

The grow layout stretches all children to the full available size but still respects limits configured by min/max values.

Features

- Auto-sizing
- Respects minimum and maximum child dimensions

Description

The Grow layout is the simplest layout in qooxdoo. It scales every child to the full available width and height (still respecting limitations of each child). It will place all children over each other with the top and left coordinates set to `0`. This layout is usually used with only one child in scenarios where exactly one child should fill the whole content (e.g. adding a TabView to a Window). This layout performs a lot better in these cases than for example a canvas layout with `edge=0`.

Layout properties

The Grow layout does not have any layout properties.

Alternative Names

- FitLayout (ExtJS)

API

Here is a link to the API of the layout manager:
qx.ui.layout.Grow

There are a few more layouts bundled with the default qooxdoo distribution but those are mostly intended for use by a specific component. For example the *Atom* uses the Atom Layout, the *SplitPane* uses the two split layouts HLayout and VLayout.

Through the simple API it should be quite easy to write custom layouts if the included ones do not meet demands. Simply derive from the Abstract layout and start with a refined version of the method renderLayout().

11.3 Tooling

11.3.1 Default Action Jobs

This page describes the jobs that are automatically available to all skeleton-based applications (particularly, applications with config.json files that include the framework's *application.json* config file). Mainly this is just a reference list with short descriptions of what the jobs do. But in some cases, there is comprehensive documentation about the interface of this job and how it can be parametrized (This would usually require changing your *config.json* configuration file).

These jobs can be invoked with the generator, e.g. as `generate.py <jobname>`.

api

Create api doc for the current library. Use the following macros to tailor the scope of classes that are going to show up in the customized apiviewer application:

```
"API_INCLUDE" = ["<class_patt1>", "<class_patt2>", ...]
"API_EXCLUDE" = ["<class_patt1>", "<class_patt2>", ...]
```

The syntax for the class pattern is like those for the *include* config key.

Classes, which are not covered by `API_INCLUDE`, are nevertheless included in the api data with their full class description *if* they are required for inheritance relationships (e.g. a class that is included derives from a class which is not). If such a required class is explicitly *excluded* with `API_EXCLUDE`, a stub entry for it will be included in the api data to just show the inheritance relationship.

api-data

Create the api data for the current library. This is included in the *api* job, but allows you to re-generate the api data *.json* files for the classes without re-generating the Apiviewer application as well. Moreover, you can supply class names as command line arguments to only re-generate the api data for those:

```
sh> generate.py api-data my.own.ClassA ...
```

Beware though that in such a case the tree information provided to the Apiviewer (i.e. what you see in the Apiviewer's tree view on the left) is also restricted to those classes (augmented by stubs for their ancestors for hierarchy resolution). But this should be fine for developing API documentation for specific classes.

build

Create build version of current application.

build-min

This job is available in the qx.Website skeleton. Create minified build version of current application.

build-module-all

This job is available in the qx.Website skeleton. Instead of building a single all-in-one qx.Website script file (see build and build-min) this will build all modules separately (qx.Website splitted in n files).

build-module-all-min

This job is available in the qx.Website skeleton. Instead of building a single all-in-one qx.Website script file (see build and build-min) this will build all modules separately (qx.Website splitted in n files) and minified.

clean

Remove local cache and generated .js files (source/build).

dependencies

Create dependency information for the current library which is stored as a Json file (under *source/script/dependencies.json*). If this file exists and is current, the Generator will use its information when following dependencies of the classes of the library.

This is particularly interesting for libraries that are used in other applications. It allows you to speed up cold-cache builds for the other application. (Mind that it doesn't make much sense for the application itself, as a *generate.py clean* or *distclean* will also wipe the dependencies Json file).

distclean

Remove the cache and all generated artefacts of this library (source, build, ...).

fix

Normalize whitespace in .js files of the current library (tabs, eol, ...).

info

Running this job will print out various information about your setup on the console. Information includes your qooxdoo and Python version, whether source and/or build version of your app has been built, stats on the cache, asf.

inspector

Create an instance of the Inspector in the current application. The inspector is a debugging tool that allows you to inspect your custom application while running. You need to run the *source* job first, the run the *inspector* job. You will then be able to open the file `source/inspector.html` in your browser. The source version of your application will be loaded into the inspector automatically.

lint

Check the source code of the .js files of the current library.

migration

Migrate the .js files of the current library to the current qooxdoo version.

Running the migration job

Here is a sample run of the migration job:

```
./generate.py migration

NOTE:    To apply only the necessary changes to your project, we
         need to know the qooxdoo version it currently works with.

Please enter your current qooxdoo version [1.0] :
```

Enter your qooxdoo version or just hit return if you are using the version given in square brackets.

```
MIGRATION SUMMARY:

Current qooxdoo version:   1.0
Upgrade path:              1.0.1 -> 1.1 -> 1.2

Affected Classes:
    feedreader.view.Header
    feedreader.view.Article
    feedreader.view.Tree
    feedreader.PreferenceWindow
    feedreader.view.ToolBar
    feedreader.FeedParser
    feedreader.view.Table
    feedreader.Application
    feedreader.test.DemoTest

NOTE:     It is advised to do a 'generate.py distclean' before migrating any files.
          If you choose 'yes', a subprocess will be invoked to run distclean,
          and after completion you will be prompted if you want to
          continue with the migration. If you choose 'no', the distclean
          step will be skipped (which might result in potentially unnecessary
          files being migrated).

Do you want to run 'distclean' now? [yes] :
```

Enter "yes".

```
WARNING: The migration process will update the files in place. Please make
         sure, you have a backup of your project. The complete output of the
         migration process will be logged to 'migration.log'.

Do you want to start the migration now? [no] :
```

Enter "yes".

Check `migration.log` for messages that contain *foo.js has been modified. Storing modifications ...* to verify changes to class code.

simulation-build

Creates a runner application (the *Simulator*) for Selenium-based GUI interaction tests of the current library.

simulation-run

Starts Rhino and executes a *Simulator* test application generated by `simulation-build`. The Simulator is configured using the "*environment*" key of this job. The following settings are supported:

- **simulator.testBrowser** (String, default: `*firefox3`)
  - A browser launcher as supported by Selenium RC (see the Selenium documentation for details).
- **simulator.autHost** (String, default: `http://localhost`)
  - Protocol and host name that Selenium should use to access the application to be tested
- **simulator.autPath** (String, default: `/<applicationName>/source/index.html`)
  - Server path of the tested application.

- **simulator.selServer** (String, default: `localhost`)
  - Host name of the machine running the Selenium RC server instance to be used for the test.
- **simulator.selPort** (Integer, default: `4444`)
  - Number of the port the Selenium RC server is listening on
- **simulator.globalErrorLogging** (Boolean, default: `false`)
  - Log uncaught exceptions in the AUT.
- **simulator.testEvents** (Boolean, default: `false`)
  - Activate AUT event testing support.
- **simulator.applicationLog** (Boolean, default: `false`)
  - Capture the AUT's log output.

Additional runtime settings are configured using the "*simulate*" key.

pretty

Pretty-formatting of the source code of the current library.

source

Create a source version of the application, using the original file path for each class.

The source version of an application is tailored towards development activities. It makes it easy to write code, run the application, test, debug and inspect the application code, fix issues, add enhancements, and repeat.

With the *source* job all the classes of the application are in their original source form, and their files are directly loaded from their original paths on the file system. If you inspect your application in a JavaScript debugger like Firebug or Chrome Developer Tools, you can identify each file individually, read its code and comments, set breakpoints, inspect variables and so forth.

If you find yourself in a situation where you want to inspect more than your current application's class files in the debugger (e.g. because you are debugging another library along the way), this job is preferable.

You have to re-run this job when you introduce new dependencies, e.g. by instantiating a class you haven't used before. This changes the set of necessary classes for your application, and the generator has to re-create the corresponding loader.

There are two variants of the *source* job available which you might find interesting. One is called source-all and will include all available classes of all involved libraries, the other is source-hybrid which improves loading speed by concatenating some of the class code. See their respective entries.

source-all

Create a source version of the application, with all classes.

source-all will include all known classes, be they part of your application, the qooxdoo framework, or any other qooxdoo library or contribution you might be using. All those classes are included in the build, whether they are currently required or not. This allows you develop your code more freely as you don't have to re-generate the application when introducing new dependencies to existing classes. All classes are already there. You only have to re-run this job when you add an entirely new class that you want to use.

The downside of this job is that due to the number of classes your application is larger and loads slower in the browser, so it is a trade-off between development speed and loading speed.

source-hybrid

Create a source version of the application, concatenating some of the class code.

The *source-hybrid* job concatenates the contents of the classes that make up the application into a few files, only leaving your own application classes separate. Having the other class files (framework, libraries, contribs) chunked together you get the loading speed of nearly the build version, while at the same time retaining the accessibility of your own application files for debugging. This makes this job ideal for fast and focused development of the application-specific classes.

Only the classes that are actually needed for the application are included, so you have to re-run this job when you introduce new dependencies.

To review the three different source jobs, if you are just getting started with qooxdoo development, use the source-all version, which is the most convenient if you are not too impatient. If you are concerned about loading speed during development, but don't mind hitting the up and return keys in your shell window once in a while, go with the default source-hybrid job. If your emphasis on the other hand is on inspection, and you want to see exactly which class files get loaded into your application and which code they provide, the source version will be your choice.

source-server

(experimental)

Run a mini web server that serves the source version of an application. The web server will export as document root a root path common to all libraries used by the source version. This overcomes e.g. restrictions by modern browsers that do not allow XHR requests over the *file://* protocol by default.

By default the server will randomly pick a free port on the local machine to run at. You can assign it a fixed port by setting the *SOURCE_SERVER_PORT* macro, e.g. like `generate.py source-server -m SOURCE_SERVER_PORT:44161`.

source-server-reload

(experimental)

Same as source-server, but adds an automatic reload feature. The web server watches the loader file of the exported source version (usually *source/script/<application>.js*), and triggers an automatic reload of the application in the browser if this changes. You usually want to use this job together with the watch job (running separately) which automatically re-generates the loader when the application classes change. This way, both jobs work hand in hand to reload the most up-to-date version of the application in the browser whenever the source files change. If the generation fails, e.g. due to a syntax error, the loader is not updated and hence the browser not reloaded.

Like with *source-server* the server prints at startup the URL to the application's index.html. If you want to load the application through the reload server it is *important that you use exactly this URL in your browser* (including the trailing ".../index.html"). On requesting this URL the reload server will instrument the file with information necessary for the reload behavior.

The reload feature can also be used when running the main application from the file system (with the *file://* protocol) or over a separate web server like Apache. In this case you just have to manually add the URL of the reload client script in the app's `index.html`, e.g. adding

```
<script type="text/javascript" src="http://localhost:44161/_active_reload/active_reload.js"/>
```

to the header section, assuming that `44161` is the port where the source server runs on. */_active_reload/active_reload.js* is the URL path to the reload client script. You then load the application over your standard web server. Just the reload notification is handled over the source server.

source-httpd-config

(experimental)

This job is similar in intent to the source-server job. But instead of starting a dedicated web server, it will create a small web server configuration to be used with an already existing web server on your machine. Various popular web servers are supported (Apache, lighttpd, nginx) and it is usually straight-forward to include the generated configuration file into the main server/virtual host configuration. The file contains hints how to achieve that for the given server implementation. You can tweak most of the settings involved in the job (server type, server URL, ...), the config key behind it is *web-server-config*.

In this way the source version of your application is integrated with an existing web server environment which comes in handy if you e.g. want to interact with backend services that are already hosted on the same web server.

The generated configuration is actually template-driven so you can add your own templates if your web server is not yet supported.

test

Create a test runner app for unit tests of the current library.

- Use the following macro to tailor the scope of classes in which unit test classes are searched for:

  ```
  "TEST_INCLUDE" = ["<class_patt1>", "<class_patt2>", ...]
  ```

  The syntax for the class pattern is like those for the *include* config key.

- The libraries from the *libraries* job will be included when building the test application (the application containing your unit tests is a separate application which is loaded into the runner application).

- If you want to break out from the reliance on the *libraries* job altogether, or have very specific settings that must be applied to the test application, you can provide a custom includer job *common-tests* which may contain a custom *library* key and other keys. But then you have to make sure it contains the Testrunner library as well.

  ```
  "common-tests" :
  {
    "extend"    : [ "libraries" ],

    "let" :      { "LOCALES" : ["de", "de_DE", "fr", "fr_FR" ] },

    "library" :
    [
      { "manifest" : "${QOOXDOO_PATH}/framework/Manifest.json" },
      { "manifest" : "${TESTRUNNER_ROOT}/Manifest.json" }
    ],

    "include" : ["testrunner.TestLoader", "${TEST_INCLUDE}", "${QXTHEME}"],

    "environment" :
    {
      "qx.theme" : "${QXTHEME}",
      "qx.globalErrorHandling" : true
    },
  ```

```
  "cache" :
  {
    "compile" : "${CACHE}"
  }
}
```

This allows you to tailor most of the parameters that influence the creation of the test application.

test-source

Create a test runner app for unit tests (source version) of the current library.

The same customization interface applies as for the default *test* job.

translation

Create .po files for the current library.

validate-config

Validates the Config (*config.json*) - and recursively all included Configs - against a schema. If a jobname argument is given only this job map (within the root Config) is checked.

This job helps especially with nested config keys, where a misconfiguration might be silently disregarded by the Generator which eventually leads to unexpected behaviour.

validate-manifest

Validates the *Manifest.json* against a schema.

Some entries in *Manifest* files are informational and therefore optional, others are required to successfully use the current library with the Generator. The job is especially helpful for developers of *contributions*, as those require some extra keys.

watch

The *watch* job watches the *source/class* path of your application for changed JavaScript files, and automatically runs the default Generator job (usually *"source-hybrid"*) in case of a change. The config key behind it is *watch-files*.

When you run the job the process will starting telling you the path it is watching, and will continue until you terminate it with Ctrl-C. On *ix like systems you can put the job in the shell's background with `&`, in order to get your shell prompt back. The job will continue running, and only produce some console output when its associate command is being run. In order to terminate it you have to bring it to the foreground again and then press Ctrl-C (Or you can use a process manager to kill it).

The implementation uses a simple polling mechanism to detect file changes, the check interval is configurable. There are technological alternatives that hook into OS kernel events, but these approaches come with a certain overhead and are more difficult to maintain cross-platform.

watch-scss

(experimental)

This job is available in the qx.Mobile skeleton. The *watch-scss* job watches SCSS files, and compiles them to CSS once they change (See the article about *mobile theming*). The *.scss files usually reside in your application's `source/resource/<name_space>/mobile/scss` folder, and will be compiled into the `css` sibling folder.

11.3.2 Default Includer Jobs

These jobs don't do anything sensible on their own, so it is no use to invoke them with the generator. But they can be used in the application's `config.json`, to modify the behaviour of other jobs, as they pick up their definitions.

cache

Provides the *cache* key with its default settings.

common

Common includer job for many default jobs, mostly used internally. You should usually not need to use it; if you do, use with care.

includes

Provides the *include* key with its default settings.

libraries

This job should take a single key, *library*. The *libraries* job is filled by default with your application and the qooxdoo framework library, plus any additional libraries you specify in a custom *libraries* job you added to your application's *config.json*. Here, you can add additional libraries and/or contributions you want to use in your application. See the linked reference for more information on the library key. Various other jobs will evaluate the *libraries* job (like *api*, *test*), to work on a common set of libraries.

```
"libraries" :
{
  "library" : [ { "manifest" : "some/other/lib/Manifest.json" }]
}
```

profiling

Includer job, to activate profiling.

log-parts

Includer job, to activate verbose logging of part generation; use with the `-v` command line switch.

log-dependencies

Includer job, to activate verbose logging of class dependencies; use with the `-v` command line switch.

11.3.3 Generator Config Keys

This page contains the complete list of configuration keys and their sub-structures.

Mandatory keys in a context are marked *'(required)'*, all other keys can be considered optional (most have default values). Special note boxes starting with *'peer-keys'* indicate interactions of the current key with other configuration keys that should be present in the job for the current key to function properly. E.g. the key *compile* will use the peer-key *cache* in the job definition for its workings. Again, in many cases fall-back defaults will be in place, but relying on them might lead to sub-optimal results.

add-css

Add CSS files to the application. Takes a list.

```
"add-css" :
[
  {
    "uri" : "<css-uri>"
  }
]
```

Note: peer-keys: *compile*

- **uri** *(required)* : URI with which the css file will be loaded, relative to the index.html.

add-script

Add pre-fabricated JS files to the application. Takes a list.

```
"add-script" :
[
  {
    "uri" : "<script-uri>"
  }
]
```

Note: peer-keys: *compile*

- **uri** *(required)* : URI with which the script will be loaded, relative to the index.html.

api

Triggers the generation of a custom Apiviewer application. Takes a map.

```
"api" :
{
  "path"   : "<path>",
  "verify" : [ "links", "types", "statistics" ],
```

```
  "warnings" :
  {
    "output" : [ "data", "console" ]
  }
  "sitemap" :
  {
    "link-uri" : "<uri>",
    "file" : "<path>"
  }
}
```

Note: peer-keys: *cache*, *include*, *library*

- **path** *(required)* : Path where the Apiviewer application is to be stored, relative to the current directory.
- **verify** : Additional checks to run during API data generation.
  - **links** : Check internal documentation links (@link{...}) for consistency.
  - **types** : Check if documented parameter and return value types are known classes, valid global objects or built-in types
  - **statistics** : Show a summary of total API items, items with missing or incomplete documentation and the documentation completeness percentage
- **warnings** : Controls the output of warning messages for API doc errors and omissions.
  - **data** : Store warning messages in the generated API data (warnings will be displayed in the API Viewer).
  - **console** : Write warning messages to the shell.
- **sitemap** : Create an XML sitemap with links for all classes in the API Viewer.
  - **link-uri** : URI template for the sitemap entries. *%s* will be replaced with the class name.
  - **file** : File path for the sitemap. Default: *<api/path>/sitemap.xml*

asset-let

Defines macros that will be replaced in *@asset* hints. Takes a map.

```
"asset-let" :
{
  "<macro_name>" : [ "foo", "bar", "baz" ]
}
```

Each entry is

- <macro_name> : [<list of replacement strings>] Like with macros, references (through '${macro_name}') to these keys in @asset hints in source files will be replaced. Unlike macros, each listed value will be used, and the result is the list of all ensuing expressions, so that all resulting assets will be honored.

Special section

cache

Define the paths to cache directories, particularly to the compile cache. Takes a map.

```
"cache" :
{
  "compile"     : "<path>",
  "downloads"   : "<path>",
  "invalidate-on-tool-change" : (true|false)
}
```

Possible keys are

- **compile** : path to the "main" cache, the directory where compile results are cached, relative to the current (default: "*${CACHE}*")
- **downloads** : directory where to put downloads (e.g. `contrib://*` libraries), relative to the current (default: "*${CACHE}*/downloads")
- **invalidate-on-tool-change** : when true, the *compile* cache (but not the downloads) will be cleared whenever the tool chain is newer (relevant mainly for trunk users; default: *true*)

Special section

clean-files

Triggers clean-up of files and directories within a project and the framework, e.g. deletion of generated files, cache contents, etc. Takes a map.

```
"clean-files" :
{
  "<doc_string>" :
  [
    "<path>",
    "<path>"
  ]
}
```

Note: peer-keys: *cache*

Each key is a doc string that will be used in logging when deleting the corresponding files.

- <doc_string> : arbitrary string
- <path> : file/path to be deleted; may be relative to config file location; *file globs* allowed

collect-environment-info

Triggers the collection of information about the qooxdoo environment, and prints it to the console. Takes a map.

```
"collect-environment-info" : {}
```

Note: peer-keys: *cache*

This key currently takes no subkeys, but you still have to provide an empty map. The information collected includes the qooxdoo version, the Python version, the path to the cache, stats about the cache contents, whether the current application has been built, asf.

combine-images

Triggers the creation of combined image files that contain various other images. Takes a map.

```
"combine-images" :
{
  "montage-cmd" : "<string_template>",
  "images" :
  {
    "<output_image>" :
    {
      "prefix": [ "<string>", "<altstring>" ],
      "layout": ("horizontal"|"vertical"),
      "input" :
      [
        {
          "prefix" : [ "<string>", "<altstring>" ],
          "files"  : [ "<path>", "<path>" ]
        }
      ]
    }
  }
}
```

Note: peer-keys: *cache*

Note: Unless you are generating a base64 combined image, this key requires an external program (ImageMagic) to run successfully.

- **montage-cmd** *(experimental)*: command line for the ImageMagick *montage* command. If you create a binary combined image (e.g. .png, .gif), the *montage* command line utility will be invoked. This command template will be used to invoke it, and is exposed here so you can adjust it to your local ImageMagick installation. If you tweak this template and shuffle things around, make sure the placeholders `%(<name>)s` remain intact. Example values are:
  - `"montage @%(tempfile)s -geometry +0+0 -gravity NorthWest -tile %(orientation)s -background None %(combinedfile)s"` *(for ImageMagick v6.x)*
  - `"montage -geometry +0+0 -gravity NorthWest -tile %(orientation)s -background None @%(tempfile)s %(combinedfile)s"` *(for ImageMagick v5.x)*

  (default: "")
- **images** : map with combine entries
  - **<output_image>** : path of output file; may be relative to the config file location; the file ending determines the file format; use *.png*, *.gif*, etc. for binary formats, or *.b64.json* for base64 combined image
    - **prefix** *(required)*: takes a list; the first element is a prefix of the path given in <output_image>, leading up to, but not including, the library name space of the output image; this prefix will be stripped from the output path, and will be replaced by an optional second element of this setting, to eventually obtain the image id of the output image;
    - **layout** : either "horizontal" or "vertical"; defines the layout of images within the combined image (default: "horizontal")
    - **input** *(required)*: list of groups of input files, each group sharing the same prefix; each group consists of:

- **prefix** *(required)*: takes a list; analogous to the *prefix* attribute of the output image, the first element of the setting will be stripped from the path of each input file, and replaced by an optional second element, to obtain the corresponding image id
- **files** : the list of input image files (*file globs* allowed); may be relative to config file location

The image id's of both the input and output files will be collected in an accompanying *<output_name>.meta* file, for later processing by the generator when creating source and build versions of the app. You may move these files around after creation, but you'll have to keep the combined image and its .meta file together in the same directory. At generation time, the generator will look for an accompanying .meta file for every image file it finds in a library. The combined image's image id will be refreshed from its current location relative to the library's resource path. But the clipped images (the images inside the combined image) will be registered under the image id's given in the .meta file (and for browser that don't support combined images, they'll have to be available on disk under this exact image id).

compile

Triggers the generation of a source or build version of the app. Takes a map.

```
"compile" :
{
  "type" : "(source|build|hybrid)"
}
```

Note: peer-keys: *compile-options*, *cache*, *include*, *library*

Generate Javascript file(s) for the application that can be loaded in the browser. This includes an initial file that acts as the loader and needs to be included by e.g. the hosting index.html page, and possibly other JS files with class code, I18N files, asf. All necessary settings for the compile run are given in the *compile-options* key, so make sure this one is properly filled.

Possible keys are

- **type** : which build type of the application should be generated (default: *source*); the types are:
  - **source** : all class code and other resources (images etc.) required for the application are referenced in their original source files on disk (e.g. application classes, framework classes, contrib/library classes, etc.); this is optimal for development and debugging (per-file error messages, setting break-points, additional checks and logging are enabled, etc.) but loads slower due to the many individual files; it is also less amenable to loading the application through a web server, and should usually be run directly from the disk (using the *file://* protocol)
  - **hybrid** : is also a development build type and combines some of the advantages of the build version with the source version; as with the source build type, a selected set of classes are loaded directly from their source files (as specified in *compile-options/code/except*); the other classes required by the application are compiled together in common .js files; this allows for faster load times while retaining good debuggability of the selected classes
  - **build** : is the deployment build type; all classes are compiled into a set of common .js files, to minimize load requests; the class code is optionally compressed and optimized (cf. *compile-options/code/optimize*); resource files from all involved libraries are copied to the build directory, so that it is fully functional and self-contained, and can be copied to e.g. a web server; this build type is unsuitable for development activities, as the code is hard to read and certain development features are optimized away, so it should only be used for production deployment of the application

compile-options

Specify various options for compile (and other) keys. Takes a map.

```
"compile-options" :
{
  "paths" :
  {
    "file"            : "<path>",
    "file-prefix"     : "<path>",
    "app-root"        : "<path>",
    "gzip"            : (true|false),
    "loader-template" : "<path>"
  },
  "uris" :
  {
    "script"          : "script",
    "resource"        : "resource",
    "add-nocache-param" : (true|false)
  },
  "code" :
  {
    "format"          : (true|false),
    "locales"         : ["de", "en"],
    "optimize"        : ["basecalls", "comments", "privates", "strings", "variables", "variants", "wh
    "decode-uris-plug"  : "<path>",
    "except"          : ["myapp.classA", "myapp.util.*"],
    "lint-check"      : (true|false)
  }
}
```

Note: peer-keys: *compile*, *lint-check*

The *compile-options* key informs all compile actions of the generator. Settings of this key are used e.g. by the jobs that create the source and the build version of an application, though in varying degrees (e.g. the source job only utilizes a few of the settings in this key, and ignores the others). Output Javascript file(s) are generated into the directory of the *paths/file* value, with *path/file* itself being the primary output file. If *paths/file* is not given, the `APPLICATION` macro has to be set in the global *let* section with a proper name, in order to determine a default output file name. For further information see the individual key descriptions to find out which build type utilizes it (in the descriptions, *(<type>)* refers to the *compile/type*, e.g. *source* or *build*)

Possible keys are

- **paths** : paths for the generated output
  - **file** : the path to the compile output file; can be relative to the config's directory (default: *<type>/script/<appname>.js*)
  - **file-prefix** : path to a file containing JavaScript which will be inserted verbatim at the beginning of each generated output file; this could be a comment with copyright headers (default: *undefined*)
  - **app-root** : (*source*) relative (in the above sense) path to the directory containing the app's HTML page (default: *./source*)
  - **loader-template** : path to a JS file that will be used as an alternative loader template; for possible macros and structure see the default (default: *${QOOXDOO_PATH}/tool/data/generator/loader.tmpl.js*)
  - **gzip** : whether to gzip output file(s) (default: *false*)

- **uris** : URIs used to reference code and resources
  - **script** : (*build*) URI from application root to code directory (default: *"script"*)
  - **resource** : (*build*) URI from application root to resource directory (default: *"resource"*)
  - **add-nocache-param** : (*source*) whether to add a `?nocache=<random_number>` parameter to the URI, to overrule browser caching when loading the application; use the *ADD_NOCACHE_PARAM* macro to tweak this setting for *source* builds (default: *false*)
- **code** : code options
  - **format** : (*build*) whether to apply simple output formatting (it adds some sensible line breaks to the output code) (default: *false*)
  - **locales** : (*build*) a list of locales to include (default: *["C"]*)
  - **optimize** : list of dimensions for optimization, max. ["basecalls", "comments", "privates", "statics", "strings", "variables", "variants", "whitespace"] (default: *[<all>]*) *special section*
  - **decode-uris-plug** : path to a file containing JS code, which will be plugged into the loader script, into the `qx.$$loader.decodeUris()` method. This allows you to post-process script URIs, e.g. through pattern matching. The current produced script URI is available and can be modified in the variable `euri`.
  - **except** : (*hybrid*) exclude the classes specified in the class pattern list from compilation when creating a *hybrid* version of the application
  - **lint-check** : (*experimental*) whether to perform lint checking during compile (default: *true*)

config-warnings

(experimental)

Taylor configuration warnings. This key can appear both at the config top-level, or at the job-level. Takes a map.

```
"config-warnings" :
{
  "job-shadowing"    : ["source-script"],
  "tl-unknown-keys"  : ["baz", "bar"],
  "job-unknown-keys" : ["foo", "bar"],
  "<config_key>"     : ["*"]
}
```

Turn off warnings printed by the generator to the console for specific configuration issues. The key is honored both at the top level of the configuration map, and within individual jobs, but some of the sub-keys are only sensible if used at the top-level (This is indicated with the individual key in the list below). Warnings are on by default (equivalent to assigning e.g. *["*"]* to the corresponding key). Like with the global *let*, a top-level *config-warnings* key is inherited by every job in the config, so its settings are like job defaults. If a given key is not applicable in its context, it is ignored. To turn off **all** warnings for a single generator run (independent of settings given in this key) use the generator `-q` *command line option*.

- **job-shadowing** *(top-level)* : Job names listed here are not warned about if the current config has a job of this name, and shadows another job of the same name from an included configuration.
- **job-unknown-keys** : List of config keys within a job which are unknown to the generator, but should not be warned about.
- **tl-unknown-keys** *(top-level)* : List of config keys on the top-level configuration map which are unknown to the generator, but should not be warned about.
- **<config_key>** : This is a generic form, where *<config_key>* has to be a legal job-level configuration key (Unknown keys, as stated above, are silently skipped). Currently supported keys are `exclude`, but more keys (like

"let", "packages", ...) might follow. The usual value is a list, where the empty list *[]* means that config warnings for this key are generally on (none exempted), and *["*"]* means they are generally off (all exempted). The interpretation of the value is key dependent.

- **exclude** : *[]* List of class patterns in the *exclude* key that the generator should not warn about.
- **include** : *true/false* Warn about classes which are included without their dependencies.
- **combine-images** : *true/false* Warn about missing or incorrect prefix spec for the images that go into the combined image.
- **environment** : *[]* The key recognizes specific elements in its list value:
  - **non-literal-keys** : Don't warn if calls to *qx.core.Environment* use non-literal keys (e.g. *"qx.core.Environment.get(foo)"* where *foo* is a variable).
  - **variants-and-url-settings** : Don't warn if the *qx.allowUrlSettings:true* environment is set while at the same time *variants* optimization is on (the two sort of contradict each other).

copy-files

Triggers files/directories to be copied. Takes a map.

```
"copy-files" :
{
  "files"     : [ "<path>", "<path>" ],
  "source" : "<path>",
  "target"  : "<path>"
}
```

Note: peer-keys: *cache*

Possible keys are

- **files** *(required)* : an array of files/directories to copy; entries will be interpreted relative to the `source` key value
- **source** : root directory to copy from; may be relative to config file location (default: "source")
- **target** : root directory to copy to; may be relative to config file location (default: "build")

copy-resources

Triggers the copying of resources. Takes a map.

```
"copy-resources" :
{
  "target" : "<path>"
}
```

Note: peer-keys: *cache*, *include*, *library*

Possible keys are

- **target** : root target directory to copy resources to; may be relative to the config file location (default: "build")

Unlike *copy-files*, `copy-resources` does not take either a "source" key, nor a "files" key. Rather, a bit of implicit knowledge is applied. Resources will be copied from the involved libraries' `source/resource` directories (this obviates a "source" key). The list of needed resources is derived from the class files (e.g. from `@asset` hints - this obviates the "files" key), and then the libraries are searched for in order. From the first library that provides a certain resource, this resource is copied to the target folder. This way you can use most resources from a standard library (like the qooxdoo framework library), but still "shadow" a few of them by resources of the same path from a different library, just by tweaking the order in which these libraries are listed in the *library* key.

default-job

Default job to be run. Takes a string.

```
"default-job" : "source"
```

If this key is present in a configuration file, the named job will be run by default when no job argument is passed to the generator on the command line.

dependencies

Allows you to influence the way class dependencies are processed by the generator. Takes a map.

```
"dependencies" :
{
  "follow-static-initializers"  : (true|false),
  "sort-topological"            : (true|false)
}
```

- **follow-static-initializers** *(not used!)*: Try to resolve dependencies introduced in class definitions when calling static methods to initialize map keys (default: *false*).
- **sort-topological** *(not used!)*: Sort the classes using a topological sorting of the load-time dependency graph (default: *false*).

desc

Provides some descriptive text for the job.

```
"desc" : "Some text."
```

The descriptive string provided here will be used when listing jobs on the command line. (Be aware since this is a normal job key it will be passed on through job inheritance, so when you look at a specific job in the job listing you might see the job description of some ancestor job).

environment

Define global key-value mappings for the application. Takes a map.

```
"environment" :
{
  "<key>" : (value | [<value>, ... ])
}
```

The "environment" of a qooxdoo application can be viewed as a global, write-once key-value store. The *environment* key in a configuration allows you to pre-define values for such keys. All key-value pairs are available at run time

through qx.core.Environment. There are pre-defined keys that are established by qooxdoo, and you can add user-defined keys. Both are handled the same.

Possible keys are

- **<key>** : a global key; keys are just strings; see qx.core.Environment for a list of pre-defined keys; if you provide a user-defined key, make sure it starts with a name space and a dot (e.g. *"myapp.keyA"*); the entry's value is either a scalar value, or a list of such values.

As soon as you specify more than one element in the list value for a key, the generator will generate different builds for each element. If the current job has more than one key defined with multiple elements in the value, the generator will generate a dedicated build **for each possible combination** of the given keys. See special section.

Special section

exclude

Exclude classes from processing in the job. Takes an array of class specifiers.

```
"exclude" : ["qx.util.*"]
```

Classes specified through the *exclude* key are excluded from the job processing, e.g. from the generated build output. The class specifiers can include simple wildcards like `"qx.util.*"` denoting class id's matching this pattern, including those from sub-name spaces.

A leading = in front of a class specifier (like in `"=qx.util.*"`) means to also remove all dependencies of the specified classes from the build, irrespective of whether they are required by other classes as well. So this will create builds that are no longer self-contained, and will break at runtime unless the required classes are provided otherwise.

When building an application the class patterns given in the *exclude* key will automatically be added to the list of *allowed globals* when checking for unknown global symbols, so they will not be warned about.

export

List of jobs to be exported if this config file is included by another, or to the generator if it is an argument.

```
"export" : ["job1", "job2", "job3"]
```

Only exported jobs will be seen by importing config files. If the current configuration file is used as an argument to the generator (either implicitly or explicitly with *-c*), these are the jobs the generator will list with *generate.py x*, and only these jobs will be runnable with *generate.py <jobname>*.

extend

Extend the current job with other jobs. Takes an array of job names.

```
"extend" : [ "job1", "job2", "job3" ]
```

The information of these (previously defined) jobs are merged into the current job description. Keys and their values missing in the current description are added, existing keys take precedence and are retained (with some keys that are merged).

Special section

fix-files

Fix white space in Javascript class files. Takes a map.

```
"fix-files" :
{
  "eol-style" : "(LF|CR|CRLF)",
  "tab-width" : 2
}
```

Note: peer-keys: *library*

---

fix-files will normalize white space in source code, by converting tabs to spaces, removing trailing white space in lines, and unifying the line end character sequence.

Possible keys are

- **eol-style** : determines which line end character sequence to use (default: *LF*)
- **tab-width** : the number of spaces to replace tabs with (default: *2*)

include

Include classes to be processed in the job. Takes an array of class specifiers.

```
"include" : ["qx.util.*"]
```

The class specifiers can include simple wildcards like 'qx.util.*' denoting all classes starting with the 'qx.util' name space. A leading = in front of a class specifier (e.g. '=qx.util.*') means 'without dependencies'. In this case, exactly the listed classes are included (wildcards expanded), but not their dependencies. Otherwise, for the given classes their dependencies are calculated recursively, and those classes are also included. (default: ["*${APPLICATION}*.Application", "*${QXTHEME}*"])

include (top-level)

Include external config files. Takes a list of maps.

```
"include" :
[
  {
    "path"    : "<path>",
    "as"      : "<name>",
    "import"  : ["job1", "job2", "job3"],
    "block"   : ["job4", "job5"]
  }
]
```

Within each specifying map, you can specify

- **path** *(required)*: Path string to the external config file which is interpreted *relative* to the current config file
- **as** : Identifier that will be used to prefix the external job names on import; without it, job names will be imported as they are.
- **import** : List of job names to import; this list will be intersected with the `export` list of the external config, and the resulting list of jobs will be included. : A single entry can also be a map of the form *{"name": <jobname>, "as": <alias>}*, so you can import individual jobs under a different name.

- **block** : List of job names to block during import; this is the opposite of the `import` key and allows you to block certain jobs from being imported (helpful if you want to import most but not all of the jobs offered by the external configuration).

Special section

jobs

Define jobs for the generator. Takes a map.

```
"jobs" :
{
  "<job_name>" : { <job_definition> }
}
```

Job definitions can take a lot of the predefined keys that are listed on this page (see the *overview* to get a comprehensive list). The can hold "actions" (keys that cause the generator to perform some action), or just settings (which makes them purely declarative). The latter case is only useful if those jobs are included by others (through the *extend* key, and thus hold settings that are used by several jobs (thereby saving you from typing).

let

Define macros. Takes a map.

```
"let" :
{
  "<macro_name>"  : "<string>",
  "<macro_name1>" : [ ... ],
  "<macro_name2>" : { ... }
}
```

Each key defines a macro and the value of its expansion. The expansion may contain references to previously defined macros (but no recursive references). References are denoted by enclosing the macro name with `${...}` and can only be used in strings. If the value of the macro is a string, references to it can be embedded in other strings (e.g. like "/home/${user}/profile"); if the value is a structured expression, like an array or map, references to it must fill the entire string (e.g. like "${MyList}").

- <macro_name> : The name of the macro.

Special section

let (top-level)

Define default macros. Takes a map (see the other *'let'*). Everything of the normal 'let' applies here, except that this let map is included automatically into every job run. There is no explicit reference to it, so be aware of side effects.

library

Define libraries to be taken into account for this job. Takes an array of maps.

```
"library" :
[
  {
    "manifest"    : "<path_or_url>",
    "uri"         : "<from_html_to_manifest_dir>"
```

```
  }
]
```

Each map can contain the keys

- **manifest** *(required)* : specifies the qooxdoo library to use; can take several forms:
  - *a local file system path*: This must reference the Manifest file of the library; may be relative to config file location.
  - `contrib://` *URL*: This must reference the catalog Manifest file of a contribution's version, as available in the *qooxdoo-contrib* catalog.
  - `http(s)://` *URL*: This must reference one of two things:
    - *a downloadeable archive*: The URL ends in an archive extension (like *.zip*), the archive contains the contribution library.
    - *a .json file*: The referenced JSON file is a catalog-style Manifest file which contains a download URL.
- **uri** : URI prefix from your HTML file to the directory of the library's "Manifest" file

Special section

lint-check

Check JavaScript source code with a lint-like utility. Takes a map.

```
"lint-check" :
{
  "allowed-globals" : [ "qx", "${APPLICATION}" ],
  "ignore-catch-param"            : (true|false),
  "ignore-deprecated-symbols"     : (true|false),
  "ignore-environment-nonlit-key" : (true|false),
  "ignore-finally-without-catch"  : (true|false),
  "ignore-multiple-mapkeys"       : (true|false),
  "ignore-multiple-vardecls"      : (true|false),
  "ignore-no-loop-block"          : (true|false),
  "ignore-reference-fields"       : (true|false),
  "ignore-undeclared-privates"    : (true|false),
  "ignore-undefined-globals"      : (true|false),
  "ignore-shadowing-locals"       : (true|false),
  "ignore-unused-parameter"       : (true|false),
  "ignore-unused-variables"       : (true|false),
  "run"                           : (true|false),
  "warn-unknown-jsdoc-keys"       : (true|false),
  "warn-jsdoc-key-syntax"         : (true|false)
}
```

Note: peer-keys: *library*, *include*

The general idea of the *ignore-** options is to say that the lint checking will check as much issues as it can, and you can turn off certain checks by setting their *ignore-** option to true. A few that are considered too picky are also true in the default config. Those can of course be enabled by setting them to false in your own configuration.

Keys are:

- **allowed-globals** : list of names that are not to be reported as bad use of globals

- **ignore-catch-param** ***(experimental)*** **:** Don't check whether the exception parameter of a *catch* clause might overwrite an existing variable binding (s. bug#1207). *(default: false)*
- **ignore-deprecated-symbols** ***(experimental)*** **:** Ignore built-in symbols that are considered bad use, like *alert* or *eval*. *(default: false)*
- **ignore-environment-nonlit-key** ***(experimental)*** **:** Ignore calls to *qx.core.Environment.(get|select)* with a non-literal key (Those calls cannot be optimized). *(default: false)*
- **ignore-finally-without-catch** ***(experimental)*** **:** Ignore if *try* statement has a *finally* clause, but no *catch* clause, as the *finally* clause might not be run in some browsers (s. bug#3688). *(default: false)*
- **ignore-multiple-mapkeys** ***(experimental)*** **:** Ignore using the same key in a map multiple times (Only the last occurrence will persist). *(default: false)*
- **ignore-multiple-vardecls** ***(experimental)*** **:** Ignore multiple declarations of the same variable (Ie. multiple 'var' statements for the same identifier). *(default: true)*
- **ignore-no-loop-block** ***(experimental)*** **:** Ignore bodies of loops or conditions that are not enclosed in `{` and `}`. *(default: false)*
- **ignore-reference-fields** ***(experimental)*** **:** Ignore reference data types in *class member attributes* (Those values will be shared across all instances of the class). *(default: false)*
- **ignore-undeclared-privates** ***(experimental)*** **:** Ignore use of *private members* in class code without them being declared in the class map. *(default: false)*
- **ignore-undefined-globals** ***(experimental)*** **:** Ignore symbols that belong to the global scope, and are not recognized as known built-in symbols or class names (You usually want to avoid those). With this option set to *false*, i.e. those globals being warned about, you can still silence the warning for symbols given in the `allowed-globals` option. *(default: false)*
- **ignore-shadowing-locals** ***(experimental)*** **:** Ignore variables declared in a local scope (function) that shadow global library symbols (such as *qx*, *q*, *qxWeb*). With this options set to *false*, code places like

  ```
  var qx = "foo";
  ```

  are warned about. (With such a code line you wouldn't be able to use any qooxdoo framework class in this function anymore). *(default: false)*
- **ignore-unused-parameter** ***(experimental)*** **:** Ignore parameters of functions or catch statements that are not used in their respective body. *(default: true)*
- **ignore-unused-variables** ***(experimental)*** **:** Ignore variables that are declared in a scope but not used. *(default: false)*
- **run** ***(experimental)*** **:** When set to *true* the actual lint checking will be performed. This key allows you to carry lint options in jobs without actually triggering the lint action. *(default: false)*
- **warn-unknown-jsdoc-keys** ***(experimental)*** **:** Unknown JSDoc @ keys are generally accepted (i.e. keys not listed in *JSDoc Reference*); setting this option to *true* will issue a warnings about them. *(default: false)*
- **warn-jsdoc-key-syntax** ***(experimental)*** **:** Warn if a known @ key is encountered that does not comply to the parsing rules (as given in *JSDoc Reference*); setting this option to *false* will disable warnings about them. *(default: true)*

log

Configure log/reporting features. Takes a map.

```
"log" :
{
  "classes-unused" : [ "custom.*", "qx.util.*" ],
  "dependencies"   :
  {
    "type"         : ("using"|"used-by"),
    "phase"        : ("runtime"|"loadtime"|null),
    "include-transitive-load-deps" : (true|false),
    "force-fresh-deps" : (true|false),
    "format"       : ("txt"|"dot"|"json"|"provider"|"flare"|"term"),
    "dot"          :
    {
      "root"           : "custom.Application",
      "file"           : "<filename>",
      "radius"         : 5,
      "span-tree-only" : (true|false),
      "compiled-class-size" : (true|false)
    },
    "json"         :
    {
      "file"       : "<filename>",
      "pretty"     : (true|false)
    },
    "flare"        :
    {
      "file"       : "<filename>",
      "pretty"     : (true|false)
    }
  },
  "filter"         :
  {
    "debug"        : [ "generator.code.PartBuilder.*" ]
  },
  "privates"       : (true|false),
  "resources"      :
  {
    "file"         : "<filename>"
  },
  "translations"   :
  {
    "untranslated-keys":
    {
      "skip-locales"   : ["C"]
    }
  }
}
```

Note: peer-keys: *cache*, *include*, *library*, *compile-options*

This key allows you to enable logging features along various axes.

- **classes-unused** : Report unused classes for the name space patterns given in the list.
- **dependencies** : print out dependency relations of classes
  - **type** *(required)*: which kind of dependencies to log
    * `using`: dependencies of the current class to other classes; uses the **using** key; supports `txt`, `dot`,

`json` and `flare` output formats

* `used-by`: dependencies of other classes to the current class; supports only `txt` format

– **phase** : limit logging to run-time or load-time dependencies; use `null` if you want to have both (default: *loadtime*)

– **include-transitive-load-deps** : for *load-time* dependencies, whether transitive dependencies (i.e. dependencies that are not lexically in the code, but are required at load-time by some lexical dependency) should be included (default: *true*)

– **force-fresh-deps** : force to re-calculate the class dependencies before logging them; this will take considerably longer but assures that the dependencies match exactly the latest state of the source trees (interesting after *statics* optimization; default: *false*)

– **format** : format of the dependency output (default: *txt*)

* `txt`: textual output to the console
* `dot`: generation of a Graphviz dot file; uses the **dot** key
* `json`: "native" Json data structure (reflecting the hierarchy of the txt output class -> [run|load]); uses the **json** key
* `provider`: similar to the `json` output, but all id's are given as path suffixes (slashes between name spaces, file extensions), and dependencies are extended with resource id's and translatable string keys (as `translation#<key>`); uses the **json** key
* `flare`: Json output suitable for prefuse Flare dependency graphs; uses the **flare** key
* `term`: textual output to the console, in the form of a term *depends(<class>, [<load-deps>,...], [<run-deps>,...])*

– **dot**:

* **span-tree-only**: only create the spanning tree from the root node, rather than the full dependency graph; reduces graph complexity by limiting incoming edges to one (i.e. for all classes at most one arrow pointing to them will be shown), even if more dependency relations exist
* **root** : the root class for the `dot` format output; only dependencies starting off of this class are included
* **file** : output file path (default *deps.dot*)
* **radius** : include only nodes that are within the given radius (or graph distance) to the root node
* **compiled-class-size** : use compiled class size to highlight graph nodes, rather than source file sizes; if true classes might have to be compiled to determine their compiled size, which could cause the log job to run longer; compile optimization settings are searched for in *compile-options/code/optimize*, defaulting to none; (default *true*)

– **json**:

* **file** : output file path (default *deps.json*)
* **pretty** : produce formatted Json, with spaces and indentation; if *false* produce compact format (default: *false*)

– **flare**:

* **file** : output file path (default *flare.json*)
* **pretty** : produce formatted Json, with spaces and indentation; if *false* produce compact format (default: *false*)

- **filter** : allows you to define certain log filter

  - **debug** : in debug ("verbose") logging enabled with the `-v` command line switch, only print debug messages from generator modules that match the given pattern

- **privates** : print out list of classes that use a specific private member
- **resources**: writes the map of resource info for the involved classes to a json-formatted file
  - **file** : output file path (default *resources.json*)
- **translations** : influence messages about translations
  - **untranslated-keys** :
    * **skip-locales** : skip locales given in the list when reporting about untranslated msgid's in a built application (default: *[]*)

Special section.

migrate-files

Migrate source files to current qooxdoo version. Takes a map.

```
"migrate-files" :
{
   "from-version" : "0.7",
   "migrate-html" : false
}
```

This key will invoke the mechanical migration tool of qooxdoo, which will run through the class files an apply successive sequences of patches and replacements to them. This allows to apply migration steps automatically to an existing qooxdoo application, to make it better comply with the current SDK version (the version the key is run in). Mind that you might have to do further adaptions by hand after the automatic migration has run. The migration tool itself is interactive and allows entering migration parameters by hand.

- **from-version** : qooxdoo version of the code before migration
- **migrate-html** : whether to patch .html files in the application (e.g. the index.html)

name

Provides some descriptive text for the whole configuration file.

```
"name" : "Some text."
```

packages

Define packages for this app. Takes a map.

```
"packages" :
{
  "parts"  :
  {
    "<part_name>" :
    {
      "include"                  : [ "app.class1", "app.class2", "app.class3.*" ],
      "expected-load-order"      : 1,
      "no-merge-private-package" : (true|false)
    }
  },
```

```
  "sizes"  :
  {
    "min-package"           : 1,
    "min-package-unshared"  : 1
  },
  "init"             : "<part_name>",
  "separate-loader"  : (true|false),
  "i18n-as-parts"    : (true|false),
  "additional-merge-constraints" : (true|false),
  "verifier-bombs-on-error"      : (true|false)
}
```

Note: peer-keys: *compile*, *library*, *include*

Keys are

- **parts** : map of part names and their properties
  - <part_name> :
    - **include** *(required)*: list of class patterns
    - **expected-load-order** : integer > 0 (default: *undefined*)
    - **no-merge-private-package** : whether the package specific to that individual part should not be merged; this can be used when carving out resource-intensive parts (default: *false*)
- **sizes** : size constraints on packages
  - **min-package** : minimal size of a package in KB (default: 0)
  - **min-package-unshared** : minimal size of an unshared package in KB (default: <min-package>)
- **init** : name of the initial part, i.e. the part to be loaded first (default: *"boot"*)
- **separate-loader** : whether loader information should be included with the boot package, or be separate; if set true, the loader package will contain no class code (default: *false*)
- **i18n-as-parts** : whether internationalization information (translations, CLDR data) should be included with the packages, or be separate; if set true, the code packages will contain no i18n data; rather, i18n data will be generated in dedicated parts, which have to be loaded by the application explicitly; see *special section* (default: *false*)
- **additional-merge-constraints** : if set to false, the generator will be more permissive when merging one package into another, which might result in fewer packages at the end, but can also result in consistencies which the part verifier will complain about (default: *true*)
- **verifier-bombs-on-error** : whether the part verifier should raise an exception, or just warn and continue (default: *true*)

Special section

pretty-print

Triggers code beautification of source class files (in-place-editing). An empty map value triggers default formatting, but further keys can tailor the output.

```
"pretty-print" :
{
  "general" :
```

```
  {
    "indent-string"        : "  ",
    "text-width"           : 80
  },
  "comments" :
  {
    "block"  :
    {
      "add"  : true
    },
    "trailing" :
    {
      "keep-column"        : false,
      "comment-cols"       : [50, 70, 90],
      "padding"            : "  "
    }
  },
  "code" :
  {
    "align-with-curlies"   : false,
    "open-curly" :
    {
      "newline-before"     : "m",
      "indent-before"      : false
    }
  }
}
```

Note: peer-keys: *library*, *include*

Keys are:

- **general** : General settings.
  - **indent-string** : "<whitespace_string>", e.g. "\t" for tab (default: " " (2 spaces))
  - **text-width** : <int >= 0> the intended text width for each source line (0 disables text width); this width is striven for, but is not a hard limit (e.g. string literals that are longer are not broken up). (default: *0*)
- **comments** : Settings for pretty-printing comments.
  - **block** : Settings for block comments ("/*...*/")
    - **add** : (true|false) Whether to automatically add JSDoc comment templates, e.g. ahead of method definitions (default: *false*)
  - **trailing** : Settings for pretty-printing comments that start after some code and do not end before the end of the line ("//..." and "/*...*/").
    - **keep-column** : (true|false) Tries to fix the start column of trailing comments to the value in the original source (default: *false*)
    - **comment-cols** : [n1, n2, ..., nN] Column positions to start trailing comments at, e.g. [50, 70, 90] (default: *[]*)
    - **padding** : "<whitespace_string>" White space to be inserted after statement end and beginning of comment (default: " " (2 spaces))
- **code** : Settings for pretty-printing code blocks.

- **align-with-curlies** : (true|false) Whether to put a block at the same column as the surrounding/ending curly bracket (default: *false*)
- **open-curly** : Settings for the opening curly brace '{'.
  - **newline-before** : "([aA]|[nN]|[mM])" Whether to insert a line break before the opening curly always (aA), never (nN) or mixed (mM) depending on block complexity (default: *"m"*)
  - **indent-before** : (true|false) Whether to indent the opening curly if it is on a new line (default: *false*)

provider

Collects application classes, resources, translatable strings and dependency information in a specific directory structure, under the `provider` root directory. Takes a map.

```
"provider" :
{
  "app-root" : "./provider",
  "include"  : ["${APPLICATION}.*"],
  "exclude"  : ["${APPLICATION}.test.*"]
}
```

Note: peer-keys: *library*, *cache*

Keys are:

- **app-root** : Chose a different root directory for the output (default: *./provider*).
- **include** : Name spaces for classes and resources to be included (default: *${APPLICATION}.**).
- **exclude** : Name spaces for classes and resources to be excluded (default: *${APPLICATION}.test.**).

require

Define prerequisite classes needed at load time. Takes a map.

```
"require" :
{
  "<class_name>" : [ "qx.util", "qx.fx" ]
}
```

Each key is a

- <class_name> : each value is an array of required classes for this class.

run

Define a list of jobs to run. Takes an array of job names.

```
"run" : [ "<job1>", "<job2>", "<job3>" ]
```

These jobs will all be run in place of the defining job (which is sort of a 'meta-job'). All further settings in the defining job will be inherited by the listed jobs (so be careful of side effects).

Special section

shell

Triggers the execution of external commands. Takes a map.

```
"shell" :
{
  "command" : ("echo foo bar baz"|["echo foo", "echo bar", "echo baz"])
}
```

Note: peer-keys: *cache*

Possible keys are

- **command** : command string or list of command strings to execute by shell

Note: Generally, the command string is passed to the executing shell "as is", with one exception: Relative paths are absolutized, so you can run those jobs from remote directories. In order to achieve this, all strings of the command are searched for path separators (e.g. '/' on Posix systems, '\' on Windows - be sure to encode this as '\\' on Windows as '\' is the Json escape character). Those strings are regarded as paths and - unless they are already absolute - are absolutized, relative to the path of the current config. So e.g. instead of writing

```
"cp file1 file2"
```

you should write

```
"cp ./file1 ./file2"
```

and it will work from everywhere.

simulate

Runs a suite of GUI tests (simulated interaction). Takes a map.

```
"simulate" :
{
  "java-classpath" : ["../rhino/js.jar", "../selenium/selenium-java-client-driver.jar"],
  "qxselenium-path" : "${SIMULATOR_ROOT}/tool",
  "rhino-class" : "org.mozilla.javascript.tools.shell.Main",
  "simulator-script" : "${BUILD_PATH}/script/simulator.js"
}
```

Possible keys are

- **java-classpath** *(required)*: Java classpath argument for Rhino application. Takes an Array. Must point to the Selenium client driver and Rhino JARs. (default: *${SIMULATOR_CLASSPATH}*)
- **qxselenium-path** *(required)*: Location of the QxSelenium Java class. (default: *${SIMULATOR_ROOT}/tool*)
- **rhino-class** *(required)*: Full name of the Mozilla Rhino class that should be used to run the simulation. Set to *org.mozilla.javascript.tools.debugger.Main* to run the test application in Rhino's visual debugger. (default: *org.mozilla.javascript.tools.shell.Main*)
- **simulator-script** *(required)*: Path of the compiled Simulator application to be run. (default: *${ROOT}/simulator/script/simulator.js*)

slice-images

Triggers cutting images into regions. Takes a map.

```
"slice-images" :
{
  "convert-cmd" : "<string_template>",
  "images" :
  {
    "<input_image>" :
    {
        "prefix"       : "<string>",
        "border-width" : (5 | [5, 10, 5, 10]),
        "trim-width"   : (true|false)
    }
  }
}
```

Note: peer-keys: *cache*

Note: This key requires an external program (ImageMagic) to run successfully.

- **convert-cmd** *(experimental)*: command line for the ImageMagick *convert* command. If you create clippings of an image, the *convert* command line utility will be invoked. This command template will be used to invoke it, and is exposed here so you can adjust it to your local ImageMagick installation. If you tweak this template and shuffle things around, make sure the placeholders `%(<name>)s` remain intact. Example value:
  - `"convert %(infile)s -crop %(xoff)sx%(yoff)s+%(xorig)s+%(yorig)s +repage %(outfile)s"` *(for ImageMagick v5.x, v6.x)*

  (default: *""*)
- **images** : map with slice entries.
  - **<input_image>** : path to input file for the slicing; may be relative to config file location
    - **prefix** *(required)* : file name prefix used for the output files; will be interpreted relative to the input file location (so a plain name will result in output files in the same directory, but you can also navigate away with `../../....` etc.)
    - **border-width** : pixel width to cut into original image when slicing borders etc. Takes either a single integer (common border width for all sides) or an array of four integers (top, right, bottom, left).
    - **trim-width** : reduce the width of the center slice to no more than 20 pixels. (default: *true*)

translate

(Re-)generate the .po files (usually located in `source/translation`) from source classes. Takes a map. The source classes of the specified name space are scanned for translatable strings. Those strings are extracted and put into map files (.po files), one for each language. Those .po files can then be edited to contain the proper translations of the source strings. For a new locale, a new file will be generated. For existing .po files, re-running the job will add and remove entries as appropriate, but otherwise keep existing translations.

```
"translate" :
{
  "namespaces"               : [ "qx.util" ],
  "locales"                  : [ "en", "de" ],
```

```
  "pofile-with-metadata"     : (true|false)
  "poentry-with-occurrences" : (true|false)
}
```

Note: peer-keys: *cache*, *library*

- **namespaces** *(required)* : List of name spaces for which .po files should be updated.
- **locales** : List of locale identifiers to update.
- **pofile-with-metadata** : Whether meta data is automatically added to a *new* .po file; on existing .po files the meta data is retained (default: *true*)
- **poentry-with-occurrences** : Whether each PO entry is preceded by `#:` comments in the *.po* files, which indicate in which source file(s) and line number(s) this key is used (default: *true*)

use

Define prerequisite classes needed at run time. Takes a map.

```
"use" :
{
  "<class_name>" : [ "qx.util", "qx.fx" ]
}
```

Each key is a

- **<class_name>** : each value is an array of used classes of this class.

validation-config

Triggers the validation of the Config (*config.json*) against a schema and prints it to the console. Takes a map.

```
"validation-config" : {}
```

This key currently takes no subkeys, but you still have to provide an empty map.

validation-manifest

Triggers the validation of the Manifest (*Manifest.json*) against a schema and prints it to the console. Takes a map.

```
"validation-manifest" : {}
```

This key currently takes no subkeys, but you still have to provide an empty map.

watch-files

Watch arbitrary files or directories for changes.

```
"watch-files" :
{
  "paths"   : [ "file/or/dir/to/watch" ],
  "command" :
  {
    "line"  : "generate.py source",
```

```
    "per-file" : (true|false),
    "exec-on-startup" : (true|false),
    "exit-on-retcode" : (true|false)
  }
  "include" : [ "*.js" ],
  "include-dirs"    : (true|false),
  "check-interval"  : 10,
}
```

Note: peer-keys: *cache*

- **paths** *(required)* : List of paths to files or directories which should be watched. If an entry is a directory, it is watched recursively (directories themselves are included according to the `include-dirs` key).
- **command** :
  - **line** : *(required)* : Shell command line to be executed when a change is detected. There are a couple of placeholders available that can be interpolated into the command string with `%(<KEY>)`. The different keys are:

Key	Description
`FILELIST`	the (space-separated) list of file paths that have changed (e.g. *foo/bar/baz.js foo/bar/yeo.js*)
`FILE`	the individual file path that has changed (e.g. *foo/bar/baz.js*; interesting when *per-file* is true)
`DIRNAME`	the directory path of an individual file (e.g. *foo/bar* in *foo/bar/baz.js*)
`BASENAME`	just the basename of an individual file including extension (e.g. *baz.js* in *foo/bar/baz.js*)
`FILENAME`	the file name without path and extension (e.g. *baz* in *foo/bar/baz.js*)
`EXTENSION`	the file extension (e.g. *.js* in *foo/bar/baz.js*)

    For example, this can be used to create a command line like this

    ```
    sass %(FILE) > path/to/css/%(FILENAME).css
    ```

    which runs an SCSS compiler on a .scss file (assuming these files are watched), and redirects the output to a file with same name but a .css extension, in a different path.

    Mind that if you specified multiple `paths` the command will be applied if *any* of them change, but for all the execution context will be the same, e.g. have the same current directory. There is currently no implicit `cd` or calculation of file paths relative to their watched roots or similar.

  - **per-file** : Whether the command should be executed for each file that has been changed. If true, command will be invoked for each file that has changed since the last check. (default: *false*)
  - **exec-on-startup**: Whether to execute the given command once when the watch job starts. This works independent of the *per-file* setting, but **Note**: If you are watching a lot of files, your shell's command line capacity might become exhausted for the first execution of command if you use the *%(FILELIST)* command macro in a *per-file:false* setting, as the Generator will try to pass *all watched files* on the command line. (default *false*)
  - **exit-on-retcode**: Whether to terminate when the given command returns a return code != 0, or to continue in this case. (default *false*)
- **include** : List of file globs to be selected when watching a directory tree. (default: *[*]*)
- **include-dirs** : Whether to include directories in the list of changed files when watching a directory tree. (default: *false*)

- **check-interval** : Seconds of elapsed time between checks for changes. (default: *2*)

web-server

(experimental)

Start a mini web server to serve local files.

```
"web-server" :
{
  "document-root" : "",
  "server-port"   : 8080,
  "log-level"     : "error",
  "allow-remote-access" : false,
  "active-reload" :
  {
    "client-script" : "<path>"
  }
}
```

Note: peer-keys: *cache*, *library*

- **document-root** : File system path to use as the web server's document root. Best left empty, so the Generator calculates a common root path of all involved qooxdoo libraries. For this to work, your libraries should be collected in the *"libraries"* default job. (default: *""*)
- **server-port** : The port the server should listen on. `0` means to pick an arbitrary free port. (default: *0*)
- **log-level** : Log level of the server, `"error"` for errors, `"info"` for more verbose logging, `"fatal"` for no logging. (default: *"error"*)
- **allow-remote-access** : Whether the web server allows access from other hosts. If set to false, access is only allowed from *localhost*. This is recommended as the web server might expose a substantial part of your hard disk, including directory indexes. (default: *false*)
- **active-reload** : Enabling active reload of the app in the browser.
  - **client-script** : The path to the client script which reloads the application in the browser if it has changed on disk. (default: *${QOOXDOO_PATH}/tool/data/generator/active_reload.js"*)

web-server-config

(experimental)

Create a web server configuration for the local source version.

```
"web-server-config" :
{
  "document-root" : "",
  "output-dir"     : ".",
  "template-dir"   : "<path>",
  "httpd-type"     : "apache2",
  "httpd-host-url" : "http://localhost:8080"
}
```

Note: peer-keys: *cache*, *library*

- **document-root** : File system path to use as the application's document root. Best left empty, so the Generator calculates a common root path of all involved qooxdoo libraries. For this to work, your libraries should be collected in the *"libraries"* default job. (default: *""*)
- **output-dir** : Directory path where the configuration file is stored. The file itself is named as "<httpd-type>.conf" so the name already exposes for which server it is being generated. (default: .)
- **template-dir** : Directory path where to look for web server-specific configuration templates. The file name itself is constructed as "httpd.<httpd-type>.tmpl.conf". (default: *${QOOXDOO_PATH}/tool/data/generator/*)

  Templates can make use of several macros that will be expanded during the generation process. Macros are referenced in the template with ${<macro_name>}. The following macros are supported:

Macro	Description
APP_DOCUMENT_ROOT	the common root path of all libraries making up the application; this is usually mapped to an alias in the web server, so that all relative URLs to application files continue to work under the web server
APP_NAMESPACE_AS_PATH	the application's namespace, but with "/" in place of "." if it is a complex name; this is usually used as a web server alias in the configuration
APP_HTTPD_CONFIG	the absolute path to the generated configuration file
LOCALHOST_APP_URI	the URL with which the source version can be loaded

- **httpd-type** : The web server implementation. Currently supported types are (apache2, lighttpd, nginx). (default: *apache2*)
- **httpd-host-url** : The host URL part (including protocol) where the server can be contacted for which the configuration is being generated. (default: *http://localhost*)

11.3.4 Generator Config Macros

This page lists the macros which are pre-defined in qooxdoo, and can (mostly) be overridden in custom configuration files. (Others, like PYTHON_CMD or QOOXDOO_VERSION, you would only want to reference, but not set).

Macro name	Description	Default value
ADD_NOCACHE_PARAM	turn *compile-options/uris/add-nocache-param* on/off for *source* builds	false
API_EXCLUDE	list of class pattern to exclude from the api documentation	[]
API_INCLUDE	list of class pattern to include in the api documentation	[”qx.*”, “${APPLICATION}.*”]
APPLICATION	application name space	<undef>
APPLICATION_MAIN_CLASS	application main class	${APPLICATION}.Application
BUILD_PATH	output path for the “build” job (can be rel. to config dir)	./build
CACHE	path to the compile cache (can be rel. to config dir)	${TMPDIR}/cache
CACHE_KEY	takes the value of a complete *cache* configuration key (i.e. a map)	{ “compile” : “${CACHE}”, “downloads” : “${CACHE}/downloads”, “invalidate-on-tool-change” : true }
COMPILE_WITH_LINT	turn *lint-check* on/off during compile runs	true
GENERATOR_OPTS	(read-only) string with the command line options the generator was invoked with (e.g. *“-c myconf.json -q”*)	<undef>
HOME	(read-only) value of the (process) environment variable “HOME”	”.” *(for safety reasons)*
LOCALES	list of locales for this application	[“en”]
OPTIMIZE	list of *optimization options* for build version	[”basecalls”, “comments”, “privates”, “statics”, “strings”, “variables”, “variants”, “whitespace”]
QOOXDOO_PATH	path to the qooxdoo installation root dir	<undef>
QOOXDOO_VERSION	the current qooxdoo version	3.0
QOOXDOO_REVISION	(read-only) the current qooxdoo repository revision	(only defined in a repository checkout)
QXICONTHEME	icon theme to use for this application	[”Tango”]
QXTHEME	theme to use for this application	“qx.theme.Modern”
PYTHON_CMD	(read-only) Python executable	(your system’s default Python executable)
ROOT	application root dir (rel. to config dir)	”.”
SIMULATION_INCLUDE	class pattern to search for GUI test classes	“${APPLICATION}.simulation.*”
SIMULATOR_CLASSPATH	Java classpath argument for GUI test runner	“${SIMULATOR_ROOT}/tool/js.jar: ${SIMULATOR_ROOT}/tool/selenium-java-client-driver.jar”
SIMULATOR_ROOT	path to the framework’s simulator component	“${QOOXDOO_PATH}/ component/ simulator”
SOURCE_SERVER_PORT	port the *source-server* should run on	0 (meaning an arbitrary free port will be picked)
TEST_INCLUDE	class pattern to search for unit test classes	“${APPLICATION}.test.*”
TEST_EXCLUDE	class pattern to exclude unit test classes	“${APPLICATION}.test.oldtests.*”

11.3.5 qooxdoo Generator Cheat Sheet - v.3.0

This cheat sheet summarizes the options available for the generator and its Json config files. For full reference see: http://manual.qooxdoo.org/3.0/pages/tool/generator/generator.html

Command-line Options

```
shell> generator.py -h
Usage: generator.py [options] job,...

Arguments:
  job,...               a list of jobs (like 'source' or 'copy-files',
                        without the quotes) to run
  x                     use 'x' (or some undefined job name) to get a
                        list of all available jobs from the configuration file

Options:
  -h, --help            show this help message and exit
  -c CFGFILE, --config=CFGFILE
                        path to configuration file containing job definitions
                        (default: config.json)
  -q, --quiet           quiet output mode (extra quiet)
  -v, --verbose         verbose output mode of job processing
  -w, --config-verbose  verbose output mode of configuration processing
  -l FILENAME, --logfile=FILENAME
                        log file
  -s, --stacktrace      enable stack traces on fatal exceptions
  -m KEY:VAL, --macro=KEY:VAL
                        define/overwrite a global 'let' macro KEY with value
                        VAL
  -d, --daemon          (EXPERIMENTAL - DON'T USE) puts the generator in
                        daemon mode
  -I, --no-progress-indicator
                        suppress animated progress indication
```

Default Jobs

api	create api doc for the current library
api-data	create api doc json data files
build	create build version of current application
clean	remove local cache and generated .js files (source/build)
distclean	remove the cache and all generated artefacts of this library (source, build, ...)
fix	normalize whitespace in .js files of the current library (tabs, eol, ...)
info	collects environment information like the qooxdoo version etc., and prints it out
inspector	create an inspector instance in the current library
lint	check the source code of the .js files of the current library
migration	migrate the .js files of the current library to the current qooxdoo version
pretty	pretty-formatting of the source code of the current library
profiling	includer job, to activate profiling
simulation-build	create a runner app for simulated interaction tests
simulation-run	launches simulated interaction tests generated with simulation-build
source	create source version of current application
source-all	create source version of current application, with all classes
source-httpd-config	generate a httpd configuration for the source version
source-hybrid	create a hybrid application (application classes as individual files, others concatenated)
source-hybrid	create a hybrid application (application classes as individual files, others concatenated)
source-server	start a lightweight web server that exports the source version
test	create a test runner app for unit tests of the current library
test-source	create a test runner app for unit tests (source version) of the current library
translation	create .po files for current library
validate-config	validates the *config.json* itself - if jobname arg is given checks dedicated job only
validate-manifest	validates the given filepath as manifest (defaults to *./Manifest.json*)

Config File Layout

This is an overview of the available configuration keys with their corresponding nesting level.

- **name** - A name or descriptive text for the configuration file.
- **include** - Include external config files. Takes a list of maps, where each map specifies an external configuration file, and options how to include it.
- **let** - Define default macros. Takes a map (see the description of the job-level 'let' further down). This let map is included automatically into every job run. There is no explicit reference to it, so be aware of side effects.
- **export** - List of jobs to be exported if this config file is included by another.
- **default-job** - The name of a job to be run as default, i.e. when invoking the generator without job arguments.
- **config-warnings** - *(experimental)* Suppress warnings from configuration aspects which you know are ok.
- **jobs** - Map of jobs. Each key is the name of a job.
  - **<jobname>** Each job's value is a map describing the job. The describing map can have any number of the following keys:
    - **add-script** - A list of URIs that will be loaded first thing when the app starts.
    - **api** - Triggers the generation of a custom Apiviewer application.
    - **asset-let** - Defines macros that will be replaced in @asset hints in source files.
    - **cache** - Define the path to cache directories, most importantly to the compile cache.

* **clean-files** - Triggers clean-up of files and directories within a project and the framework, e.g. deletion of generated files, cache contents, etc.
* **collect-environment-info** - Collects various information about the qooxdoo environment (like version, cache, etc.) and prints it to the console.
* **combine-images** - Triggers creation of a combined image file that contains various images.
* **compile** - Triggers the generation of a source or build version of the application.
* **compile-options** - Define various options that influence compile runs (both source and build version).
* **config-warnings** - *(experimental)* Suppress warnings from configuration aspects which you know are ok.
* **copy-files** - Triggers files/directories to be copied, usually between source and build version.
* **copy-resources** - Triggers the copying of resources, usually between source and build version.
* **dependencies** - Fine-tune the processing of class dependencies.
* **desc** - A string describing the job.
* **environment** - Define key:value pairs for the application, covering settings, variants and features.
* **exclude** - List classes to be excluded from the job. Takes an array of class specifiers.
* **extend** - Extend the current job with other jobs. Takes an array of job names. The information of these jobs are merged into the current job description, so the current job sort of "inherits" their settings.
* **fix-files** - Fix white space in source files.
* **include** - List classes to be processed in the job. Takes an array of class specifiers.
* **let** - Define macros. Takes a map where each key defines a macro and the value its expansion.
* **library** - Define libraries to be taken into account for this job. Takes an array of maps, each map specifying one library to consider. The most important part therein is the "manifest" specification.
* **lint-check** - Check source code with a lint-like utility.
* **log** - Tailor log output of job.
* **migrate-files** - Migrate source code to the current qooxdoo version.
* **packages** - Define packages for the application.
* **pretty-print** - Triggers code beautification of source class files (in-place-editing). An empty map value triggers default formatting, but further keys can tailor the output.
* **provider** - Collects classes, resources and dependency information and puts them in a specific directory structure under the provider root.
* **require** - Define prerequisite classes needed at load time. Takes a map, where the keys are class names and the values lists of prerequisite classes.
* **run** - Define a list of jobs to run in place of the current job.
* **shell** - Triggers the execution of one or more external command(s).
* **simulate** - Triggers the execution of a GUI test (simulated interaction) suite.
* **slice-images** - Triggers cutting images into regions.
* **translate** - Re-generate .po files from source classes.
* **use** - Define prerequisite classes needed at run time. Takes a map, where the keys are class names and the values lists of prerequisite classes.

Configuration Keys

Here are the configuration keys with their individual value syntax.

```
"add-css" :
[
  {
    "uri" : "<css-uri>"
  }
]

"add-script" :
[
  {
    "uri" : "<script-uri>"
  }
]

"api" :
{
  "path"   : "<path>",
  "verify" : [ "links", "types", "statistics" ],
  "warnings" :
  {
    "output" : [ "data", "console" ]
  }
  "sitemap" :
  {
    "link-uri" : "<uri>",
    "file" : "<path>"
  }
}

"asset-let" :
{
  "<macro_name>" : [ "foo", "bar", "baz" ]
}

"cache" :
{
  "compile"     : "<path>",
  "downloads"   : "<path>",
  "invalidate-on-tool-change" : (true|false)
}

"clean-files" :
{
  "<doc_string>" :
  [
    "<path>",
    "<path>"
  ]
}

"collect-environment-info" : {}

"combine-images" :
{
  "montage-cmd" : "<string_template>",
```

```
  "images" :
  {
    "<output_image>" :
    {
      "prefix": [ "<string>", "<altstring>" ],
      "layout": ("horizontal"|"vertical"),
      "input" :
      [
        {
          "prefix" : [ "<string>", "<altstring>" ],
          "files"  : [ "<path>", "<path>" ]
        }
      ]
    }
  }
}

"compile" :
{
  "type" : "(source|build|hybrid)"
}

"compile-options" :
{
  "paths" :
  {
    "file"            : "<path>",
    "file-prefix"     : "<path>",
    "app-root"        : "<path>",
    "gzip"            : (true|false),
    "loader-template" : "<path>"
  },
  "uris" :
  {
    "script"          : "script",
    "resource"        : "resource",
    "add-nocache-param" : (true|false)
  },
  "code" :
  {
    "format"          : (true|false),
    "locales"         : ["de", "en"],
    "optimize"        : ["basecalls", "comments", "privates", "strings", "variables", "variants", "wh
    "decode-uris-plug"  : "<path>",
    "except"          : ["myapp.classA", "myapp.util.*"]
  }
}

"config-warnings" :
{
  "job-shadowing"    : ["source-script"],
  "tl-unknown-keys"  : ["baz", "bar"],
  "job-unknown-keys" : ["foo", "bar"],
  "<config_key>"     : ["*"]
}

"copy-files" :
{
```

```
  "files"     : [ "<path>", "<path>" ],
  "source" : "<path>",
  "target"  : "<path>"
}

"copy-resources" :
{
  "target" : "<path>"
}

"default-job" : "source"

"dependencies" :
{
  "follow-static-initializers"  : (true|false),
  "sort-topological"            : (true|false)
}

"desc" : "Some text."

"environment" :
{
  "<key>" : (value | [<value>, ... ])
}

"exclude" : ["qx.util.*"]
"export" : ["job1", "job2", "job3"]

"extend" : [ "job1", "job2", "job3" ]

"fix-files" :
{
  "eol-style" : "(LF|CR|CRLF)",
  "tab-width" : 2
}

"include" : ["qx.util.*"]

"include" :
[
  {
    "path"   : "<path>",
    "as"     : "<name>",
    "import" : ["job1", "job2", "job3"],
    "block"  : ["job4", "job5"]
  }
]

"jobs" :
{
  "<job_name>" : { <job_definition> }
}

"let" :
{
  "<macro_name>"  : "<string>",
  "<macro_name1>" : [ ... ],
  "<macro_name2>" : { ... }
```

```
}

"library" :
[
  {
    "manifest"   : "<path>",
    "uri"        : "<from_html_to_manifest_dir>"
  }
]

"lint-check" :
{
  "allowed-globals" : [ "qx", "${APPLICATION}" ],
  "ignore-catch-param"            : (true|false),
  "ignore-deprecated-symbols"     : (true|false),
  "ignore-environment-nonlit-key" : (true|false),
  "ignore-finally-without-catch"  : (true|false),
  "ignore-multiple-mapkeys"       : (true|false),
  "ignore-multiple-vardecls"      : (true|false),
  "ignore-no-loop-block"          : (true|false),
  "ignore-reference-fields"       : (true|false),
  "ignore-undeclared-privates"    : (true|false),
  "ignore-undefined-globals"      : (true|false),
  "ignore-shadowing-locals"       : (true|false),
  "ignore-unused-parameter"       : (true|false),
  "ignore-unused-variables"       : (true|false),
  "run"                           : (true|false),
  "warn-unknown-jsdoc-keys"       : (true|false),
  "warn-jsdoc-key-syntax"         : (true|false)
}

"log" :
{
  "classes-unused" : [ "custom.*", "qx.util.*" ],
  "dependencies"   :
  {
    "type"         : ("using"|"used-by"),
    "phase"        : ("runtime"|"loadtime"|null),
    "include-transitive-load-deps" : (true|false),
    "force-fresh-deps" : (true|false),
    "format"       : ("txt"|"dot"|"json"|"provider"|"flare"|"term"),
    "dot"          :
    {
      "root"           : "custom.Application",
      "file"           : "<filename>",
      "radius"         : 5,
      "span-tree-only" : (true|false),
      "compiled-class-size" : (true|false)
    },
    "json"         :
    {
      "file"       : "<filename>",
      "pretty"     : (true|false)
    },
    "flare"        :
    {
      "file"       : "<filename>",
      "pretty"     : (true|false)
```

```
    }
  },
  "filter"         :
  {
    "debug"        : [ "generator.code.PartBuilder.*" ]
  },
  "privates"       : (true|false),
  "resources"      :
  {
    "file"         : "<filename>"
  },
  "translations"   :
  {
    "untranslated-keys":
    {
      "skip-locales"   : ["C"]
    }
  }
}

"migrate-files" :
{
   "from-version" : "0.7",
   "migrate-html" : false
}

"name" : "Some text."

"packages" :
{
  "parts"  :
  {
    "<part_name>" :
    {
      "include"                  : [ "app.class1", "app.class2", "app.class3.*" ],
      "expected-load-order"      : 1,
      "no-merge-private-package" : (true|false)
    }
  },
  "sizes"  :
  {
    "min-package"           : 1,
    "min-package-unshared"  : 1
  },
  "init"             : "<part_name>",
  "separate-loader"  : (true|false),
  "i18n-as-parts"    : (true|false),
  "additional-merge-constraints" : (true|false),
  "verifier-bombs-on-error"      : (true|false)
}

"pretty-print" :
{
  "general" :
  {
    "indent-string"        : "  ",
    "text-width"           : 80
  },
```

```
  "comments" :
  {
    "block"  :
    {
      "add"  : true
    },
    "trailing" :
    {
      "keep-column"        : false,
      "comment-cols"       : [50, 70, 90],
      "padding"            : "  "
    }
  },
  "code" :
  {
    "align-with-curlies"   : false,
    "open-curly" :
    {
      "newline-before"     : "m",
      "indent-before"      : false
    }
  }
}

"provider" :
{
  "app-root" : "./provider",
  "include"  : ["${APPLICATION}.*"],
  "exclude"  : ["${APPLICATION}.test.*"]
}

"require" :
{
  "<class_name>" : [ "qx.util", "qx.fx" ]
}

"run" : [ "<job1>", "<job2>", "<job3>" ]

"shell" :
{
  "command" : ("echo foo bar baz"|["echo foo", "echo bar", "echo baz"])
}

"simulate" :
{
  "java-classpath" : ["../rhino/js.jar", "../selenium/selenium-java-client-driver.jar"],
  "qxselenium-path" : "${SIMULATOR_ROOT}/tool",
  "rhino-class" : "org.mozilla.javascript.tools.shell.Main",
  "simulator-script" : "${BUILD_PATH}/script/simulator.js"
}

"slice-images" :
{
  "convert-cmd" : "<string_template>",
  "images" :
  {
    "<input_image>" :
    {
```

```
        "prefix"       : "<string>",
        "border-width" : (5 | [5, 10, 5, 10]),
        "trim-width"   : (true|false)
    }
  }
}

"translate" :
{
  "namespaces"               : [ "qx.util" ],
  "locales"                  : [ "en", "de" ],
  "pofile-with-metadata"     : (true|false)
  "poentry-with-occurrences" : (true|false)
}

"use" :
{
  "<class_name>" : [ "qx.util", "qx.fx" ]
}

"watch-files" :
{
  "paths"   : [ "file/or/dir/to/watch" ],
  "command" :
  {
    "line"  : "generate.py source",
    "per-file" : (true|false)
  }
  "include" : [ "*.js" ],
  "include-dirs"    : (true|false),
  "check-interval"  : 10,
  "exit-on-retcode" : (true|false)
}

"web-server" :
{
  "document-root" : "",
  "server-port"  : 8080,
  "log-level"    : "error",
  "allow-remote-access" : false
}

"web-server-config" :
{
  "output-dir"     : ".",
  "template-dir"   : "<path>",
  "httpd-type"     : "apache2",
  "httpd-host-url" : "http://localhost:8080"
}
```

11.3.6 Syntax Diagrams

A short summary of the elements used in syntax diagrams.

Syntax symbol	Description
:=	production rule (*"non-terminal can be expanded to ..."*)
{ ... }	0..N occurrences (*"*"*)
[...]	0..1 occurrences (*"?"*)
(...)	grouping
... | ...	alternative
' ... '	literal
< ... **>**	placeholder for literal
? ... **?**	comment

11.3.7 The Format of PO Files

This is a condensed (and rather qooxdoo-slanted) version of the official PO file format description. Not all features described here are tested to work with current qooxdoo.

.po files are made up of entries. The first entry is usually used to maintain meta-data, the other entries contain message id's and their translations.

A simple example:

```
# A simple .po file
msgid ""
msgstr ""
"Project-Id-Version: 1.0\n"
"Report-Msgid-Bugs-To: you@your.org\n"
"POT-Creation-Date: 2012-08-28 17:19+0100\n"
"PO-Revision-Date: 2012-08-28 17:19+0100\n"
"Last-Translator: you <you@your.org>\n"
"Language-Team: Team <yourteam@your.org>\n"
"MIME-Version: 1.0\n"
"Content-Type: text/plain; charset=utf-8\n"
"Content-Transfer-Encoding: 8bit\n"

msgid "This field is required."
msgstr "Este campo es obligatorio."
```

Each entry has the following structure:

```
#  translator-comments
#. extracted-comments
#: reference...
#, flag...
#| msgid previous-untranslated-string
msgctxt context
msgid untranslated-string
msgstr translated-string
```

or

```
# an entry with plural forms
#, range: 0..10
msgid untranslated-string-singular
msgid_plural untranslated-string-plural
msgstr[0] translated-string-case-0
...
msgstr[N] translated-string-case-n
```

White-space and all comments are optional. Dangling white space or comments (after the last entry) should be avoided. Explanations of the various lines:

- **'# '** : (# and at least one white space). Comments like this are usually maintained by the person editing the po file, e.g the translator.
- **'#.'**: These are comments provided by developers in source code, usually aimed at the translator, and are automatically extracted by tools into the po file. (All comments starting with # and some non-white character are considered "automatic comments" which are in some way manipulated by tools).
- **'#:'**: Here appear comma-separated occurrences of this msgid in source code, e.g. like `#: src/msgcmp.c:338 src/po-lex.c:699`; extracted by tools.
- **'#,'**: *flag...* is a comma-separated list of a number of pre-defined keywords, like `fuzzy, range, c-format, no-python-format, ...`. These flags can both be provided by humans as well as tools, and inform further tool processing (e.g. when checking validity of msgid and translations).
- **'#|'** : Comments starting with this indicator keep previous values of this entry, e.g. `"#| msgid previous-untranslated-entry"` or `"#| msgctxt previous-context"`. Only provided by tools under certain circumstances (e.g. fuzzy matching).
- **'msgid'** : The message id, the key for this entry. *msgid* and one of the *msgstr* forms are the only mandatory lines for each entry. *msgid*'s are extracted from source files by tools.

  For the untranslated-string the following constraints apply (the same holds for the translated-strings, e.g. with `msgstr`):

  - The string follows C syntax. It has to start on the same line as the *msgid* keyword.
  - It is enclosed by double quotes.
  - It allows embedded escape ("control") sequences: `\n, \t, \\, \"`
  - The string can optionally be broken across multiple lines. These parts are concatenated without space to make up the actual value. The line with *msgid* must at least contain an empty part. This is independent of embedded `\n` escapes. Example:

    ```
    msgid ""
    "This is the start "
    "and this is the end."
    ```

- **'msgid_plural'** : The plural form of the message id.
- **'msgstr'** : The translation of the message id.
- **'msgstr[<num>]'** : Translations depending on singular/plural forms (some languages differentiate if the plural is actually exactly 2, 3, or more concrete numbers of the involved entities; e.g. the translation for "two houses" might differ from the translation of "three houses"). *msgstr[0]* represents the singular translation. The source code needs to provide the desired number to pick the right translation at runtime. For these kinds of plural forms the `"#, range: min..max"` flag can be used to instruct the translator how big *N* can be.
- **'msgctxt'** : A context word for the msgid, e.g. a module/package/component name. This is used to disambiguate entries with *the same msgid* within a single .po file. An empty string for *context* is different from a missing *msgctxt* line. Has to be provided by the developer of the source code. *(This entry introduces extra complexity, so try to avoid).*

11.4 Miscellaneous

11.4.1 Third-party Components

The qooxdoo project makes use of components and tools from other projects and endeavours. This applies to the framework JavaScript class code, the tool chain, and static resources. This page gives an overview over those components which are included with the SDK or other deliverables. Please refer to the contained files for version information of a particular component.

Besides foreign files we have included in the project, we also want to list the tools we use to either produce or consume genuine files of our source tree (beyond basic text editors ;-), so it is easy to oversee all the project's dependencies.

Framework JavaScript Code

These are components that are integrated into the framework class code. I.e. if you are using classes from the framework to create your custom application, chances are that these components will make it into the deploy version of your application.

Component	License
Sizzle	MIT
mustache.js	MIT
SWFFix	MIT
Sinon.JS	BSD
parseUri	MIT
iScroll	MIT

Application JavaScript Code

These are components that are used by the JavaScript code of our demo apps. I.e. if you are using classes from the framework to create your custom application none of these components will ever make it into your application.

Component	License
ACE	BSD (mod.)
highlight.js	BSD (3-Clause)

Resources

Static resource files, like images, CSS, etc. Static resources are frequently included in custom application, so it is very likely some of them will make it into your own custom application.

Component	License
Tango Icons	CC BY-SA 2.5
Oxygen Icons	LGPLv3
CLDR Data	Unicode Terms of Use
JQTouch Project	MIT
iScroll	MIT

Tool Chain

These are the Python modules we use that are not self-written nor part of a vanilla Python 2.5 SDK. While they are shipped with our SDK they are only used while the tool chain runs, and never become part of the resulting custom application.

Module	License
argparse	Python License 2
cssmin	BSD-compat
demjson	LGPL 3
elementtree	old-style Python (HPND)
graph	MIT
jsonschema	MIT
polib	MIT
pyparsing	MIT
simplejson	MIT
textile	BSD

Components or tools that are not included with the SDK

These tools we use on our development machines, e.g. to prepare the qooxdoo SDK, run automated tests, create reports, and the like. They are not required to use any of qooxdoo's deliverables, but can be interesting for users that pursue specific interests.

Tool	License
ImageMagick	GPL-compat
Make	GPL 3.0 or later
Mozilla Rhino	MPL 1.1/GPL 2.0, Unnamed License
RRDTool	GPL
Selenium	Apache License 2.0
Sphinx	BSD
TeX Live	mixed free licenses
qxMaven	LGPL, EPL

11.5 Glossary

11.5.1 Glossary

API Viewer A popular qooxdoo application, the API Viewer is a class browser for the framework class hierarchy, written in qooxdoo. It allows for customized views, where the framework classes are displayed together with the classes of an application, in order to provide automated application documentation. The data displayed is extracted from the JavaScript source code where it is maintained as JavaDoc-like comments.

Build Process qooxdoo comes with its own build system, usually referred to as the "build process" or "build system". It is a collection of ''make" Makefiles and command line tools. Together they help to maintain a development environment and is seamlessly used throughout the framework, the standard applications that come with qooxdoo, and is recommended for any custom application. Its features encompass checking of dependencies and maintaining lists of used framework classes, generating files to "glue" everything together, copying code, HTML, style and resource files around, pretty-formatting of source code, generating complete and compressed JavaScript files, and creating distribution-ready, self-contained application folders. Particularly, the build system helps to maintain a Source and a Build Version of a qooxdoo application.

Build Version The "Build Version" of a qooxdoo application is the version where all application files together with all relevant framework classes have been compressed and optimized, to provide a self-contained and efficient Web application that can be distributed to any Web environment.

Class A JS object created with `qx.Class.define()`.

Compiler A compiler is a tool that translates code written in some programming language into another language, usually a lower-level one. In qooxdoo we are transforming JavaScript into optimized JavaScript, which is often referred to as *translation* (as the target language is on the same level as the source language). But as it is the more popular term, we usually refer to this process as compilation as well.

Constructor A class method that is run everytime a new instance of the class is created. Used to do initialisation on the class instance. In qooxdoo this method is named *construct*.

Destructor A class method that is run everytime a class instance is deleted.

Event A notification that signals a special situation in time. Events usually take the form of concrete objects. Important for reactive systems like user interfaces, to notify parts of the software of a particular situation, e.g. a user action like a keyboard stroke or a mouse click.

Exception An exceptional situation that prohibits the normal continuation of the program flow.

Framework A coherent collection of a library, documentation, tools and a programming model which application developers use to create applications.

Generator The generator is the backbone of qooxdoo's build process. It is the main tool that drives various other tools to achieve the various goals of the build process, like dependency checking, compression and resource management.

Initialization The process of setting up a certain software component, like an object, for its work, or the programming code to achieve such a setting up.

Interface An Interface is "a class without implementation", i.e. a class-like structure that only names class features like attributes and methods without providing an implementation. It is created with `qx.Interface.define()`.

Key Keys are the "left-hand side" of the key-value pairs in a map. Map keys have to be unique within the map.

Map A data structure that contains key-value pairs. Each value can be looked up by using the key on the map. In JavaScript, maps are also object literals, i.e. each map constitutes an object.

Member A class attribute, usually a method. Within qooxdoo, members usually refer to instance methods (as opposed to static methods).

Meta-Theme A theme that only references other themes.

Mixin A Mixin is a class you cannot instantiate, but provides a certain set of features. Mixins are the included in "proper" classes to add this feature set without the necessity to re-implement it. It is created with `qx.Mixin.define()`.

Package A JavaScript file that is loaded by an application.

Pollution Application-specific variables that are added to the global name space in the JavaScript interpreter.

Property A class attribute that is not accessed directly, but rather through automatic accessor methods (getters/setters/resetters, initializers, ...).

Quirks Mode *"Quirks mode refers to a technique used by some web browsers for the sake of maintaining backwards compatibility with web pages designed for older browsers, instead of strictly complying with W3C and IETF standards in standards mode."* [Wikipedia]

RIA Rich internet application. A desktop-like application with menus, toolbars, etc. that runs over the Internet in a browser.

Ribbon *"The ribbon is a graphical user interface widget composed of a strip across the top of the window that exposes all functions the program can perform in a single place, with additional ribbons appearing based on the context of the data."* [Wikipedia]

Skeleton A minimal qooxdoo application that serves as a starting point for custom applications. qooxdoo provides several skeleton applications, according to intended application domain.

Source Version The "source version" of a qooxdoo application is the version where all class files are loaded individually and in their original source form. This is less efficient when loaded into the browser, but much better for debugging and error tracing. Hence, it is the preferred development version.

Style A set of visual attributes that determine how a certain element is displayed. This encompasses things like foreground and background colors, background images, font types and border styles.

Theme A comprehensive set of style definitions that can be used to give an application a consistent look and feel through all of its visual elements.

Widget Visual user interface element, like a button, a text input field or a scroll bar. Usually, widgets have their own specific behaviours, i.e. a way of reacting to user interaction, but there are also pure display widgets.

Window A distinct rectangular region on the screen, usually with borders and a top bar that allows to drag it around. More specifically a browser window.

11.6 License

11.6.1 qooxdoo License

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Once this change is made in a given copy, it is irreversible for
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This option is useful when you wish to copy part of the code of
the Library into a program that is not a library.

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under the terms of Sections 1 and 2 above provided that you accompany
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medium customarily used for software interchange.

If distribution of object code is made by offering access to copy
from a designated place, then offering equivalent access to copy the
source code from the same place satisfies the requirement to
distribute the source code, even though third parties are not
compelled to copy the source along with the object code.

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Library, but is designed to work with the Library by being compiled or
linked with it, is called a "work that uses the Library". Such a
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However, linking a "work that uses the Library" with the Library
creates an executable that is a derivative of the Library (because it
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Section 6 states terms for distribution of such executables.

When a "work that uses the Library" uses material from a header file

that is part of the Library, the object code for the work may be a derivative work of the Library even though the source code is not. Whether this is true is especially significant if the work can be linked without the Library, or if the work is itself a library. The threshold for this to be true is not precisely defined by law.

If such an object file uses only numerical parameters, data structure layouts and accessors, and small macros and small inline functions (ten lines or less in length), then the use of the object file is unrestricted, regardless of whether it is legally a derivative work. (Executables containing this object code plus portions of the Library will still fall under Section 6.)

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