

Ticket Monster Tutorial

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Part I

What is TicketMonster?

Chapter 1

Preamble

TicketMonster is an example application that focuses on Java EE6 - JPA 2, CDI, EJB 3.1 and JAX-RS along with HTML5 and jQuery Mobile. It is a moderately complex application that demonstrates how to build modern web applications optimized for mobile & desktop. TicketMonster is representative of an online ticketing broker - providing access to events (e.g. concerts, shows, etc) with an online booking application.

Apart from being a demo, TicketMonster provides an already existing application structure that you can use as a starting point for your app. You could try out your use cases, test your own ideas, or, contribute improvements back to the community.



Fork us on GitHub!

The accompanying tutorials walk you through the various tools & technologies needed to build TicketMonster on your own. Alternatively you can download TicketMonster as a completed application and import it into your favorite IDE.

Before we dive into the code, let's discuss the requirements for the application.

Chapter 2

Use cases

We have grouped the current use cases in two major categories: end user oriented, and administrative.

2.1 What can end users do?

The end users of the application want to attend some cool events. They will try to find shows, create bookings, or cancel bookings. The use cases are:

- look for current events;
 - look for venues;
 - select shows (events taking place at specific venues) and choose a performance time;
 - book tickets;
 - view current bookings;
 - cancel bookings;
-

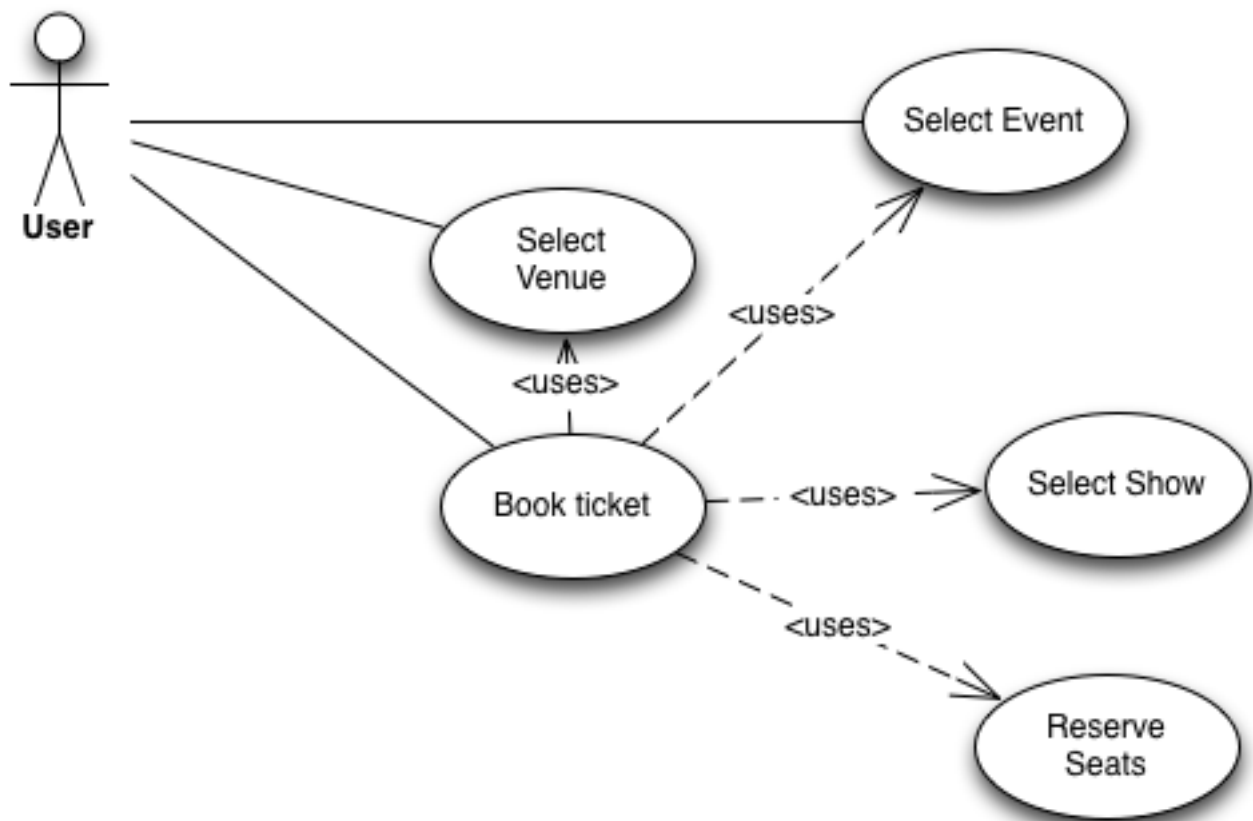


Figure 2.1: End user use cases

2.2 What can administrators do?

Administrators are more concerned the operation of the business. They will manage the *master data*: information about venues, events and shows, and will want to see how many tickets have been sold. The use cases are:

- add, remove and update events;
- add, remove and update venues (including venue layouts);
- add, remove and update shows and performances;
- monitor ticket sales for current shows;

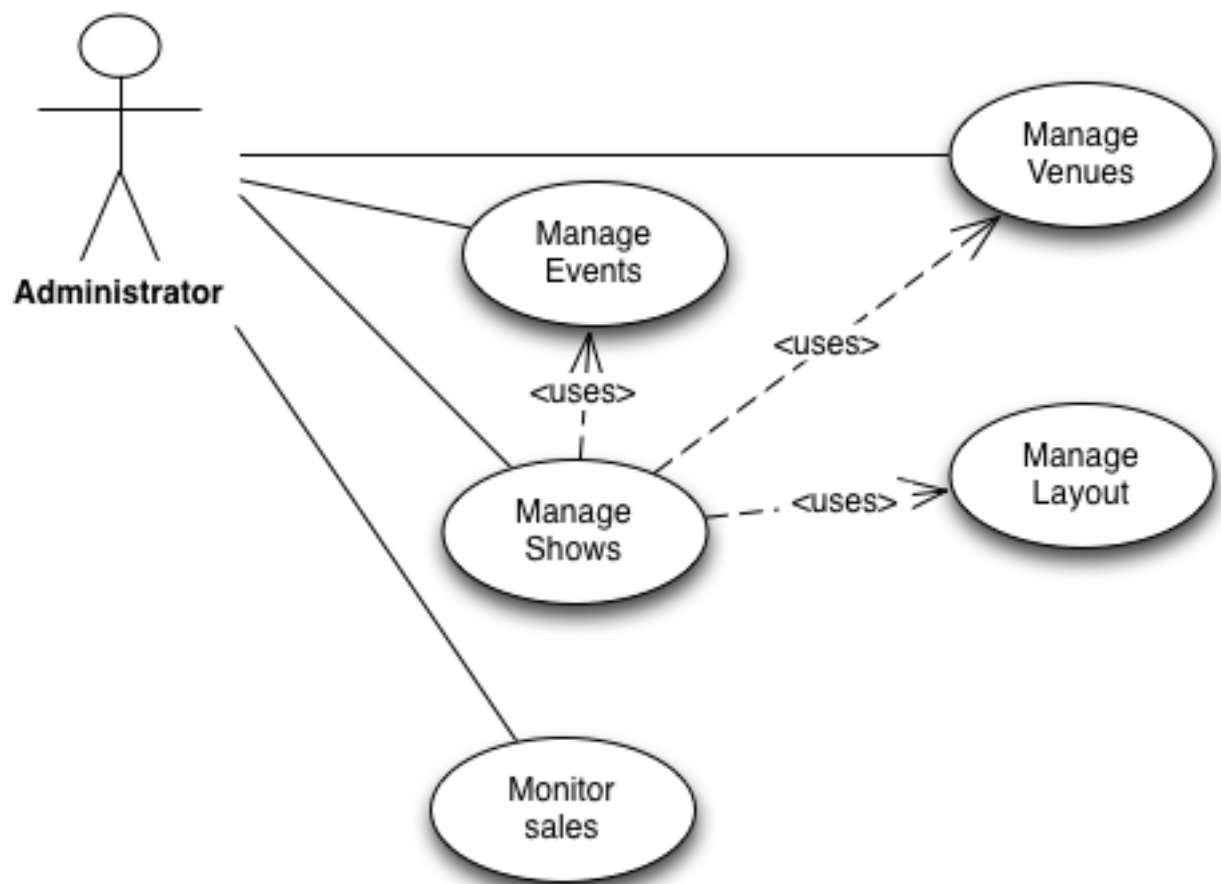


Figure 2.2: Administration use cases

Chapter 3

Architecture

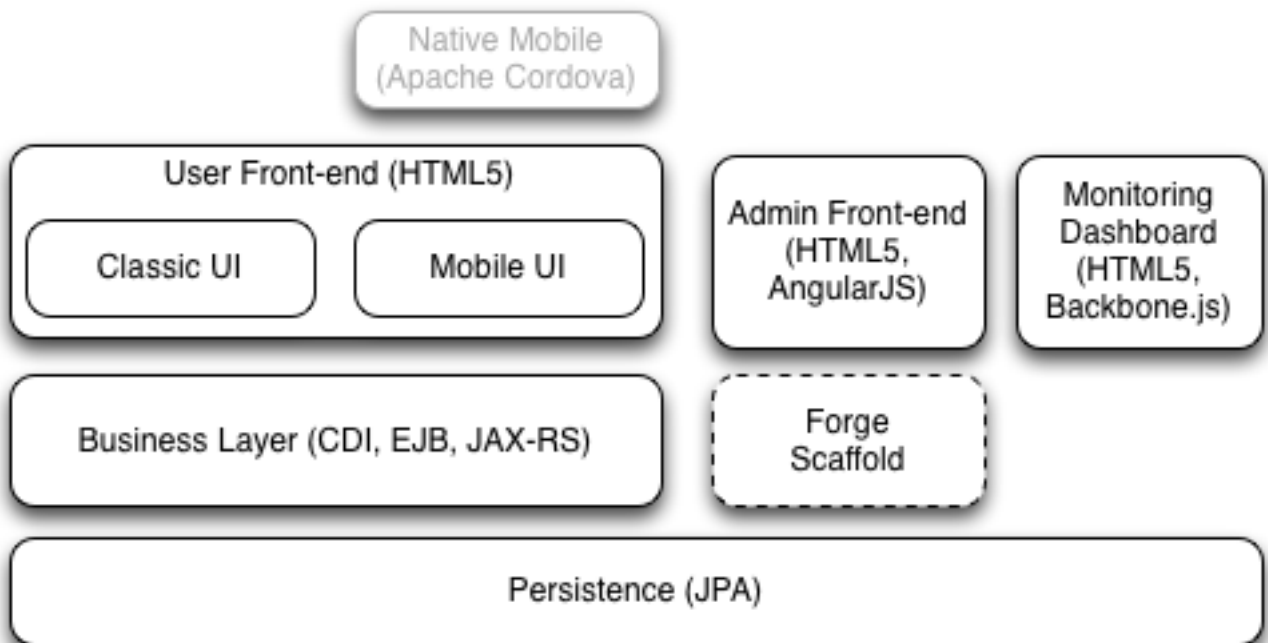


Figure 3.1: TicketMonster architecture

The application uses Java EE 6 services to provide business logic and persistence, utilizing technologies such as CDI, EJB 3.1 and JAX-RS, JPA 2. These services back the user-facing booking process, which is implemented using HTML5 and JavaScript, with support for mobile devices through jQuery Mobile.

The administration site is centered around CRUD use cases, so instead of writing everything manually, the business layer and UI are generated by Forge, using EJB 3.1, CDI and JAX-RS. For a better user experience, Twitter Bootstrap is used.

Monitoring sales requires staying in touch with the latest changes on the server side, so this part of the application will be developed in HTML5 and JavaScript using a polling solution.

Chapter 4

How can you run it?

4.1 Building TicketMonster

TicketMonster can be built from Maven, by running the following Maven command:

```
mvn clean package
```

If you want to run the Arquillian tests as part of the build, you can enable one of the two available Arquillian profiles.

For running the tests in an *already running* application server instance, use the `arqu-jbossas-remote` profile.

```
mvn clean package -Parqu-jbossas-remote
```

If you want the test runner to *start* an application server instance, use the `arqu-jbossas-managed` profile. You must set up the `JBOSS_HOME` property to point to the server location, or update the `src/main/test/resources/arquillian.xml` file.

```
mvn clean package -Parqu-jbossas-managed
```

If you intend to deploy into **OpenShift**, you can use the `postgresql-openshift` profile:

```
mvn clean package -Ppostgresql-openshift
```

4.2 Running TicketMonster

You can run TicketMonster into a local JBoss AS7 instance or on OpenShift.

4.2.1 Running TicketMonster locally

First, start *JBoss Enterprise Application Platform 6* or *JBoss AS 7* with the *Web Profile*.

1. Open a command line and navigate to the root of the JBoss server directory.
2. The following shows the command line to start the server with the web profile:

```
For Linux:    JBOSS_HOME/bin/standalone.sh
For Windows: JBOSS_HOME\bin\standalone.bat
```

Then, *deploy TicketMonster*.

1. Make sure you have started the JBoss Server as described above.
2. Type this command to build and deploy the archive into a running server instance.

```
mvn clean package jboss-as:deploy
```

(You can use the `arq-jbossas-remote` profile for running tests as well)

3. This will deploy `target/ticket-monster.war` to the running instance of the server.
4. Now you can see the application running at <http://localhost:8080/ticket-monster>.

4.2.2 Running TicketMonster in OpenShift

First, *create an OpenShift project*.

1. Make sure that you have an OpenShift domain and you have created an application using the `jbossas-7` cartridge (for more details, get started [here](#)). If you want to use PostgreSQL, add the `postgresql-8.4` cartridge too.
2. Ensure that the Git repository of the project is checked out.

Then, *build and deploy it*.

1. Build TicketMonster using either:

- the default profile (with H2 database support)

```
mvn clean package
```

- the `postgresql-openshift` profile (with PostgreSQL support) if the PostgreSQL cartridge is enabled in OpenShift.

```
mvn clean package -Ppostgresql-openshift
```

2. Copy the `target/ticket-monster.war` file in the OpenShift Git repository (located at `<root-of-openshift-application-git-repository>`).

```
cp target/ticket-monster.war  
<root-of-openshift-application-git-repository>/deployments/ROOT.war
```

3. Navigate to `<root-of-openshift-application-git-repository>` folder
4. Remove the existing `src` folder and `pom.xml` file.

```
git rm -r src  
git rm pom.xml
```

5. Add the copied file to the repository, commit and push to Openshift

```
git add deployments/ROOT.war  
git commit -m "Deploy TicketMonster"  
git push
```

6. Now you can see the application running at `http://<app-name>-<domain-name>.rhcloud.com`

Chapter 5

Learn more

The example is accompanied by a series of tutorials that will walk you through the process of creating the TicketMonster application from end to end.

After reading this series you will understand how to:

- set up your project;
- define the persistence layer of the application;
- design and implement the business layer and expose it to the front-end via RESTful endpoints;
- implement a mobile-ready front-end using HTML 5, JSON, JavaScript and jQuery Mobile;
- develop a HTML5-based administration interface rapidly using JBoss Forge;
- thoroughly test your project using JUnit and Arquillian;

Throughout the series, you will be shown how to achieve these goals using JBoss Developer Studio.

Part II

Introduction & Getting Started

Chapter 6

Purpose and Target Audience

The target audience for this tutorial are those individuals who do not yet have a great deal of experience with:

- Eclipse + JBoss Tools (JBoss Developer Studio)
- JBoss Enterprise Application 6 or JBoss AS 7
- Java EE 6 features like JAX-RS
- HTML5 & jQuery for building an mobile web front-end.

This tutorial sets the stage for the creation of TicketMonster - our sample application that illustrates how to bring together the best features of **Java EE 6 + HTML5 + JBoss** to create a rich, mobile-optimized and dynamic application.

TicketMonster is developed as an open source application, and you can find it [at github](#).

If you prefer to watch instead of read, a large portion of this content is also covered in [video form](#).

In this tutorial, we will cover the following topics:

- Working with JBoss Developer Studio (Eclipse + JBoss Tools)
 - Creating of a Java EE 6 project via a Maven archetype
 - Leveraging m2e and m2e-wtp
 - Using Forge to create a JPA entity
 - Using Hibernate Tools
 - Database Schema Generation
 - Deployment to a local JBoss Server
 - Adding a JAX-RS endpoint
 - Adding a jQuery Mobile client
 - Using the Mobile BrowserSim
-

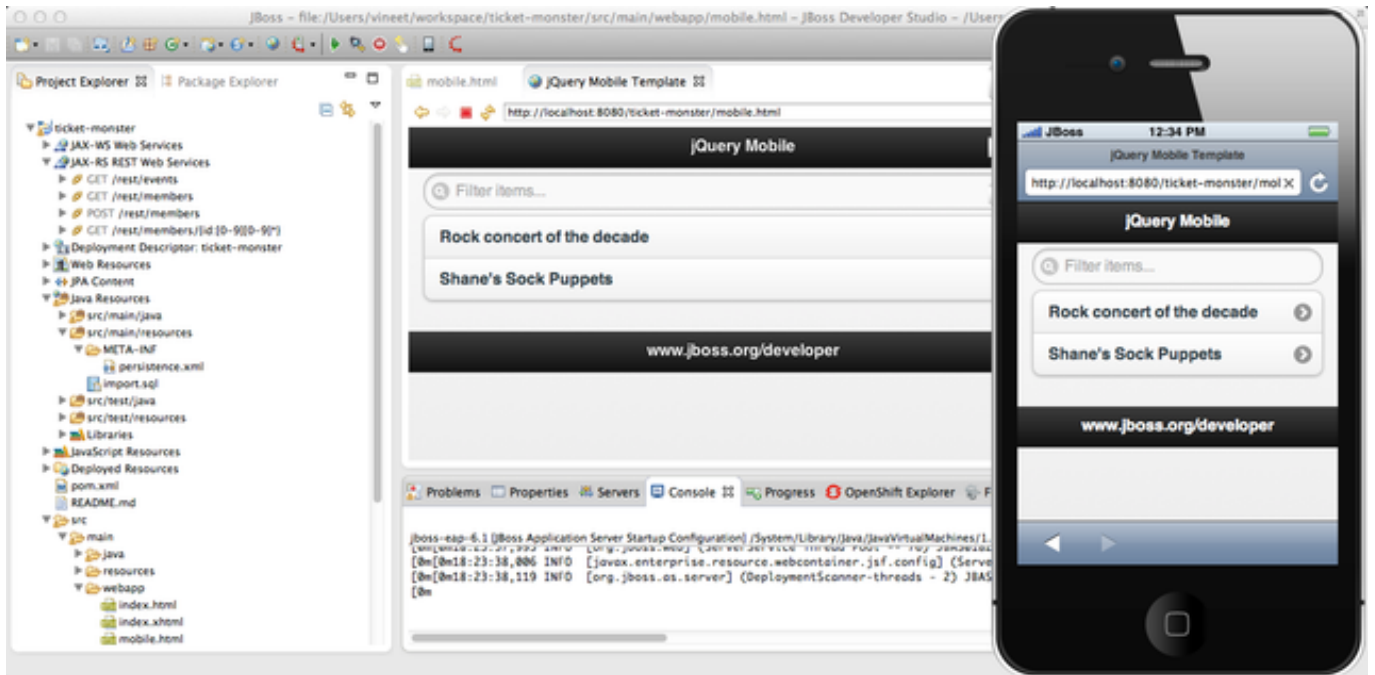


Figure 6.1: JBoss Developer Studio 7 with Mobile BrowserSim

Chapter 7

Installation

The first order of business is to get your development environment setup and JBoss Developer Studio v7 installed. JBoss Developer Studio is Eclipse Kepler (e4.3) for Java EE Developers plus select JBoss Tools and is available for free. Visit <https://devstudio.jboss.com/download/7.x.html> to download it. You may also choose to install JBoss Tools 4.1 into your existing Eclipse for Java EE Developers installation. This document uses screenshots depicting JBoss Developer Studio.

You must have a Java Development Kit (JDK) installed, either v6 or v7 will work - whilst a JVM runtime will work for most use cases, for a developer environment it is normally best to have the full JDK. System requirements for JBoss Developer Studio are listed in the System Requirements chapter of the [JBoss Developer Studio 7.0 Installation Guide](#) online documentation.

Tip

If you prefer to see JBoss Developer studio being installed, then check out [this video](#).

To see JBoss Tools being installed into Eclipse, see [this video](#).

The JBoss Developer Studio installer has a (very long!) name such as `jbdevstudio-product-universal-7.0.0.GA-v20130720-0044-B364.jar` where the latter portion of the file name relates to build date and version information and the text near the front related to the target operating system. The "universal" installer is for any operating system. To launch the installer you may simply be able to double-click on the .jar file name or you may need to issue the following from the operating system command line:

```
java -jar jbdevstudio-product-universal-7.0.0.GA-v20130720-0044-B364.jar
```

We recommend using the "universal" installer as it handles Windows, Mac OS X and Linux - 32-bit and 64-bit versions.

Note

Even if you are installing on a 64-bit OS, you may still wish to use the 32-bit JVM for the JBoss Developer Studio (or Eclipse + JBoss Tools). Only the 32-bit version provides a supported version of the Visual Page Editor - a split-pane editor that gives you a glimpse of what your HTML/XHTML (JSF, JSP, etc) will look like. Also, the 32-bit version uses less memory than the 64-bit version. You may still run your application server in 64-bit JVMs if needed to insure compatibility with the production environment whilst keeping your IDE in 32-bit mode. Visual Page Editor has experimental support for 64-bit JVMs in JBoss Developer Studio 7. Please refer [the JBoss Tools Visual Editor FAQ](#) for details.

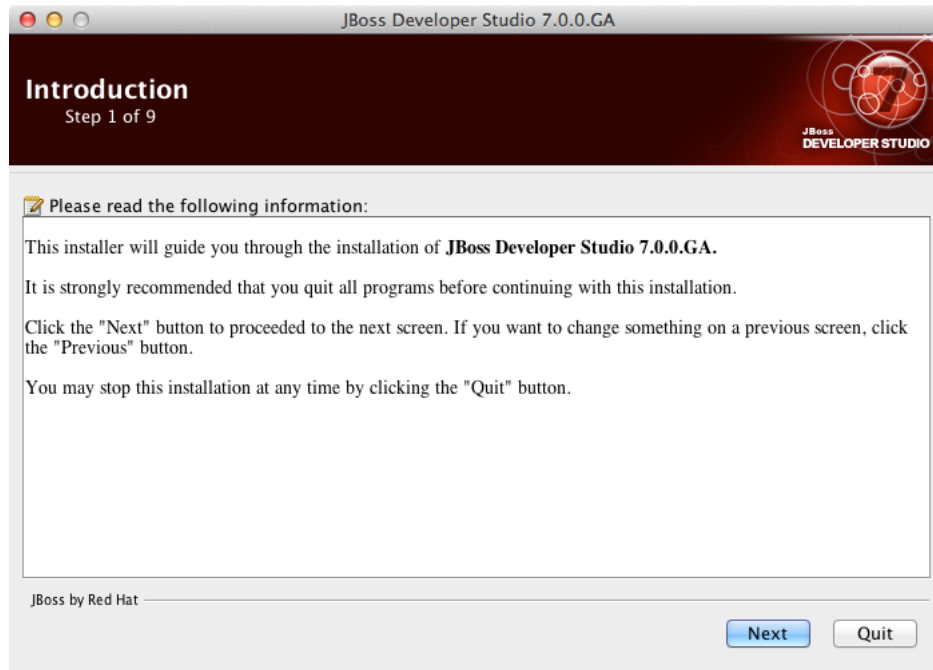


Figure 7.1: Installation Wizard, Step 1 of 9

The rest of the steps are fairly self explanatory. If you run into trouble, please consult the videos above as they explore a few troubleshooting tips related to JRE/JDK setup.

Please make sure to say **Yes** to the prompt that says "Will you allow JBoss Tools team to receive anonymous usage statistics for this Eclipse instance with JBoss Tools?". This information is very helpful to us when it comes to prioritizing our QA efforts in terms of operating system platforms. More information concerning our usage tracking can be found at <http://www.jboss.org/tools/usage>

You can skip the step in the installation wizard that allows you to install JBoss Enterprise Application Platform 6 or JBoss AS 7 as we will do this in the next step.

Chapter 8

Creating a new Java EE 6 project with Maven

Tip

For a deeper dive into the world of Maven and how it is used with JBoss Developer Studio and JBoss Enterprise Application Platform 6 (or JBoss Tools and JBoss AS 7) review [this video](#).

Now that everything is properly installed, configured, running and verified to work, let's build something "from scratch".

We recommend that you switch to the JBoss Perspective if you have not already.

Tip

If you close JBoss Central, it is only a click away - simply click on the JBoss icon in the Eclipse toolbar - it is normally the last icon, on the last row - assuming you are in the JBoss Perspective.

First, select **Start from scratch** → **Java EE Web Project** in JBoss Central. Under the covers, this uses a Maven archetype which creates a Java EE 6 web application (.war), based around Maven. The project can be built outside of the IDE, and in continuous integration solutions like Hudson/Jenkins.

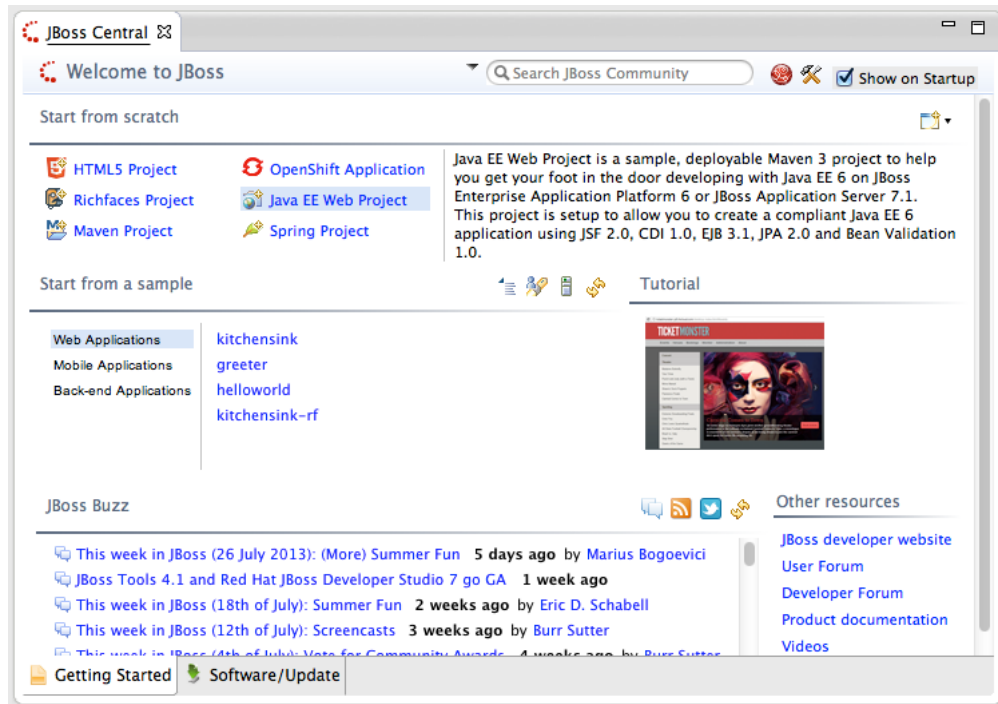


Figure 8.1: JBoss Central

You will be prompted with a dialog box that verifies that JBoss Developer Studio is configured correctly. If you are in a brand new workspace, the application server will not be configured yet and you will notice the lack of a check mark on the server/runtime row.

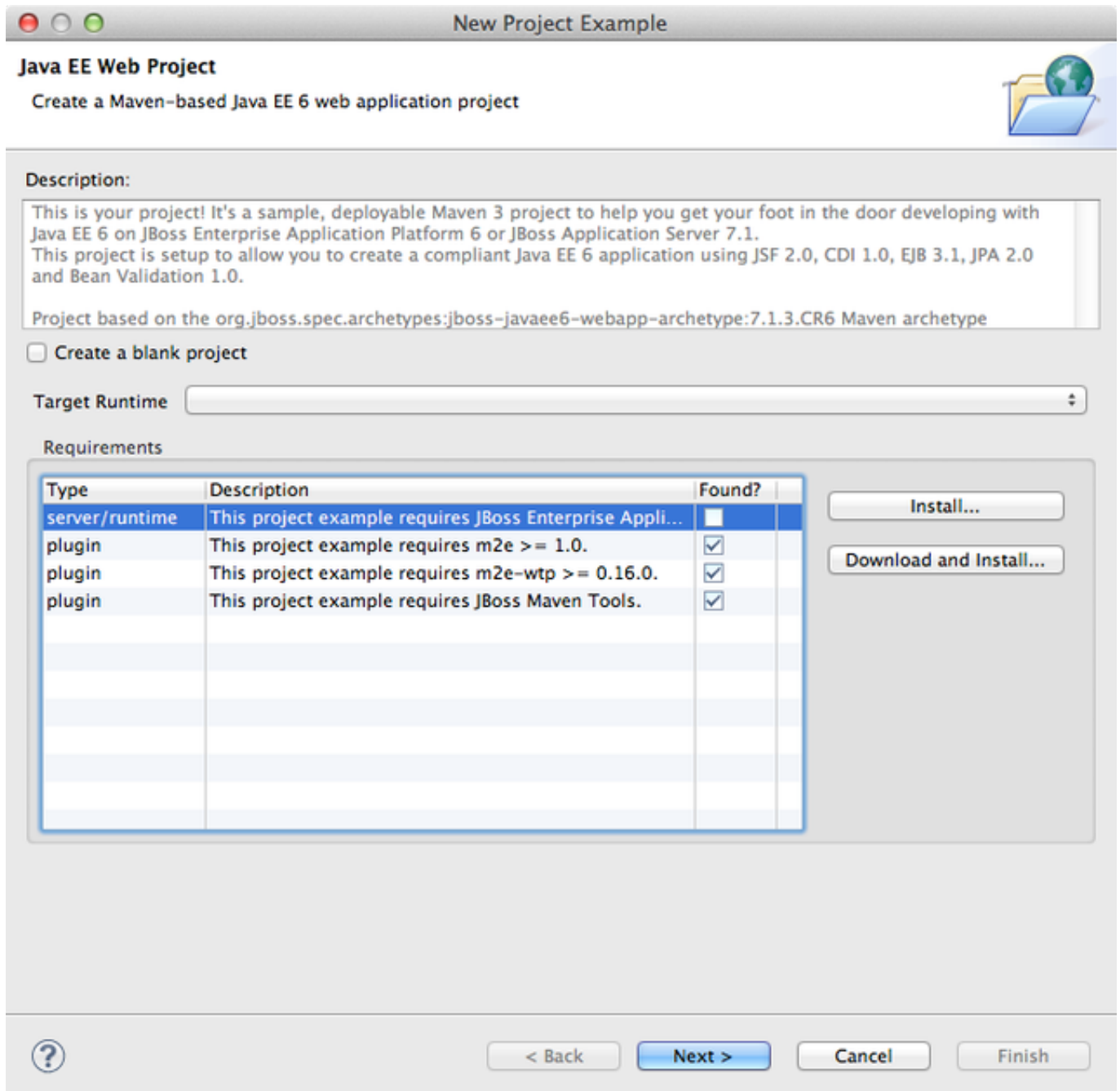


Figure 8.2: New Project Wizard

Note

There are several ways to add JBoss Enterprise Application Platform 6 or JBoss AS 7 to JBoss Developer Studio. The **Install...** button on the new project wizard is probably the easiest, but you can use any of the methods you are familiar with!

To add JBoss Enterprise Application Platform or JBoss AS 7, click on the **Install...** button, or if you have not yet downloaded and unzipped the server, click on the **Download and Install...** button.

**Caution**

The download option only works with the community application server. Although the enterprise application server is listed, it still needs to be manually downloaded.

Selecting **Install...** will pop up the JBoss Runtime Detection section of Preferences. You can always get back to this dialog by selecting **Preferences** → **JBoss Tools** → **JBoss Tools Runtime Detection**.

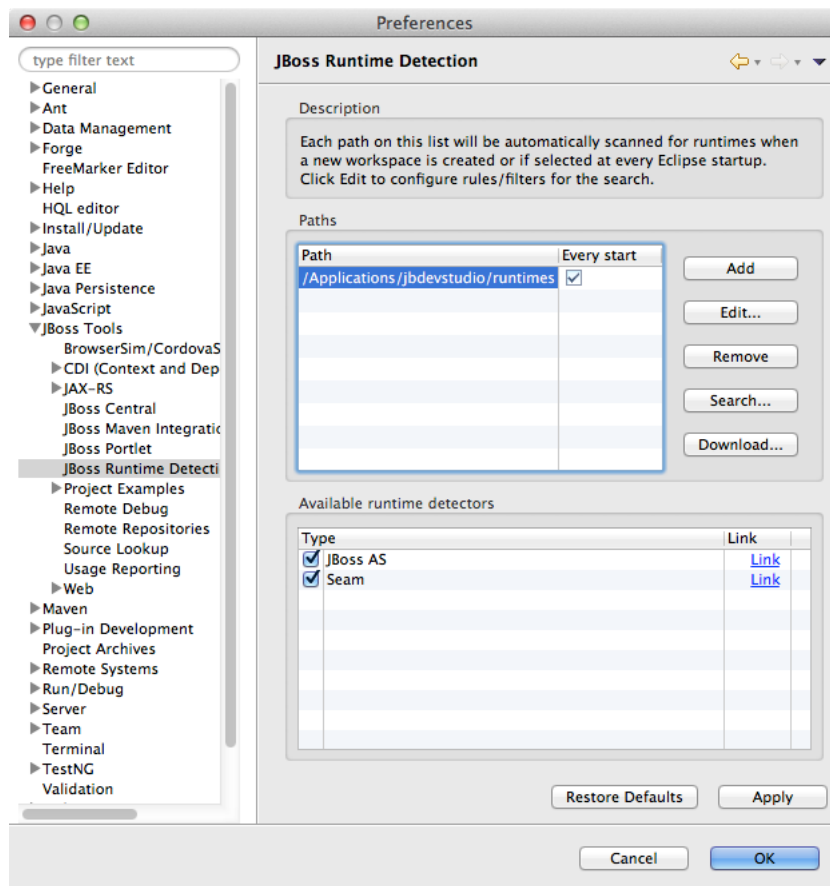


Figure 8.3: JBoss Tools Runtime Detection

Select the **Add** button which will take you to a file browser dialog where you should locate your unzipped JBoss server.

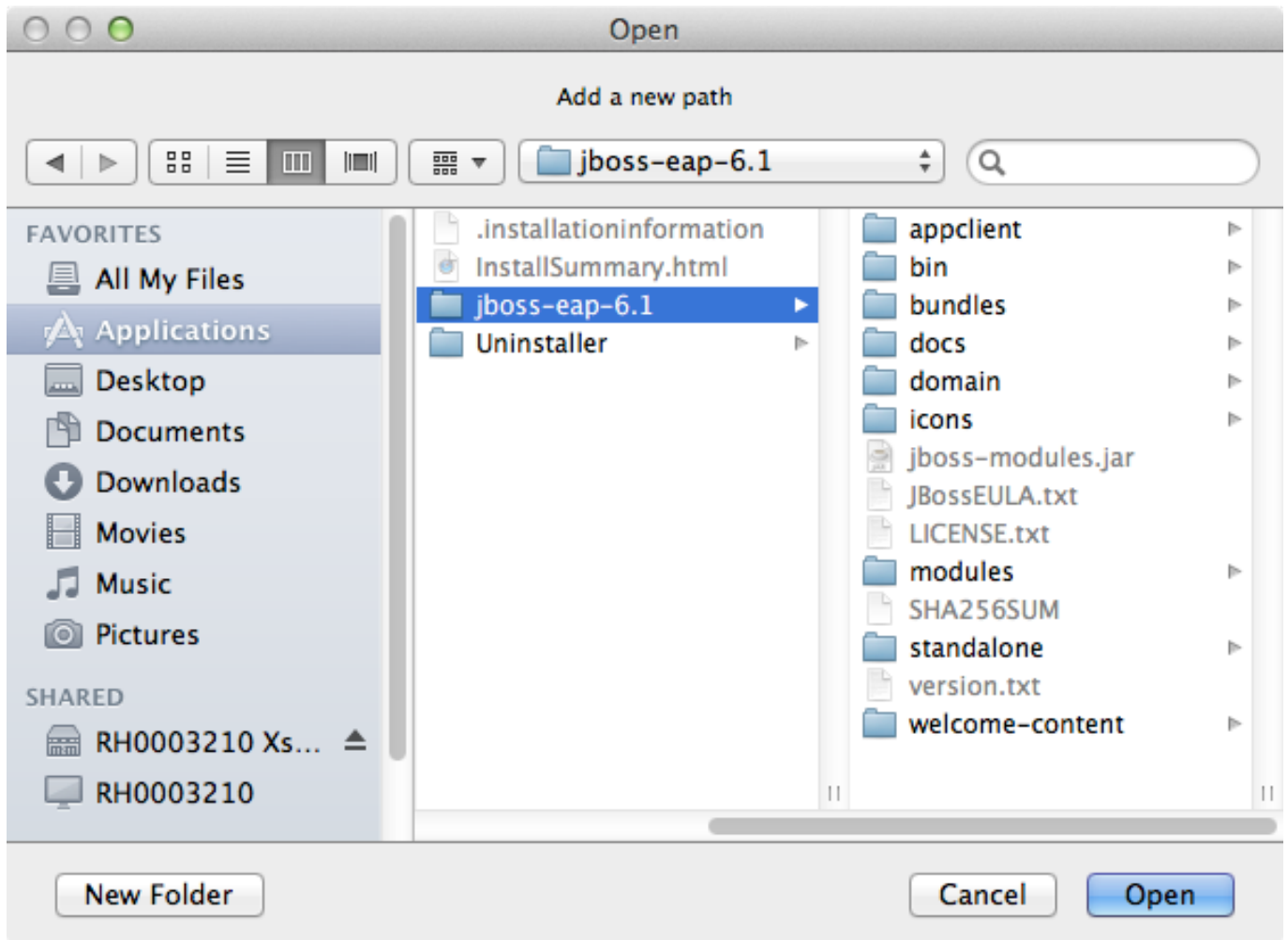


Figure 8.4: Runtime Open Dialog

Select **Open** and JBoss Developer Studio will pop up the **Searching for runtimes...** window.

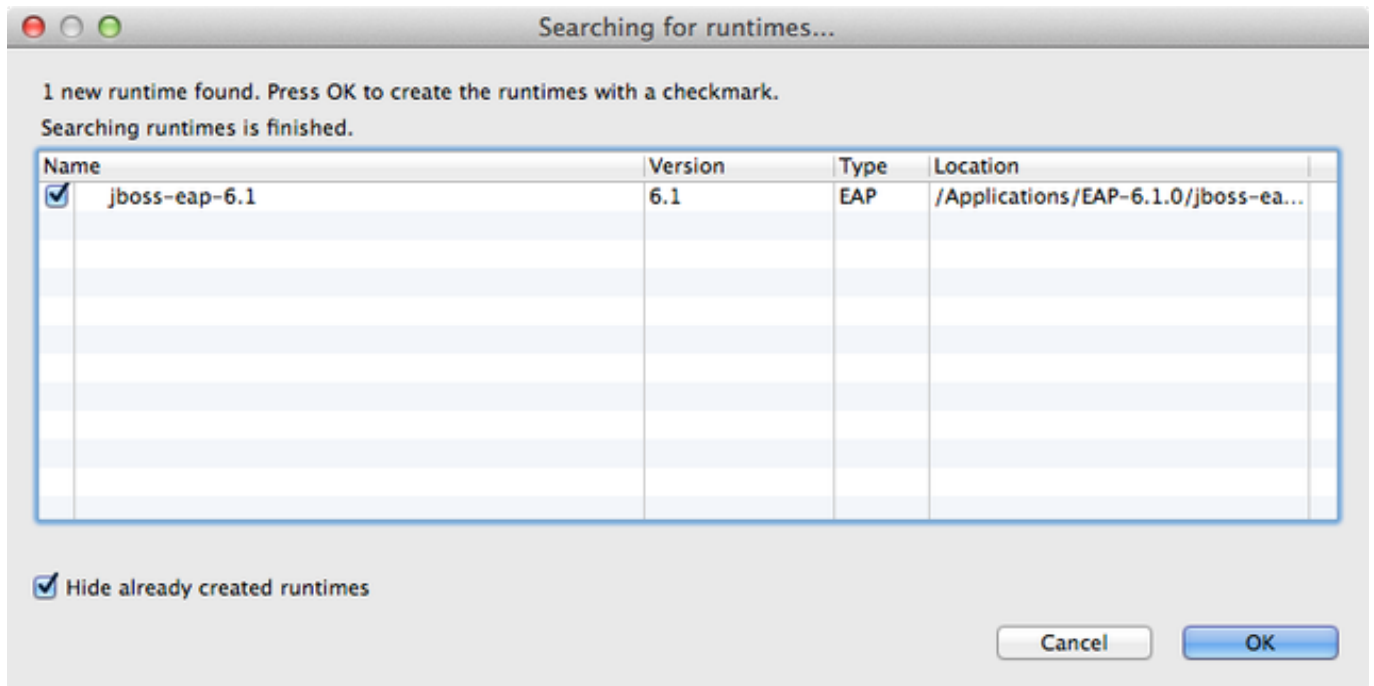


Figure 8.5: Searching for runtimes window

Simply select **OK**. You should see the added runtime in the Paths list.

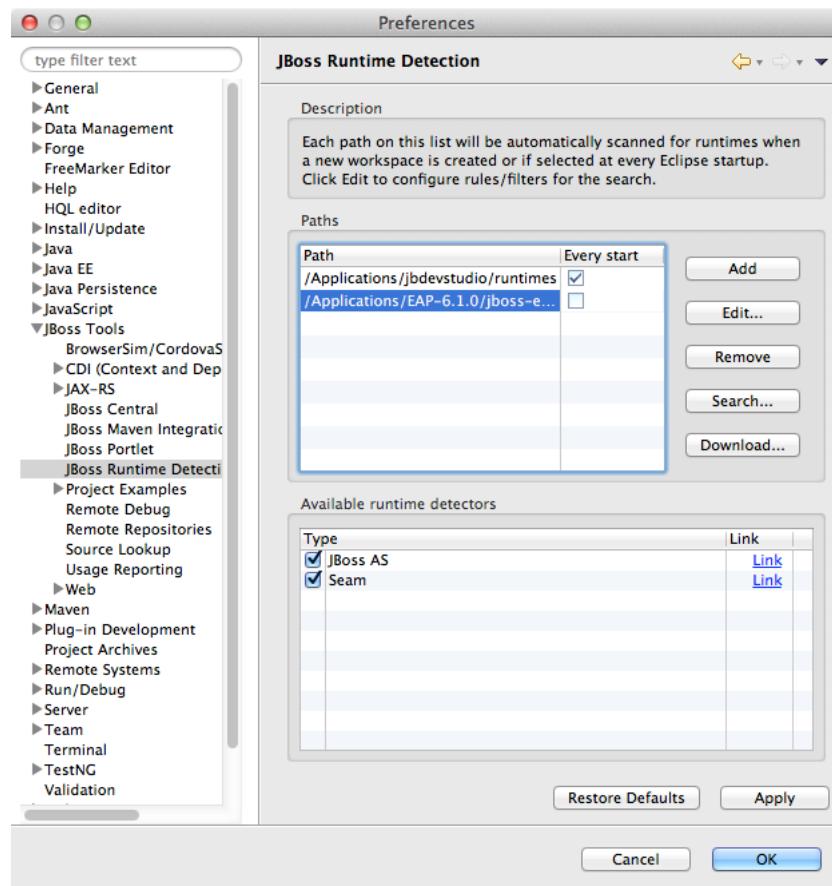


Figure 8.6: JBoss Tools Runtime Detection Completed

Select **OK** to close the **Preferences** dialog, and you will be returned to the **New Project Example** dialog, with the the server/run-time found.

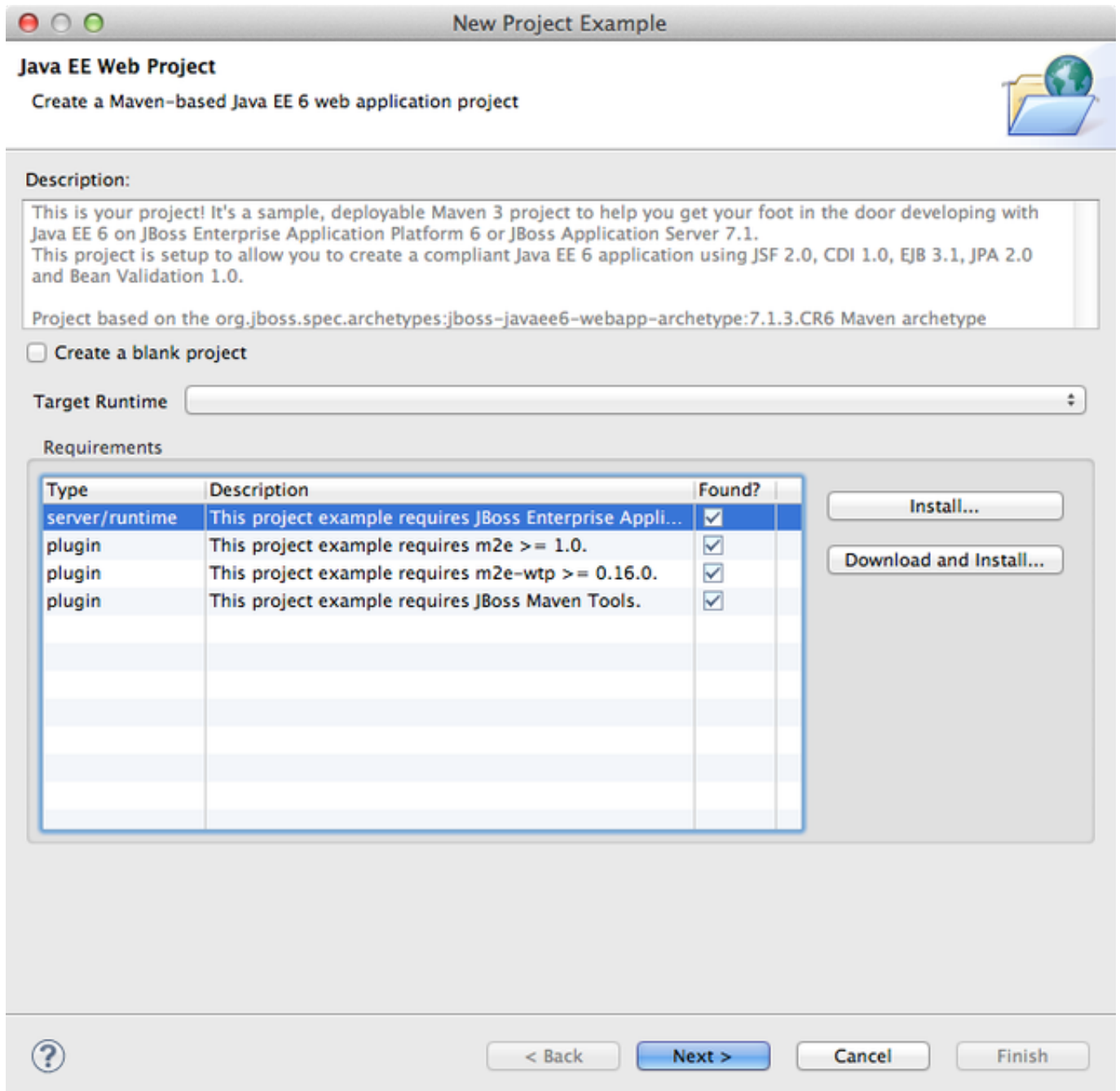


Figure 8.7: JBoss AS 7.0/7.1 or EAP 6 Found

The **Target Runtime** allows you to choose between JBoss Enterprise Application Platform and JBoss AS 7. If it is left empty, JBoss AS 7 will be elected.

**Caution**

Choosing an enterprise application server as the runtime will require you to configure Maven to use the JBoss Enterprise Maven repositories. For instructions on configure the Maven repositories, visit the [JBoss Enterprise Application Platform 6.1 documentation](#).

Select **Next**.

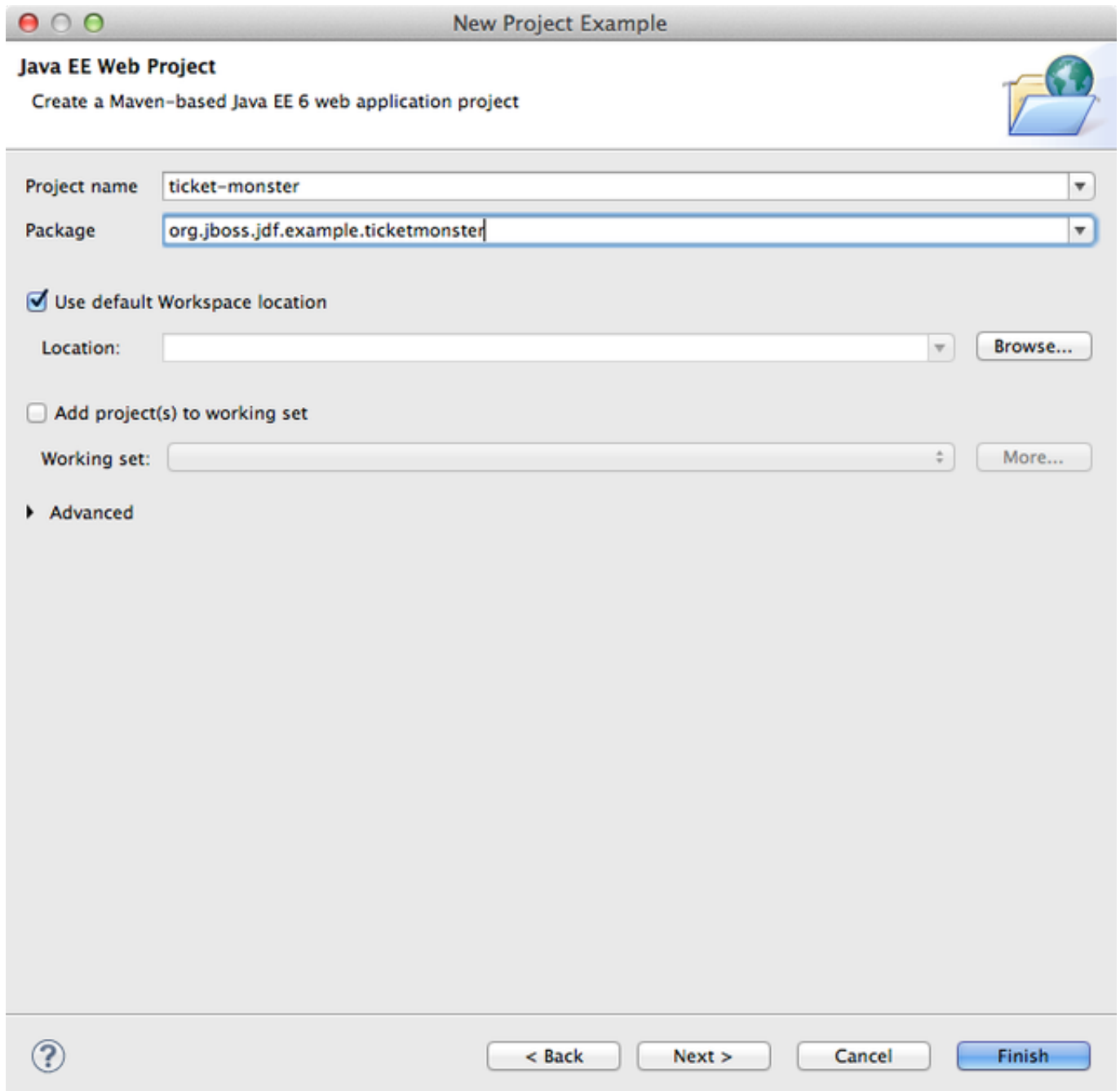


Figure 8.8: New Project Wizard Step 2

The default **Project name** is `jboss-javaee6-webapp`. If this field appears blank, it is because your workspace already contains a "jboss-javaee6-webapp" in which case just provide another name for your project. Change the project name to `ticket-monster`, and the package name to `org.jboss.jdf.example.ticketmonster`.

Select **Finish**.

JBoss Tools/JBoss Developer Studio will now generate the template project and import it into the workspace. You will see it pop up into the Project Explorer and a message that asks if you would like to review the readme file.

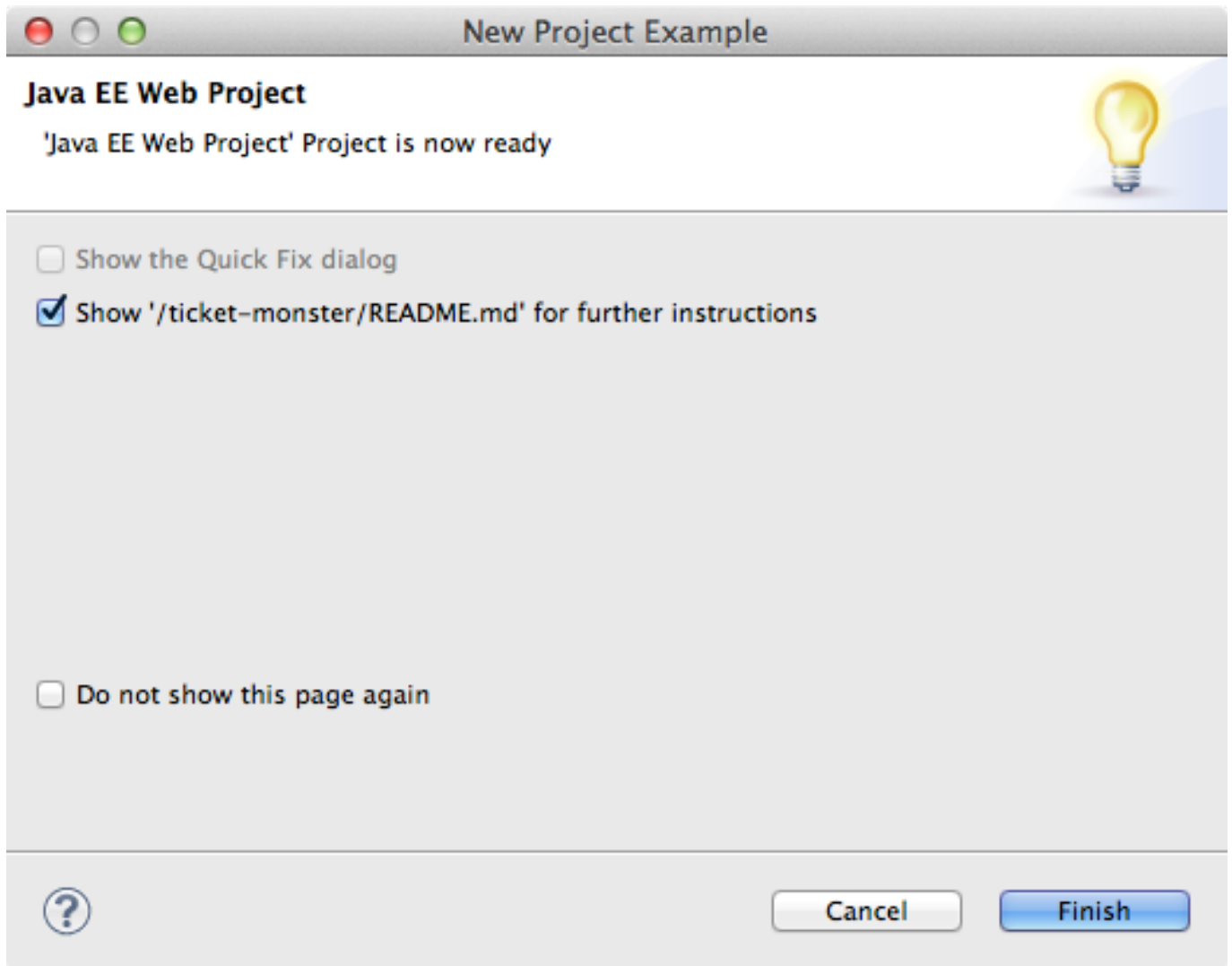


Figure 8.9: New Project Wizard Step 3

Select **Finish**

Chapter 9

Exploring the newly generated project

Using the **Project Explorer**, open up the generated project, and double-click on the `pom.xml`.

The generated project is a Maven-based project with a `pom.xml` in its root directory.

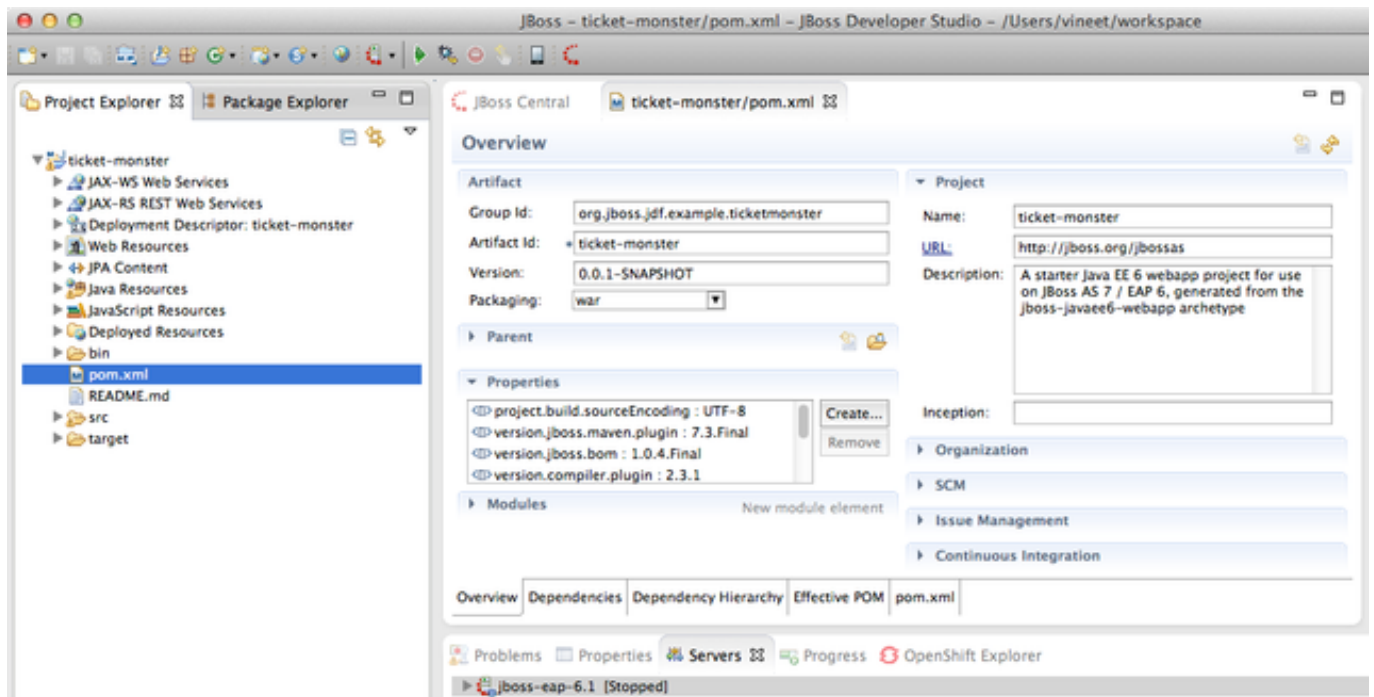


Figure 9.1: Project Explorer

JBoss Developer Studio and JBoss Tools include m2e and m2e-wtp. m2e is the Maven Eclipse plug-in and provides a graphical editor for editing `pom.xml` files, along with the ability to run maven goals directly from within Eclipse. m2e-wtp allows you to deploy your Maven-based project directly to any Web Tools Project (WTP) compliant application server. This means you can drag & drop, use **Run As** → **Run on Server** and other mechanisms to have the IDE deploy your application.

The `pom.xml` editor has several tabs along its bottom edge.

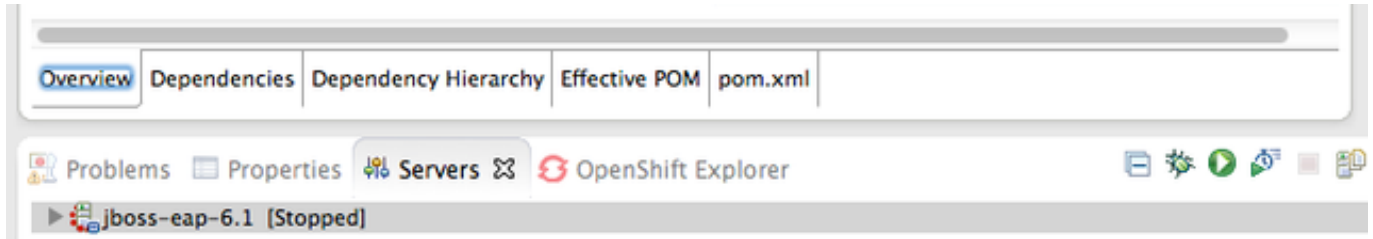


Figure 9.2: pom.xml Editor Tabs

For this tutorial, we do not need to edit the `pom.xml` as it already provides the Java EE 6 APIs that we will need (e.g. JPA, JAX-RS, CDI). You should spend some time exploring the **Dependencies** and the **pom.xml** (source view) tabs.

One key element to make note of is `<version.jboss.bom>1.0.4.Final</version.jboss.bom>` which establishes if this project uses JBoss Enterprise Application Platform or JBoss AS dependencies. The BOM (Bill of Materials) specifies the versions of the Java EE (and other) APIs defined in the dependency section.

If you are using JBoss Enterprise Application Platform 6 and you selected that as your Target Runtime, you will find a `-redhat-1` suffix on the version string. You may need to setup the JBoss Enterprise Maven repository to use the certified dependencies in your project, details of which are available [here](#).

**Caution**

The specific version of the BOM (e.g. `1.0.4.Final`) is likely to change, so do not be surprised if the version is slightly different.

The recommended version of the BOM for a runtime (EAP 6 or AS 7) can be obtained by visiting [the JBoss Stacks site](#).

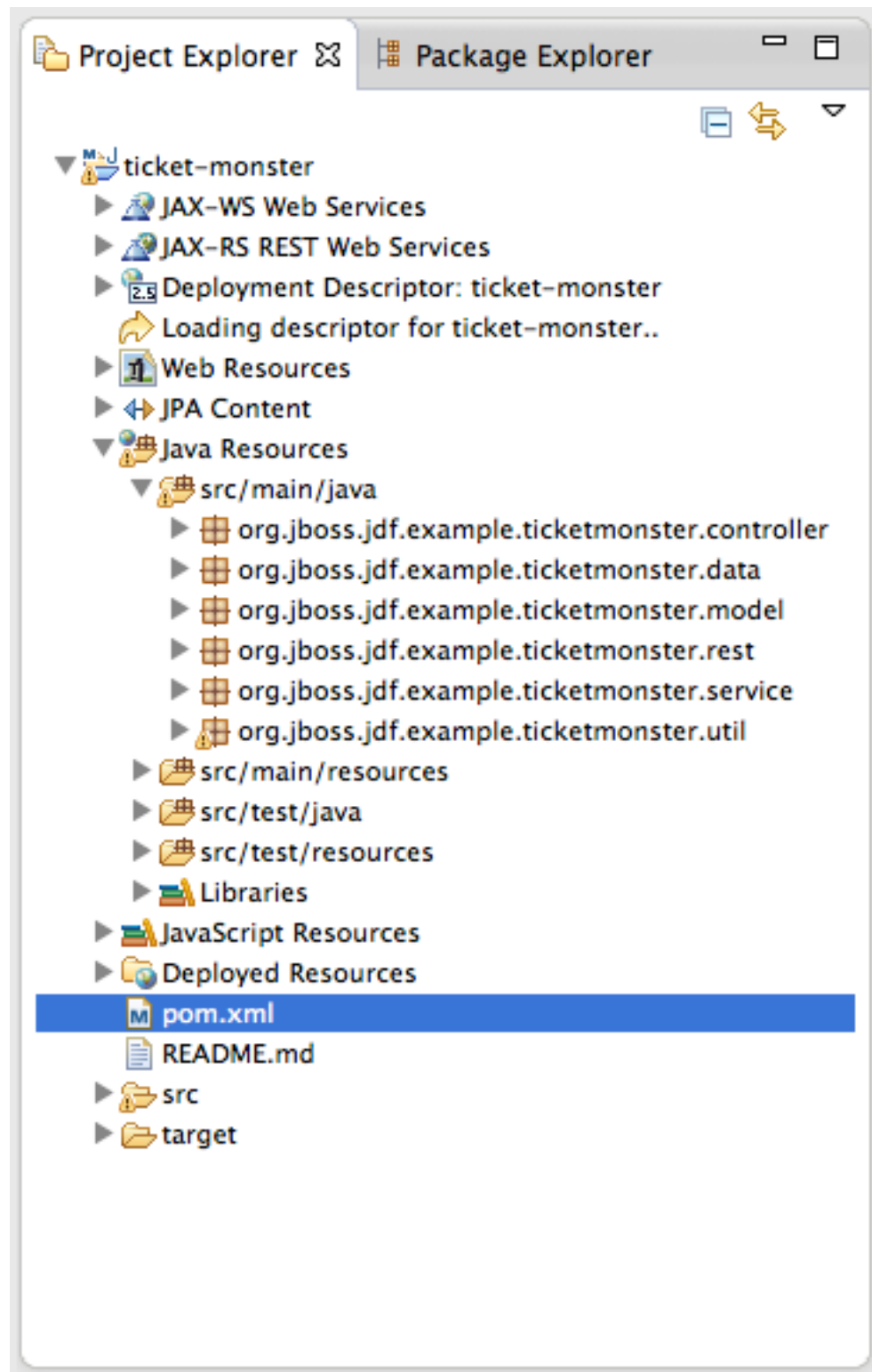


Figure 9.3: Project Explorer Java Packages

Using the **Project Explorer**, drill-down into `src/main/java` under **Java Resources**.

The initial project includes the following Java packages:

`.controller`

contains the backing beans for `#{newMember}` and `#{memberRegistration}` in the JSF page `index.xhtml`

.data

contains a class which uses `@Produces` and `@Named` to return the list of members for `index.xhtml`

.model

contains the JPA entity class, a POJO annotated with `@Entity`, annotated with Bean Validation (JSR 303) constraints

.rest

contains the JAX-RS endpoints, POJOs annotated with `@Path`

.service

handles the registration transaction for new members

.util

contains `Resources.java` which sets up an alias for `@PersistenceContext` to be injectable via `@Inject`

Now, let's explore the resources in the project.

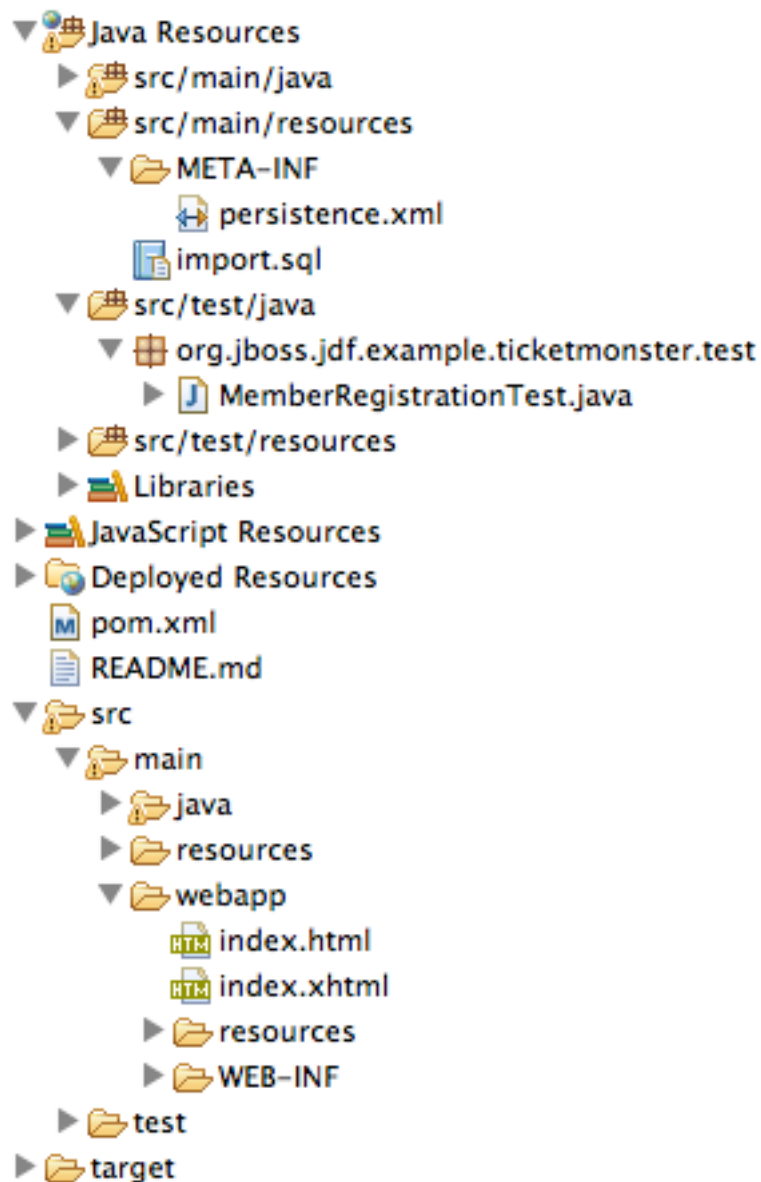


Figure 9.4: Project Explorer Resources

Under src you will find:

main/resources/import.sql

contains insert statements that provides initial database data. This is particularly useful when `hibernate.hbm2ddl.auto=create` is set in `persistence.xml`. `hibernate.hbm2ddl.auto=create-drop` causes the schema to be recreated each time the application is deployed.

main/resources/META-INF/persistence.xml

establishes that this project contains JPA entities and it identifies the datasource, which is deployed alongside the project. It also includes the `hibernate.hbm2ddl.auto` property set to `create-drop` by default.

test/java/test

provides the `.test` package that contains `MemberRegistrationTest.java`, an Arquillian based test that runs both from within JBoss Developer Studio via **Run As** → **JUnit Test** and at the command line:

```
mvn test -Parq-jbossas-remote
```

Note that you will need to start the JBoss Enterprise Application Platform 6 or JBoss AS 7 server before running the test.

src/main/webapp

contains `index.xhtml`, the JSF-based user interface for the sample application. If you double-click on that file you will see Visual Page Editor allows you to visually navigate through the file and see the source simultaneously. Changes to the source are immediately reflected in the visual pane.

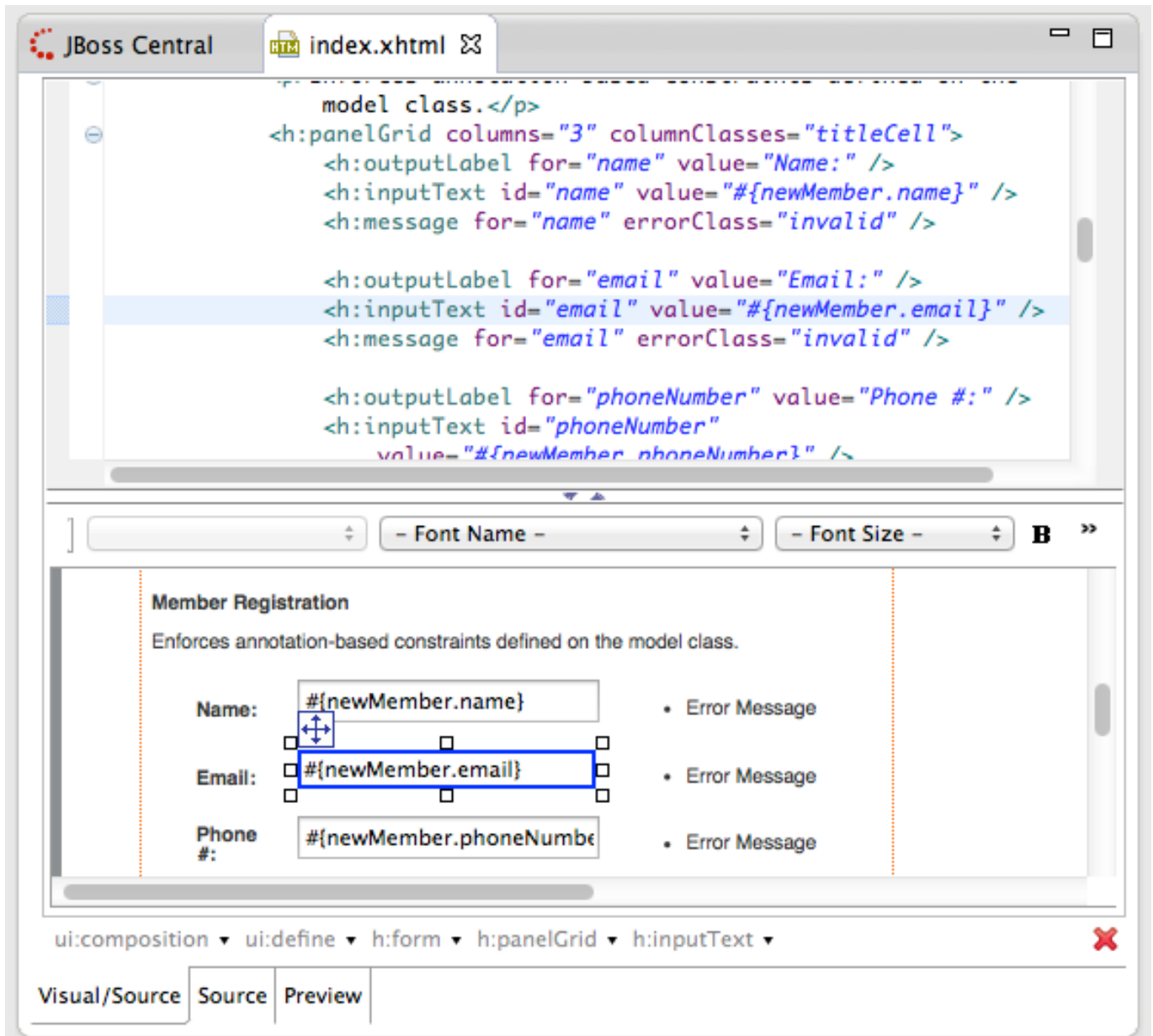


Figure 9.5: Visual Page Editor

In `src/main/webapp/WEB-INF`, you will find three key files:

beans.xml

is an empty file that indicates this is a CDI capable EE6 application

faces-config.xml

is an empty file that indicates this is a JSF capable EE6 application

ticket-monster-ds.xml

when deployed, creates a new datasource within the JBoss container

Chapter 10

Adding a new entity using Forge

There are several ways to add a new JPA entity to your project:

Starting from scratch

Right-click on the `.model` package and select **New** → **Class**. JPA entities are annotated POJOs so starting from a simple class is a common approach.

Reverse Engineering

Right-click on the "model" package and select **New** → **JPA Entities from Tables**. For more information on this technique see [this video](#)

Using Forge

to create a new entity for your project using a CLI (we will explore this in more detail below)

Reverse Engineering with Forge

Forge has a Hibernate Tools plug-in that allows you to script the conversion of RDBMS schema into JPA entities. For more information on this technique see [this video](#).

For the purposes of this tutorial, we will take advantage of Forge to add a new JPA entity. This requires the least keystrokes, and we do not yet have a RDBMS schema to reverse engineer. There is also an optional section for adding an entity using **New** → **Class**.

Right-click on the `.model` package in the **Project Explorer** and select **Show In** → **Forge Console**.

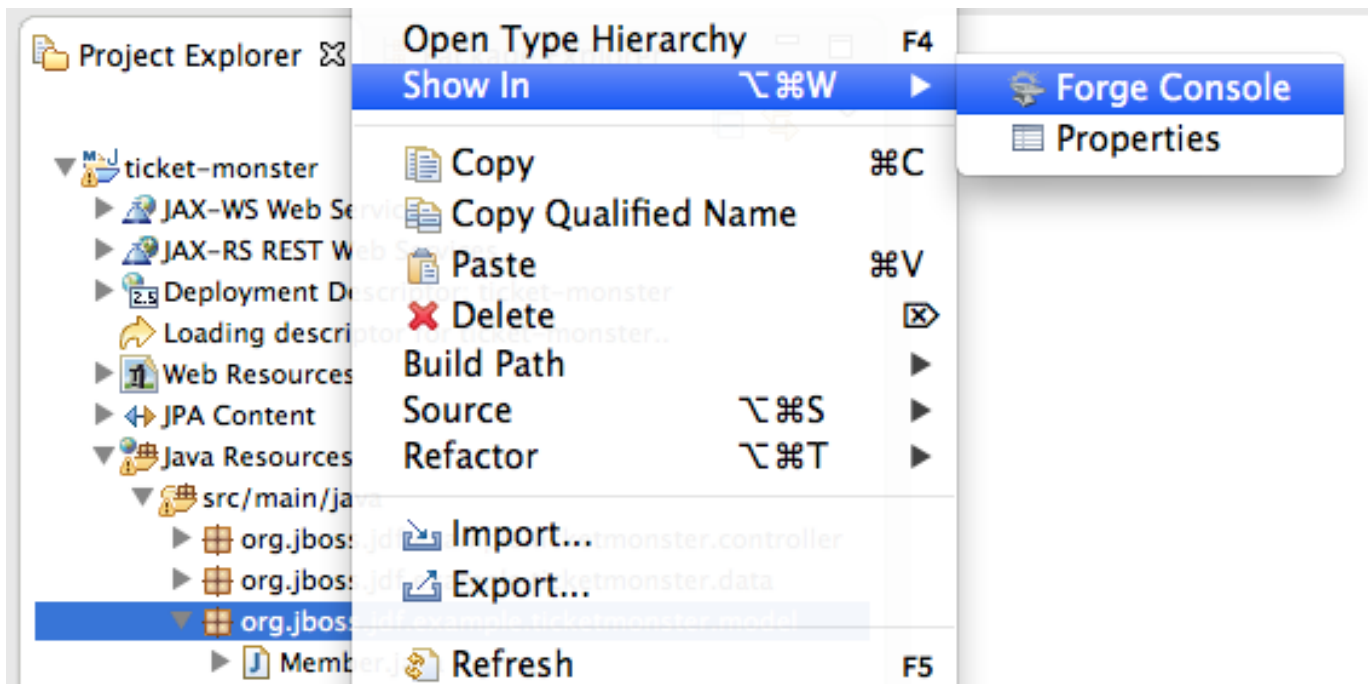


Figure 10.1: Show In Forge Console

Tip

Alternative methods to activate Forge include:

- **Window** → **Show View** → **Forge Console**
- **Ctrl 4** (Windows) or **Cmd 4** (Mac).

Note: the Show In method will issue a "pick-up" command to switch you to the right location within your project.

The first time you start Forge, you will be prompted with a **Forge Not Running** dialog, select **Yes**.

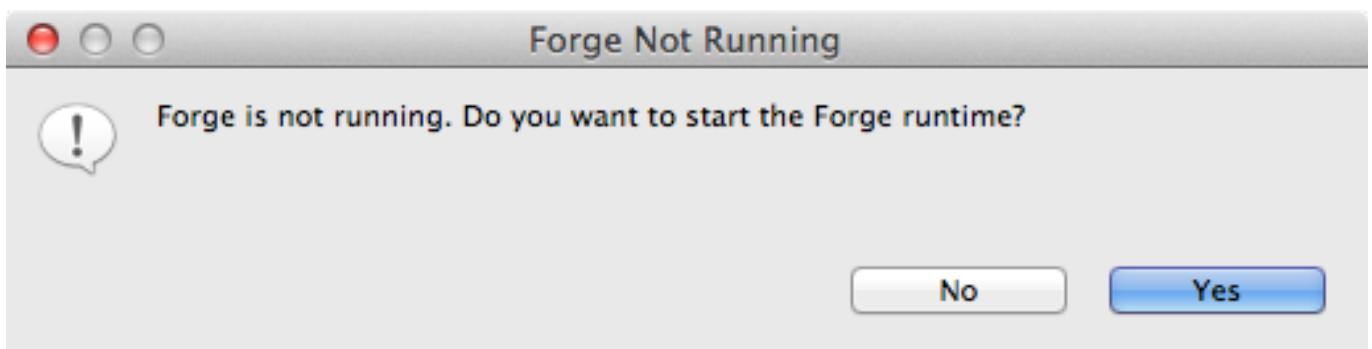


Figure 10.2: Show Forge Not Running

Tip

If you are not prompted you can always start Forge using the green arrow (or stop via the red square) in the Forge Console tab.



Figure 10.3: Show Forge Start/Stop



Figure 10.4: Show Forge Console

Forge is a command-oriented rapid application development tool that allows you to enter commands that generate classes and code. It will automatically update the IDE for you. A key feature is "content assist" or "tab completion", activated by pressing **tab**.

To generate an entity, use these commands:

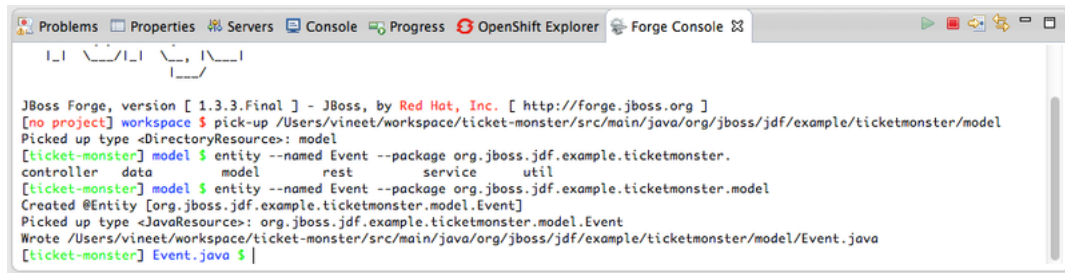
```
entity --named Event --package org.jboss.jdf.example.ticketmonster.model
field string --named name
validation setup --provider JAVA_EE
constraint NotNull --onProperty name
constraint Size --onProperty name --min 5 --max 50 --message "Must be > 5 and < 50"
field string --named description
constraint Size --onProperty description --min 20 --max 1000 --message "Must be > 20 and < 1000"
field boolean --named major
field string --named picture
```

Let's work through this, step by step.

At the `[ticket-monster] model $` prompt, type `en` and hit the `tab` key on your keyboard. `entity` will fill in. Hit `tab` again and `entity --named` will appear. Type in `Event` and add a space—Forge can not anticipate the name of your new entity!

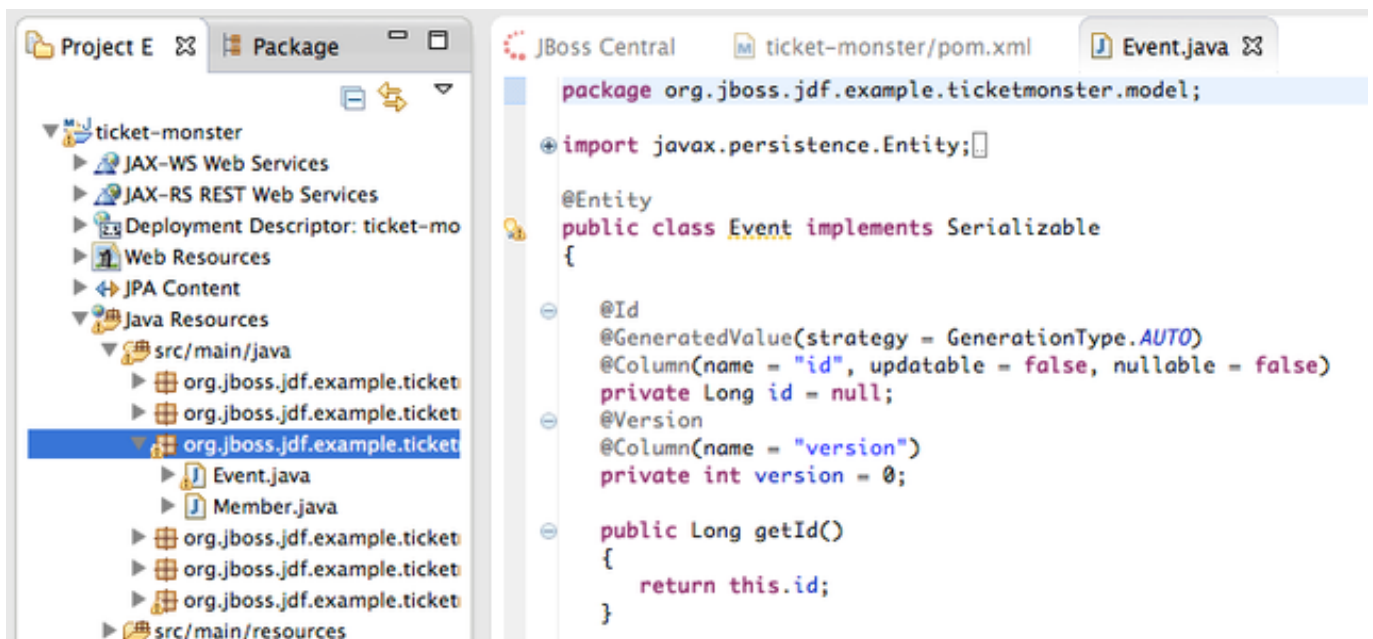
Hit `tab` again and select `--package`. Now, hit `tab` repeatedly to fill in `org.jboss.jdf.example.ticketmonster`. Since there are multiple entries underneath examples, Forge will display those options. Type in `m` and hit `tab` to select `model`.

Now hit the `Enter/Return` key to watch the command execute. The `Event` entity will be generated into the "model" package and open up inside of Eclipse.



```
JBoss Forge, version [ 1.3.3.Final ] - JBoss, by Red Hat, Inc. [ http://forge.jboss.org ]
[no project] workspace $ pick-up /Users/vineet/workspace/ticket-monster/src/main/java/org/jboss/jdf/example/ticketmonster/model
Picked up type <DirectoryResource>: model
[ticket-monster] model $ entity --named Event --package org.jboss.jdf.example.ticketmonster.
controller data model rest service util
[ticket-monster] model $ entity --named Event --package org.jboss.jdf.example.ticketmonster.model
Created @Entity [org.jboss.jdf.example.ticketmonster.model.Event]
Picked up type <JavaResource>: org.jboss.jdf.example.ticketmonster.model.Event
Wrote /Users/vineet/workspace/ticket-monster/src/main/java/org/jboss/jdf/example/ticketmonster/model/Event.java
[ticket-monster] Event.java $
```

Figure 10.5: Forge new entity



```
package org.jboss.jdf.example.ticketmonster.model;

import javax.persistence.Entity;

@Entity
public class Event implements Serializable
{
    @Id
    @GeneratedValue(strategy = GenerationType.AUTO)
    @Column(name = "id", updatable = false, nullable = false)
    private Long id = null;

    @Version
    @Column(name = "version")
    private int version = 0;

    public Long getId()
    {
        return this.id;
    }
}
```

Figure 10.6: Event Entity

Note

@Entity public class is placed on the same line as `import java.lang.Override` by Forge. Using the formatter your IDE provides on the entity will make this look more like you would expect!

Forge has automatically changed the context of the CLI to Event.java, and typing `ls` will provide a listing of the fields and methods.



Figure 10.7: Forge ls

Now that the base `Event` entity has been created, let's add the fields and their JSR 303 Bean Validation constraints.

This next step involves adding a name property for the `Event` entity so that an event could hold data like "Rock Concert".

Type `fi` and hit `tab` to fill in `field`, if you hit `tab` again, Forge will list out the possible field types. Type in `s` and hit `tab`, Forge will respond with `string`. Hit `tab` again to get `--named` and type in `name`. You should end up with the command `field string --named name`, to execute it, press `enter`. This will add a `private String name;` field, and the appropriate accessor and mutator (getter and setter) methods. You should also notice that the `toString` method is tweaked to include `name` as well.

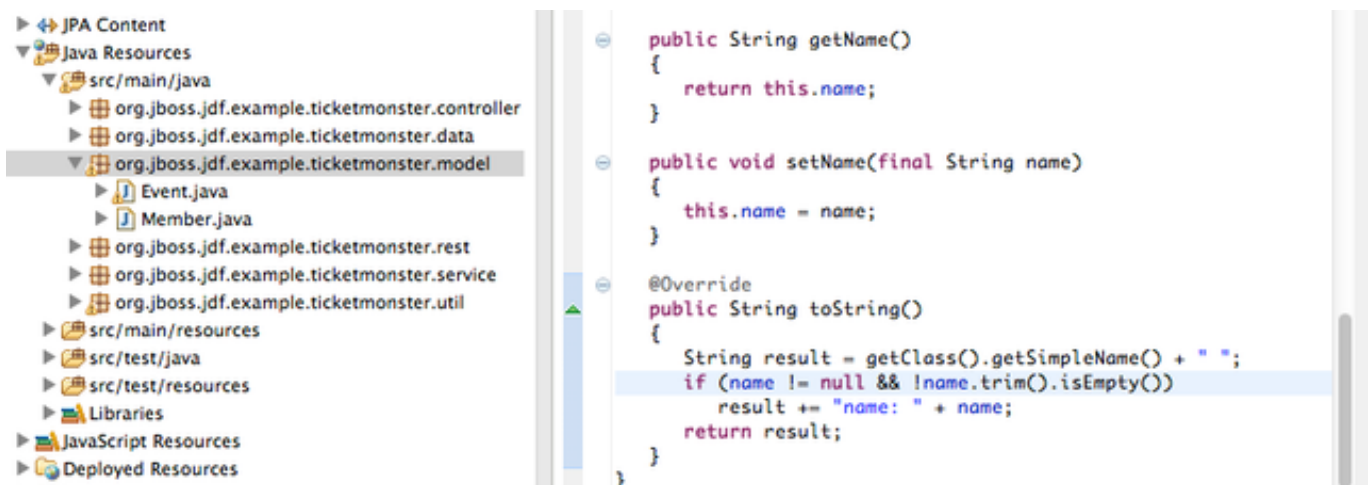


Figure 10.8: @Column name

From this point forward, we will assume you have the basics of using Forge's interactive command line. The remaining commands to run are:

```

validation setup --provider JAVA_EE
constraint NotNull --onProperty name
constraint Size --onProperty name --min 5 --max 50 --message "Must be > 5 and < 50"
field string --named description
constraint Size --onProperty description --min 20 --max 1000 --message "Must be > 20 and < 1000"
field boolean --named major
field string --named picture

```

The easiest way to see the results of Forge operating on the `Event.java` JPA Entity is to use the **Outline View** of JBoss Developer Studio. It is normally on the right-side of the IDE when using the JBoss Perspective.

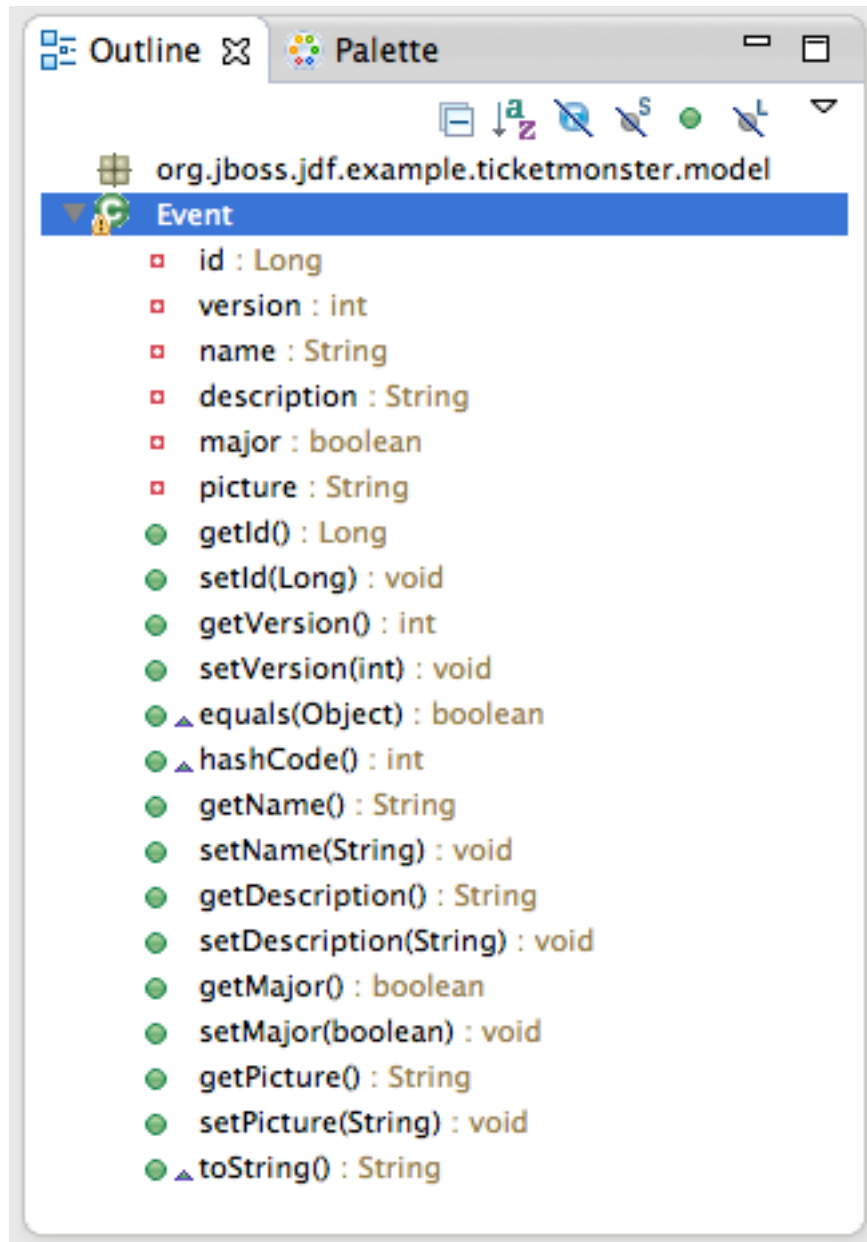


Figure 10.9: Outline View

Chapter 11

Reviewing persistence.xml & updating import.sql

By default, the entity classes generate the database schema, and is controlled by `src/main/resources/persistence.xml`.

The two key settings are the `<jta-data-source>` and the `hibernate.hbm2ddl.auto` property. The `datasource` maps to the `datasource` defined in `src/main/webapp/ticket-monster-ds.xml`.

The `hibernate.hbm2ddl.auto=create-drop` property indicates that all database tables will be dropped when an application is undeployed, or redeployed, and created when the application is deployed.

The `import.sql` file contains SQL statements that will inject sample data into your initial database structure. Add the following insert statements:

```
insert into Event (id, name, description, major, picture, version) values (1, 'Shane''s Sock
Puppets', 'This critically acclaimed masterpiece...', true,
'http://dl.dropbox.com/u/65660684/640px-Carnival_Puppets.jpg', 1);
insert into Event (id, name, description, major, picture, version) values (2, 'Rock concert
of the decade', 'Get ready to rock...', true,
'http://dl.dropbox.com/u/65660684/640px-Weir%2C_Bob_(2007)_2.jpg', 1);
```


Chapter 12

Adding a new entity using JBoss Developer Studio

Alternatively, we can add an entity with JBoss Developer Studio or JBoss Tools.

First, right-click on the `.model` package and select **New** → **Class**. Enter the class name as `Venue` - our concerts & shows happen at particular stadiums, concert halls and theaters.

First, add some private fields representing the entities properties, which translate to the columns in the database table.

```
package org.jboss.jdf.example.ticketmonster.model;

public class Venue {
    private Long id;
    private String name;
    private String description;
    private int capacity;
}
```

Now, right-click on the editor itself, and from the pop-up, context menu select **Source** → **Generate Getters and Setters**.

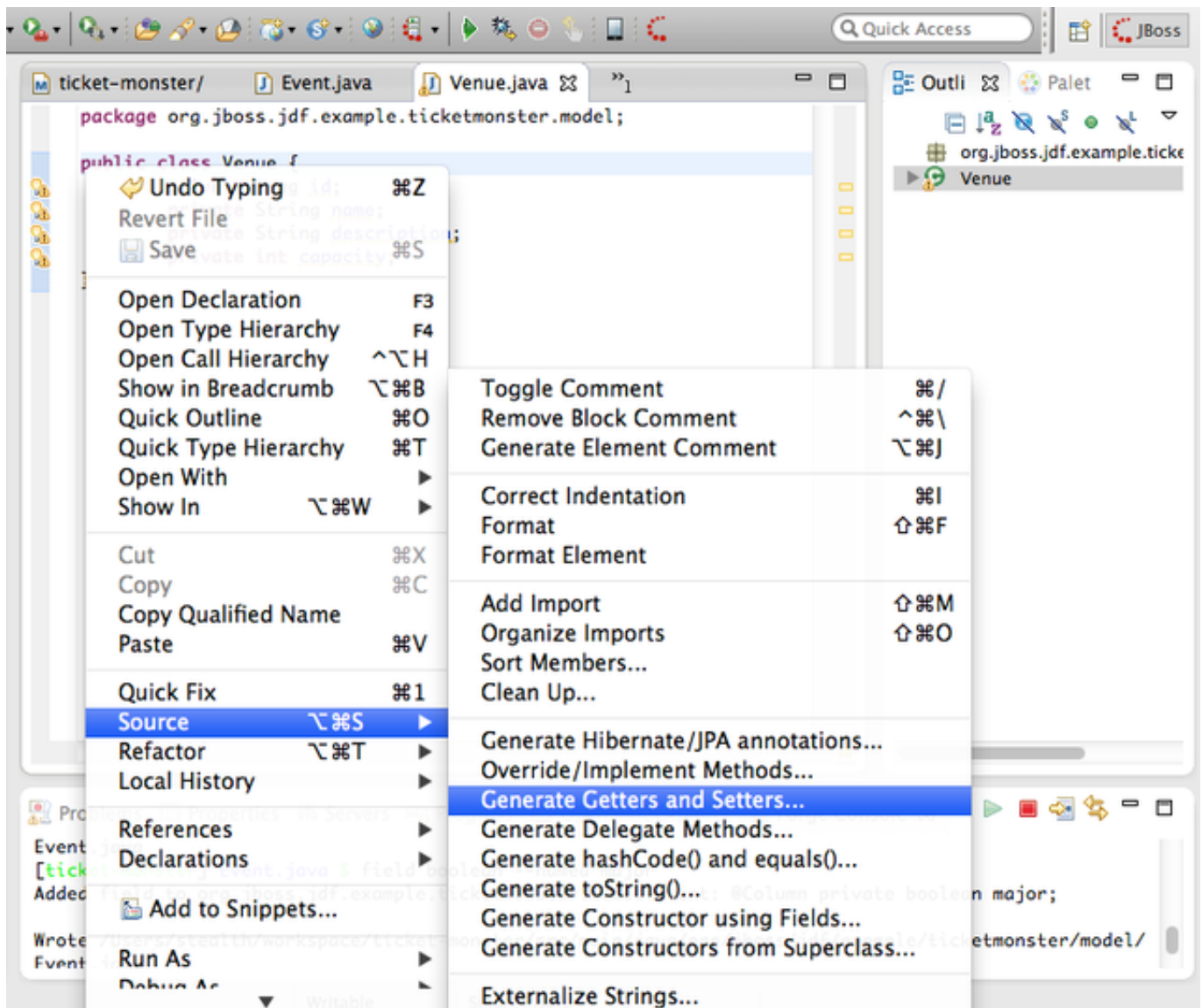


Figure 12.1: Generate Getters and Setters Menu

This will create accessor and mutator methods for all your fields, making them accessible properties for the entity class.

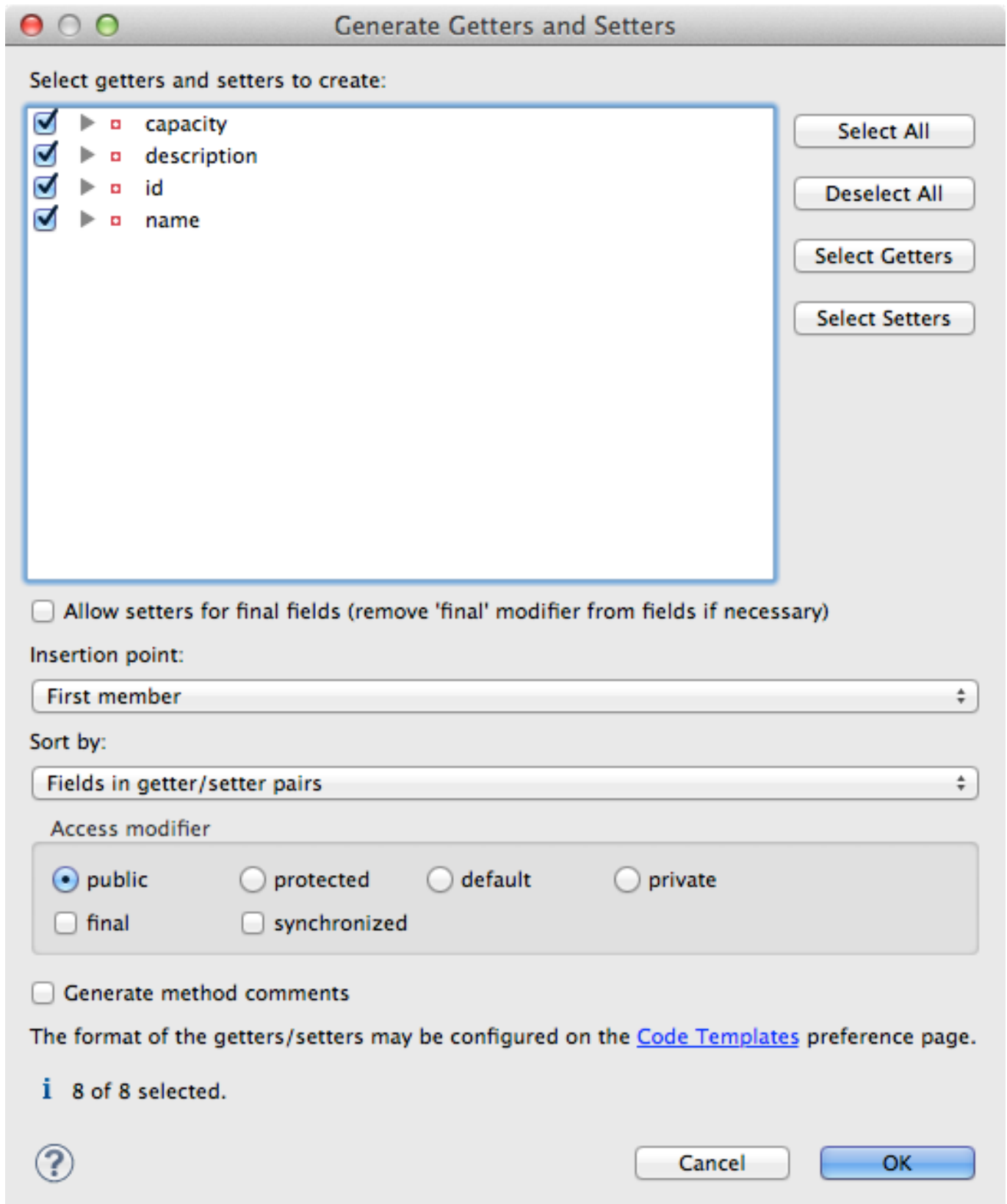


Figure 12.2: Generate Getters and Setters Dialog

Click **Select All** and then **OK**.

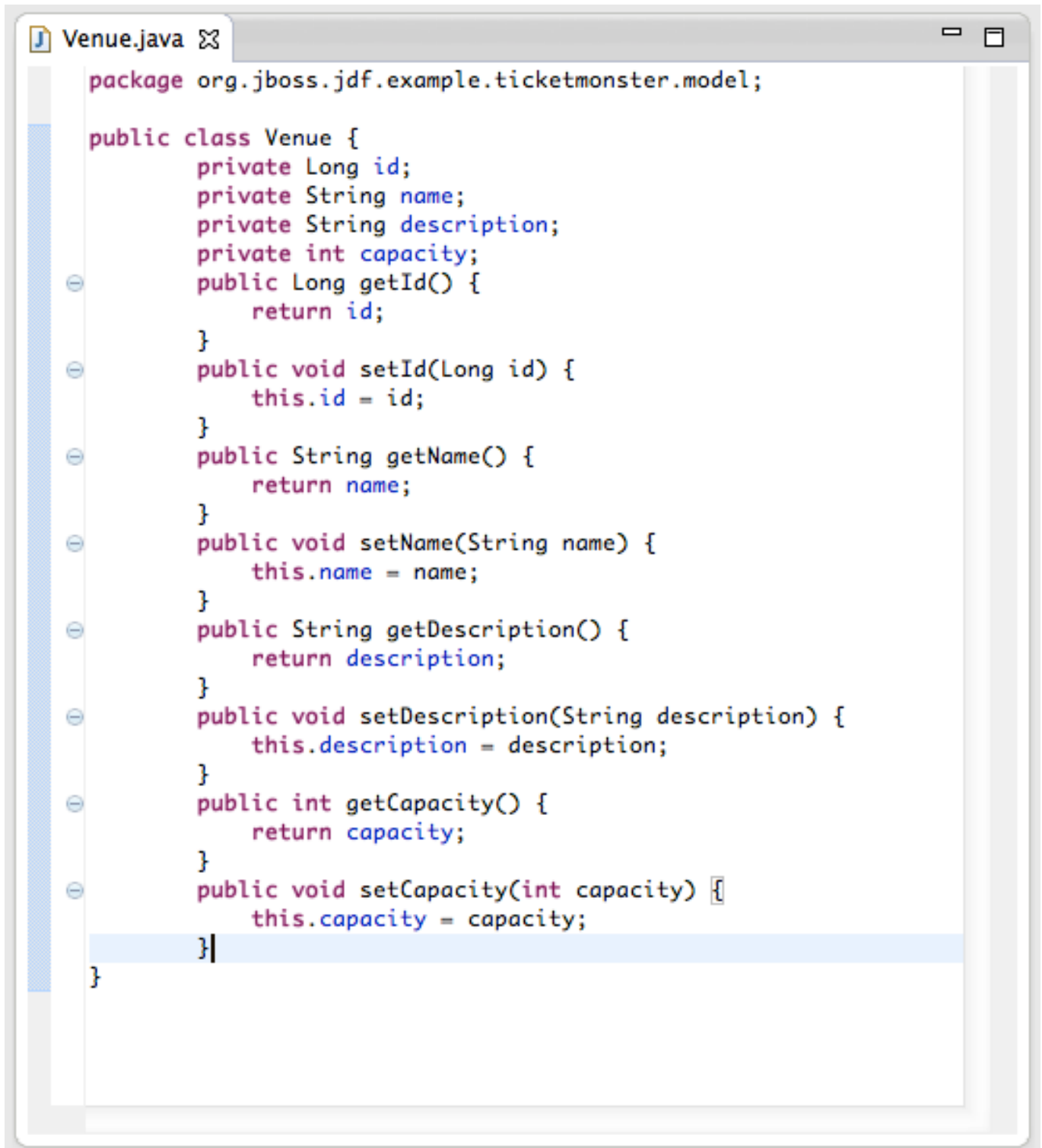


Figure 12.3: Venue.java with gets/sets

Now, right-click on the editor, from the pop-up context menu select **Source** → **Generate Hibernate/JPA Annotations**. If you are prompted to save Venue.java, simply select OK.

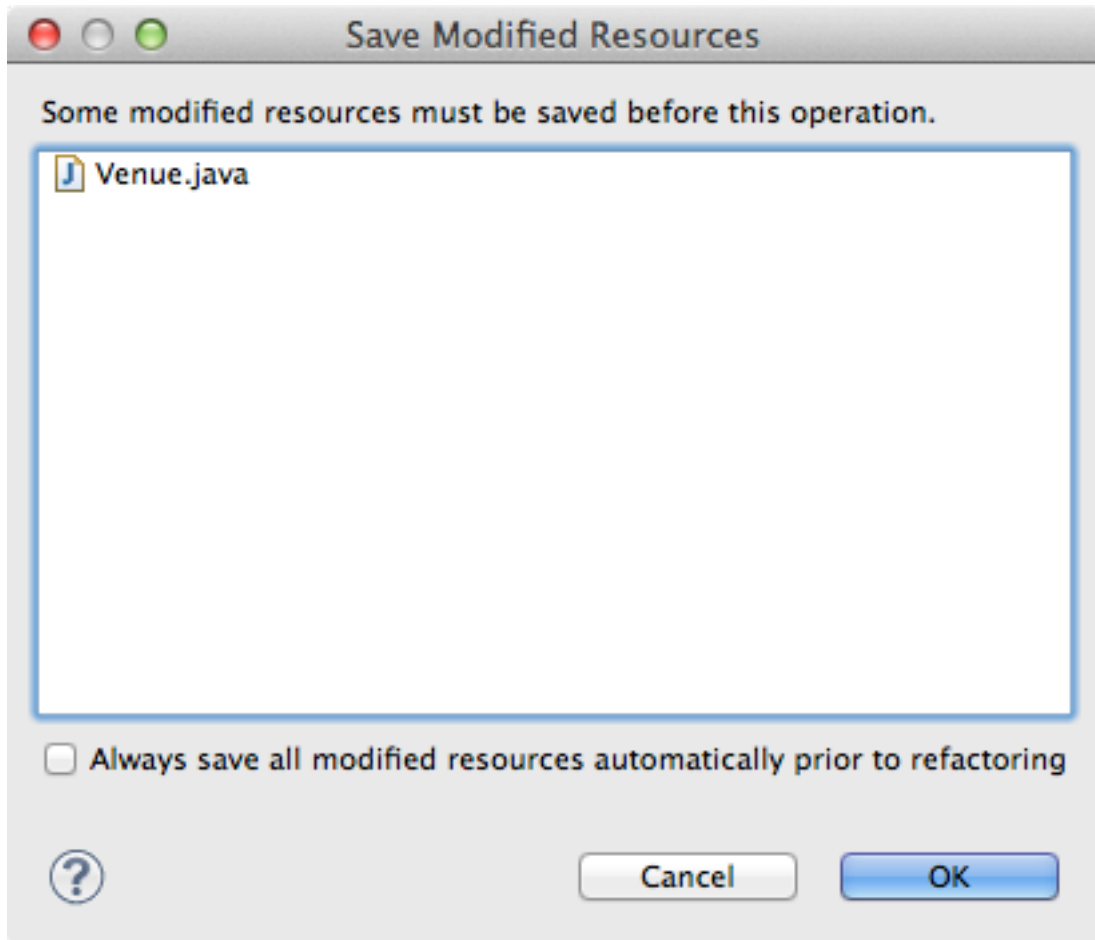


Figure 12.4: Save Modified Resources

The **Hibernate: add JPA annotations** wizard will start up. First, verify that `Venue` is the class you are working on.

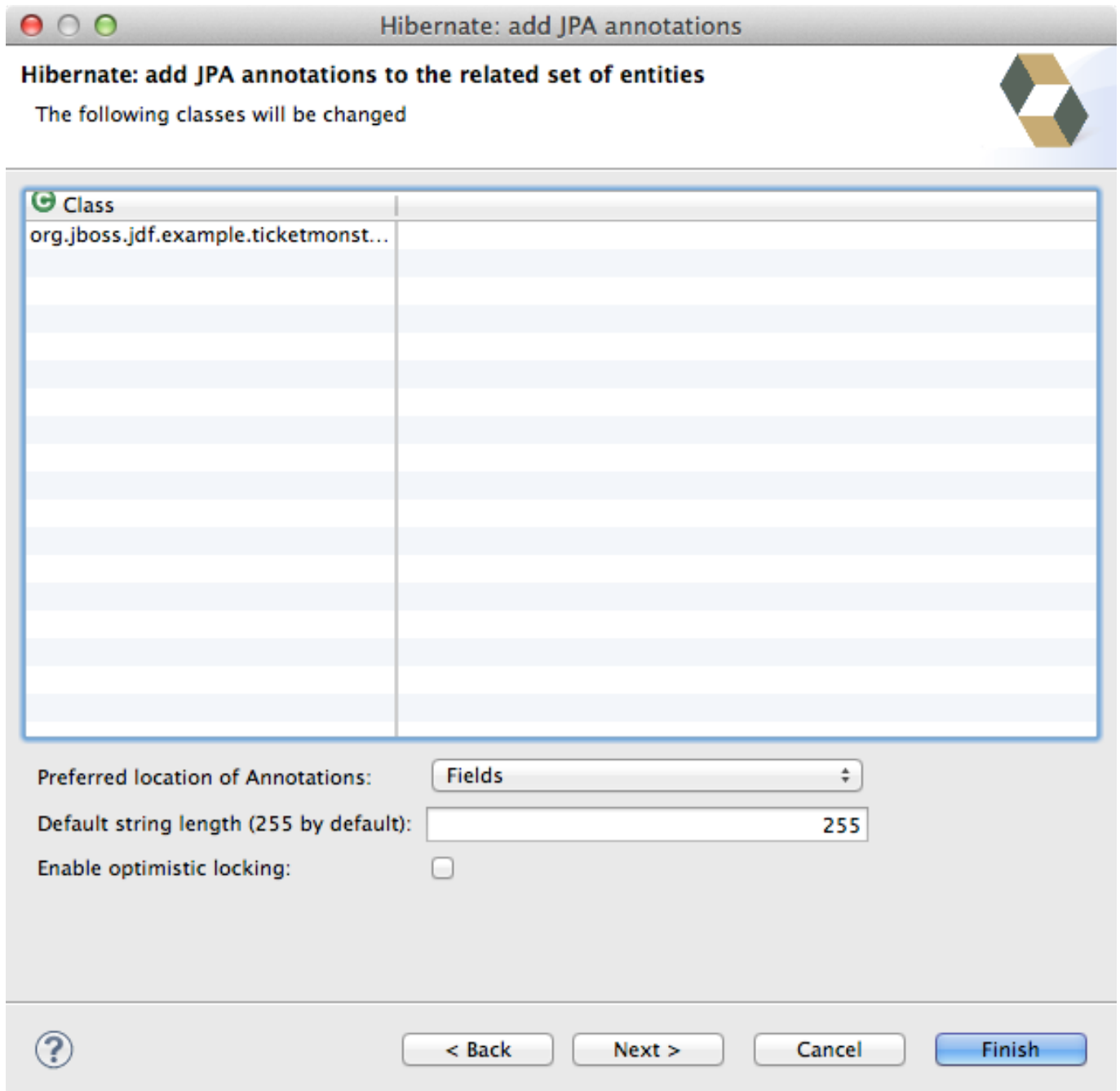


Figure 12.5: Hibernate: add JPA annotations

Select **Next**.

The next step in the wizard will provide a sampling of the refactored sources – describing the basic changes that are being made to Venue.

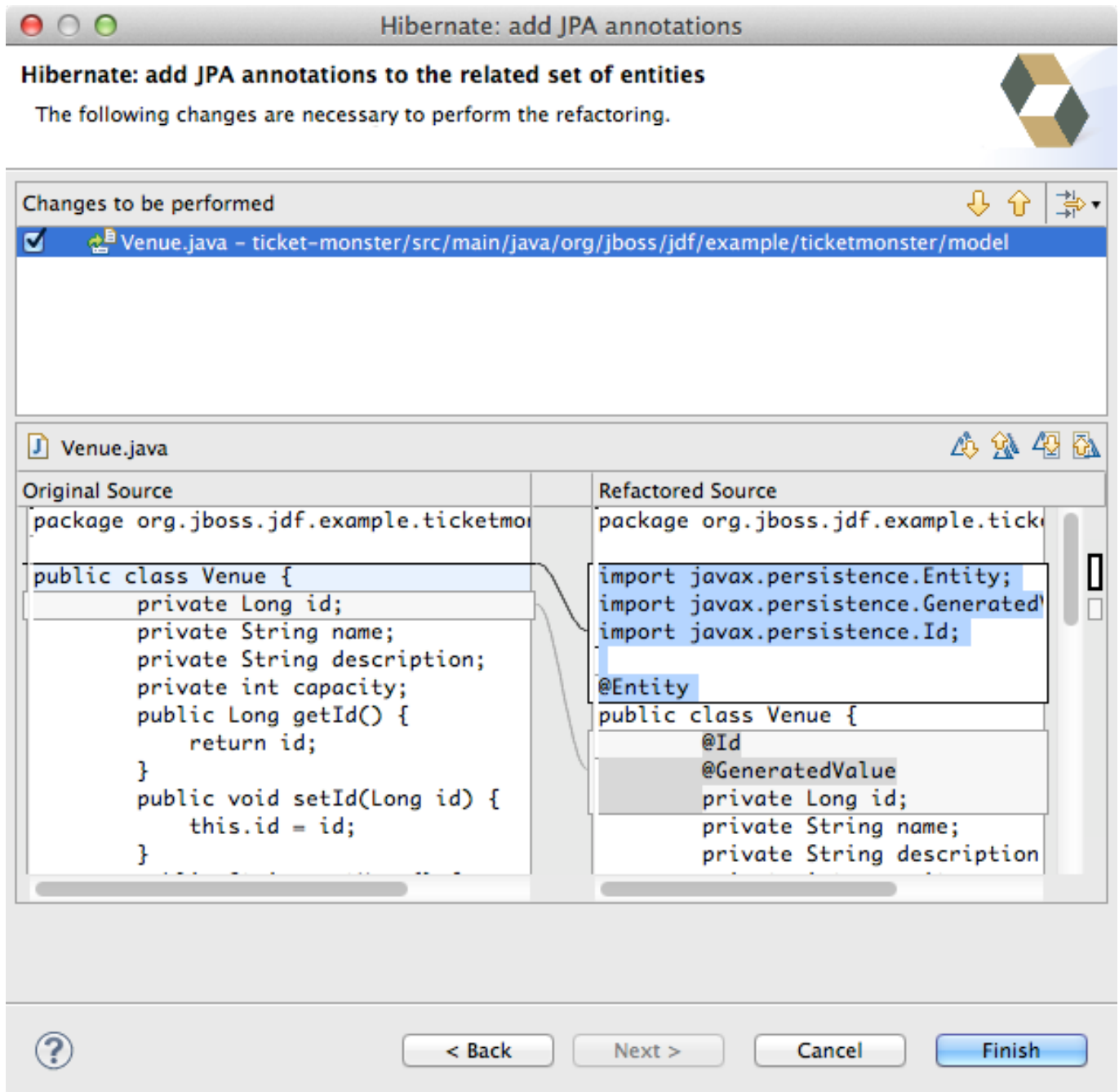


Figure 12.6: Hibernate: add JPA annotations Step 2

Select **Finish**.

Now you may wish to add the Bean Validation constraint annotations, such as `@NotNull` to the fields.

Chapter 13

Deployment

At this point, if you have not already deployed the application, right click on the project name in the Project Explorer and select **Run As** → **Run on Server**. If needed, this will startup the application server instance, compile & build the application and push the application into the `JBOSS_HOME/standalone/deployments` directory. This directory is scanned for new deployments, so simply placing your war in the directory will cause it to be deployed.

**Caution**

If you have been using another application server or web server such as Tomcat, shut it down now to avoid any port conflicts.

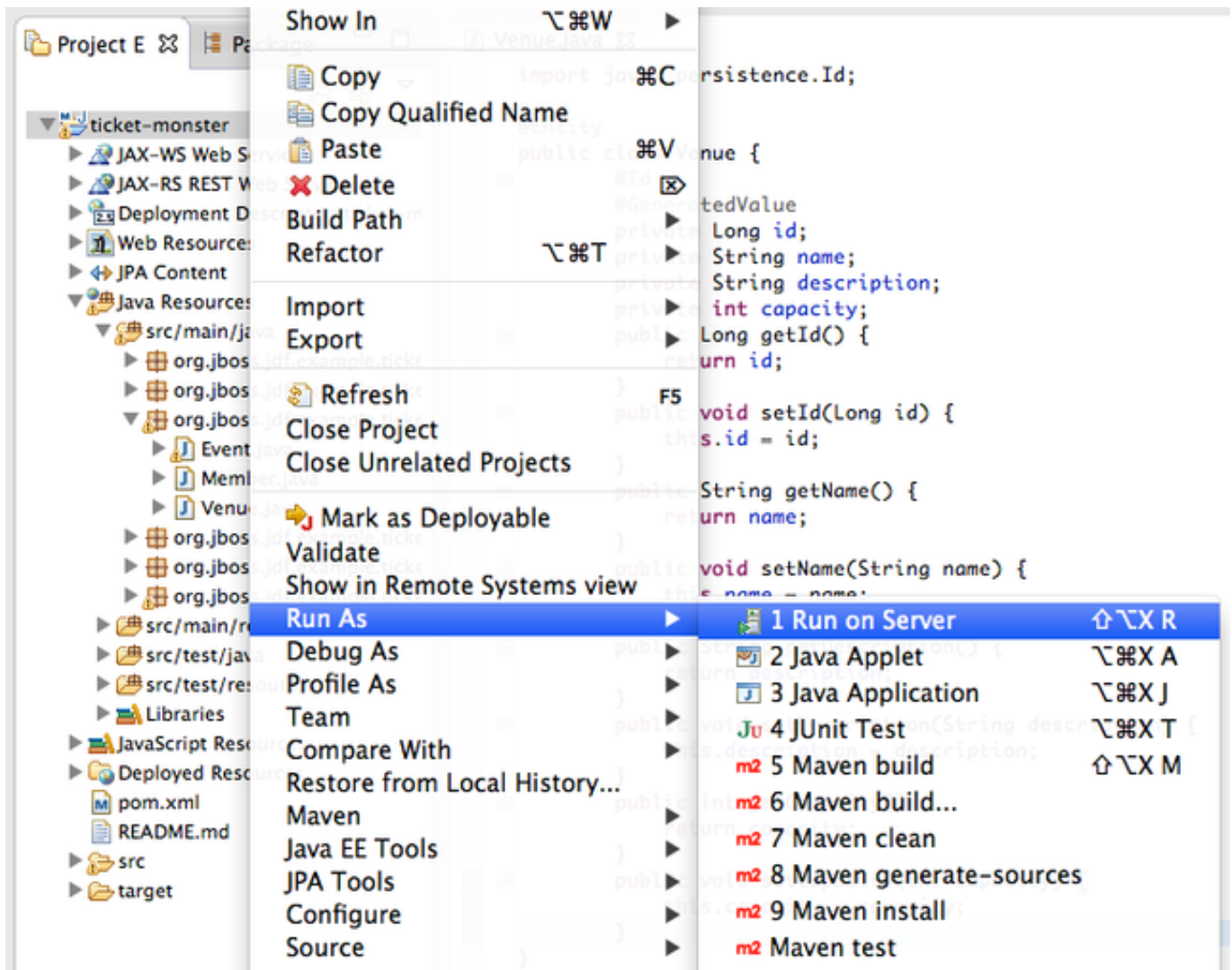


Figure 13.1: Run As → Run on Server

Now, deploy the h2console webapp. You can read how to do this in the [h2console quickstart](#).

The **Run As** → **Run on Server** option will also launch the internal Eclipse browser with the appropriate URL so that you can immediately begin interacting with the application.

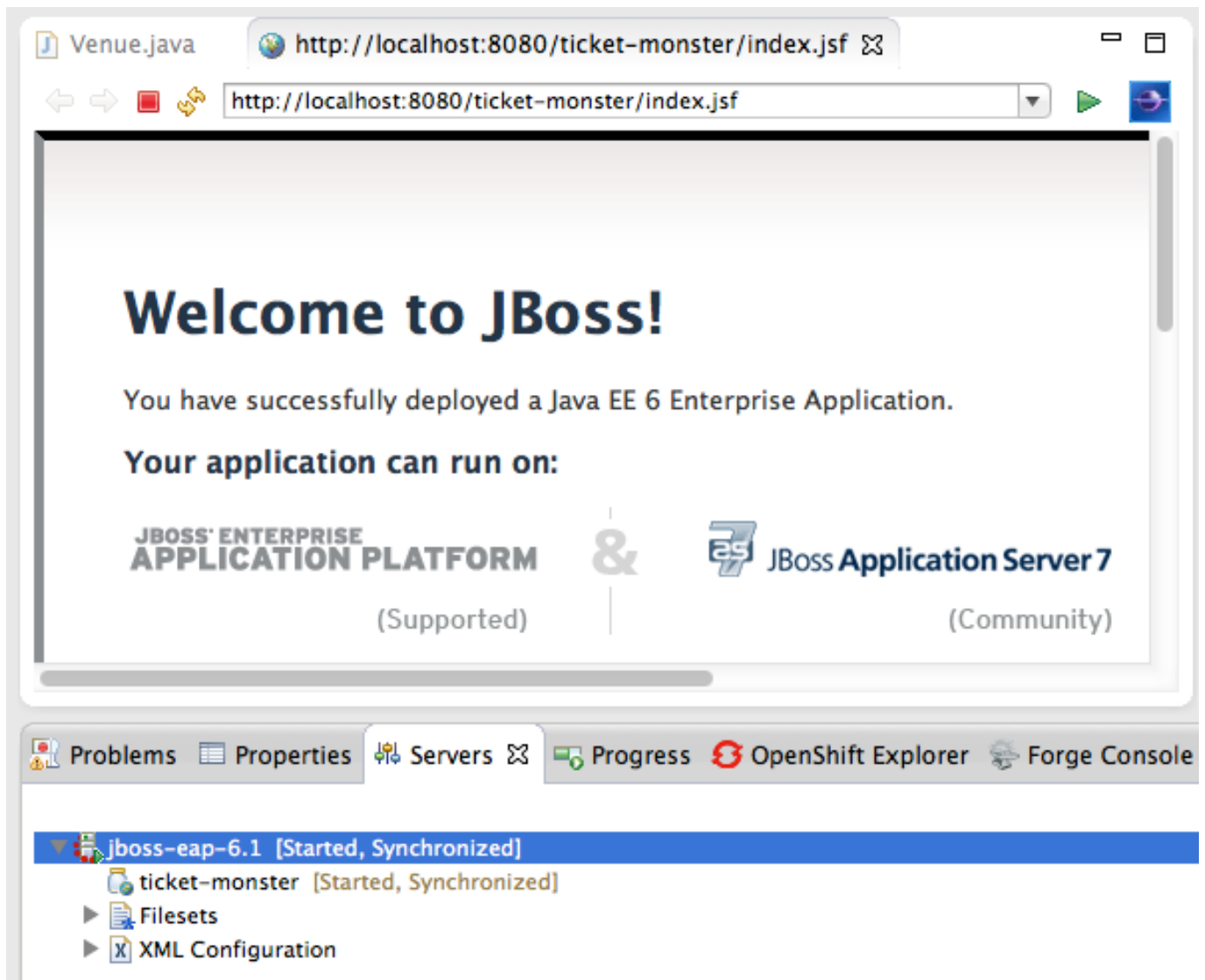


Figure 13.2: Eclipse Browser after Run As → Run on Server

Now, go to <http://localhost:8080/h2console> to start up the h2 console.

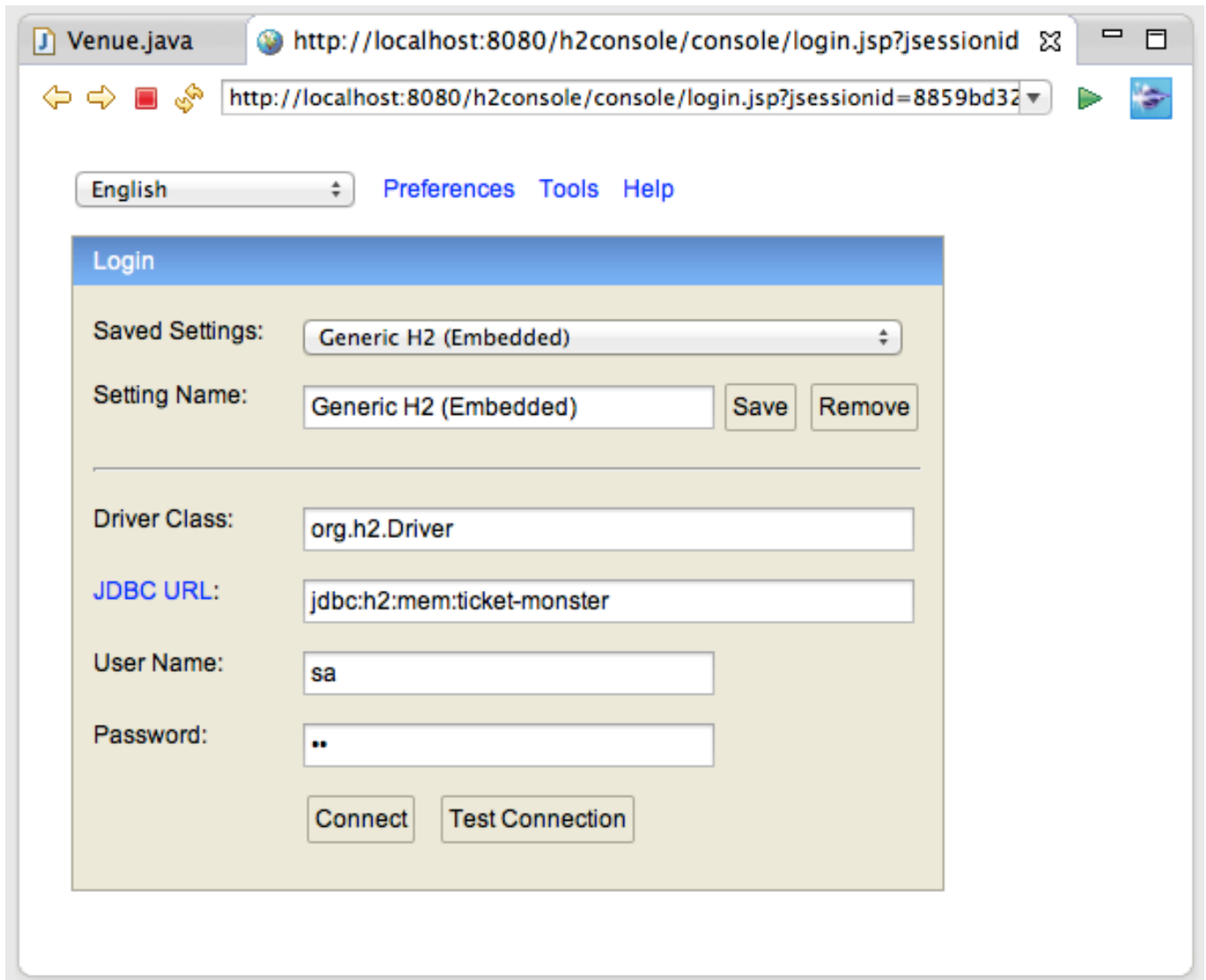


Figure 13.3: h2console in browser

Use `jdbc:h2:mem:ticket-monster` as the JDBC URL (this is defined in `src/main/webapp/WEB-INF/ticket-monster.xml`), `sa` as the username and `sa` as the password.

Click **Connect**

You will see both the `EVENT` table, the `VENUE` table and the `MEMBER` tables have been added to the H2 schema.

And if you enter the SQL statement: `select * from event` and select the **Run** (Ctrl-Enter) button, it will display the data you entered in the `import.sql` file in a previous step. With these relatively simple steps, you have verified that your new EE 6 JPA entities have been added to the system and deployed successfully, creating the supporting RDBMS schema as needed.

The screenshot shows the H2 Console web interface in a browser. The address bar shows the URL: `http://localhost:8080/h2console/console/login.do?sessionId=8859bd32d928ae9414b155bf822f4c`. The interface includes a sidebar with a tree view of the database schema: `jdbc:h2:mem:ticket-monster`, `EVENT`, `MEMBER`, `VENUE`, `INFORMATION_SCHEMA`, `Sequences`, `Users`, and `H2 1.3.168-redhat-2 (2012-07-1)`. The main area has a toolbar with buttons for `Run (Ctrl+Enter)`, `Clear`, and `SQL statement:`. Below the toolbar, the SQL statement `select * from event` is entered. The results are displayed in a table with 6 columns: `ID`, `DESCRIPTION`, `MAJOR`, `NAME`, `PICTURE`, and `VERSION`. The table contains 2 rows. Below the table, it says `(2 rows, 80 ms)` and there is an `Edit` button.

ID	DESCRIPTION	MAJOR	NAME	PICTURE	VERSION
1	This critically acclaimed masterpiece...	TRUE	Shane's Sock Puppets	http://dl.dropbox.com/u/65660684/640px-Carnival_Puppets.jpg	1
2	Get ready to rock...	TRUE	Rock concert of the decade	http://dl.dropbox.com/u/65660684/640px-Weir%2C_Bob_(2007)_2.jpg	1

Figure 13.4: h2console Select * from Event

Chapter 14

Adding a JAX-RS RESTful web service

The goal of this section of the tutorial is to walk you through the creation of a POJO with the JAX-RS annotations.

Right-click on the `.rest` package, select **New** → **Class** from the context menu, and enter `EventService` as the class name.

Java Class
Create a new Java class.

Source folder:

Package:

☐ Enclosing type:

Name:

Modifiers: ☒ public ☐ default ☐ private ☐ protected
☐ abstract ☐ final ☐ static

Superclass:

Interfaces:

Which method stubs would you like to create?

☐ public static void main(String[] args)
☐ Constructors from superclass
☒ Inherited abstract methods

Do you want to add comments? (Configure templates and default value [here](#))

☐ Generate comments

Figure 14.1: New Class EventService

Select **Finish**.

Replace the contents of the class with this sample code:

```
package org.jboss.jdf.example.ticketmonster.rest;

@Path("/events")
@RequestScoped
public class EventService {
    @Inject
    private EntityManager em;

    @GET
    @Produces(MediaType.APPLICATION_JSON)
    public List<Event> getAllEvents() {
        final List<Event> results =
            em.createQuery(
                "select e from Event e order by e.name").getResultList();
        return results;
    }
}
```

This class is a JAX-RS endpoint that returns all Events.

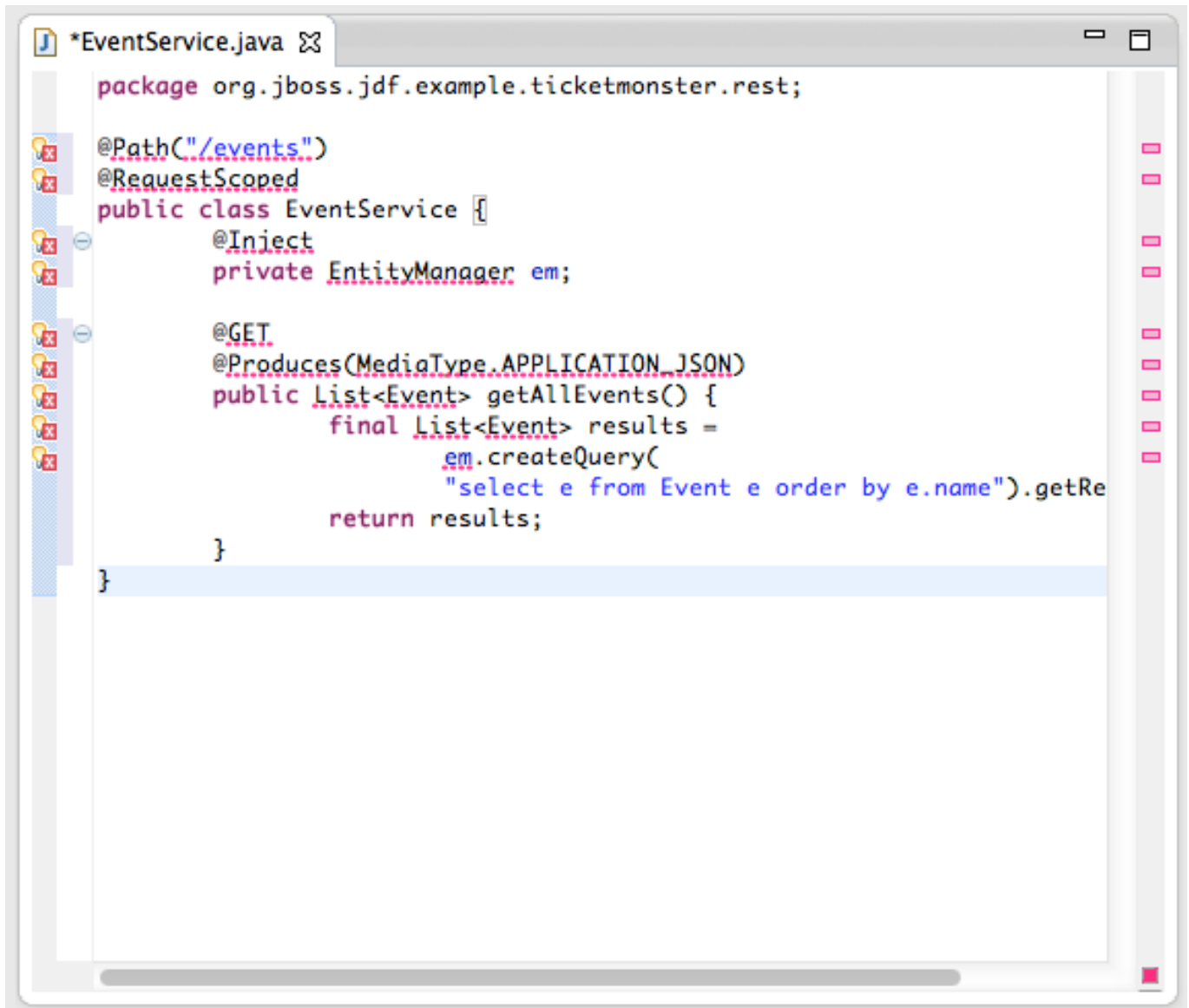


Figure 14.2: EventService after Copy and Paste

You'll notice a lot of errors, relating to missing imports. The easiest way to solve this is to right-click inside the editor and select **Source** → **Organize Imports** from the context menu.

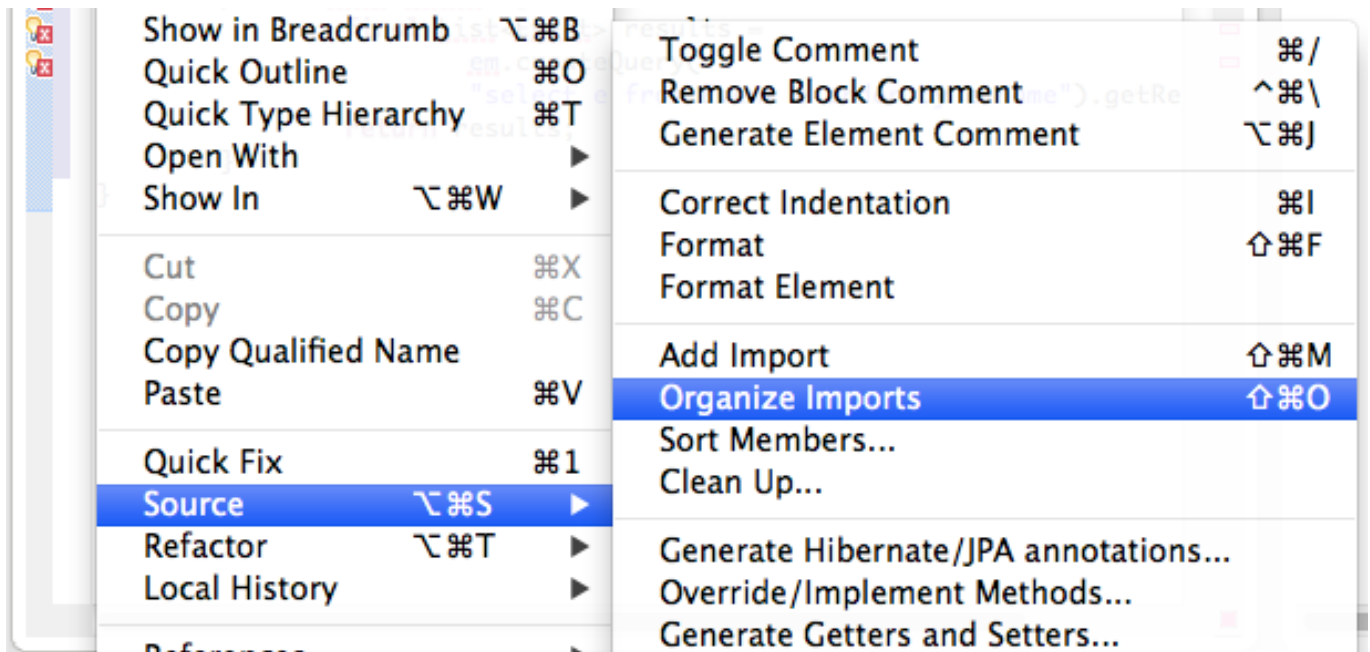


Figure 14.3: Source → Organize → Imports

Some of the class names are not unique. Eclipse will prompt you with any decisions around what class is intended. Select the following:

- `javax.ws.rs.core.MediaType`
- `org.jboss.jdf.example.ticketmonster.model.Event`
- `javax.ws.rs.Produces`
- `java.util.List`
- `java.inject.Inject`
- `java.enterprise.context.RequestScoped`

The following screenshots illustrate how you handle these decisions. The Figure description indicates the name of the class you should select.

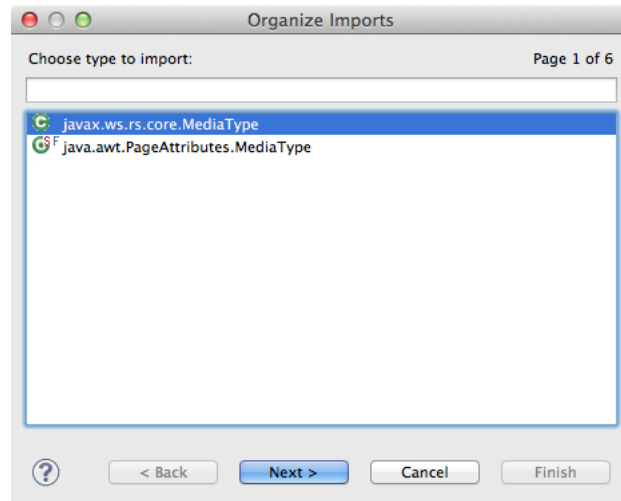


Figure 14.4: javax.ws.rs.core.MediaType

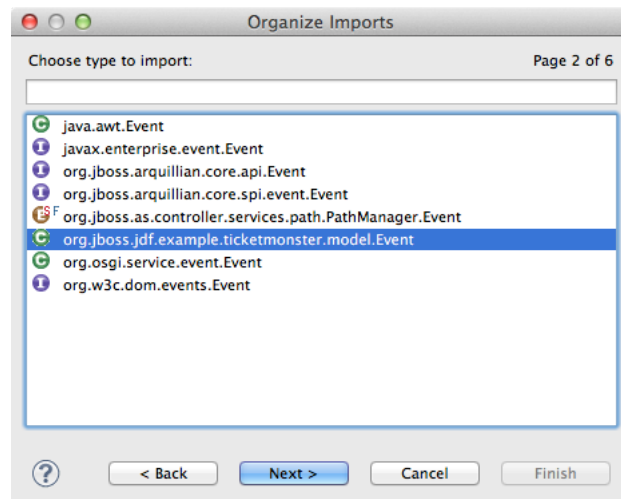


Figure 14.5: org.jboss.jdf.example.ticketmonster.model.Event

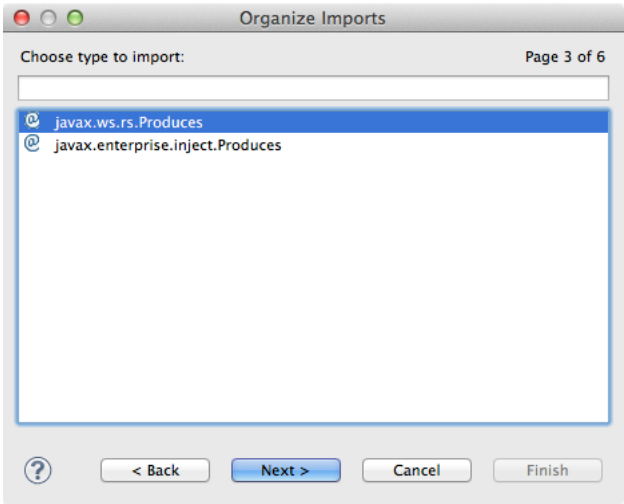


Figure 14.6: javax.ws.rs.Produces

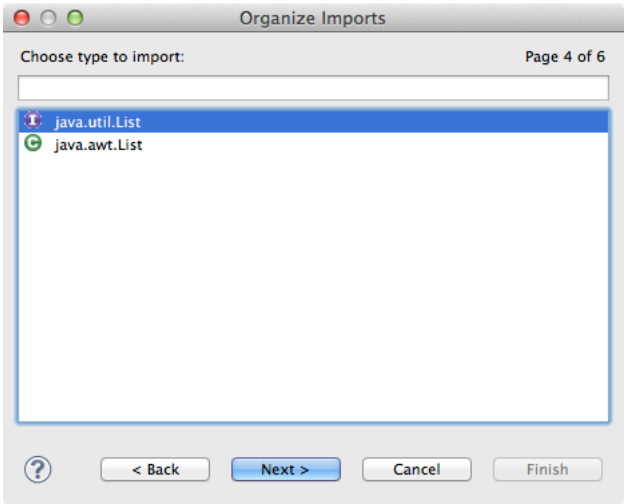


Figure 14.7: java.util.List

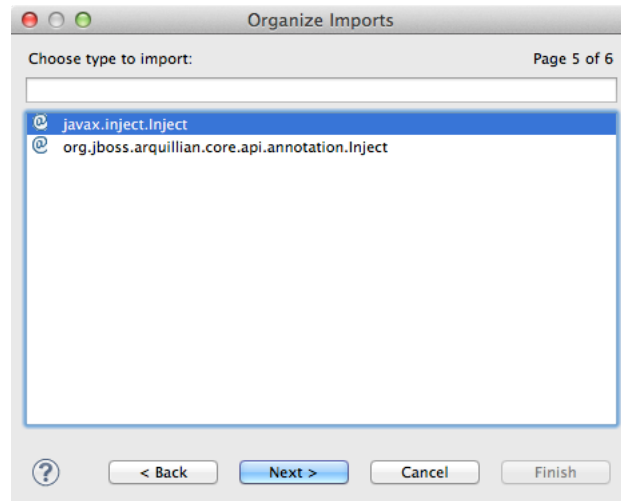


Figure 14.8: javax.inject.Inject

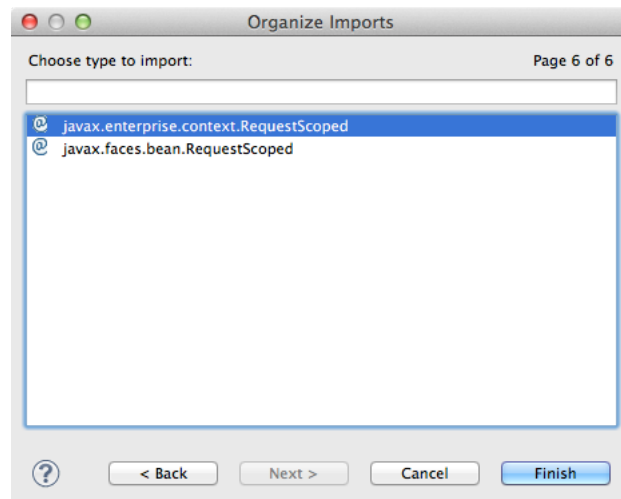


Figure 14.9: javax.enterprise.context.RequestScoped

You should end up with these imports:

```
import java.util.List;

import javax.enterprise.context.RequestScoped;
import javax.inject.Inject;
import javax.persistence.EntityManager;
import javax.ws.rs.GET;
import javax.ws.rs.Path;
import javax.ws.rs.Produces;
import javax.ws.rs.core.MediaType;

import org.jboss.jdf.example.ticketmonster.model.Event;
```

Once these import statements are in place you should have no more compilation errors. When you save `EventService.java`, you will see it listed in JAX-RS REST Web Services in the Project Explorer.

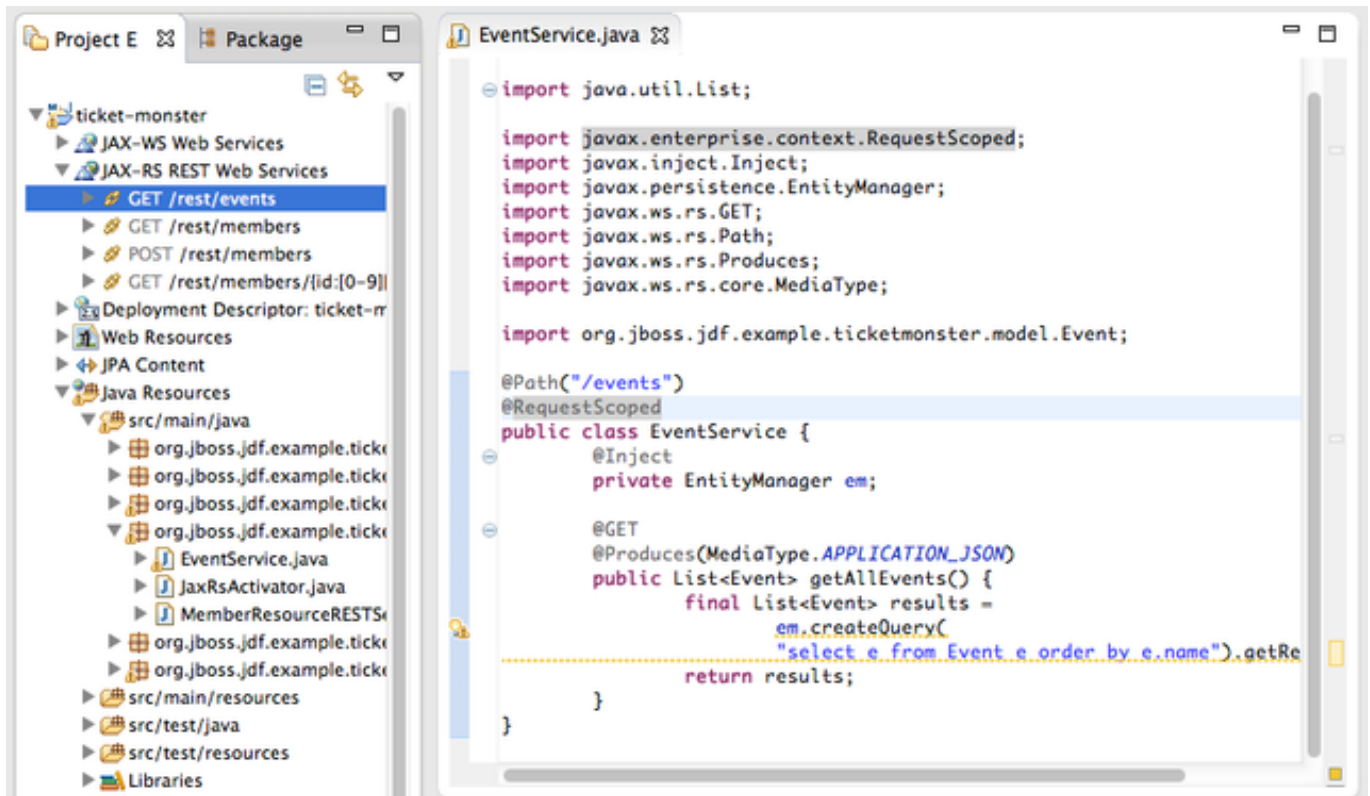


Figure 14.10: Project Explorer JAX-RS Services

This feature of JBoss Developer Studio and JBoss Tools provides a nice visual indicator that you have successfully configured your JAX-RS endpoint.

You should now redeploy your project via **Run As** → **Run on Server**, or by right clicking on the project in the **Servers** tab and select **Full Publish**.

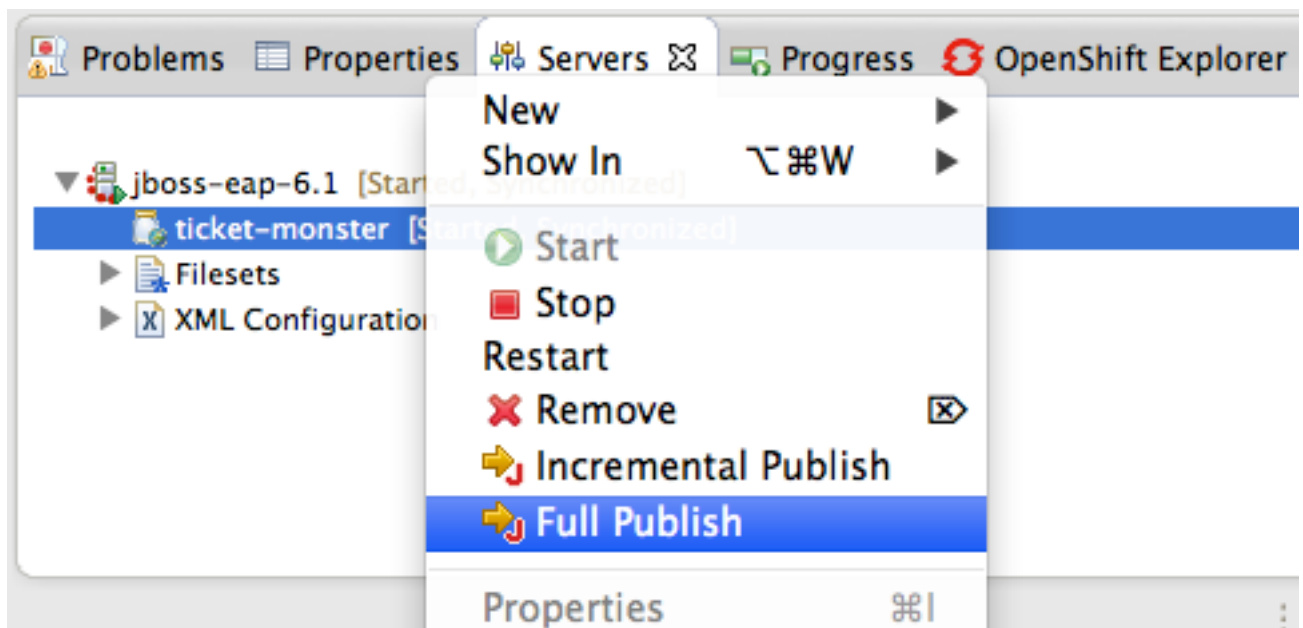


Figure 14.11: Full Publish

Using a browser, visit <http://localhost:8080/ticket-monster/rest/events> to see the results of the query, formatted as JSON (JavaScript Object Notation).

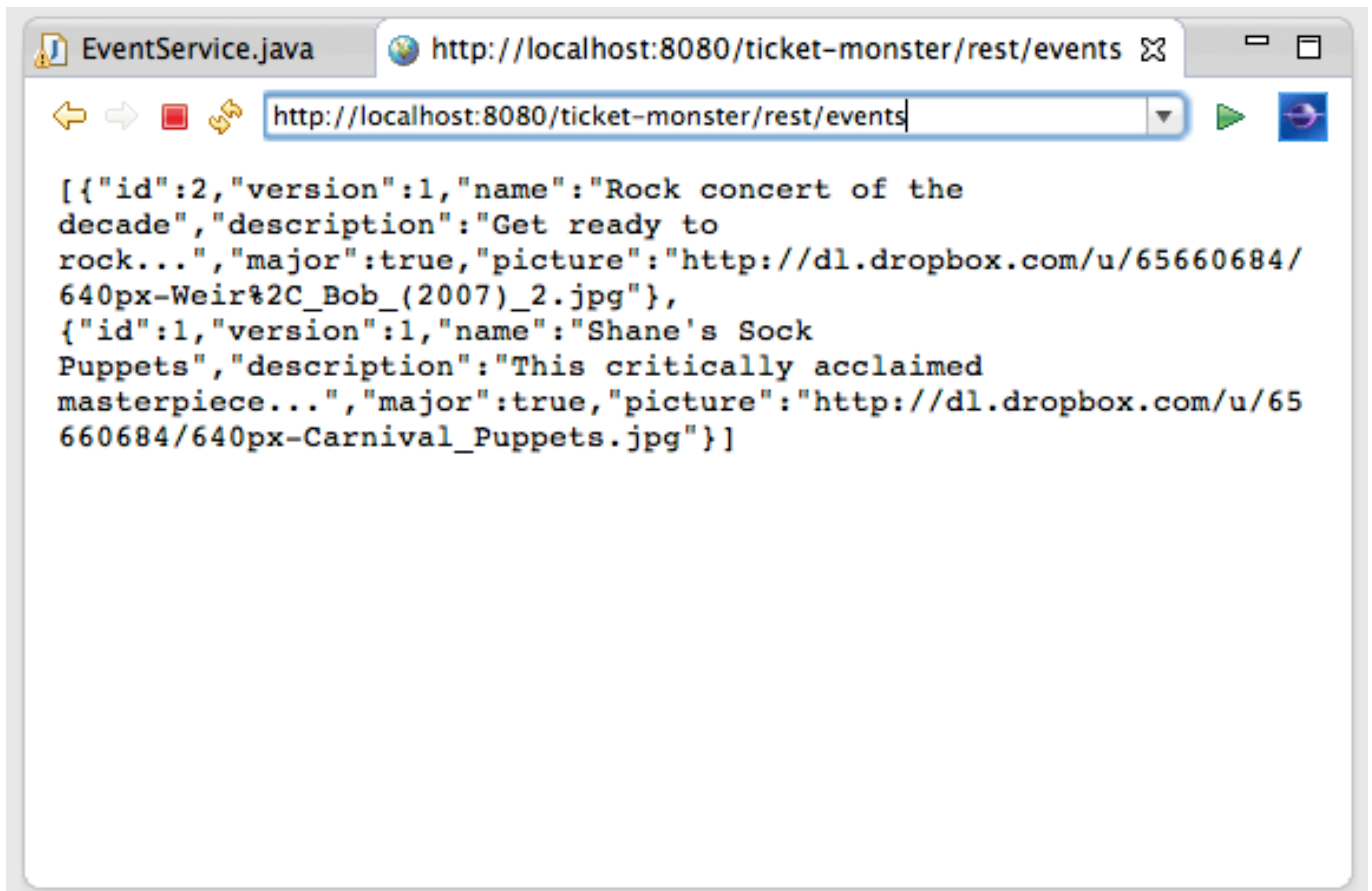


Figure 14.12: JSON Response

Note

The `rest` prefix is setup in a file called `JaxRsActivator.java` which contains a small bit of code that sets up the application for JAX-RS endpoints.

Chapter 15

Adding a jQuery Mobile client application

Now, it is time to add a HTML5, jQuery based client application that is optimized for the mobile web experience.

There are numerous JavaScript libraries that help you optimize the end-user experience on a mobile web browser. We have found that jQuery Mobile is one of the easier ones to get started with but as your skills mature, you might investigate solutions like Sencha Touch, Zepto or Jo. This tutorial focuses on jQuery Mobile as the basis for creating the UI layer of the application.

The UI components interact with the JAX-RS RESTful services (e.g. `EventService.java`).

Tip

For more information on building HTML5 + REST applications with JBoss technologies, check out [Aerogear](#).

These next steps will guide you through the creation of a file called `mobile.html` that provides a mobile friendly version of the application, using jQuery Mobile.

First, using the Project Explorer, navigate to `src/main/webapp`, and right-click on `webapp`, and choose **New HTML file**.

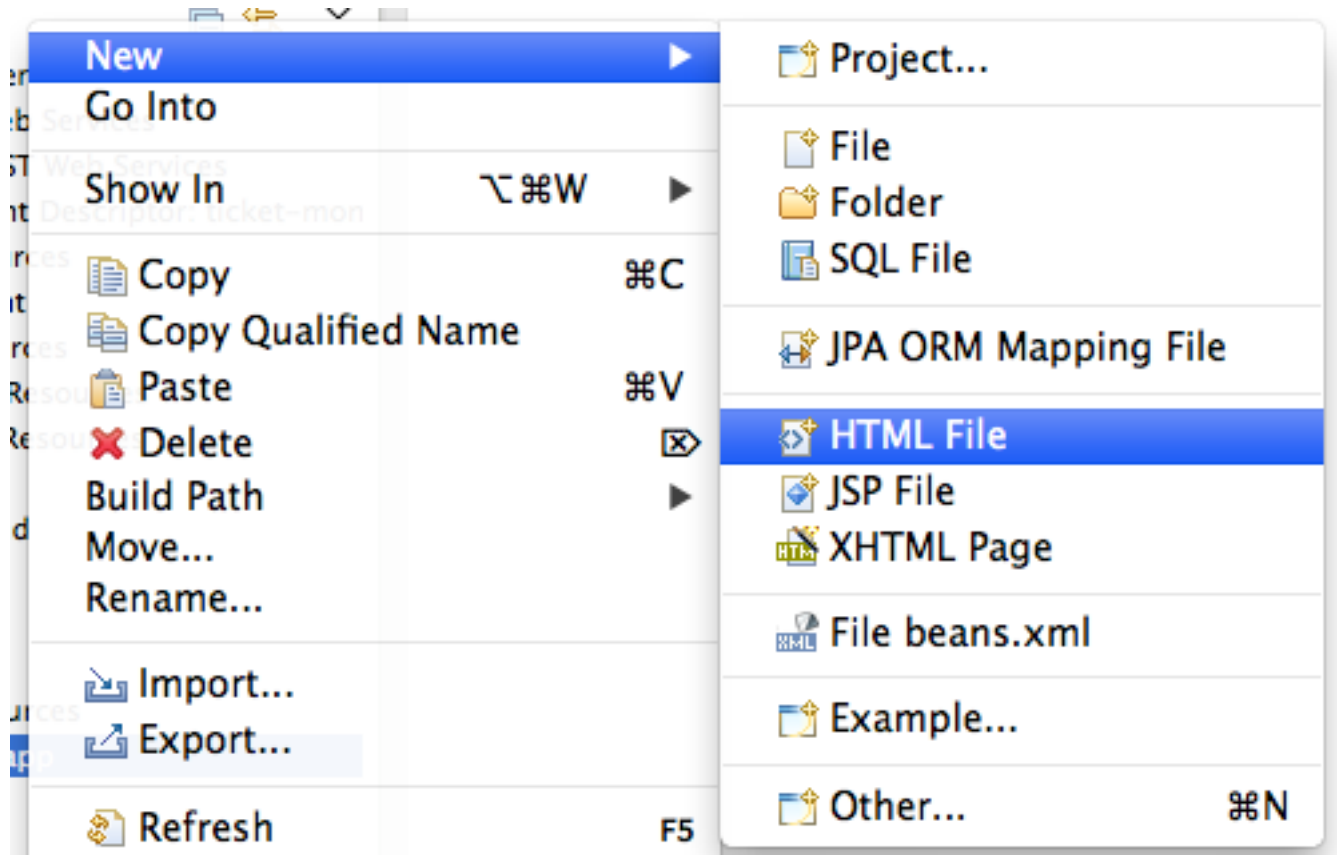


Figure 15.1: New HTML File

**Caution**

In certain versions of JBoss Developer Studio, the New HTML File Wizard may start off with your target location being `m2e-wtp/web-resources`, this is an incorrect location and it is a bug, [JBIDE-11472](#). It has been corrected in JBoss Developer Studio 6.

Change directory to `ticket-monster/src/main/webapp` and enter name the file `mobile.html`.

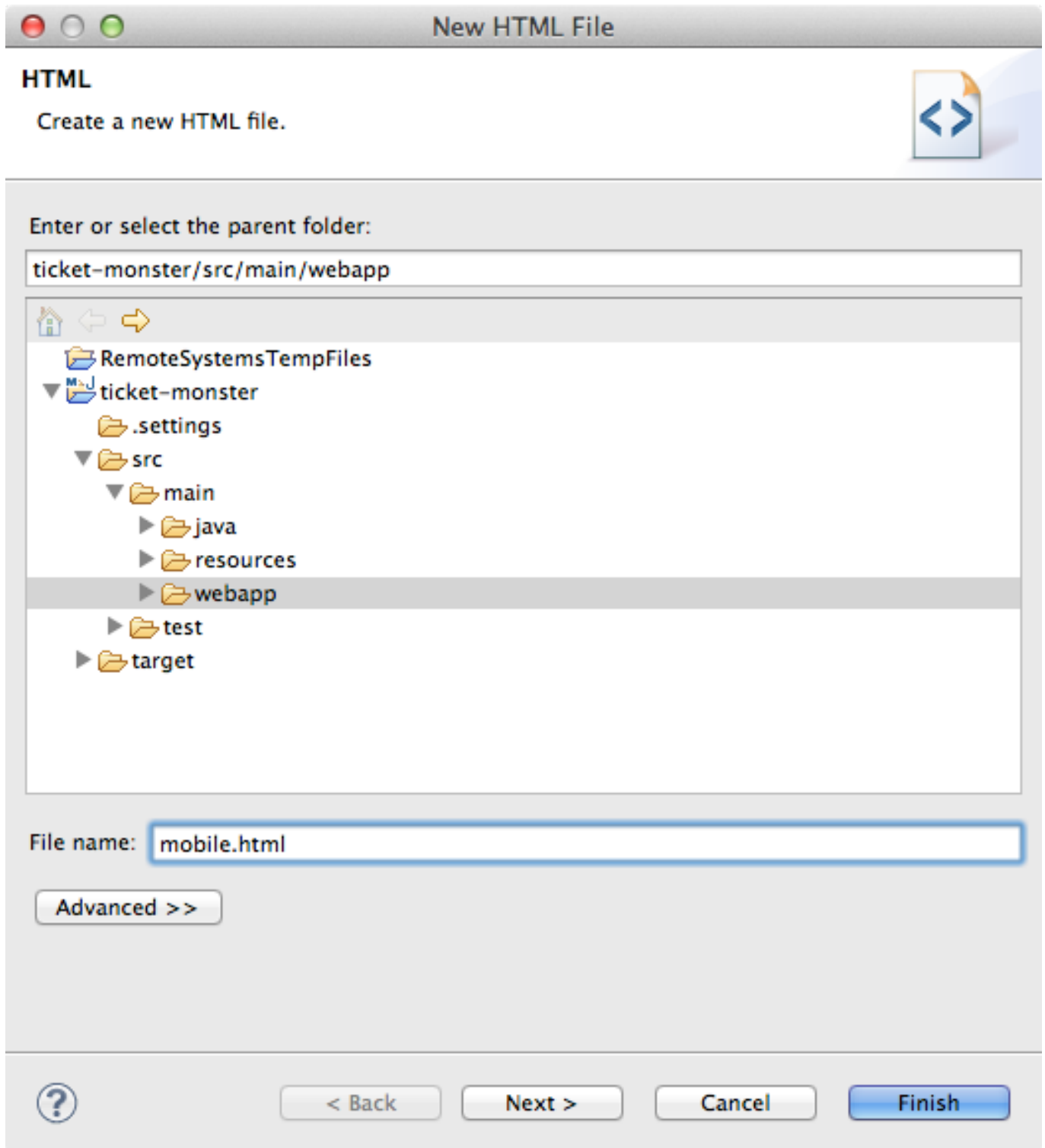


Figure 15.2: New HTML File src/main/webapp

Select **Next**.

On the **Select HTML Template** page of the **New HTML File** wizard, select **New HTML File (5)**. This template will get you started with a boilerplate HTML5 document.

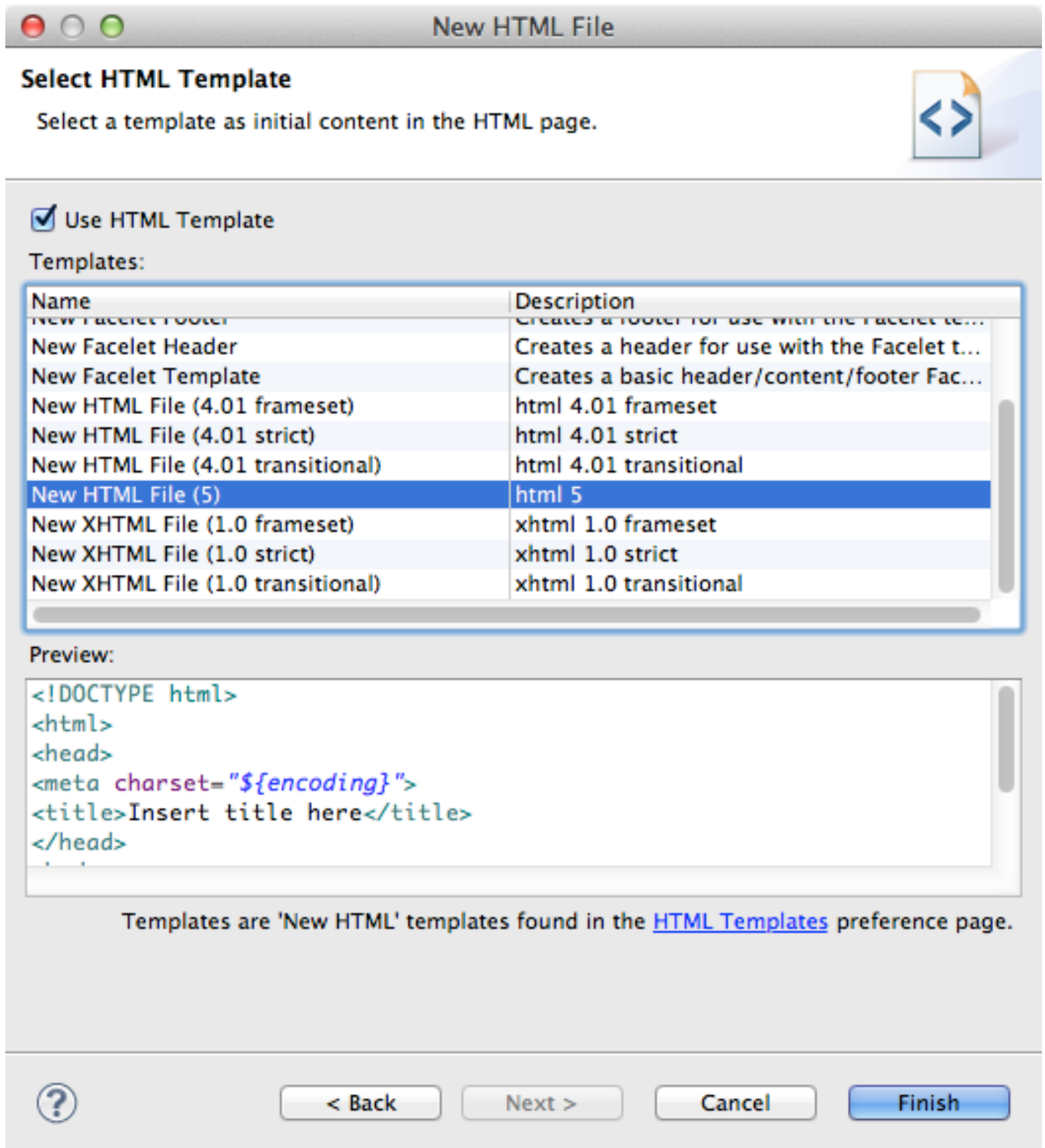


Figure 15.3: Select New HTML File (5) Template

Select **Finish**.

The document must start with `<!DOCTYPE html>` as this identifies the page as HTML 5 based. For this particular phase of the tutorial, we are not introducing a bunch of HTML 5 specific concepts like the new form fields (`type=email`), websockets or the new CSS capabilities. For now, we simply wish to get our mobile application completed as soon as possible. The good news is that jQuery and jQuery Mobile make the consumption of a RESTful endpoint very simple.

You will now notice the Palette View visible in the JBoss perspective. This view contains a collection of popular jQuery Mobile widgets that can be dragged and dropped into the HTML pages to speed up construction of jQuery Mobile pages.

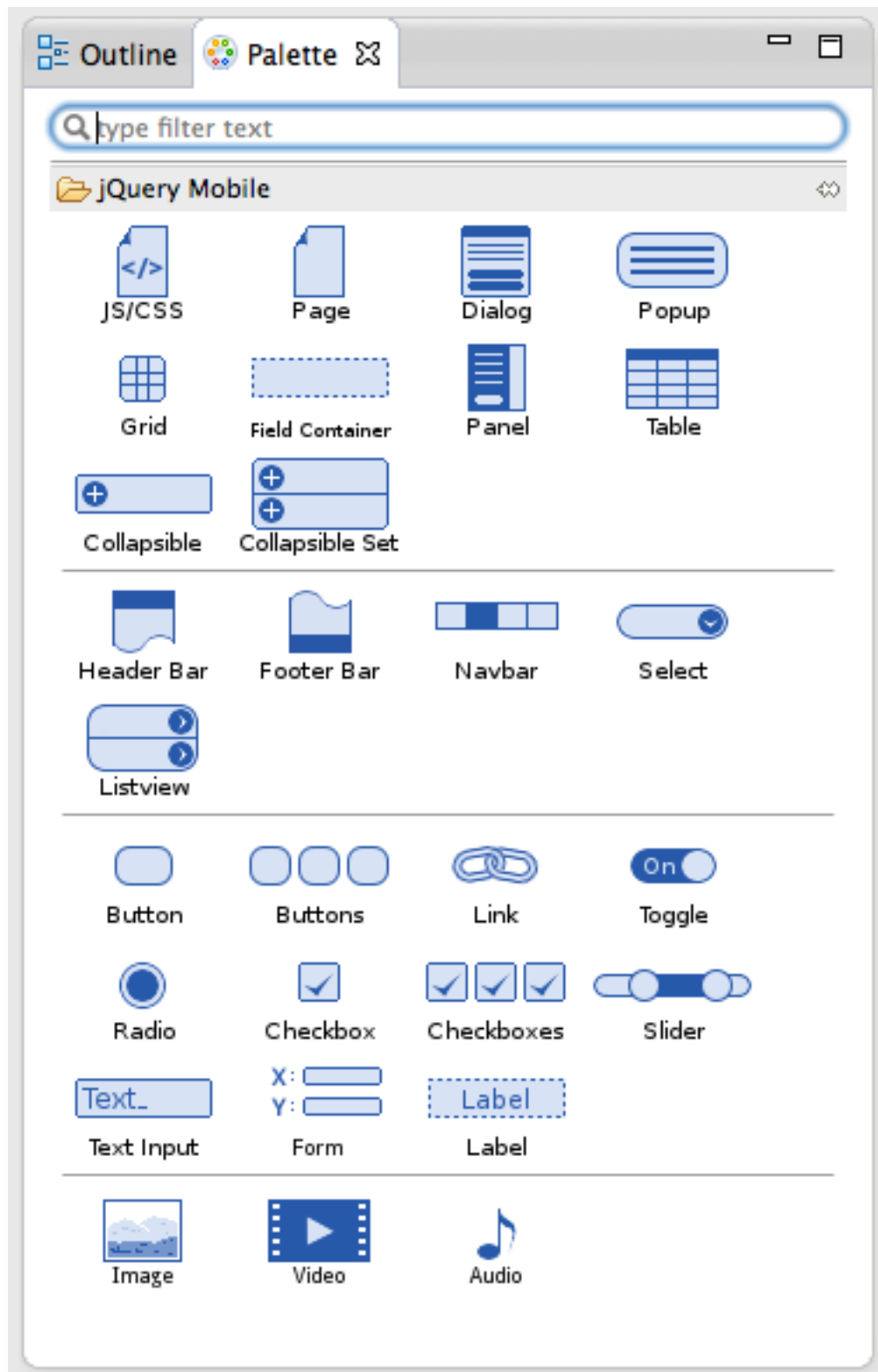


Figure 15.4: The jQuery Mobile Palette

Tip

For a deeper dive into the jQuery Mobile palette feature in JBoss Developer Studio review [this video](#).

Let us first set the title of the HTML5 document as:

```
<!DOCTYPE html>
<html>
<head>
<meta charset="UTF-8">
<title>TicketMonster</title>
</head>
<body>

</body>
</html>
```

We shall now add the jQuery and jQuery Mobile JavaScript and CSS files to the HTML document. Luckily for us we can do this by clicking the *JS/CSS* widget in the palette.

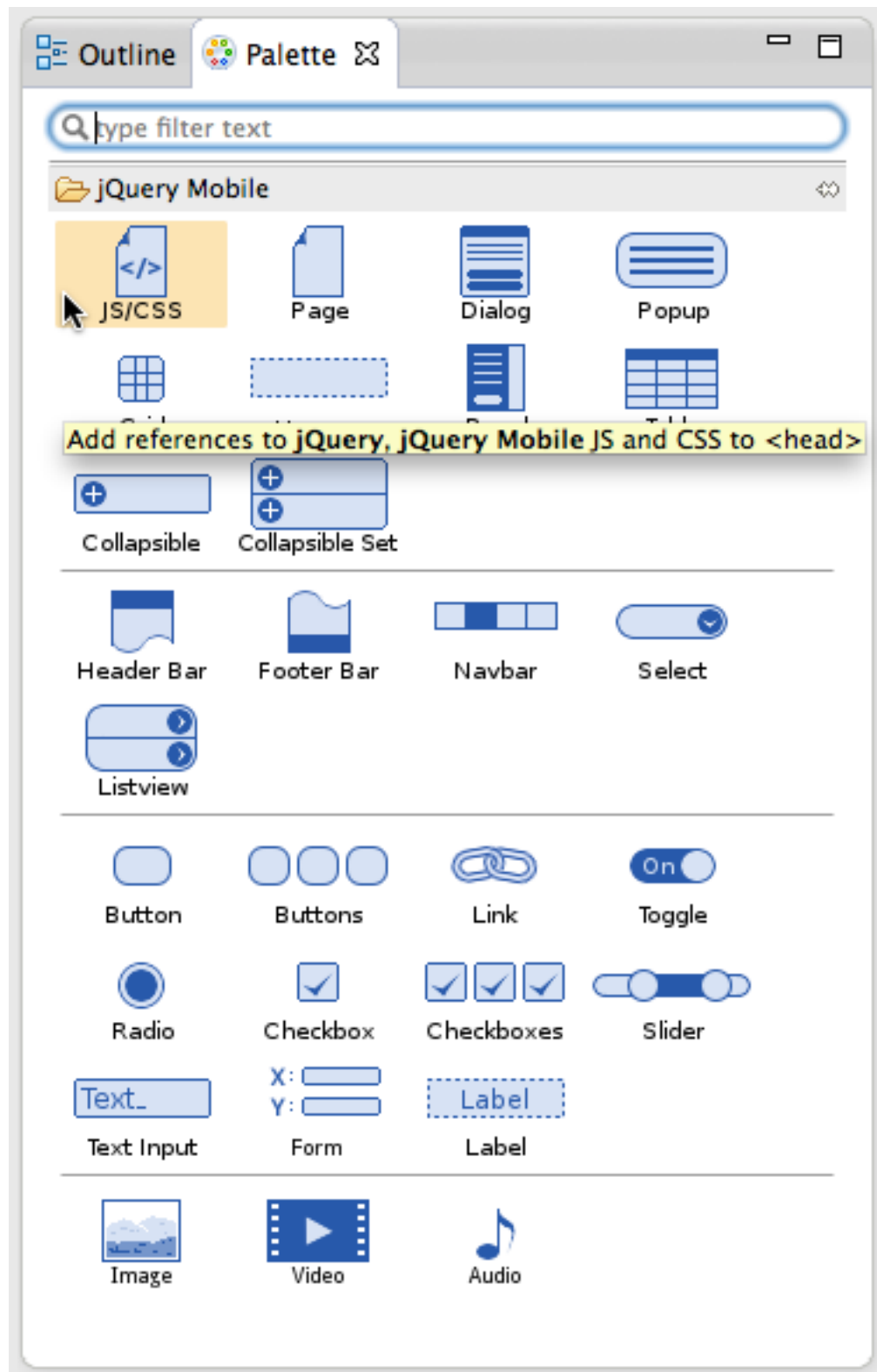


Figure 15.5: Click the JS/CSS widget

This results in the following document with the jQuery JavaScript file and the jQuery Mobile JavaScript and CSS files being added to the *head* element.

```
<!DOCTYPE html>
<html>
<head>
  <meta name="viewport" content="width=device-width, initial-scale=1">
  <link rel="stylesheet"
href="http://code.jquery.com/mobile/1.3.1/jquery.mobile-1.3.1.min.css" />
  <script src="http://code.jquery.com/jquery-1.9.1.min.js"></script>
  <script src="http://code.jquery.com/mobile/1.3.1/jquery.mobile-1.3.1.min.js"></script>
  <meta charset="UTF-8">
  <title>TicketMonster</title>
</head>
<body>

</body>
</html>
```

We shall now proceed to setup the page layout. Click the *page* widget in the palette to do so. Ensure that the cursor is in the `<body>` element of the document when you do so.

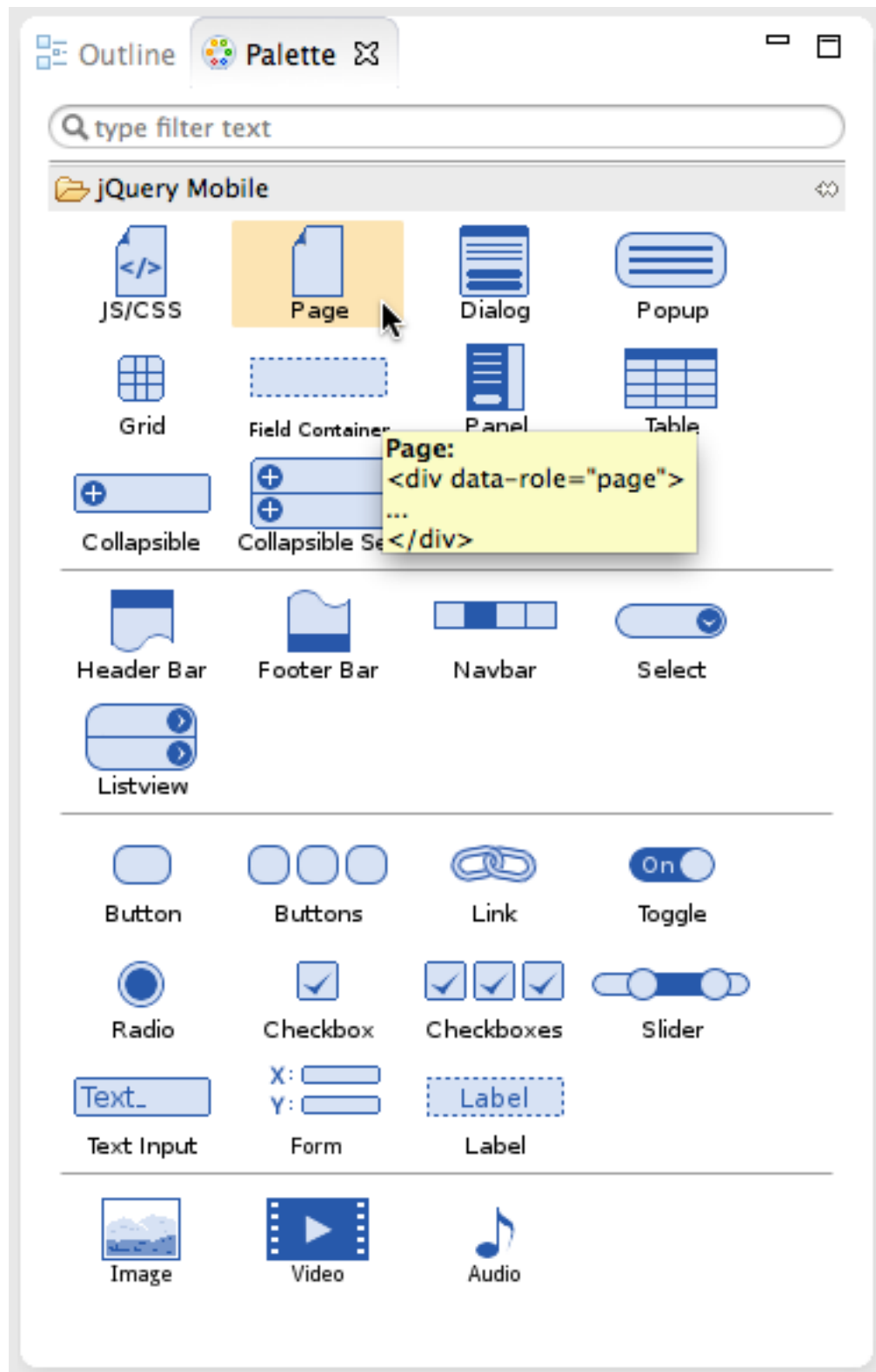


Figure 15.6: Click the page widget

**Caution**

When you click some of the widgets in the palette, it is important to have the cursor in the right element of the document. Failing to observe this will result in the widget being added in undesired locations. Alternatively, you can drag and drop the widget to the desired location in the document.

This opens a dialog to configure the jQuery Mobile page.

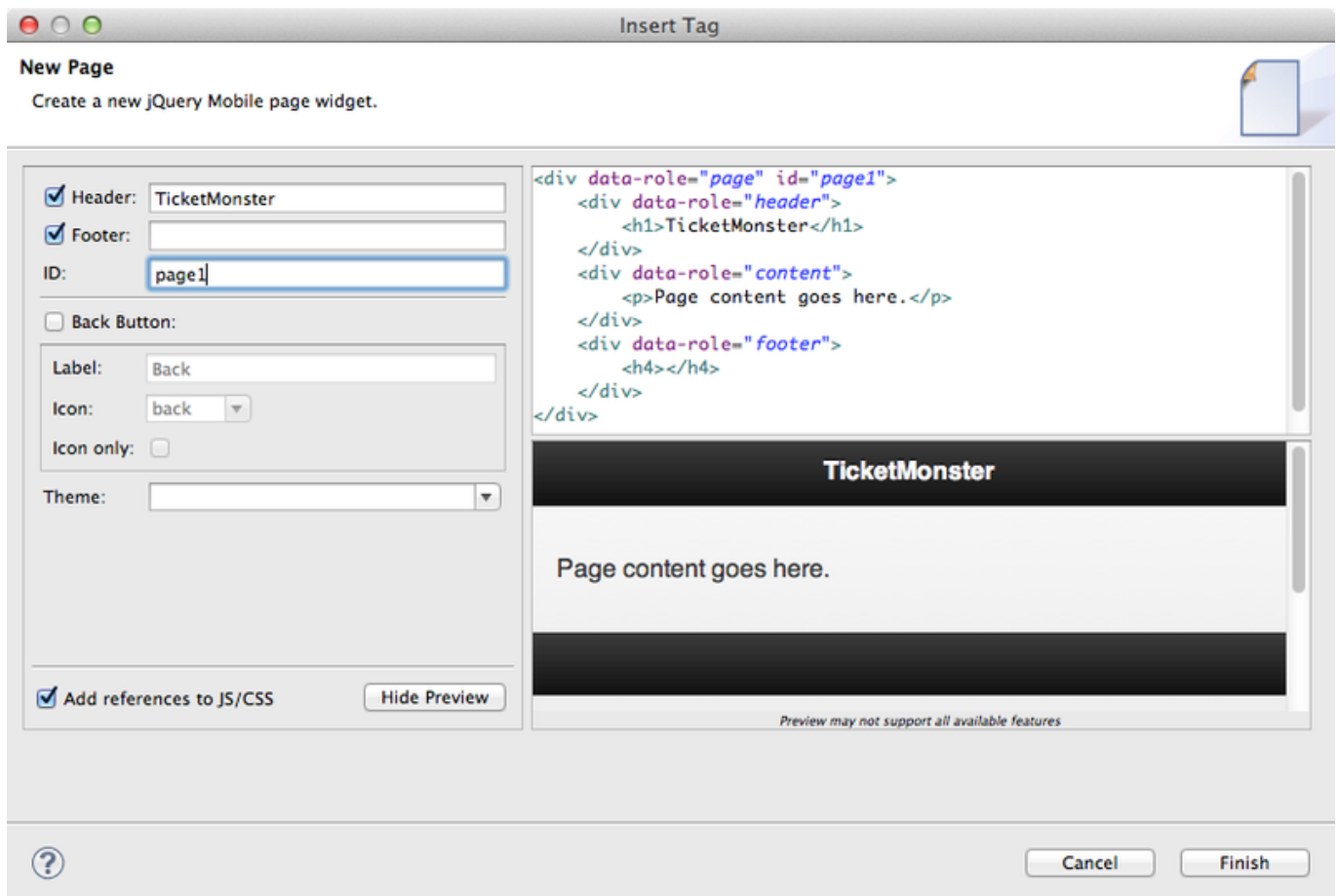


Figure 15.7: Create a new jQuery Mobile page

Set the page title as "TicketMonster", footer as blank, and the ID as "page1". Click **Finish** to add a new jQuery Mobile page to the document. The layout is now established.

```
<!DOCTYPE html>
<html>
<head>
  <meta name="viewport" content="width=device-width, initial-scale=1">
  <link rel="stylesheet"
href="http://code.jquery.com/mobile/1.3.1/jquery.mobile-1.3.1.min.css" />
  <script src="http://code.jquery.com/jquery-1.9.1.min.js"></script>
  <script src="http://code.jquery.com/mobile/1.3.1/jquery.mobile-1.3.1.min.js"></script>
  <meta charset="UTF-8">
  <title>TicketMonster</title>
</head>
<body>
  <div data-role="page" id="page1">
```



```
<div data-role="header">
  <h1>TicketMonster</h1>
</div>
<div data-role="content">
  <p>Page content goes here.</p>
</div>
<div data-role="footer">
  <h4></h4>
</div>
</div>
</body>
</html>
```

To populate the page content, remove the paragraph element: `<p>Page content goes here.</p>` to start with a blank content section. Click the *Listview* widget in the palette to start populating the content section.

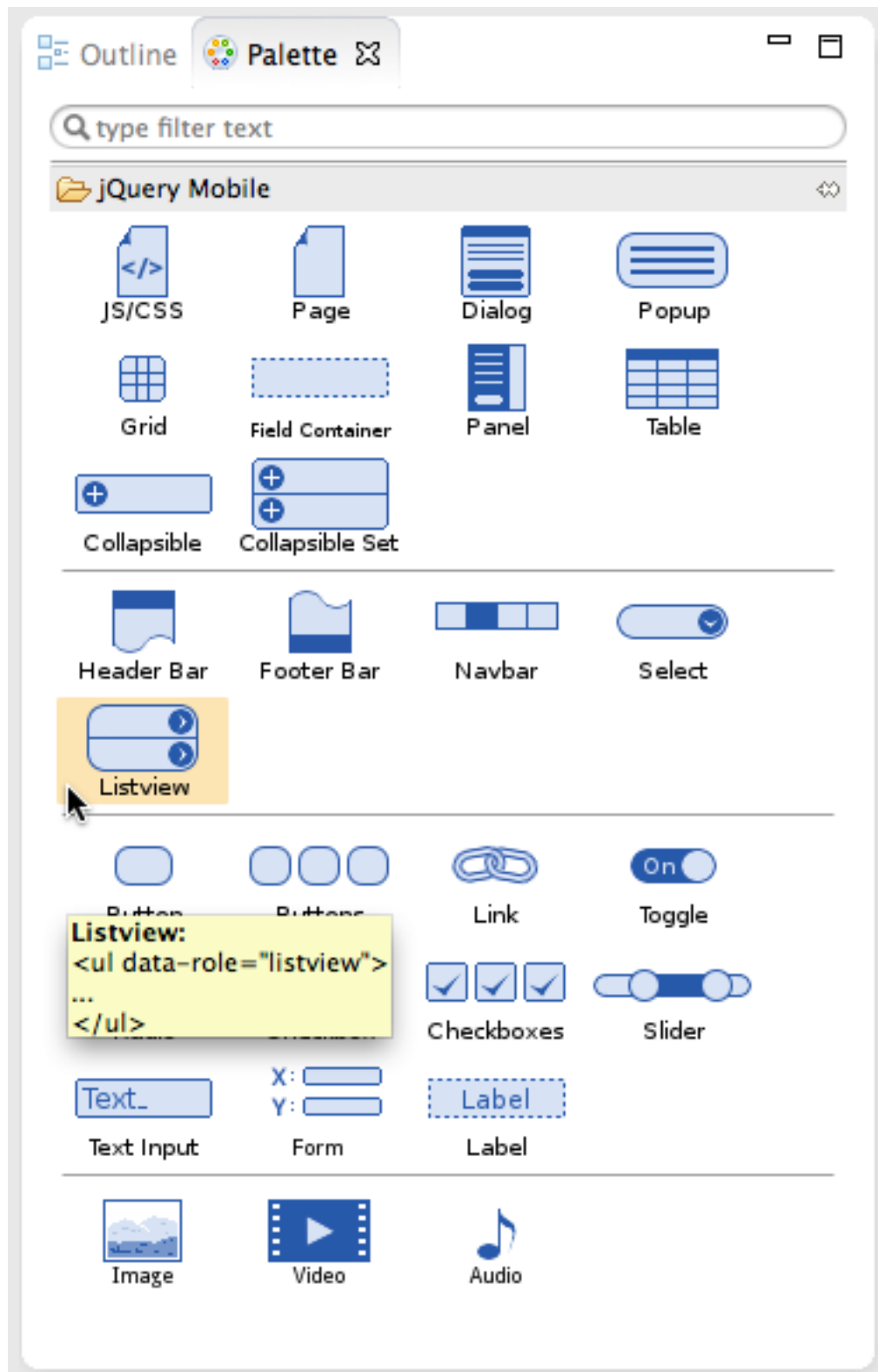


Figure 15.8: Click the Listview widget

This opens a new dialog to configure the jQuery Mobile listview widget.

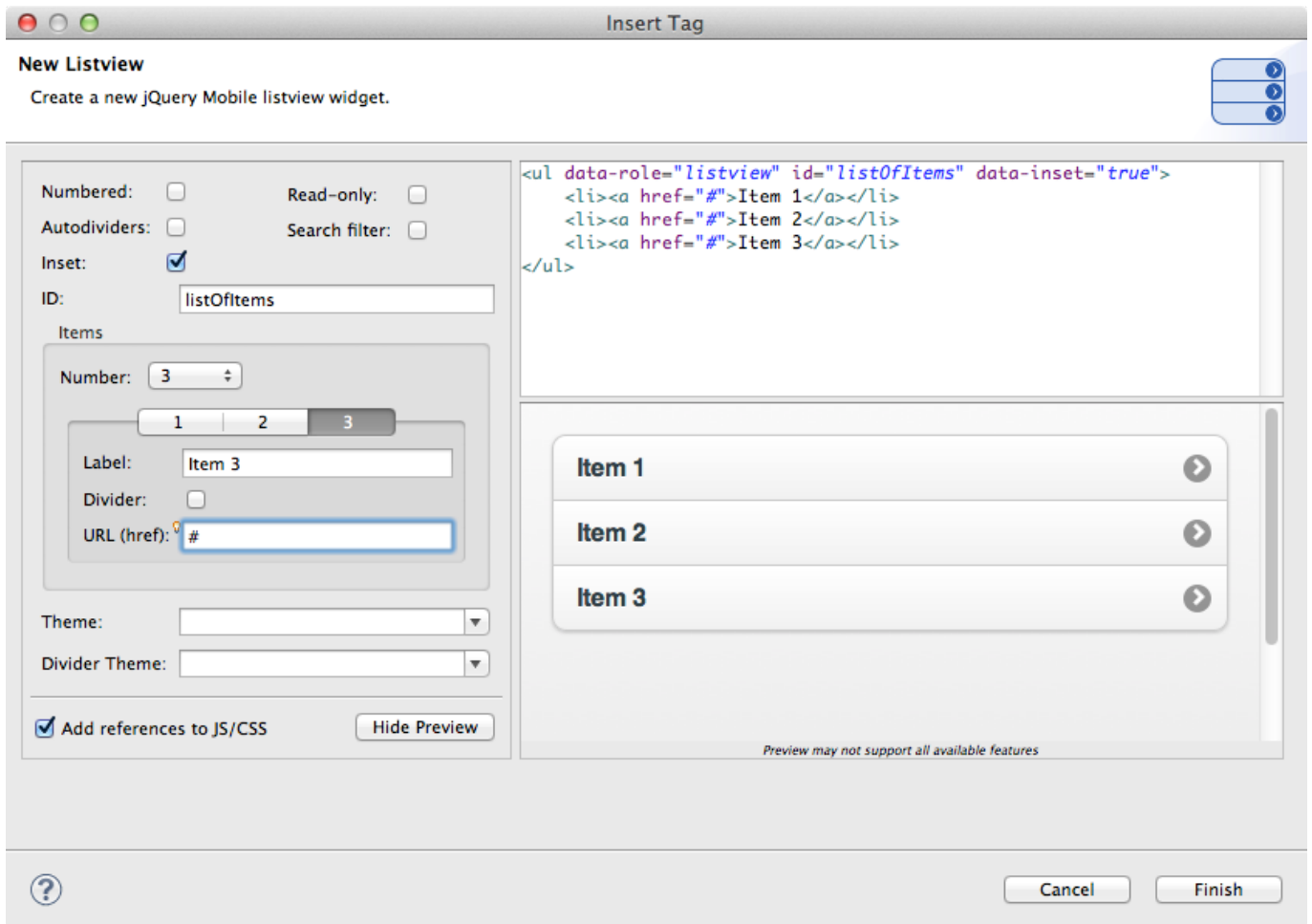


Figure 15.9: Add a jQuery Mobile Listview widget

Select the inset checkbox to display the list as an inset list. Inset lists do not span the entire widget of the display. Set the ID as "listOfItems". Retain the number of items in the list as three, and also their labels, but modify the URL values to #. Retain the default values for the other fields, and click **Finish**. This will create a listview widget with 3 item entries in the list. The jQuery Mobile page is now structurally complete.

```
<!DOCTYPE html>
<html>
<head>
  <meta name="viewport" content="width=device-width, initial-scale=1">
  <link rel="stylesheet"
href="http://code.jquery.com/mobile/1.3.1/jquery.mobile-1.3.1.min.css" />
  <script src="http://code.jquery.com/jquery-1.9.1.min.js"></script>
  <script src="http://code.jquery.com/mobile/1.3.1/jquery.mobile-1.3.1.min.js"></script>
  <meta charset="UTF-8">
  <title>TicketMonster</title>
</head>
<body>
  <div data-role="page" id="page1">
    <div data-role="header">
      <h1>TicketMonster</h1>
    </div>
    <div data-role="content">
      <ul data-role="listview" id="listOfItems" data-inset="true">
        <li><a href="#">Item 1</a></li>
```

```
        <li><a href="#">Item 2</a></li>
        <li><a href="#">Item 3</a></li>
    </ul>
</div>
<div data-role="footer">
    <h4></h4>
</div>
</div>
</body>
</html>
```

You might notice that in the **Visual Page Editor**, the visual portion is not that attractive, this is because the majority of jQuery Mobile magic happens at runtime and our visual page editor simply displays the HTML without embellishment.

Visit <http://localhost:8080/ticket-monster/mobile.html>.

Note

Note: Normally HTML files are deployed automatically, if you find it missing, just use Full Publish or Run As Run on Server as demonstrated in previous steps.

As soon as the page loads, you can view the jQuery Mobile enhanced page.

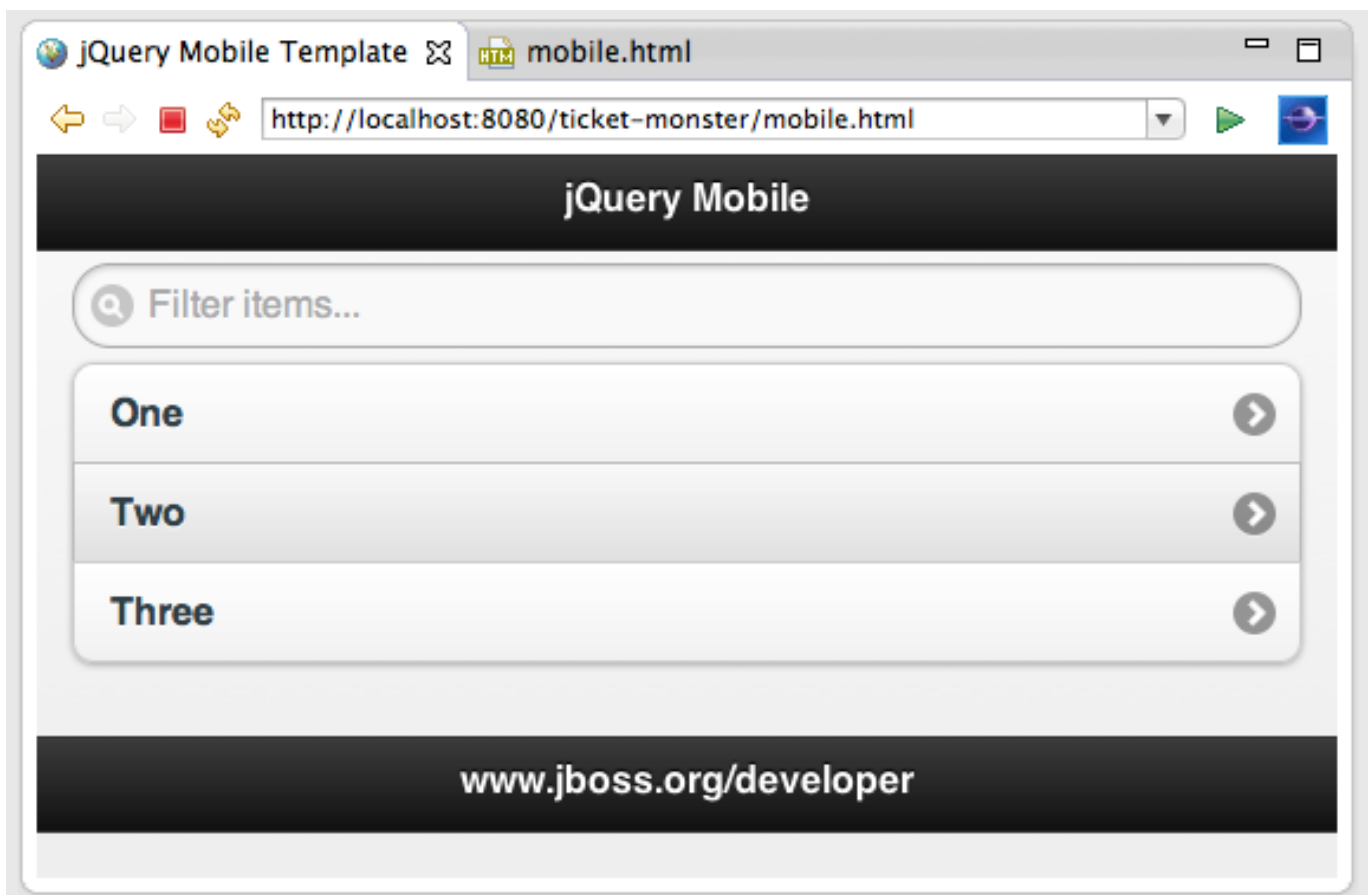


Figure 15.10: jQuery Mobile Template

One side benefit of using a HTML5 + jQuery-based front-end to your application is that it allows for fast turnaround in development. Simply edit the HTML file, save the file and refresh your browser.

Now the secret sauce to connecting your front-end to your back-end is simply observing the jQuery Mobile *pageinit* JavaScript event and including an invocation of the previously created Events JAX-RS service.

Insert the following block of code as the last item in the `<head>` element

```
<head>
...
<title>TicketMonster</title>
<script type="text/javascript">
    $(document).on("pageinit", "#page1", function(event){
        $.getJSON("rest/events", function(events) {
            // console.log("returned are " + events);
            var listOfEvents = $("#listOfItems");
            listOfEvents.empty();
            $.each(events, function(index, event) {
                // console.log(event.name);
                listOfEvents.append("<li><a href='#'>" + event.name + "</a>");
            });
            listOfEvents.listview("refresh");
        });
    });
</script>
</head>
```

Note:

- On triggering *pageinit* on the page having id "page1"
- using `$.getJSON("rest/events")` to hit the `EventService.java`
- a commented out `// console.log`, causes problems in IE
- Getting a reference to `listOfItems` which is declared in the HTML using an id attribute
- Calling `.empty` on that list - removing the exiting One, Two, Three items
- For each event - based on what is returned in step 1
- another commented out `// console.log`
- append the found event to the UL in the HTML
- refresh the `listOfItems`

Note

You may find the `.append("...")` syntax unattractive, embedding HTML inside of the JS `.append` method, this can be corrected using various JS templating techniques.

The result is ready for the average mobile phone. Simply refresh your browser to see the results.

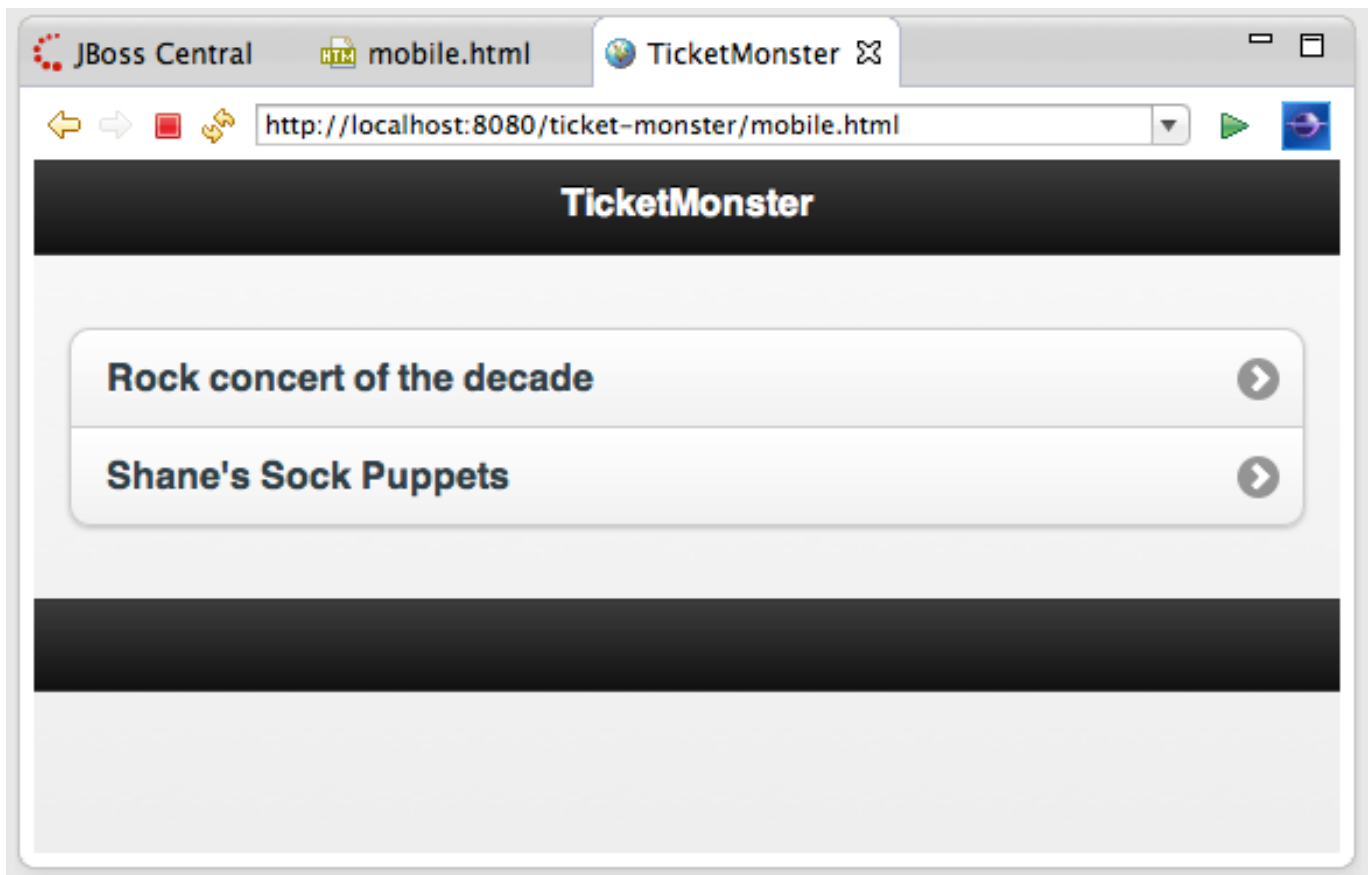


Figure 15.11: jQuery Mobile REST Results

JBoss Developer Studio and JBoss Tools includes BrowerSim to help you better understand what your mobile application will look like. Look for a "phone" icon in the toolbar, visible in the JBoss Perspective.



Figure 15.12: Mobile BrowserSim icon in Eclipse Toolbar

Note

The BrowserSim tool takes advantage of a locally installed Safari (Mac & Windows) on your workstation. It does not package a whole browser by itself. You will need to install Safari on Windows to leverage this feature – but that is more economical than having to purchase a MacBook to quickly look at your mobile-web focused application!

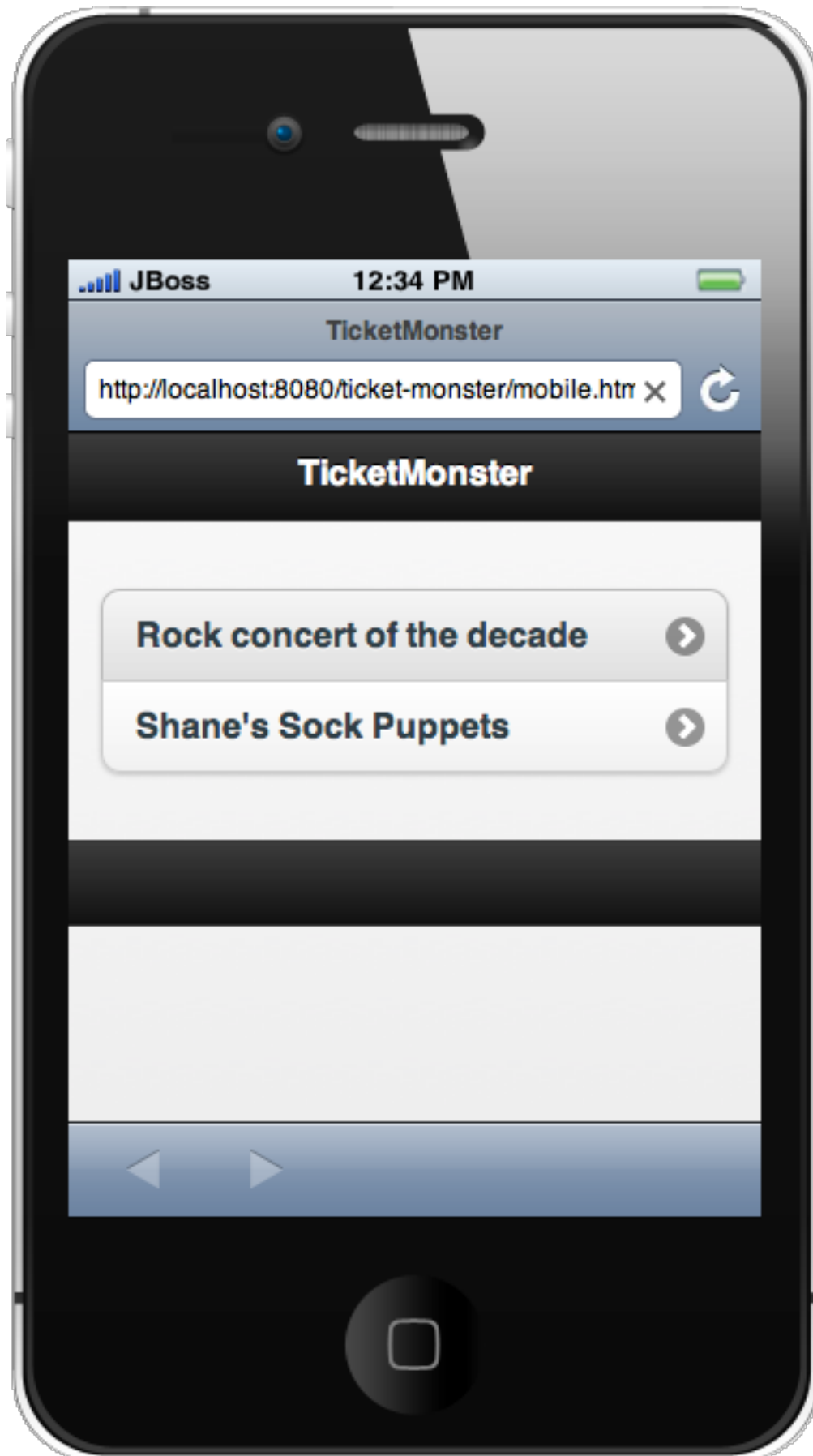


Figure 15.13: Mobile BrowserSim

The Mobile BrowserSim has a Devices menu, on Mac it is in the top menu bar and on Windows it is available via right-click as a pop-up menu. This menu allows you to change user-agent and dimensions of the browser, plus change the orientation of the device.

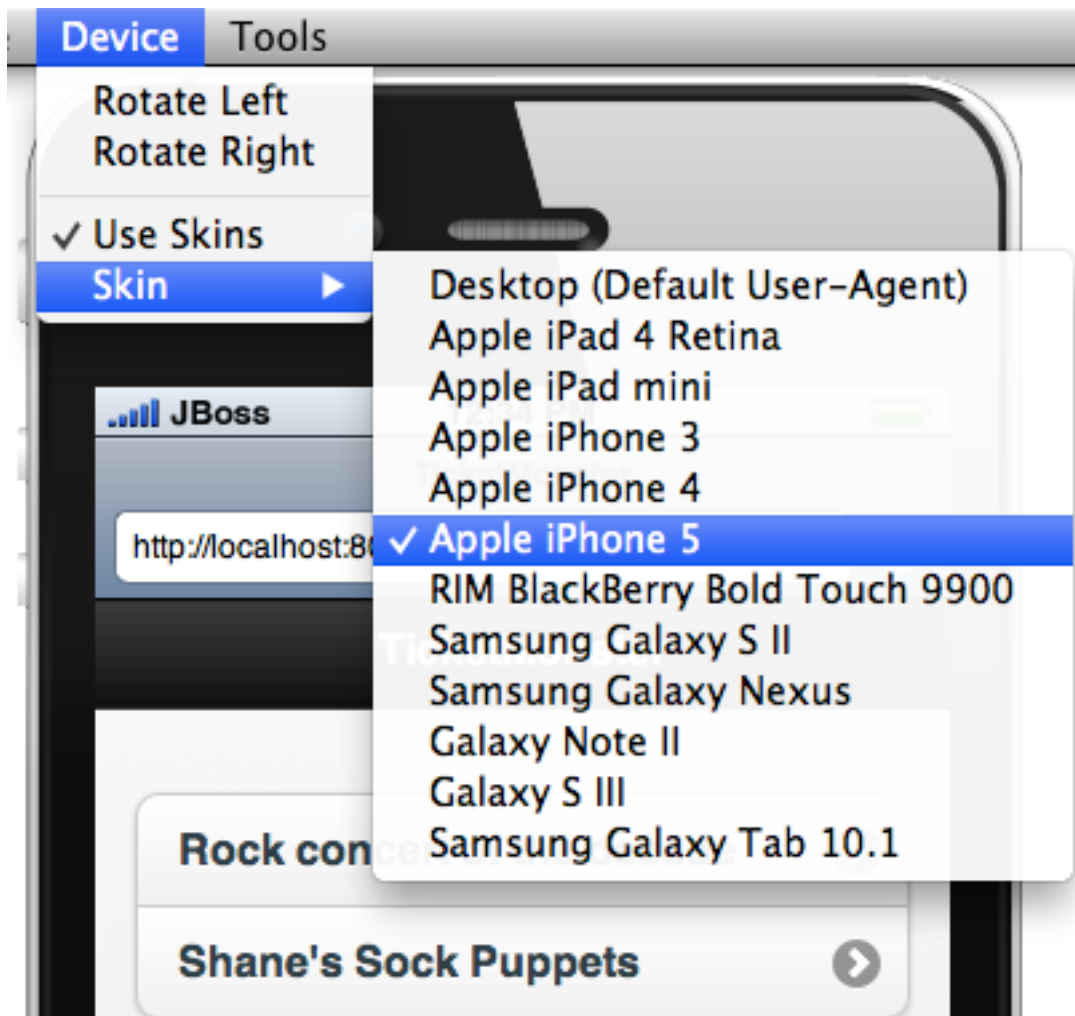


Figure 15.14: Mobile BrowserSim Devices Menu

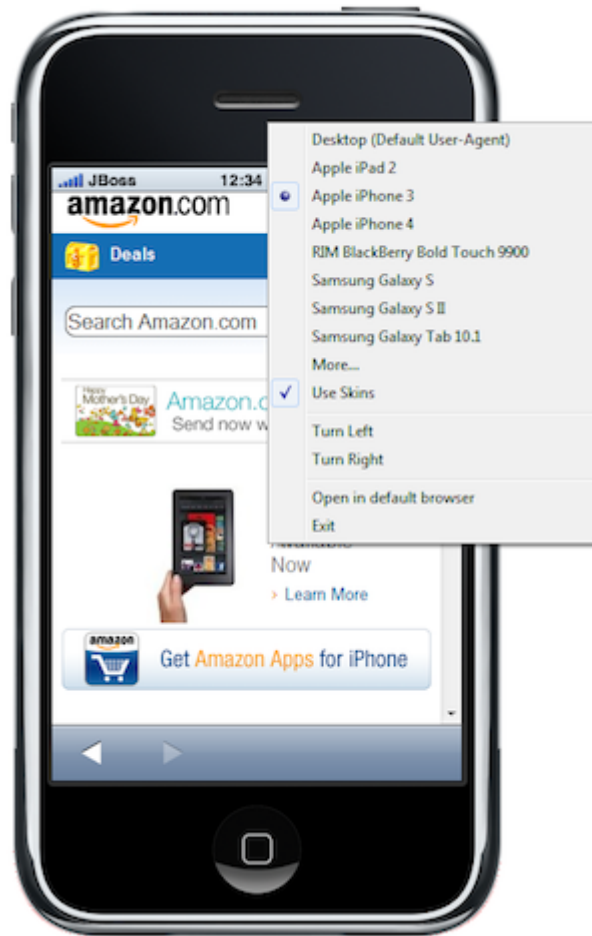


Figure 15.15: Mobile BrowserSim on Windows 7

You can also add your own custom device/browser types.

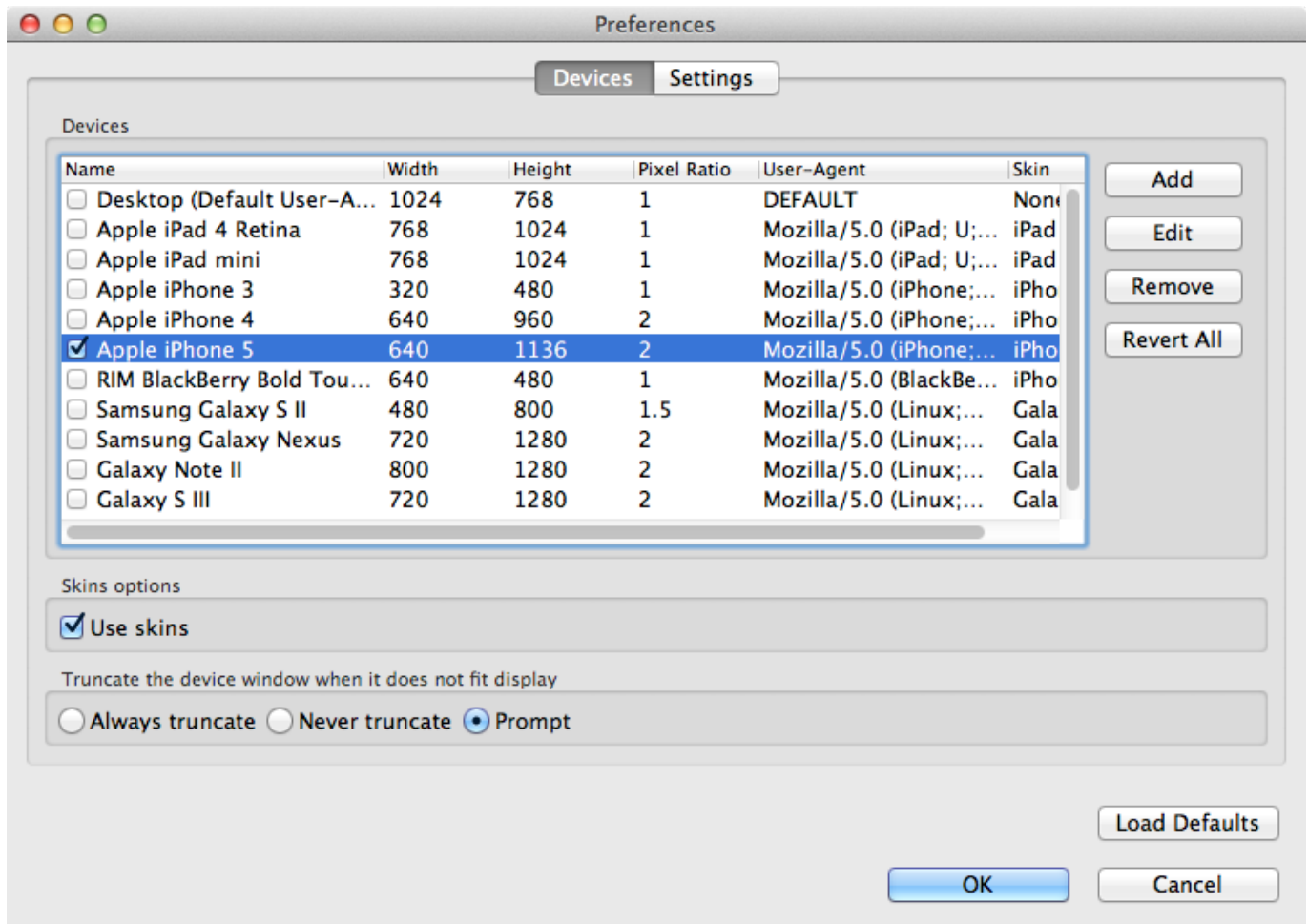


Figure 15.16: Mobile BrowserSim Custom Devices Window

Under the **File** menu, you will find a **View Page Source** option that will open up the mobile-version of the website's source code inside of JBoss Developer Studio. This is a very useful feature for learning how other developers are creating their mobile web presence.

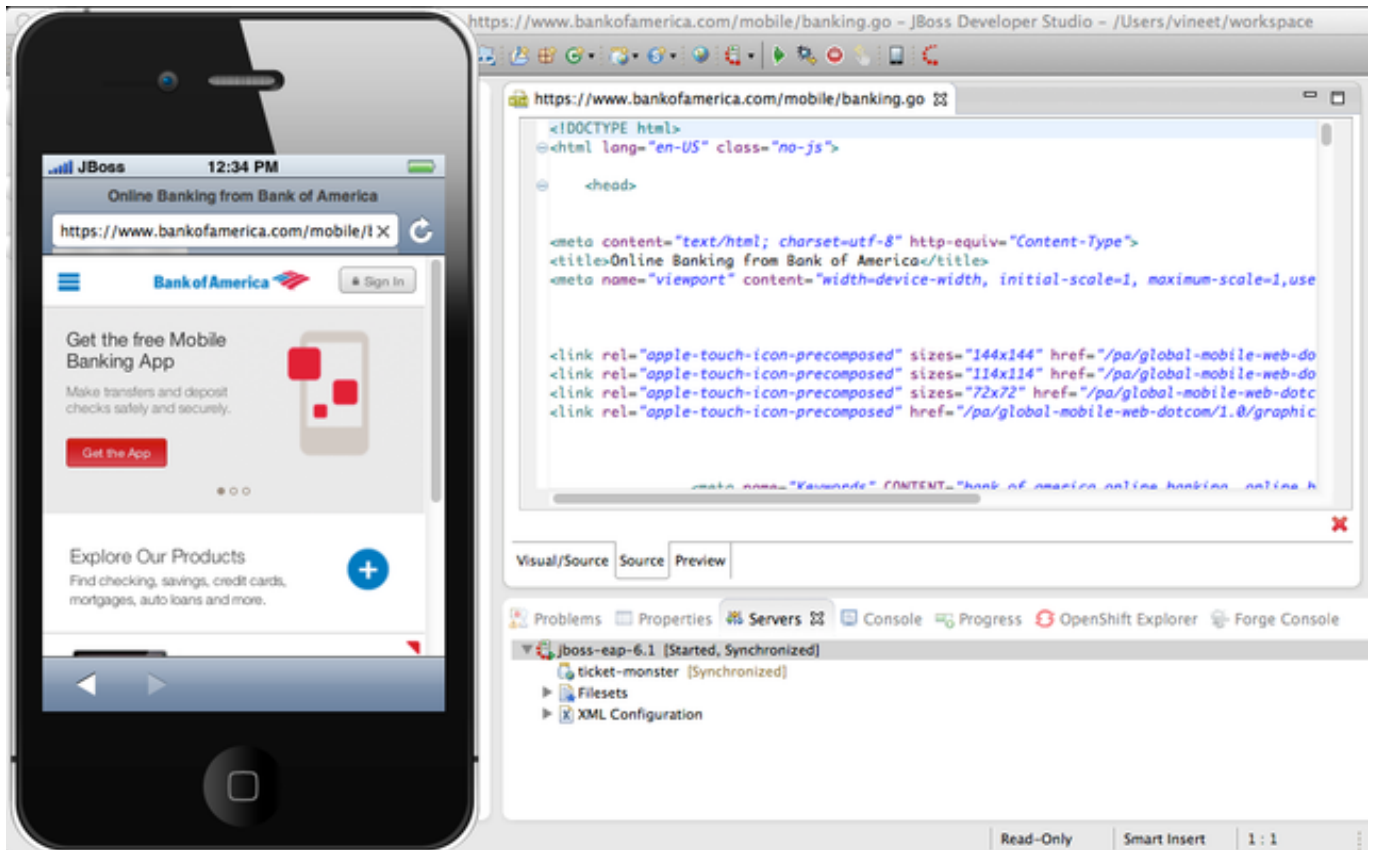


Figure 15.17: Mobile BrowserSim View Source

Chapter 16

Conclusion

This concludes our introduction to building HTML5 Mobile Web applications using Java EE 6 with Forge and JBoss Developer Studio. At this point, you should feel confident enough to tackle any of the additional exercises to learn how the TicketMonster sample application is constructed.

16.1 Cleaning up the generated code

Before we proceed with the tutorial and implement TicketMonster, we need to clean up some of the archetype-generated code. The Member management code, while useful for illustrating the general setup of a Java EE 6 web application, will not be part of TicketMonster, so we can safely remove some packages, classes, and resources:

- All the Member-related persistence and business code:

- `src/main/java/org/jboss/jdf/example/ticketmonster/controller`
- `src/main/java/org/jboss/jdf/example/ticketmonster/data`
- `src/main/java/org/jboss/jdf/example/ticketmonster/model/Member.java`
- `src/main/java/org/jboss/jdf/example/ticketmonster/rest/MemberResourceRESTService.java`
- `src/main/java/org/jboss/jdf/example/ticketmonster/service/MemberRegistration.java`

- Generated web content

- `src/main/webapp/index.html`
- `src/main/webapp/index.xhtml`
- `src/main/webapp/WEB-INF/templates/default.xhtml`

- JSF configuration (we will re-add it via Forge)

- `src/main/webapp/WEB-INF/faces-config.xml`

- Prototype mobile application (we will generate a proper mobile interface)

- `src/main/webapp/mobile.html`

Also, we will update the `src/main/resources/import.sql` file and remove the Member entity insertion:

```
insert into Member (id, name, email, phone_number) values (0, 'John Smith',  
    'john.smith@mailinator.com', '2125551212')
```

The data file should contain only the Event data import:

```
insert into Event (id, name, description, major, picture, version) values (1, 'Shane''s Sock  
Puppets', 'This critically acclaimed masterpiece...', true,  
'http://dl.dropbox.com/u/65660684/640px-Carnival_Puppets.jpg', 1);  
insert into Event (id, name, description, major, picture, version) values (2, 'Rock concert  
of the decade', 'Get ready to rock...', true,  
'http://dl.dropbox.com/u/65660684/640px-Weir%2C_Bob_(2007)_2.jpg', 1);
```

Part III

Building the persistence layer with JPA2 and Bean Validation

Chapter 17

What will you learn here?

You have set up your project successfully. Now it is time to begin working on the TicketMonster application, and the first step is adding the persistence layer. After reading this guide, you'll understand what design and implementation choices to make. Topics covered include:

- RDBMS design using JPA entity beans
- How to validate your entities using Bean Validation
- How to populate test data
- Basic unit testing using JUnit

We'll round out the guide by revealing the required, yet short and sweet, configuration.

The tutorial will show you how to perform all these steps in JBoss Developer Studio, including screenshots that guide you through. For those of you who prefer to watch and learn, the included videos show you how we performed all the steps.

TicketMonster contains 14 entities, of varying complexity. In the introduction, you have seen the basic steps for creating a couple of entities (`Event` and `Venue`) and interacting with them. In this tutorial we'll go deeper into domain model design, we'll classify the entities, and walk through designing and creating one of each group.

Chapter 18

Your first entity

The simplest kind of entities are often those representing lookup tables. `TicketCategory` is a classic lookup table that defines the ticket types available (e.g. Adult, Child, Pensioner). A ticket category has one property - *description*.

What's in a name?

Using a consistent naming scheme for your entities can help another developer get up to speed with your code base. We've named all our lookup tables `XXXCategory` to allow us to easily spot them.

Let's start by creating a JavaBean to represent the ticket category:

`src/main/java/org/jboss/jdf/example/ticketmonster/model/TicketCategory.java`

```
public class TicketCategory {

    /* Declaration of fields */

    /**
     * <p>
     * The description of the of ticket category.
     * </p>
     */
    private String description;

    /* Boilerplate getters and setters */

    public String getDescription() {
        return description;
    }

    public void setDescription(String description) {
        this.description = description;
    }

    @Override
    public String toString() {
        return description;
    }
}
```

We're going to want to keep the ticket category in collections (for example, to present it as part of drop down in the UI), so it's important that we properly implement `equals()` and `hashCode()`. At this point, we need to define a property (or group of properties) that uniquely identifies the ticket category. We refer to these properties as the "entity's natural identity".

Defining an entity's natural identity

Using an ORM introduces additional constraints on object identity. Defining the properties that make up an entity's natural identity can be tricky, but is very important. Using the object's identity, or the synthetic identity (database generated primary key) identity can introduce unexpected bugs into your application, so you should always ensure you use a natural identity. You can read more about the issue at <https://community.jboss.org/wiki/EqualsAndHashCode>.

For ticket category, the choice of natural identity is easy and obvious - it must be the one property, *description* that the entity has! Having identified the natural identity, adding an `equals()` and `hashCode()` method is easy. In Eclipse, choose *Source* → *Generate hashCode() and equals()*...

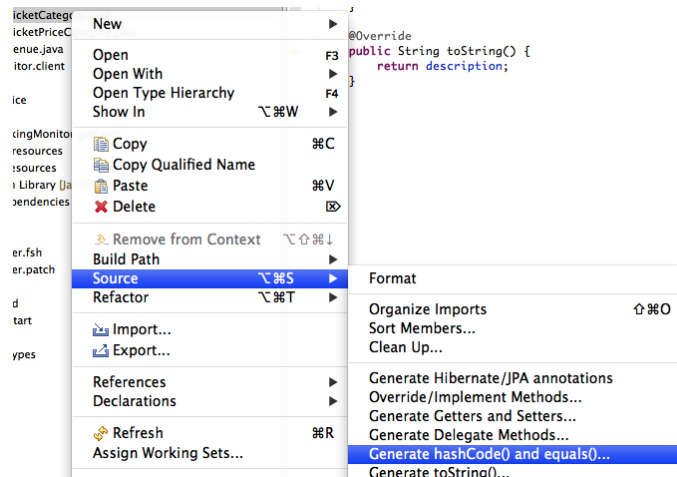


Figure 18.1: Generate hashCode() and equals() in Eclipse

Now, select the properties to include:

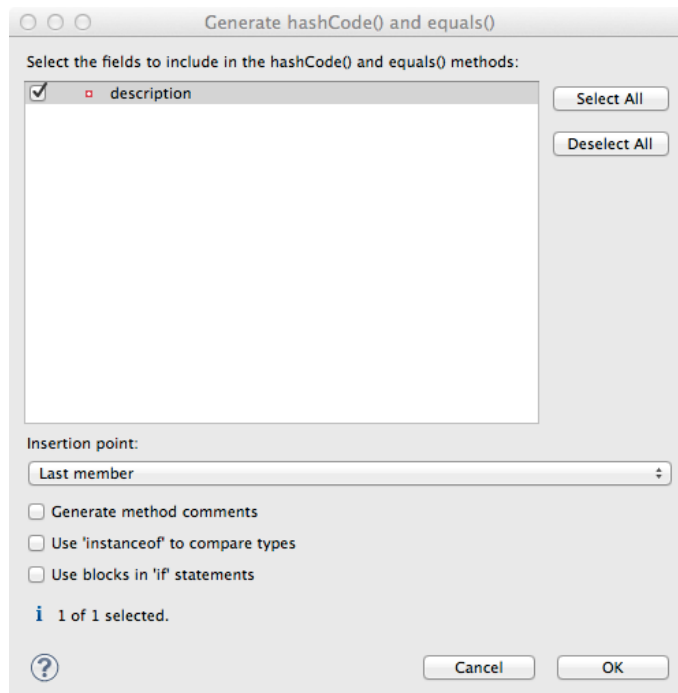


Figure 18.2: Generate hashCode() and equals() in Eclipse

Now that we have a JavaBean, let's proceed to make it an entity. First, add the `@Entity` annotation to the class:

src/main/java/org/jboss/jdf/example/ticketmonster/model/TicketCategory.java

```
@Entity
public class TicketCategory {

    ...

}
```

And, add the synthetic id:

src/main/java/org/jboss/jdf/example/ticketmonster/model/TicketCategory.java

```
@Entity
public class TicketCategory {

    /* Declaration of fields */

    /**
     * The synthetic id of the object.
     */
    @Id
    @GeneratedValue(strategy = GenerationType.IDENTITY)
    private Long id;

    ...

    /* Boilerplate getters and setters */

    public Long getId() {
        return id;
    }

    public void setId(Long id) {
        this.id = id;
    }

    ...

}
```

As we decided that our natural identifier was the description, we should introduce a unique constraint on the property:

src/main/java/org/jboss/jdf/example/ticketmonster/model/TicketCategory.java

```
@Entity
public class TicketCategory {

    /* Declaration of fields */

    ...

    /**
     * <p>
     * The description of the of ticket category.
     * </p>
     *
     * <p>
     * The description forms the natural id of the ticket category, and so must be unique.
     * </p>
     *
     */

}
```

```
@Column(unique = true)
private String description;

...
}
```

It's very important that any data you place in the database is of the highest quality - this data is probably one of your organisations most valuable assets! To ensure that bad data doesn't get saved to the database by mistake, we'll use Bean Validation to enforce constraints on our properties.

What is Bean Validation?

Bean Validation (JSR 303) is a Java EE specification which:

- provides a unified way of declaring and defining constraints on an object model.
- defines a runtime engine to validate objects

Bean Validation includes integration with other Java EE specifications, such as JPA. Bean Validation constraints are automatically applied before data is persisted to the database, as a last line of defence against bad data.

The *description* of the ticket category should not be empty for two reasons. Firstly, an empty ticket category description is no use to a person trying to book a ticket - it doesn't convey any information. Secondly, as the description forms the natural identity, we need to make sure the property is always populated.

Let's add the Bean Validation constraint `@NotEmpty`:

src/main/java/org/jboss/jdf/example/ticketmonster/model/TicketCategory.java

```
@Entity
public class TicketCategory {

    /* Declaration of fields */

    ...

    /**
     * <p>
     * The description of the of ticket category.
     * </p>
     *
     * <p>
     * The description forms the natural id of the ticket category, and so must be unique.
     * </p>
     *
     * <p>
     * The description must not be null and must be one or more characters, the Bean
     * Validation constraint @NotEmpty
     * enforces this.
     * </p>
     */
    @Column(unique = true)
    @NotEmpty
    private String description;

    ...
}
```

And that is our first entity! Here is the complete entity:

src/main/java/org/jboss/jdf/example/ticketmonster/model/TicketCategory.java

```
/**
 * <p>
 * A lookup table containing the various ticket categories. E.g. Adult, Child, Pensioner, etc.
 * </p>
 */
@Entity
public class TicketCategory {

    /* Declaration of fields */

    /**
     * The synthetic id of the object.
     */
    @Id
    @GeneratedValue(strategy = GenerationType.IDENTITY)
    private Long id;

    /**
     * <p>
     * The description of the of ticket category.
     * </p>
     *
     * <p>
     * The description forms the natural id of the ticket category, and so must be unique.
     * </p>
     *
     * <p>
     * The description must not be null and must be one or more characters, the Bean
     Validation constraint <code>@NotEmpty</code>
     * enforces this.
     * </p>
     */
    @Column(unique = true)
    @NotEmpty
    private String description;

    /* Boilerplate getters and setters */

    public Long getId() {
        return id;
    }

    public void setId(Long id) {
        this.id = id;
    }

    public String getDescription() {
        return description;
    }

    public void setDescription(String description) {
        this.description = description;
    }

    /* toString(), equals() and hashCode() for TicketCategory, using the natural identity of
    the object */

    @Override
    public boolean equals(Object o) {
        if (this == o)
```

```
        return true;
    if (o == null || getClass() != o.getClass())
        return false;

    TicketCategory that = (TicketCategory) o;

    if (description != null ? !description.equals(that.description) : that.description !=
        null)
        return false;

    return true;
}

@Override
public int hashCode() {
    return description != null ? description.hashCode() : 0;
}

@Override
public String toString() {
    return description;
}
}
```

TicketMonster contains another lookup tables, EventCategory. It's pretty much identical to TicketCategory, so we leave it as an exercise to the reader to investigate, and understand. If you are building the application whilst following this tutorial, copy the source over from the TicketMonster example.

Chapter 19

Database design & relationships

First, let's understand the the entity design.

An `Event` may occur at any number of venues, on various days and at various times. The intersection between an event and a venue is a `Show`, and each show can have a `Performance` which is associated with a date and time.

Venues are a separate grouping of entities, which, as mentioned, intersect with events via shows. Each venue consists of groupings of seats, each known as a `Section`.

Every section, in every show is associated with a ticket category via the `TicketPrice` entity.

Users must be able to book tickets for performances. A `Booking` is associated with a performance, and contains a collection of tickets.

Finally, both events and venues can have "media items", such as images or videos attached.

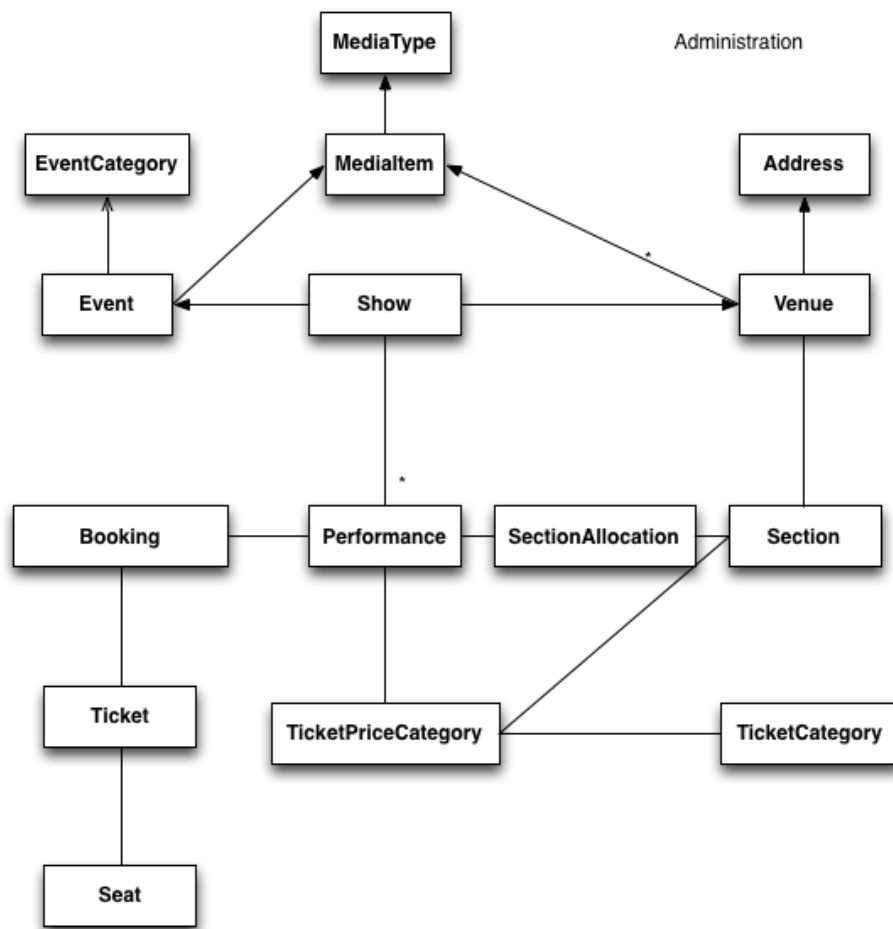


Figure 19.1: Entity-Relationship Diagram

19.1 Media items

Storing large binary objects, such as images or videos in the database isn't advisable (as it can lead to performance issues), and playback of videos can also be tricky, as it depends on browser capabilities. For TicketMonster, we decided to make use of existing services to host images and videos, such as YouTube or Flickr. All we store in the database is the URL the application should use to access the media item, and the type of the media item (note that the URL forms a media items natural identifier). We need to know the type of the media item in order to render the media correctly in the view layer.

In order for a view layer to correctly render the media item (e.g. display an image, embed a media player), it's likely that special code has had to have been added. For this reason we represent the types of media that TicketMonster understands as a closed set, unmodifiable at runtime. An enum is perfect for this!

Luckily, JPA has native support for enums, all we need to do is add the `@Enumerated` annotation:

src/main/java/org/jboss/jdf/example/ticketmonster/model/MediaItem.java

```

* . .
*
**
* <p>
* The type of the media, required to render the media item correctly.
* </p>
*

```

```

    * <p>
    * The media type is a <em>closed set</em> - as each different type of media requires
    support coded into the view layers, it
    * cannot be expanded upon without rebuilding the application. It is therefore
    represented by an enumeration. We instruct
    * JPA to store the enum value using it's String representation, so that we can later
    reorder the enum members, without
    * changing the data. Of course, this does mean we can't change the names of media items
    once the app is put into
    * production.
    * </p>
    */
    @Enumerated(String)
    private MediaType mediaType;

    ...

```

@Enumerated(String) or @Enumerated(Ordinal)?

JPA can store an enum value using its ordinal (position in the list of declared enums) or its String (the name it is given). If you choose to store an ordinal, you mustn't alter the order of the list. If you choose to store the name, you mustn't change the enum name. The choice is yours!

The rest of `MediaItem` shouldn't present a challenge to you. If you are building the application whilst following this tutorial, copy both `MediaItem` and `MediaType` from the TicketMonster project.

19.2 Events

In Chapter 18 we saw how to build simple entities with properties, identify and apply constraints using Bean Validation, identify the natural id and add a synthetic id. From now on we'll assume you know how to build simple entities - for each new entity that we build, we will start with its basic structure and properties filled in.

So, here is our starting point for `Event` (where we left at the end of the introduction, and including some comments reflecting the explanations above):

src/main/java/org/jboss/jdf/example/ticketmonster/model/Event.java

```

@Entity
public class Event {

    /* Declaration of fields */

    /**
     * The synthetic ID of the object.
     */
    @Id
    @GeneratedValue(strategy = GenerationType.IDENTITY)
    private Long id;

    /**
     * <p>
     * The name of the event.
     * </p>
     *
     * <p>
     * The name of the event forms its natural identity and cannot be shared between events.
     * </p>
     */
}

```



```
* <p>
* Two constraints are applied using Bean Validation
* </p>
*
* <ol>
* <li><code>@NotNull</code> &mdash; the name must not be null.</li>
* <li><code>@Size</code> &mdash; the name must be at least 5 characters and no more than
50 characters. This allows for
* better formatting consistency in the view layer.</li>
* </ol>
*/
@Column(unique = true)
@NotNull
@Size(min = 5, max = 50, message = "An event's name must contain between 5 and 50
characters")
private String name;

/**
* <p>
* A description of the event.
* </p>
*
* <p>
* Two constraints are applied using Bean Validation
* </p>
*
* <ol>
* <li><code>@NotNull</code> &mdash; the description must not be null.</li>
* <li><code>@Size</code> &mdash; the name must be at least 20 characters and no more
than 1000 characters. This allows for
* better formatting consistency in the view layer, and also ensures that event
organisers provide at least some description
* - a classic example of a business constraint.</li>
* </ol>
*/
@NotNull
@Size(min = 20, max = 1000, message = "An event's name must contain between 20 and 1000
characters")
private String description;

/* Boilerplate getters and setters */

public Long getId() {
    return id;
}

public void setId(Long id) {
    this.id = id;
}

public String getName() {
    return name;
}

public void setName(String name) {
    this.name = name;
}

public String getDescription() {
    return description;
}
```

```

public void setDescription(String description) {
    this.description = description;
}

/* toString(), equals() and hashCode() for Event, using the natural identity of the
object */

@Override
public boolean equals(Object o) {
    if (this == o)
        return true;
    if (o == null || getClass() != o.getClass())
        return false;

    Event event = (Event) o;

    if (name != null ? !name.equals(event.name) : event.name != null)
        return false;

    return true;
}

@Override
public int hashCode() {
    return name != null ? name.hashCode() : 0;
}

@Override
public String toString() {
    return name;
}
}

```

First, let's add a media item to Event. As multiple events (or venues) could share the same media item, we'll model the relationship as *many-to-one* - many events can reference the same media item.

Relationships supported by JPA

JPA can model four types of relationship between entities - one-to-one, one-to-many, many-to-one and many-to-many. A relationship may be bi-directional (both sides of the relationship know about each other) or uni-directional (only one side knows about the relationship).

Many database models are hierarchical (parent-child), as is TicketMonster's. As a result, you'll probably find you mostly use one-to-many and many-to-one relationships, which allow building parent-child models.

Creating a many-to-one relationship is very easy in JPA. Just add the `@ManyToOne` annotation to the field. JPA will take care of the rest. Here's the property for Event:

src/main/java/org/jboss/jdf/example/ticketmonster/model/Event.java

```

...

/**
 * <p>
 * A media item, such as an image, which can be used to entice a browser to book a ticket.
 * </p>
 *
 * <p>
 * Media items can be shared between events, so this is modeled as a
 * @ManyToOne relationship.
 * </p>

```

```

*
* <p>
* Adding a media item is optional, and the view layer will adapt if none is provided.
* </p>
*
*/
@ManyToOne
private MediaItem mediaItem;

...

public MediaItem getMediaItem() {
    return mediaItem;
}

public void setMediaItem(MediaItem picture) {
    this.mediaItem = picture;
}

...

```

There is no need for a media item to know who references it (in fact, this would be a poor design, as it would reduce the reusability of `MediaItem`), so we can leave this as a uni-directional relationship.

An event will also have a category. Once again, many events can belong to the same event category, and there is no need for an event category to know what events are in it. To add this relationship, we add the `eventCategory` property, and annotate it with `@ManyToOne`, just as we did for `MediaItem`.

And that's Event created. Here is the full source:

src/main/java/org/jboss/jdf/example/ticketmonster/model/Event.java

```

/**
 * <p>
 * Represents an event, which may have multiple performances with different dates and venues.
 * </p>
 *
 * <p>
 * Event's principle members are it's relationship to {@link EventCategory} - specifying the
 * type of event it is - and
 * {@link MediaItem} - providing the ability to add media (such as a picture) to the event
 * for display. It also contains
 * meta-data about the event, such as it's name and a description.
 * </p>
 *
 */
@Entity
public class Event {

    /* Declaration of fields */

    /**
     * The synthetic ID of the object.
     */
    @Id
    @GeneratedValue(strategy = GenerationType.IDENTITY)
    private Long id;

    /**
     * <p>
     * The name of the event.
     * </p>
     *

```

```

* <p>
* The name of the event forms it's natural identity and cannot be shared between events.
* </p>
*
* <p>
* Two constraints are applied using Bean Validation
* </p>
*
* <ol>
* <li><code>@NotNull</code> &mdash; the name must not be null.</li>
* <li><code>@Size</code> &mdash; the name must be at least 5 characters and no more than
50 characters. This allows for
* better formatting consistency in the view layer.</li>
* </ol>
*/
@Column(unique = true)
@NotNull
@Size(min = 5, max = 50, message = "An event's name must contain between 5 and 50
characters")
private String name;

/**
* <p>
* A description of the event.
* </p>
*
* <p>
* Two constraints are applied using Bean Validation
* </p>
*
* <ol>
* <li><code>@NotNull</code> &mdash; the description must not be null.</li>
* <li><code>@Size</code> &mdash; the name must be at least 20 characters and no more
than 1000 characters. This allows for
* better formatting consistency in the view layer, and also ensures that event
organisers provide at least some description
* - a classic example of a business constraint.</li>
* </ol>
*/
@NotNull
@Size(min = 20, max = 1000, message = "An event's name must contain between 20 and 1000
characters")
private String description;

/**
* <p>
* A media item, such as an image, which can be used to entice a browser to book a ticket.
* </p>
*
* <p>
* Media items can be shared between events, so this is modeled as a
<code>@ManyToOne</code> relationship.
* </p>
*
* <p>
* Adding a media item is optional, and the view layer will adapt if none is provided.
* </p>
*
*/
@ManyToOne
private MediaItem mediaItem;

```

```
/**
 * <p>
 * The category of the event
 * </p>
 *
 * <p>
 * Event categories are used to ease searching of available of events, and hence this is
 modeled as a relationship
 * </p>
 *
 * <p>
 * The Bean Validation constraint <code>@NotNull</code> indicates that the event category
 must be specified.
 */
@ManyToOne
@NotNull
private EventCategory category;

/* Boilerplate getters and setters */

public Long getId() {
    return id;
}

public void setId(Long id) {
    this.id = id;
}

public String getName() {
    return name;
}

public void setName(String name) {
    this.name = name;
}

public MediaItem getMediaItem() {
    return mediaItem;
}

public void setMediaItem(MediaItem picture) {
    this.mediaItem = picture;
}

public EventCategory getCategory() {
    return category;
}

public void setCategory(EventCategory category) {
    this.category = category;
}

public String getDescription() {
    return description;
}

public void setDescription(String description) {
    this.description = description;
}

/* toString(), equals() and hashCode() for Event, using the natural identity of the
 object */
```

```

@Override
public boolean equals(Object o) {
    if (this == o)
        return true;
    if (o == null || getClass() != o.getClass())
        return false;

    Event event = (Event) o;

    if (name != null ? !name.equals(event.name) : event.name != null)
        return false;

    return true;
}

@Override
public int hashCode() {
    return name != null ? name.hashCode() : 0;
}

@Override
public String toString() {
    return name;
}
}

```

19.3 Shows

A show is an event at a venue. It consists of a set of performances of the show. A show also contains the list of ticket prices available.

Let's start building Show. Here's is our starting point:

src/main/java/org/jboss/jdf/example/ticketmonster/model/Show.java

```

/**
 * <p>
 * A show is an instance of an event taking place at a particular venue. A show can have
 * multiple performances.
 * </p>
 */
@Entity
public class Show {

    /* Declaration of fields */

    /**
     * The synthetic id of the object.
     */
    @Id
    @GeneratedValue(strategy = GenerationType.IDENTITY)
    private Long id;

    /**
     * <p>
     * The event of which this show is an instance. The <code>@ManyToOne</code> JPA mapping
     * establishes this relationship.
     * </p>
     */
}

```

```
* <p>
* The <code>@NotNull</code> Bean Validation constraint means that the event must be
specified.
* </p>
*/
@ManyToOne
@NotNull
private Event event;

/**
* <p>
* The venue where this show takes place. The <code>@ManyToOne</code> JPA mapping
establishes this relationship.
* </p>
*
* <p>
* The <code>@NotNull</code> Bean Validation constraint means that the venue must be
specified.
* </p>
*/
@ManyToOne
@NotNull
private Venue venue;

/* Boilerplate getters and setters */

public Long getId() {
    return id;
}

public void setId(Long id) {
    this.id = id;
}

public Event getEvent() {
    return event;
}

public void setEvent(Event event) {
    this.event = event;
}

public Venue getVenue() {
    return venue;
}

public void setVenue(Venue venue) {
    this.venue = venue;
}

/* toString(), equals() and hashCode() for Show, using the natural identity of the object
*/
@Override
public boolean equals(Object o) {
    if (this == o)
        return true;
    if (o == null || getClass() != o.getClass())
        return false;

    Show show = (Show) o;

    if (event != null ? !event.equals(show.event) : show.event != null)
```

```

        return false;
    if (venue != null ? !venue.equals(show.venue) : show.venue != null)
        return false;

    return true;
}

@Override
public int hashCode() {
    int result = event != null ? event.hashCode() : 0;
    result = 31 * result + (venue != null ? venue.hashCode() : 0);
    return result;
}

@Override
public String toString() {
    return event + " at " + venue;
}
}

```

If you've been paying attention, you'll notice that there is a problem here. We've identified that the natural identity of this entity is formed of two properties - the *event* and the *venue*, and we've correctly coded the `equals()` and `hashCode()` methods (or had them generated for us!). However, we haven't told JPA that these two properties, in combination, must be unique. As there are two properties involved, we can no longer use the `@Column` annotation (which operates on a single property/table column), but now must use the class level `@Table` annotation (which operates on the whole entity/table). Change the class definition to read:

src/main/java/org/jboss/jdf/example/ticketmonster/model/Show.java

```

...

@Entity
@Table(uniqueConstraints = @UniqueConstraint(columnNames = { "event_id", "venue_id" }))
public class Show {

    ...

}

```

You'll notice that JPA requires us to use the column names, rather than property names here. The column names used in the `@UniqueConstraint` annotation are those generated by default for properties called `event` and `venue`.

Now, let's add the set of performances to the event. Unlike previous relationships we've seen, the relationship between a show and its performances is bi-directional. We chose to model this as a bi-directional relationship in order to improve the generated database schema (otherwise you end with complicated mapping tables which makes updates to collections hard). Let's add the set of performances:

src/main/java/org/jboss/jdf/example/ticketmonster/model/Show.java

```

...

/**
 * <p>
 * The set of performances of this show.
 * </p>
 *
 * <p>
 * The <code>@OneToMany</code> JPA mapping establishes this relationship. Collection
members
 * are fetched eagerly, so that they can be accessed even after the entity has become
detached.
 * This relationship is bi-directional (a performance knows which show it is part of),
and the <code>mappedBy</code>

```



```

    * attribute establishes this.
    * </p>
    *
    */
    @OneToMany(fetch=EAGER, mappedBy = "show", cascade = ALL)
    @OrderBy("date")
    private Set<Performance> performances = new HashSet<Performance>();

    ...

    public Set<Performance> getPerformances() {
        return performances;
    }

    public void setPerformances(Set<Performance> performances) {
        this.performances = performances;
    }

    ...

```

As the relationship is bi-directional, we specify the `mappedBy` attribute on the `@OneToMany` annotation, which informs JPA to create a bi-directional relationship. The value of the attribute is name of property which forms the other side of the relationship - in this case, not unsurprisingly `show`!

As `Show` is the owner of `Performance` (and without a `show`, a performance cannot exist), we add the `cascade = ALL` attribute to the `@OneToMany` annotation. As a result, any persistence operation that occurs on a `show`, will be propagated to it's performances. For example, if a `show` is removed, any associated performances will be removed as well.

When retrieving a `show`, we will also retrieve its associated performances by adding the `fetch = EAGER` attribute to the `@OneToMany` annotation. This is a design decision which required careful consideration. In general, you should favour the default lazy initialization of collections: their content should be accessible on demand. However, in this case we intend to marshal the contents of the collection and pass it across the wire in the JAX-RS layer, after the entity has become detached, and cannot initialize its members on demand.

We'll also need to add the set of ticket prices available for this `show`. Once more, this is a bi-directional relationship, owned by the `show`. It looks just like the set of performances.

Here's the full source for `Show`:

src/main/java/org/jboss/jdf/example/ticketmonster/model/Show.java

```

/**
 * <p>
 * A show is an instance of an event taking place at a particular venue. A show can have
 * multiple performances.
 * </p>
 *
 * <p>
 * A show contains a set of performances, and a set of ticket prices for each section of the
 * venue for this show.
 * </p>
 *
 * <p>
 * The event and venue form the natural id of this entity, and therefore must be unique. JPA
 * requires us to use the class level
 * <code>@Table</code> constraint.
 * </p>
 *
 */
/*
 * We suppress the warning about not specifying a serialVersionUID, as we are still
 * developing this app, and want the JVM to
 * generate the serialVersionUID for us. When we put this app into production, we'll generate
 * and embed the serialVersionUID
 */

```

```
*/
@SuppressWarnings("serial")
@Entity
@Table(uniqueConstraints = @UniqueConstraint(columnNames = { "event_id", "venue_id" }))
public class Show implements Serializable {

    /* Declaration of fields */

    /**
     * The synthetic id of the object.
     */
    @Id
    @GeneratedValue(strategy = GenerationType.IDENTITY)
    private Long id;

    /**
     * <p>
     * The event of which this show is an instance. The <code>@ManyToOne</code> JPA mapping
     * establishes this relationship.
     * </p>
     *
     * <p>
     * The <code>@NotNull</code> Bean Validation constraint means that the event must be
     * specified.
     * </p>
     */
    @ManyToOne
    @NotNull
    private Event event;

    /**
     * <p>
     * The event of which this show is an instance. The <code>@ManyToOne</code> JPA mapping
     * establishes this relationship.
     * </p>
     *
     * <p>
     * The <code>@NotNull</code> Bean Validation constraint means that the event must be
     * specified.
     * </p>
     */
    @ManyToOne
    @NotNull
    private Venue venue;

    /**
     * <p>
     * The set of performances of this show.
     * </p>
     *
     * <p>
     * The <code>@OneToMany</code> JPA mapping establishes this relationship. TODO Explain
     * EAGER fetch.
     * This relationship is bi-directional (a performance knows which show it is part of),
     * and the <code>mappedBy</code>
     * attribute establishes this. We cascade all persistence operations to the set of
     * performances, so, for example if a show
     * is removed, then all of it's performances will also be removed.
     * </p>
     *
     * <p>
     * Normally a collection is loaded from the database in the order of the rows, but here
     */
}
```

```
we want to make sure that
* performances are ordered by date - we let the RDBMS do the heavy lifting. The
* <code>@OrderBy</code> annotation instructs JPA to do this.
* </p>
*/
@OneToMany(fetch = EAGER, mappedBy = "show", cascade = ALL)
@OrderBy("date")
private Set<Performance> performances = new HashSet<Performance>();

/**
* <p>
* The set of ticket prices available for this show.
* </p>
*
* <p>
* The <code>@OneToMany</code> JPA mapping establishes this relationship.
* This relationship is bi-directional (a ticket price category knows which show it is
part of), and the <code>mappedBy</code>
* attribute establishes this. We cascade all persistence operations to the set of
performances, so, for example if a show
* is removed, then all of it's ticket price categories are also removed.
* </p>
*/
@OneToMany(mappedBy = "show", cascade = ALL, fetch = EAGER)
private Set<TicketPrice> ticketPrices = new HashSet<TicketPrice>();

/* Boilerplate getters and setters */

public Long getId() {
    return id;
}

public void setId(Long id) {
    this.id = id;
}

public Event getEvent() {
    return event;
}

public void setEvent(Event event) {
    this.event = event;
}

public Set<Performance> getPerformances() {
    return performances;
}

public void setPerformances(Set<Performance> performances) {
    this.performances = performances;
}

public Venue getVenue() {
    return venue;
}

public void setVenue(Venue venue) {
    this.venue = venue;
}

public Set<TicketPrice> getTicketPrices() {
    return ticketPrices;
}
```

```

    }

    public void setTicketPrices(Set<TicketPrice> ticketPrices) {
        this.ticketPrices = ticketPrices;
    }

    /* toString(), equals() and hashCode() for Show, using the natural identity of the object
    */
    @Override
    public boolean equals(Object o) {
        if (this == o)
            return true;
        if (o == null || getClass() != o.getClass())
            return false;

        Show show = (Show) o;

        if (event != null ? !event.equals(show.event) : show.event != null)
            return false;
        if (venue != null ? !venue.equals(show.venue) : show.venue != null)
            return false;

        return true;
    }

    @Override
    public int hashCode() {
        int result = event != null ? event.hashCode() : 0;
        result = 31 * result + (venue != null ? venue.hashCode() : 0);
        return result;
    }

    @Override
    public String toString() {
        return event + " at " + venue;
    }
}

```

19.4 Performances

Finally, let's create the `Performance` class, which represents an instance of a `Show`. `Performance` is pretty straightforward. It contains the date and time of the performance, and the show of which it is a performance. Together, the show, and the date and time, make up the natural identity of the performance. Here's the source for `Performance`:

src/main/java/org/jboss/jdf/example/ticketmonster/model/Performance.java

```

/**
 * <p>
 * A performance represents a single instance of a show.
 * </p>
 *
 * <p>
 * The show and date form the natural id of this entity, and therefore must be unique. JPA
 * requires us to use the class level
 * <code>@Table</code> constraint.
 * </p>
 */
@Entity
@Table(uniqueConstraints = @UniqueConstraint(columnNames = { "date", "show_id" }))

```

```
public class Performance {

    /* Declaration of fields */

    /**
     * The synthetic id of the object.
     */
    @Id
    @GeneratedValue(strategy = GenerationType.IDENTITY)
    private Long id;

    /**
     * <p>
     * The date and start time of the performance.
     * </p>
     *
     * <p>
     * A Java {@link Date} object represents both a date and a time, whilst an RDBMS splits
     out Date, Time and Timestamp.
     * Therefore we instruct JPA to store this date as a timestamp using the
     <code>@Temporal(TIMESTAMP)</code> annotation.
     * </p>
     *
     * <p>
     * The date and time of the performance is required, and the Bean Validation constraint
     <code>@NotNull</code> enforces this.
     * </p>
     */
    @Temporal(TIMESTAMP)
    @NotNull
    private Date date;

    /**
     * <p>
     * The show of which this is a performance. The <code>@ManyToOne</code> JPA mapping
     establishes this relationship.
     * </p>
     *
     * <p>
     * The show of which this is a performance is required, and the Bean Validation
     constraint <code>@NotNull</code> enforces
     * this.
     * </p>
     */
    @ManyToOne
    @NotNull
    private Show show;

    /* Boilerplate getters and setters */

    public Long getId() {
        return id;
    }

    public void setId(Long id) {
        this.id = id;
    }

    public void setShow(Show show) {
        this.show = show;
    }
}
```

```

    public Show getShow() {
        return show;
    }

    public Date getDate() {
        return date;
    }

    public void setDate(Date date) {
        this.date = date;
    }

    /* equals() and hashCode() for Performance, using the natural identity of the object */

    @Override
    public boolean equals(Object o) {
        if (this == o)
            return true;
        if (o == null || getClass() != o.getClass())
            return false;

        Performance that = (Performance) o;

        if (date != null ? !date.equals(that.date) : that.date != null)
            return false;
        if (show != null ? !show.equals(that.show) : that.show != null)
            return false;

        return true;
    }

    @Override
    public int hashCode() {
        int result = date != null ? date.hashCode() : 0;
        result = 31 * result + (show != null ? show.hashCode() : 0);
        return result;
    }
}

```

Of interest here is the storage of the date and time.

A Java `Date` represents "a specific instance in time, with millisecond precision" and is the recommended construct for representing date and time in the JDK. A RDBMS's *DATE* type typically has day precision only, and uses the *DATETIME* or *TIMESTAMP* types to represent an instance in time, and often only to second precision.

As the mapping between Java date and time, and database date and time isn't straightforward, JPA requires us to use the `@Temporal` annotation on any property of type `Date`, and to specify whether the `Date` should be stored as a date, a time or a timestamp (date and time).

19.5 Venue

Now, let's build out the entities to represent the venue.

We start by adding an entity to represent the venue. A venue needs to have a name, a description, a capacity, an address, an associated media item and a set sections in which people can sit. If you completed the introduction chapter, you should already have some of these properties set, so we will update the `Venue` class to look like in the definition below.

src/main/java/org/jboss/jdf/example/ticketmonster/model/Venue.java

```

/**
 * <p>

```

```
* Represents a single venue
* </p>
*
*/
@Entity
public class Venue {

    /* Declaration of fields */

    /**
     * The synthetic id of the object.
     */
    @Id
    @GeneratedValue(strategy = GenerationType.IDENTITY)
    private Long id;

    /**
     * <p>
     * The name of the event.
     * </p>
     *
     * <p>
     * The name of the event forms it's natural identity and cannot be shared between events.
     * </p>
     *
     * <p>
     * The name must not be null and must be one or more characters, the Bean Validation
     * constraint <code>@NotEmpty</code> enforces this.
     * </p>
     */
    @Column(unique = true)
    @NotEmpty
    private String name;

    /**
     * The address of the venue
     */
    @Embedded
    private Address address = new Address();

    /**
     * A description of the venue
     */
    private String description;

    /**
     * <p>
     * A set of sections in the venue
     * </p>
     *
     * <p>
     * The <code>@OneToMany</code> JPA mapping establishes this relationship.
     * Collection members are fetched eagerly, so that they can be accessed even after the
     * entity has become detached. This relationship is bi-directional (a section knows which
     * venue it is part of), and the <code>mappedBy</code> attribute establishes this. We
     * cascade all persistence operations to the set of performances, so, for example if a
     venue
     * is removed, then all of it's sections will also be removed.
     * </p>
     */
    @OneToMany(cascade = ALL, fetch = EAGER, mappedBy = "venue")
    private Set<Section> sections = new HashSet<Section>();
```

```
/**
 * The capacity of the venue
 */
private int capacity;

/**
 * An optional media item to entice punters to the venue. The @ManyToOne
 establishes the relationship.
 */
@ManyToOne
private MediaItem mediaItem;

/* Boilerplate getters and setters */

public Long getId() {
    return id;
}

public void setId(Long id) {
    this.id = id;
}

public String getName() {
    return name;
}

public void setName(String name) {
    this.name = name;
}

public Address getAddress() {
    return address;
}

public void setAddress(Address address) {
    this.address = address;
}

public MediaItem getMediaItem() {
    return mediaItem;
}

public void setMediaItem(MediaItem description) {
    this.mediaItem = description;
}

public String getDescription() {
    return description;
}

public void setDescription(String description) {
    this.description = description;
}

public Set<Section> getSections() {
    return sections;
}

public void setSections(Set<Section> sections) {
    this.sections = sections;
}
```



```

public int getCapacity() {
    return capacity;
}

public void setCapacity(int capacity) {
    this.capacity = capacity;
}

/* toString(), equals() and hashCode() for Venue, using the natural identity of the
object */

@Override
public boolean equals(Object o) {
    if (this == o)
        return true;
    if (o == null || getClass() != o.getClass())
        return false;

    Venue venue = (Venue) o;

    if (address != null ? !address.equals(venue.address) : venue.address != null)
        return false;
    if (name != null ? !name.equals(venue.name) : venue.name != null)
        return false;

    return true;
}

@Override
public int hashCode() {
    int result = name != null ? name.hashCode() : 0;
    result = 31 * result + (address != null ? address.hashCode() : 0);
    return result;
}

@Override
public String toString() {
    return name;
}
}

```

In creating this entity, we've followed all the design and implementation decisions previously discussed, with one new concept. Rather than add the properties for street, city, postal code etc. to this object, we've extracted them into the `Address` object, and included it in the `Venue` object using composition. This would allow us to reuse the `Address` object in other places (such as a customer's address).

A RDBMS doesn't have a similar concept to composition, so we need to choose whether to represent the address as a separate entity, and create a relationship between the venue and the address, or whether to map the properties from `Address` to the table for the owning entity, in this case `Venue`. It doesn't make much sense for an address to be a full entity - we're not going to want to run queries against the address in isolation, nor do we want to be able to delete or update an address in isolation - in essence, the address doesn't have a standalone identity outside of the object into which it is composed.

To *embed* the `Address` into `Venue` we add the `@Embeddable` annotation to the `Address` class. However, unlike a full entity, there is no need to add an identifier. Here's the source for `Address`:

src/main/java/org/jboss/jdf/example/ticketmonster/model/Address.java

```

/**
 * <p>
 * A reusable representation of an address.
 * </p>

```

```
*
* <p>
* Addresses are used in many places in an application, so to observe the DRY principle, we
* model Address as an embeddable
* entity. An embeddable entity appears as a child in the object model, but no relationship
* is established in the RDBMS..
* </p>
*/
@Embeddable
public class Address {

    /* Declaration of fields */
    private String street;
    private String city;
    private String country;

    /* Declaration of boilerplate getters and setters */

    public String getStreet() {
        return street;
    }

    public void setStreet(String street) {
        this.street = street;
    }

    public String getCity() {
        return city;
    }

    public void setCity(String city) {
        this.city = city;
    }

    public String getCountry() {
        return country;
    }

    public void setCountry(String country) {
        this.country = country;
    }

    /* toString(), equals() and hashCode() for Address, using the natural identity of the
    object */

    @Override
    public boolean equals(Object o) {
        if (this == o)
            return true;
        if (o == null || getClass() != o.getClass())
            return false;

        Address address = (Address) o;

        if (city != null ? !city.equals(address.city) : address.city != null)
            return false;
        if (country != null ? !country.equals(address.country) : address.country != null)
            return false;
        if (street != null ? !street.equals(address.street) : address.street != null)
            return false;

        return true;
    }
}
```

```

    }

    @Override
    public int hashCode() {
        int result = street != null ? street.hashCode() : 0;
        result = 31 * result + (city != null ? city.hashCode() : 0);
        result = 31 * result + (country != null ? country.hashCode() : 0);
        return result;
    }

    @Override
    public String toString() {
        return street + ", " + city + ", " + country;
    }
}

```

19.6 Sections

A venue consists of a number of seating sections. Each seating section has a name, a description, the number of rows in the section, and the number of seats in a row. It's natural identifier is the name of section combined with the venue (a venue can't have two sections with the same name). `Section` doesn't introduce any new concepts, so go ahead and copy the source in, if you are building the application whilst following this tutorial.

19.7 Booking, Ticket & Seat

There aren't many new concepts to explore in `Booking`, `Ticket` and `Seat`, so if you are following along with the tutorial, you should copy in the `Booking`, `Ticket` and `Seat` classes.

Once the user has selected an event, identified the venue, and selected a performance, they have the opportunity to request a number of seats in a given section, and select the category of tickets required. Once they chosen their seats, and entered their email address, a `Booking` is created.

A booking consists of the date the booking was created, an email address (as `TicketMonster` doesn't yet have fully fledged user management), a set of tickets and the associated performance. The set of tickets shows us how to create a uni-directional one-to-many relationship:

src/main/java/org/jboss/jdf/example/ticketmonster/model/Booking.java

```

...

/**
 * <p>
 * The set of tickets contained within the booking. The <code>@OneToMany</code> JPA
mapping establishes this relationship.
 * </p>
 *
 * <p>
 * The set of tickets is eagerly loaded because FIXME . All operations are cascaded to
each ticket, so for example if a
 * booking is removed, then all associated tickets will be removed.
 * </p>
 *
 * <p>
 * This relationship is uni-directional, so we need to inform JPA to create a foreign key
mapping. The foreign key mapping
 * is not visible in the {@link Ticket} entity despite being present in the database.
 * </p>
 *
 */

```

```
    */  
    @OneToMany(fetch = EAGER, cascade = ALL)  
    @JoinColumn      @NotEmpty  
    @Valid  
    private Set<Ticket> tickets = new HashSet<Ticket>();  
  
    ...
```

We add the `@JoinColumn` annotation, which sets up a foreign key in `Ticket`, but doesn't expose the booking on `Ticket`. This prevents the use of messy mapping tables, whilst preserving the integrity of the entity model.

A ticket embeds the seat allocated, and contains a reference to the category under which it was sold. It also contains the price at which it was sold.

Chapter 20

Connecting to the database

In this example, we are using the in-memory H2 database, which is very easy to set up on JBoss AS. JBoss AS allows you deploy a datasource inside your application's WEB-INF directory. You can locate the source in `src/main/webapp/WEB-INF/ticket-mon`

src/main/webapp/WEB-INF/ticket-monster-ds.xml

```
<datasources xmlns="http://www.jboss.org/ironjacamar/schema"
  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xsi:schemaLocation="http://www.jboss.org/ironjacamar/schema
http://docs.jboss.org/ironjacamar/schema/datasources_1_0.xsd">
  <!-- The datasource is bound into JNDI at this location. We reference
        this in META-INF/persistence.xml -->
  <datasource jndi-name="java:jboss/datasources/ticket-monsterDS"
    pool-name="ticket-monster" enabled="true" use-java-context="true">
    <connection-url>
      jdbc:h2:mem:ticket-monster;DB_CLOSE_ON_EXIT=FALSE;DB_CLOSE_DELAY=-1
    </connection-url>
    <driver>h2</driver>
    <security>
      <user-name>sa</user-name>
      <password>sa</password>
    </security>
  </datasource>
</datasources>
```

The datasource configures an H2 in-memory database, called *ticket-monster*, and registers a datasource in JNDI at the address:

`java:jboss/datasources/ticket-monsterDS`

Now we need to configure JPA to use the datasource. This is done in `src/main/resources/META-INF/persistence.xml`:

src/main/resources/persistence.xml

```
<persistence version="2.0"
  xmlns="http://java.sun.com/xml/ns/persistence"
  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xsi:schemaLocation="
    http://java.sun.com/xml/ns/persistence
    http://java.sun.com/xml/ns/persistence/persistence_2_0.xsd">
  <persistence-unit name="primary">
    <!-- If you are running in a production environment, add a managed
          data source, this example data source is just for development and testing! -->
    <!-- The datasource is deployed as WEB-INF/ticket-monster-ds.xml, you
          can find it in the source at src/main/webapp/WEB-INF/ticket-monster-ds.xml -->
    <jta-data-source>java:jboss/datasources/ticket-monsterDS</jta-data-source>
```

```
<properties>
  <!-- Properties for Hibernate -->
  <property name="hibernate.hbm2ddl.auto" value="create-drop" />
  <property name="hibernate.show_sql" value="false" />
</properties>
</persistence-unit>
</persistence>
```

As our application has only one datasource, and hence one persistence unit, the name given to the persistence unit doesn't really matter. We call ours `primary`, but you can change this as you like. We tell JPA about the datasource bound in JNDI.

Hibernate includes the ability to generate tables from entities, which here we have configured. We don't recommend using this outside of development. Updates to databases in production should be done manually.

Chapter 21

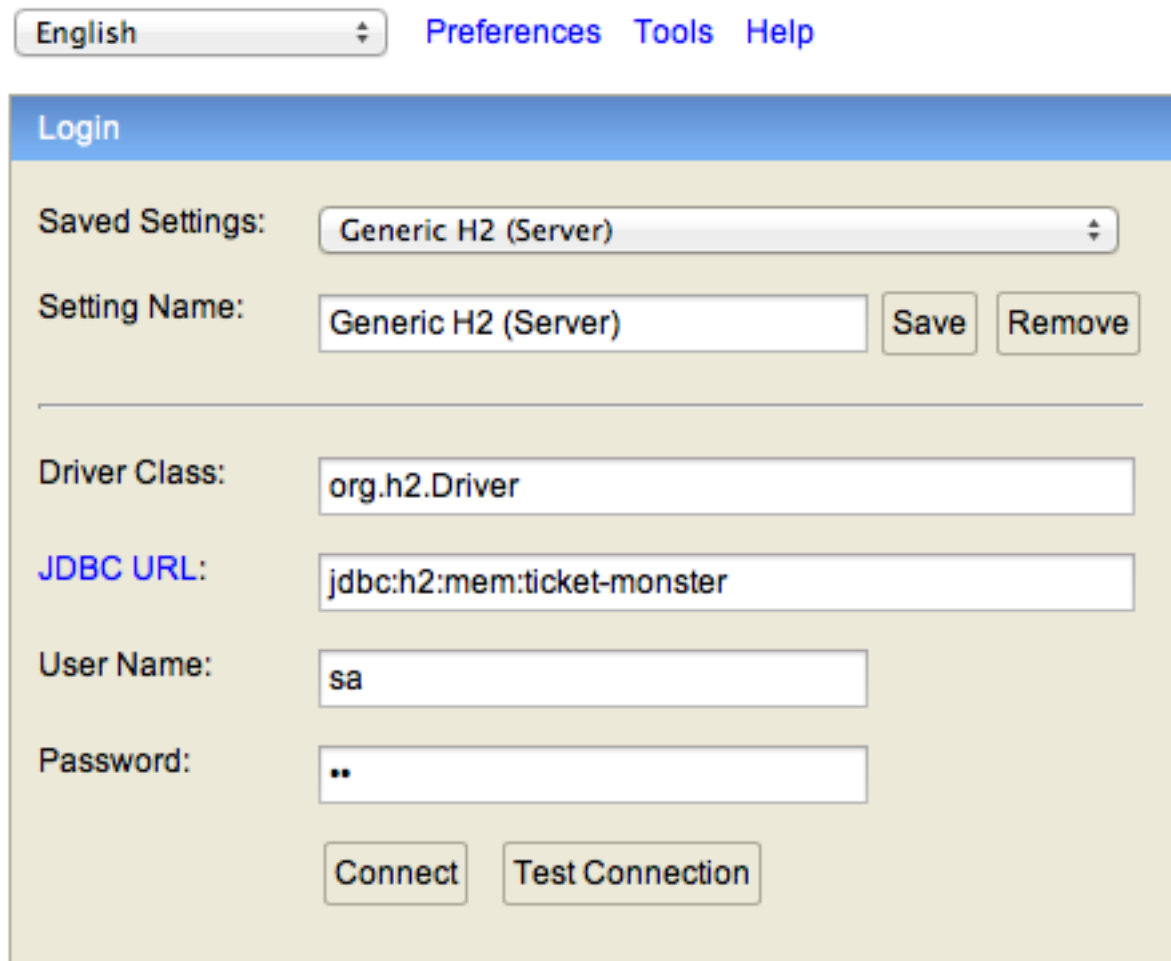
Populating test data

Whilst we develop our application, it's useful to be able to populate the database with test data. Luckily, Hibernate makes this easy. Just add a file called `import.sql` onto the classpath of your application (we keep it in `src/main/resources/import.sql`). In it, we just write standard sql statements suitable for the database we are using. To do this, you need to know the generated column and table names for your entities. The best way to work these out is to look at the h2console.

The h2console is included in the JBoss AS quickstarts, along with instructions on how to use it. For more information, see <http://jboss.org/jdf/quickstarts/jboss-as-quickstart/h2-console/>

Where do I look for my data?

The database URL is `jdbc:h2:mem:ticket-monster`. After you have downloaded `h2console.war` and deployed it on the server, make sure that the application is running on the server and use this value to connect to your running application's database.



The screenshot shows the h2console application interface. At the top, there is a language dropdown menu set to 'English' and navigation links for 'Preferences', 'Tools', and 'Help'. Below this is a 'Login' window. The 'Saved Settings' section shows a dropdown menu with 'Generic H2 (Server)' selected. Below this, the 'Setting Name' is 'Generic H2 (Server)', with 'Save' and 'Remove' buttons. The 'Driver Class' is 'org.h2.Driver'. The 'JDBC URL' is 'jdbc:h2:mem:ticket-monster'. The 'User Name' is 'sa' and the 'Password' is masked with two dots. At the bottom are 'Connect' and 'Test Connection' buttons.

English	Preferences	Tools	Help
Login			
Saved Settings:	Generic H2 (Server)		
Setting Name:	Generic H2 (Server)	Save	Remove
Driver Class:	org.h2.Driver		
JDBC URL:	jdbc:h2:mem:ticket-monster		
User Name:	sa		
Password:	..		
Connect		Test Connection	

Figure 21.1: h2console settings

Chapter 22

Conclusion

You now have a working data model for your TicketMonster application, our next tutorial will show you how to create the business services layer or something like that - it seems to end abruptly.

Part IV

Building The Business Services With JAX-RS

Chapter 23

What Will You Learn Here?

We've just defined the domain model of the application and created its persistence layer. Now we need to define the services that implement the business logic of the application and expose them to the front-end. After reading this, you'll understand how to design the business layer and what choices to make while developing it. Topics covered include:

- Encapsulating business logic in services and integrating with the persistence tier
- Using CDI for integrating individual services
- Integration testing using Arquillian
- Exposing RESTful services via JAX-RS

The tutorial will show you how to perform all these steps in JBoss Developer Studio, including screenshots that guide you through.

Chapter 24

Business Services And Their Relationships

TicketMonster's business logic is implemented by a number of classes, with different responsibilities:

- managing media items
- allocating tickets
- handling information on ticket availability
- remote access through a RESTful interface

The services are consumed by various other layers of the application:

- the media management and ticket allocation services encapsulate complex functionality, which in turn is exposed externally by RESTful services that wrap them
- RESTful services are mainly used by the HTML5 view layer
- the ticket availability service is used by the HTML5 and JavaScript based monitor

Where to draw the line?

A business service is an encapsulated, reusable logical component that groups together a number of well-defined cohesive business operations. Business services perform business operations, and may coordinate infrastructure services such as persistence units, or even other business services as well. The boundaries drawn between them should take into account whether the newly created services represent , potentially reusable components.

As you can see, some of the services are intended to be consumed within the business layer of the application, while others provide an external interface as JAX-RS services. We will start by implementing the former, and we'll finish up with the latter. During this process, you will discover how CDI, EJB and JAX-RS make it easy to define and wire together our services.

Chapter 25

Preparations

25.1 Adding Jackson Core

The first step for setting up our service architecture is to add Jackson Core as a dependency in the project. Adding Jackson Core as a provided dependency will enable you to use the Jackson annotations in the project. This is necessary to obtain a certain degree of control over the content of the JSON responses.

pom.xml

```
<project ...>
  ...
  <dependencies>
    <!-- This is the dependency for Jackson Core, which we use for
         fine tuning the content of the JSON responses -->
    <dependency>
      <groupId>org.codehaus.jackson</groupId>
      <artifactId>jackson-core-asl</artifactId>
      <version>1.8.1</version>
      <scope>provided</scope>
    </dependency>
  </dependencies>
  ...
</project>
```

Why do you need the Jackson annotations?

JAX-RS does not specify mediatype-agnostic annotations for certain use cases. You will encounter atleast one of them in the project. The object graph contains cyclic/bi-directional relationships among entities like Venue, Section, Show, Performance and TicketPrice. JSON representations for these objects will need tweaking to avoid stack overflow errors and the like, at runtime.

JBoss Enterprise Application 6 and JBoss AS 7 uses Jackson to perform serialization and dserialization of objects, thus requiring use of Jackson annotations to modify this behavior. `@JsonIgnoreProperties` from Jackson will be used to suppress serialization and deserialization of one of the fields involved in the cycle.

25.2 Verifying the versions of the JBoss BOMs

The next step is to verify if we're using the right version of the JBoss BOMs in the project. Using the right versions of the BOMs ensures that you work against a known set of tested dependencies. Verify that the property `jboss.bom.version` contains the value `1.0.7.CR8` or higher:

pom.xml

```
<project ...>
  ...
  <properties>
    ...
    <jboss.bom.version>1.0.7.CR8</jboss.bom.version>
    ...
  </properties>
  ...
</project>
```

Doing so will ensure that ShrinkWrap Resolvers 2.0.0.Final is present in the test classpath. This would be used in the Arquillian tests for the application.

25.3 Enabling CDI

The next step is to enable CDI in the deployment by creating a `beans.xml` file in the `WEB-INF` folder of the web application.

src/main/webapp/WEB-INF/beans.xml

```
<beans xmlns="http://java.sun.com/xml/ns/javaee"
  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xsi:schemaLocation="http://java.sun.com/xml/ns/javaee
    http://java.sun.com/xml/ns/javaee/beans_1_0.xsd">
</beans>
```

If you used the Maven archetype

If you used the Maven archetype to create the project, this file will exist already in the project - it is added automatically.

You may wonder why the file is empty! Whilst `beans.xml` can specify various deployment-time configuration (e.g. activation of interceptors, decorators or alternatives), it can also act as a marker file, telling the container to enable CDI for the deployment (which it doesn't do, unless `beans.xml` is present).

Contexts and Dependency Injection (CDI)

As its name suggests, CDI is the contexts and dependency injection standard for Java EE. By enabling CDI in your application, deployed classes become managed components and their lifecycle and wiring becomes the responsibility of the Java EE server. In this way, we can reduce coupling between components, which is a requirement of a well-designed architecture. Now, we can focus on implementing the responsibilities of the components and describing their dependencies in a declarative fashion. The runtime will do the rest for you: instantiating and wiring them together, as well as disposing of them as needed.

25.4 Adding utility classes

Next, we add some helper classes providing low-level utilities for the application. We won't get in their implementation details here, but you can study their source code for details.

Copy the following classes from the original example to `src/main/java/org/jboss/jdf/example/ticketmonster/uti`.

- `Base64`
 - `ForwardingMap`
 - `MultivaluedHashMap`
 - `Reflections`
 - `Resources`
-

Chapter 26

Internal Services

We begin the service implementation by implementing some helper services.

26.1 The Media Manager

First, let's add support for managing media items, such as images. The persistence layer simply stores URLs, referencing media items stored by online services. The URL look like http://dl.dropbox.com/u/65660684/640px-Roy_Thomson_Hall_Toronto.jpg.

Now, we could use the URLs in our application, and retrieve these media items from the provider. However, we would prefer to cache these media items in order to improve application performance and increase resilience to external failures - this will allow us to run the application successfully even if the provider is down. The `MediaManager` is a good illustration of a business service; it performs the retrieval and caching of media objects, encapsulating the operation from the rest of the application.

We begin by creating `MediaManager`:

src/main/java/org/jboss/jdf/example/ticketmonster/service/MediaManager.java

```
/**
 * <p>
 * The media manager is responsible for taking a media item, and returning either the URL
 * of the cached version (if the application cannot load the item from the URL), or the
 * original URL.
 * </p>
 *
 * <p>
 * The media manager also transparently caches the media items on first load.
 * </p>
 *
 * <p>
 * The computed URLs are cached for the duration of a request. This provides a good balance
 * between consuming heap space, and computational time.
 * </p>
 */
public class MediaManager {

    /**
     * Locate the tmp directory for the machine
     */
    private static final File tmpDir;

    static {
        String dataDir = System.getenv("OPENSIFT_DATA_DIR");
        String parentDir = dataDir != null ? dataDir : System.getProperty("java.io.tmpdir");
```

```

        tmpDir = new File(parentDir, "org.jboss.jdf.examples.ticket-monster");
        if (tmpDir.exists()) {
            if (tmpDir.isFile())
                throw new IllegalStateException(tmpDir.getAbsolutePath() + " already exists,
and is a file. Remove it.");
            } else {
                tmpDir.mkdir();
            }
        }

/**
 * A request scoped cache of computed URLs of media items.
 */
private final Map<MediaItem, MediaPath> cache;

public MediaManager() {

    this.cache = new HashMap<MediaItem, MediaPath>();
}

/**
 * Load a cached file by name
 *
 * @param fileName
 * @return
 */
public File getCachedFile(String fileName) {
    return new File(tmpDir, fileName);
}

/**
 * Obtain the URL of the media item. If the URL h has already been computed in this
 * request, it will be looked up in the request scoped cache, otherwise it will be
 * computed, and placed in the request scoped cache.
 */
public MediaPath getPath(MediaItem mediaItem) {
    if (cache.containsKey(mediaItem)) {
        return cache.get(mediaItem);
    } else {
        MediaPath mediaPath = createPath(mediaItem);
        cache.put(mediaItem, mediaPath);
        return mediaPath;
    }
}

/**
 * Compute the URL to a media item. If the media item is not cacheable, then, as long
 * as the resource can be loaded, the original URL is returned. If the resource is not
 * available, then a placeholder image replaces it. If the media item is cacheable, it
 * is first cached in the tmp directory, and then path to load it is returned.
 */
private MediaPath createPath(MediaItem mediaItem) {
    if(mediaItem == null) {
        return
createCachedMedia(Reflections.getResource("not_available.jpg").toExternalForm(), IMAGE);
    } else if (!mediaItem.getMediaType().isCacheable()) {
        if (checkResourceAvailable(mediaItem)) {
            return new MediaPath(mediaItem.getUrl(), false, mediaItem.getMediaType());
        } else {
            return
createCachedMedia(Reflections.getResource("not_available.jpg").toExternalForm(), IMAGE);
        }
    }
}

```



```
    } else {
        return createCachedMedia(mediaItem);
    }
}

/**
 * Check if a media item can be loaded from it's URL, using the JDK URLConnection classes.
 */
private boolean checkResourceAvailable(MediaItem mediaItem) {
    URL url = null;
    try {
        url = new URL(mediaItem.getUrl());
    } catch (MalformedURLException e) {
    }

    if (url != null) {
        try {
            URLConnection connection = url.openConnection();
            if (connection instanceof HttpURLConnection) {
                return ((HttpURLConnection) connection).getResponseCode() ==
                    HttpURLConnection.HTTP_OK;
            } else {
                return connection.getContentLength() > 0;
            }
        } catch (IOException e) {
        }
    }
    return false;
}

/**
 * The cached file name is a base64 encoded version of the URL. This means we don't need
 * to maintain a database of cached
 * files.
 */
private String getCachedFileName(String url) {
    return Base64.encodeToString(url.getBytes(), false);
}

/**
 * Check to see if the file is already cached.
 */
private boolean alreadyCached(String cachedFileName) {
    File cache = getCachedFile(cachedFileName);
    if (cache.exists()) {
        if (cache.isDirectory()) {
            throw new IllegalStateException(cache.getAbsolutePath() + " already exists,
and is a directory. Remove it.");
        }
        return true;
    } else {
        return false;
    }
}

/**
 * To cache a media item we first load it from the net, then write it to disk.
 */
private MediaPath createCachedMedia(String url, MediaType mediaType) {
    String cachedFileName = getCachedFileName(url);
    if (!alreadyCached(cachedFileName)) {
        URL _url = null;
```

```

        try {
            _url = new URL(url);
        } catch (MalformedURLException e) {
            throw new IllegalStateException("Error reading URL " + url);
        }

        try {
            InputStream is = null;
            OutputStream os = null;
            try {
                is = new BufferedInputStream(_url.openStream());
                os = new BufferedOutputStream(getCachedOutputStream(cachedFileName));
                while (true) {
                    int data = is.read();
                    if (data == -1)
                        break;
                    os.write(data);
                }
            } finally {
                if (is != null)
                    is.close();
                if (os != null)
                    os.close();
            }
        } catch (IOException e) {
            throw new IllegalStateException("Error caching " +
mediaType.getDescription(), e);
        }
    }
    return new MediaPath(cachedFileName, true, mediaType);
}

private MediaPath createCachedMedia(MediaItem mediaItem) {
    return createCachedMedia(mediaItem.getUrl(), mediaItem.getMediaType());
}

private OutputStream getCachedOutputStream(String fileName) {
    try {
        return new FileOutputStream(getCachedFile(fileName));
    } catch (FileNotFoundException e) {
        throw new IllegalStateException("Error creating cached file", e);
    }
}
}
}

```

The service delegates to a number of internal methods that do the heavy lifting, but exposes a simple API, to the external observer it simply converts the `MediaItem` entities into `MediaPath` data structures, that can be used by the application to load the binary data of the media item. The service will retrieve and cache the data locally in the filesystem, if possible (e.g. streamed videos aren't cacheable!).

src/main/java/org/jboss/jdf/example/ticketmonster/service/MediaPath.java

```

public class MediaPath {

    private final String url;
    private final boolean cached;
    private final MediaType mediaType;

    public MediaPath(String url, boolean cached, MediaType mediaType) {
        this.url = url;
        this.cached = cached;
    }
}

```

```
        this.mediaType = mediaType;
    }

    public String getUrl() {
        return url;
    }

    public boolean isCached() {
        return cached;
    }

    public MediaType getMediaType() {
        return mediaType;
    }
}
```

The service can be injected by type into the components that depend on it.

We should also control the lifecycle of this service. The `MediaManager` stores request-specific state, so should be scoped to the web request, the CDI `@RequestScoped` is perfect.

src/main/java/org/jboss/jdf/example/ticketmonster/service/MediaManager.java

```
...
@RequestScoped
public class MediaManager {
    ...
}
```

26.2 The Seat Allocation Service

The seat allocation service finds free seats at booking time, in a given section of the venue. It is a good example of how a service can coordinate infrastructure services (using the injected persistence unit to get access to the `ServiceAllocation` instance) and domain objects (by invoking the `allocateSeats` method on a concrete allocation instance).

Isolating this functionality in a service class makes it possible to write simpler, self-explanatory code in the layers above and opens the possibility of replacing this code at a later date with a more advanced implementation (for example one using an in-memory cache).

src/main/java/org/jboss/jdf/example/ticketmonster/service/SeatAllocationService.java

```
@SuppressWarnings("serial")
public class SeatAllocationService implements Serializable {

    @Inject
    EntityManager entityManager;

    public AllocatedSeats allocateSeats(Section section, Performance performance, int
seatCount, boolean contiguous) {
        SectionAllocation sectionAllocation = retrieveSectionAllocationExclusively(section,
performance);
        List<Seat> seats = sectionAllocation.allocateSeats(seatCount, contiguous);
        return new AllocatedSeats(sectionAllocation, seats);
    }

    public void deallocateSeats(Section section, Performance performance, List<Seat> seats) {
        SectionAllocation sectionAllocation = retrieveSectionAllocationExclusively(section,
performance);
        for (Seat seat : seats) {
```

```
        if (!seat.getSection().equals(section)) {
            throw new SeatAllocationException("All seats must be in the same section!");
        }
        sectionAllocation.deallocate(seat);
    }
}

private SectionAllocation retrieveSectionAllocationExclusively(Section section,
Performance performance) {
    SectionAllocation sectionAllocationStatus = (SectionAllocation)
entityManager.createQuery(

        "select s from SectionAllocation s where " +

        "s.performance.id = :performanceId and " +

        "s.section.id = :sectionId")

        .setParameter("performanceId", performance.getId())

        .setParameter("sectionId", section.getId())

        .getSingleResult();
    entityManager.lock(sectionAllocationStatus, LockModeType.PESSIMISTIC_WRITE);
    return sectionAllocationStatus;
}
}
```

Next, we define the `AllocatedSeats` class that we use for storing seat reservations for a booking, before they are made persistent.

`src/main/java/org/jboss/jdf/example/ticketmonster/service/AllocatedSeats.java`

```
public class AllocatedSeats {

    private final SectionAllocation sectionAllocation;

    private final List<Seat> seats;

    public AllocatedSeats(SectionAllocation sectionAllocation, List<Seat> seats) {
        this.sectionAllocation = sectionAllocation;
        this.seats = seats;
    }

    public SectionAllocation getSectionAllocation() {
        return sectionAllocation;
    }

    public List<Seat> getSeats() {
        return seats;
    }

    public void markOccupied() {
        sectionAllocation.markOccupied(seats);
    }
}
```

Chapter 27

JAX-RS Services

The majority of services in the application are JAX-RS web services. They are critical part of the design, as they next service is used for provide communication with the HTML5 view layer. The JAX-RS services range from simple CRUD to processing bookings and media items.

To pass data across the wire we use JSON as the data marshalling format, as it is less verbose and easier to process than XML by the JavaScript client-side framework.

27.1 Initializing JAX-RS

To activate JAX-RS we add the class below, which instructs the container to look for JAX-RS annotated classes and install them as endpoints. This class should exist already in your project, as it is generated by the archetype, so make sure that it is there and it contains the code below:

src/main/java/org/jboss/jdf/example/ticketmonster/rest/JaxRsActivator.java

```
@ApplicationPath("/rest")
public class JaxRsActivator extends Application {
    /* class body intentionally left blank */
}
```

All the JAX-RS services are mapped relative to the `/rest` path, as defined by the `@ApplicationPath` annotation.

27.2 A Base Service For Read Operations

Most JAX-RS services must provide both a (filtered) list of entities or individual entity (e.g. events, venues and bookings). Instead of duplicating the implementation into each individual service we create a base service class and wire the helper objects in.

src/main/java/org/jboss/jdf/example/ticketmonster/rest/BaseEntityService.java

```
/**
 * <p>
 * A number of RESTful services implement GET operations on a particular type of entity. For
 * observing the DRY principle, the generic operations are implemented in the
 * <code>BaseEntityService</code>
 * class, and the other services can inherit from here.
 * </p>
 *
 * <p>
 * Subclasses will declare a base path using the JAX-RS {@link Path} annotation, for
 * example:
 */
```

```

* </p>
*
* <pre>
* <code>
* &#064;Path("/widgets")
* public class WidgetService extends BaseEntityService<Widget> {
* ...
* }
* </code>
* </pre>
*
* <p>
* will support the following methods:
* </p>
*
* <pre>
* <code>
* GET /widgets
* GET /widgets/:id
* GET /widgets/count
* </code>
* </pre>
*
* <p>
* Subclasses may specify various criteria for filtering entities when retrieving a list
* of them, by supporting
* custom query parameters. Pagination is supported by default through the query
* parameters <code>first</code>
* and <code>maxResults</code>.
* </p>
*
* <p>
* The class is abstract because it is not intended to be used directly, but subclassed
* by actual JAX-RS
* endpoints.
* </p>
*
* /
public abstract class BaseEntityService<T> {

    @Inject
    private EntityManager entityManager;

    private Class<T> entityClass;

    public BaseEntityService() {}

    public BaseEntityService(Class<T> entityClass) {
        this.entityClass = entityClass;
    }

    public EntityManager getEntityManager() {
        return entityManager;
    }

}

```

Now we add a method to retrieve all entities of a given type:

src/main/java/org/jboss/jdf/example/ticketmonster/rest/BaseEntityService.java

```

public abstract class BaseEntityService<T> {

```

```

...

/**
 * <p>
 *   A method for retrieving all entities of a given type. Supports the query parameters
 *   <code>first</code>
 *   and <code>maxResults</code> for pagination.
 * </p>
 *
 * @param uriInfo application and request context information (see {@see UriInfo} class
 *   information for more details)
 * @return
 */
@GET
@Produces(MediaType.APPLICATION_JSON)
public List<T> getAll(@Context UriInfo uriInfo) {
    return getAll(uriInfo.getQueryParameters());
}

public List<T> getAll(MultivaluedMap<String, String> queryParameters) {
    final CriteriaBuilder criteriaBuilder = entityManager.getCriteriaBuilder();
    final CriteriaQuery<T> criteriaQuery = criteriaBuilder.createQuery(entityClass);
    Root<T> root = criteriaQuery.from(entityClass);
    Predicate[] predicates = extractPredicates(queryParameters, criteriaBuilder, root);
    criteriaQuery.select(criteriaQuery.getSelection()).where(predicates);
    criteriaQuery.orderBy(criteriaBuilder.asc(root.get("id")));
    TypedQuery<T> query = entityManager.createQuery(criteriaQuery);
    if (queryParameters.containsKey("first")) {
        Integer firstRecord = Integer.parseInt(queryParameters.getFirst("first"))-1;
        query.setFirstResult(firstRecord);
    }
    if (queryParameters.containsKey("maxResults")) {
        Integer maxResults = Integer.parseInt(queryParameters.getFirst("maxResults"));
        query.setMaxResults(maxResults);
    }

    return query.getResultList();
}

/**
 * <p>
 *   Subclasses may choose to expand the set of supported query parameters (for adding
 *   more filtering
 *   criteria) by overriding this method.
 * </p>
 * @param queryParameters - the HTTP query parameters received by the endpoint
 * @param criteriaBuilder - {@link CriteriaBuilder} used by the invoker
 * @param root    {@link Root} used by the invoker
 * @return a list of {@link Predicate}s that will added as query parameters
 */
protected Predicate[] extractPredicates(MultivaluedMap<String, String> queryParameters,
                                         CriteriaBuilder criteriaBuilder, Root<T> root) {
    return new Predicate[]{};
}
}

```

The newly added method ‘getAll’ is annotated with @GET which instructs JAX-RS to call it when a GET HTTP requests on the JAX-RS’ endpoint base URL `/rest/<entityRoot>` is performed. But remember, this is not a true JAX-RS endpoint. It is an abstract class and it is not mapped to a path. The classes that extend it are JAX-RS endpoints, and will have to be mapped to a path, and are able to process requests.

The `@Produces` annotation defines that the response sent back by the server is in JSON format. The JAX-RS implementation will automatically convert the result returned by the method (a list of entities) into JSON format.

As well as configuring the marshaling strategy, the annotation affects content negotiation and method resolution. If the client requests JSON content specifically, this method will be invoked.

Note

Even though it is not shown in this example, you may have multiple methods that handle a specific URL and HTTP method, whilst consuming and producing different types of content (JSON, HTML, XML or others).

Subclasses can also override the `extractPredicates` method and add own support for additional query parameters to `GET /rest/<entityRoot>` which can act as filter criteria.

The `getAll` method supports retrieving a range of entities, which is especially useful when we need to handle very large sets of data, and use pagination. In those cases, we need to support counting entities as well, so we add a method that retrieves the entity count:

src/main/java/org/jboss/jdf/example/ticketmonster/rest/BaseEntityService.java

```
public abstract class BaseEntityService<T> {

    ...

    /**
     * <p>
     *   A method for counting all entities of a given type
     * </p>
     *
     * @param uriInfo application and request context information (see {@see UriInfo} class
     * information for more details)
     * @return
     */
    @GET
    @Path("/count")
    @Produces(MediaType.APPLICATION_JSON)
    public Map<String, Long> getCount(@Context UriInfo uriInfo) {
        CriteriaBuilder criteriaBuilder = entityManager.getCriteriaBuilder();
        CriteriaQuery<Long> criteriaQuery = criteriaBuilder.createQuery(Long.class);
        Root<T> root = criteriaQuery.from(entityClass);
        criteriaQuery.select(criteriaBuilder.count(root));
        Predicate[] predicates = extractPredicates(uriInfo.getQueryParameters(),
        criteriaBuilder, root);
        criteriaQuery.where(predicates);
        Map<String, Long> result = new HashMap<String, Long>();
        result.put("count", entityManager.createQuery(criteriaQuery).getSingleResult());
        return result;
    }

}
```

We use the `@Path` annotation to map the new method to a sub-path of `/rest/<entityRoot>`. Now all the JAX-RS endpoints that subclass `BaseEntityService` will be able to get entity counts from `'rest/<entityRoot>/count'`. Just like `getAll`, this method also delegates to `extractPredicates`, so any customizations done there by subclasses

Next, we add a method for retrieving individual entities.

src/main/java/org/jboss/jdf/example/ticketmonster/rest/BaseEntityService.java

```
...
public abstract class BaseEntityService<T> {
```



```

...

/**
 * <p>
 *     A method for retrieving individual entity instances.
 * </p>
 * @param id entity id
 * @return
 */
@GET
@Path("/{id:[0-9][0-9]*}")
@Produces(MediaType.APPLICATION_JSON)
public T getSingleInstance(@PathParam("id") Long id) {
    final CriteriaBuilder criteriaBuilder = entityManager.getCriteriaBuilder();
    final CriteriaQuery<T> criteriaQuery = criteriaBuilder.createQuery(entityClass);
    Root<T> root = criteriaQuery.from(entityClass);
    Predicate condition = criteriaBuilder.equal(root.get("id"), id);

    criteriaQuery.select(criteriaBuilder.createQuery(entityClass).getSelection()).where(condition);
    return entityManager.createQuery(criteriaQuery).getSingleResult();
}
}

```

This method is similar to `getAll` and `getCount`, and we use the `@Path` annotation to map it to a sub-path of `/rest/<entityRoot>`. The annotation attribute identifies the expected format of the URL (here, the last segment has to be a number) and binds a portion of the URL to a variable (here named `id`). The `@PathParam` annotation allows the value of the variable to be passed as a method argument. Data conversion is performed automatically.

Now, all the JAX-RS endpoints that subclass `BaseEntityService` will get two operations for free:

GET /rest/<entityRoot>
retrieves all entities of a given type

GET /rest/<entityRoot>/<id>
retrieves an entity with a given id

27.3 Retrieving Venues

Adding support for retrieving venues is now extremely simple. We refactor the class we created during the introduction, and make it extend `BaseEntityService`, passing the entity type to the superclass constructor. We remove the old retrieval code, which is not needed anymore.

src/main/java/org/jboss/jdf/example/ticketmonster/rest/VenueService.java

```

/**
 * <p>
 *     A JAX-RS endpoint for handling {@link Venue}s. Inherits the actual
 *     methods from {@link BaseEntityService}.
 * </p>
 */
@Path("/venues")
/**
 * <p>
 *     This is a stateless service, so a single shared instance can be used in this case.
 * </p>
 */
@Stateless
public class VenueService extends BaseEntityService<Venue> {

    public VenueService() {

```

```

        super (Venue.class);
    }
}

```

We add the `@Path` annotation to the class, to indicate that this is a JAX-RS resource which can serve URLs starting with `/rest/venues`.

We define this service (along with all the other JAX-RS services) as an EJB (see how simple is that in Java EE 6!) to benefit from automatic transaction enrollment. Since the service is fundamentally stateless, we take advantage of the new EJB 3.1 singleton feature.

Now, we can retrieve venues from URLs like `/rest/venues` or `rest/venues/1`.

27.4 Retrieving Events

Just like `VenueService`, the `EventService` implementation we use for `TicketMonster` is a direct subclass of `BaseEntityService`. Refactor the existing class, remove the old retrieval code and make it extend `BaseEntityService`.

One additional functionality we will implement is querying events by category. We can use URLs like `/rest/events?category=1` to retrieve all concerts, for example (1 is the category id of concerts). This is done by overriding the `extractPredicates` method to handle any query parameters (in this case, the `category` parameter).

src/main/java/org/jboss/jdf/example/ticketmonster/rest/EventService.java

```

/**
 * <p>
 *   A JAX-RS endpoint for handling {@link Event}s. Inherits the actual
 *   methods from {@link BaseEntityService}, but implements additional search
 *   criteria.
 * </p>
 */
@Path("/events")
/**
 * <p>
 *   This is a stateless service, we declare it as an EJB for transaction demarcation
 * </p>
 */
@Stateless
public class EventService extends BaseEntityService<Event> {

    public EventService() {
        super (Event.class);
    }

    /**
     * <p>
     *   We override the method from parent in order to add support for additional search
     *   criteria for events.
     * </p>
     * @param queryParameters - the HTTP query parameters received by the endpoint
     * @param criteriaBuilder - {@link CriteriaBuilder} used by the invoker
     * @param root    {@link Root} used by the invoker
     * @return
     */
    @Override
    protected Predicate[] extractPredicates(
        MultivaluedMap<String, String> queryParameters,
        CriteriaBuilder criteriaBuilder,
        Root<Event> root) {
        List<Predicate> predicates = new ArrayList<Predicate>();

```

```

        if (queryParameters.containsKey("category")) {
            String category = queryParameters.getFirst("category");
            predicates.add(criteriaBuilder.equal(root.get("category").get("id"), category));
        }

        return predicates.toArray(new Predicate[]{});
    }
}

```

The `ShowService` and `BookingService` follow the same pattern and we leave the implementation as an exercise to the reader (knowing that its contents can always be copied over to the appropriate folder).

Of course, we also want to change data with our services - we want to create and delete bookings as well!

27.5 Creating and deleting bookings

To create a booking, we add a new method, which handles `POST` requests to `/rest/bookings`. This is not a simple CRUD method, as the client does not send a booking, but a booking request. It is the responsibility of the service to process the request, reserve the seats and return the full booking details to the invoker.

src/main/java/org/jboss/jdf/example/ticketmonster/rest/BookingService.java

```

/**
 * <p>
 *     A JAX-RS endpoint for handling {@link Booking}s. Inherits the GET
 *     methods from {@link BaseEntityService}, and implements additional REST methods.
 * </p>
 */
@Path("/bookings")
/**
 * <p>
 *     This is a stateless service, we declare it as an EJB for transaction demarcation
 * </p>
 */
@Stateless
public class BookingService extends BaseEntityService<Booking> {

    @Inject
    SeatAllocationService seatAllocationService;

    @Inject @Created
    private Event<Booking> newBookingEvent;

    public BookingService() {
        super(Booking.class);
    }

    /**
     * <p>
     *     Create a booking. Data is contained in the bookingRequest object
     * </p>
     * @param bookingRequest
     * @return
     */
    @SuppressWarnings("unchecked")
    @POST
    /**
     * <p> Data is received in JSON format. For easy handling, it will be unmarshalled in the
     support

```

```
* {@link BookingRequest} class.
*/
@Consumes(MediaType.APPLICATION_JSON)
public Response createBooking(BookingRequest bookingRequest) {
    try {
        // identify the ticket price categories in this request
        Set<Long> priceCategoryIds = bookingRequest.getUniquePriceCategoryIds();

        // load the entities that make up this booking's relationships
        Performance performance = getEntityManager().find(Performance.class,
bookingRequest.getPerformance());

        // As we can have a mix of ticket types in a booking, we need to load all of them
that are relevant,
        // id
        Map<Long, TicketPrice> ticketPricesById = loadTicketPrices(priceCategoryIds);

        // Now, start to create the booking from the posted data
        // Set the simple stuff first!
        Booking booking = new Booking();
        booking.setContactEmail(bookingRequest.getEmail());
        booking.setPerformance(performance);
        booking.setCancellationCode("abc");

        // Now, we iterate over each ticket that was requested, and organize them by
section and category
        // we want to allocate ticket requests that belong to the same section
contiguously
        Map<Section, Map<TicketCategory, TicketRequest>> ticketRequestsPerSection
            = new TreeMap<Section, java.util.Map<TicketCategory,
TicketRequest>>(SectionComparator.instance());
        for (TicketRequest ticketRequest : bookingRequest.getTicketRequests()) {
            final TicketPrice ticketPrice =
ticketPricesById.get(ticketRequest.getTicketPrice());
            if (!ticketRequestsPerSection.containsKey(ticketPrice.getSection())) {
                ticketRequestsPerSection
                    .put(ticketPrice.getSection(), new HashMap<TicketCategory,
TicketRequest>());
            }
            ticketRequestsPerSection.get(ticketPrice.getSection()).put (
ticketPricesById.get(ticketRequest.getTicketPrice()).getTicketCategory(), ticketRequest);
        }

        // Now, we can allocate the tickets
        // Iterate over the sections, finding the candidate seats for allocation
        // The process will acquire a write lock for a given section and performance
        // Use deterministic ordering of sections to prevent deadlocks
        Map<Section, AllocatedSeats> seatsPerSection =
            new TreeMap<Section,
org.jboss.jdf.example.ticketmonster.service.AllocatedSeats>(SectionComparator.instance());
        List<Section> failedSections = new ArrayList<Section>();
        for (Section section : ticketRequestsPerSection.keySet()) {
            int totalTicketsRequestedPerSection = 0;
            // Compute the total number of tickets required (a ticket category doesn't
impact the actual seat!)
            final Map<TicketCategory, TicketRequest> ticketRequestsByCategories =
ticketRequestsPerSection.get(section);
            // calculate the total quantity of tickets to be allocated in this section
            for (TicketRequest ticketRequest : ticketRequestsByCategories.values()) {
                totalTicketsRequestedPerSection += ticketRequest.getQuantity();
            }
        }
    }
}
```

```

        // try to allocate seats

        AllocatedSeats allocatedSeats =
            seatAllocationService.allocateSeats(section,
performance, totalTicketsRequestedPerSection, true);
        if (allocatedSeats.getSeats().size() == totalTicketsRequestedPerSection) {
            seatsPerSection.put(section, allocatedSeats);
        } else {
            failedSections.add(section);
        }
    }
    if (failedSections.isEmpty()) {
        for (Section section : seatsPerSection.keySet()) {
            // allocation was successful, begin generating tickets
            // associate each allocated seat with a ticket, assigning a price
category to it
            final Map<TicketCategory, TicketRequest> ticketRequestsByCategories =
ticketRequestsPerSection.get(section);
            AllocatedSeats allocatedSeats = seatsPerSection.get(section);
            allocatedSeats.markOccupied();
            int seatCounter = 0;
            // Now, add a ticket for each requested ticket to the booking
            for (TicketCategory ticketCategory :
ticketRequestsByCategories.keySet()) {
                final TicketRequest ticketRequest =
ticketRequestsByCategories.get(ticketCategory);
                final TicketPrice ticketPrice =
ticketPricesById.get(ticketRequest.getTicketPrice());
                for (int i = 0; i < ticketRequest.getQuantity(); i++) {
                    Ticket ticket =
new
Ticket(allocatedSeats.getSeats().get(seatCounter + i), ticketCategory,
ticketPrice.getPrice());
                    // getEntityManager().persist(ticket);
                    booking.getTickets().add(ticket);
                }
                seatCounter += ticketRequest.getQuantity();
            }
            // Persist the booking, including cascaded relationships
            booking.setPerformance(performance);
            booking.setCancellationCode("abc");
            getEntityManager().persist(booking);
            newBookingEvent.fire(booking);
            return
Response.ok().entity(booking).type(MediaType.APPLICATION_JSON_TYPE).build();
        } else {
            Map<String, Object> responseEntity = new HashMap<String, Object>();
            responseEntity.put("errors", Collections.singletonList("Cannot allocate the
requested number of seats!"));
            return
Response.status(Response.Status.BAD_REQUEST).entity(responseEntity).build();
        }
    } catch (ConstraintViolationException e) {
        // If validation of the data failed using Bean Validation, then send an error
        Map<String, Object> errors = new HashMap<String, Object>();
        List<String> errorMessages = new ArrayList<String>();
        for (ConstraintViolation<?> constraintViolation : e.getConstraintViolations()) {
            errorMessages.add(constraintViolation.getMessage());
        }
        errors.put("errors", errorMessages);
        // A WebApplicationException can wrap a response

```

```

        // Throwing the exception causes an automatic rollback
        throw new
WebApplicationException(Response.status(Response.Status.BAD_REQUEST).entity(errors).build());
    } catch (Exception e) {
        // Finally, handle unexpected exceptions
        Map<String, Object> errors = new HashMap<String, Object>();
        errors.put("errors", Collections.singletonList(e.getMessage()));
        // A WebApplicationException can wrap a response
        // Throwing the exception causes an automatic rollback
        throw new
WebApplicationException(Response.status(Response.Status.BAD_REQUEST).entity(errors).build());
    }
}

/**
 * Utility method for loading ticket prices
 * @param priceCategoryIds
 * @return
 */
private Map<Long, TicketPrice> loadTicketPrices(Set<Long> priceCategoryIds) {
    List<TicketPrice> ticketPrices = (List<TicketPrice>) getEntityManager()
        .createQuery("select p from TicketPrice p where p.id in :ids")
        .setParameter("ids", priceCategoryIds).getResultList();
    // Now, map them by id
    Map<Long, TicketPrice> ticketPricesById = new HashMap<Long, TicketPrice>();
    for (TicketPrice ticketPrice : ticketPrices) {
        ticketPricesById.put(ticketPrice.getId(), ticketPrice);
    }
    return ticketPricesById;
}
}

```

We won't get into the details of the inner workings of the method - it implements a fairly complex algorithm - but we'd like to draw attention to a few particular items.

We use the `@POST` annotation to indicate that this method is executed on inbound HTTP POST requests. When implementing a set of RESTful services, it is important that the semantic of HTTP methods are observed in the mappings. Creating new resources (e.g. bookings) is typically associated with HTTP POST invocations. The `@Consumes` annotation indicates that the type of the request content is JSON and identifies the correct unmarshalling strategy, as well as content negotiation.

The `BookingService` delegates to the `SeatAllocationService` to find seats in the requested section, the required `SeatAllocationService` instance is initialized and supplied by the container as needed. The only thing that our service does is to specify the dependency in form of an injection point - the field annotated with `@Inject`.

We would like other parts of the application to be aware of the fact that a new booking has been created, therefore we use the CDI to fire an event. We do so by injecting an `Event<Booking>` instance into the service (indicating that its payload will be a booking). In order to individually identify this event as referring to event creation, we use a CDI qualifier, which we need to add:

src/main/java/org/jboss/jdf/example/ticketmonster/util/qualifier/Created.java

```

/**
 * {@link Qualifier} to mark a Booking as new (created).
 */
@Qualifier
@Target({ElementType.FIELD, ElementType.PARAMETER, ElementType.METHOD, ElementType.TYPE})
@Retention(RetentionPolicy.RUNTIME)
public @interface Created {
}

```

What are qualifiers?

CDI uses a type-based resolution mechanism for injection and observers. In order to distinguish between implementations of an interface, you can use qualifiers, a type of annotations, to disambiguate. Injection points and event observers can use qualifiers to narrow down the set of candidates

We also need allow the removal of bookings, so we add a method:

src/main/java/org/jboss/jdf/example/ticketmonster/rest/BookingService.java

```
@Singleton
public class BookingService extends BaseEntityService<Booking> {
    ...

    @Inject @Cancelled
    private Event<Booking> cancelledBookingEvent;
    ...
    /**
     * <p>
     * Delete a booking by id
     * </p>
     * @param id
     * @return
     */
    @DELETE
    @Path("/{id:[0-9][0-9]*}")
    public Response deleteBooking(@PathParam("id") Long id) {
        Booking booking = getEntityManager().find(Booking.class, id);
        if (booking == null) {
            return Response.status(Response.Status.NOT_FOUND).build();
        }
        getEntityManager().remove(booking);
        cancelledBookingEvent.fire(booking);
        return Response.ok().build();
    }
}
```

We use the `@DELETE` annotation to indicate that it will be executed as the result of an HTTP DELETE request (again, the use of the DELETE HTTP verb is a matter of convention).

We need to notify the other components of the cancellation of the booking, so we fire an event, with a different qualifier.

src/main/java/org/jboss/jdf/example/ticketmonster/util/qualifier/Cancelled.java

```
/**
 * {@link Qualifier} to mark a Booking as cancelled.
 */
@Qualifier
@Target({ElementType.FIELD, ElementType.PARAMETER, ElementType.METHOD, ElementType.TYPE})
@Retention(RetentionPolicy.RUNTIME)
public @interface Cancelled {
}
```

The other services, including the `MediaService` that handles media items follow roughly the same patterns as above, so we leave them as an exercise to the reader.

Chapter 28

Testing the services

We've now finished implementing the services and there is a significant amount of functionality in the application. Before taking any step forward, you need to make sure the services work correctly: we need to test them.

Testing enterprise services be a complex task as the implementation is based on services provided by a container: dependency injection, access to infrastructure services such as persistence, transactions etc.. Unit testing frameworks, whilst offering a valuable infrastructure for running tests, do not provide these capabilities.

One of the traditional approaches has been the use of mocking frameworks to simulate *what will happen* in the runtime environment. While certainly providing a solution mocking brings its own set of problems (e.g. the additional effort required to provide a proper simulation or the risk of introducing errors in the test suite by incorrectly implemented mocks).

Fortunately, Arquillian provides the means to testing your application code within the container, with access to all the services and container features. In this section we will show you how to create a few Arquillian tests for your business services.

What to test?

A common asked question is: how much application functionality should we test? The truth is, you can never test too much. That being said, resources are always limited and tradeoffs are part of an engineer's work. Generally speaking, trivial functionality (setters/getters/toString methods) is a big concern compared to the actual business code, so you probably want to focus your efforts on the business code. Testing should include individual parts (unit testing), as well as aggregates (integration testing).

28.1 A Basic Deployment Class

In order to create Arquillian tests, we need to define the deployment. The code under test, as well as its dependencies is packaged and deployed in the container.

Much of the deployment contents is common for all tests, so we create a helper class with a method that creates the base deployment with all the general content.

src/test/java/org/jboss/jdf/ticketmonster/test/TicketMonsterDeployment.java

```
public class TicketMonsterDeployment {

    public static WebArchive deployment() {
        return ShrinkWrap
            .create(WebArchive.class, "test.war")
            .addPackage(Resources.class.getPackage())
            .addAsResource("META-INF/test-persistence.xml", "META-INF/persistence.xml")
            .addAsResource("import.sql")
            .addAsWebInfResource(EmptyAsset.INSTANCE, "beans.xml")
            // Deploy our test datasource
            .addAsWebInfResource("test-ds.xml");
    }
}
```



```
}  
}
```

Arquillian uses Shrinkwrap to define the contents of the deployment.

28.2 Writing RESTful service tests

For testing our JAX-RS RESTful services, we need to add the corresponding application classes to the deployment. Since we need to do that for each test we create, we abide by the DRY principles and create a utility class.

src/test/java/org/jboss/jdf/ticketmonster/test/rest/RESTDeployment.java

```
public class RESTDeployment {  
  
    public static WebArchive deployment() {  
        return TicketMonsterDeployment.deployment()  
            .addPackage(Booking.class.getPackage())  
            .addPackage(BaseEntityService.class.getPackage())  
            .addPackage(MockMultivaluedMap.class.getPackage())  
            .addClass(SeatAllocationService.class)  
            .addClass(AllocatedSeats.class)  
            .addClass(MediaPath.class)  
            .addClass(MediaManager.class);  
    }  
}
```

Now, we create the first test to validate the proper retrieval of individual events.

src/test/java/org/jboss/jdf/ticketmonster/test/rest/VenueServiceTest.java

```
@RunWith(Arquillian.class)  
public class VenueServiceTest {  
  
    @Deployment  
    public static WebArchive deployment() {  
        return RESTDeployment.deployment();  
    }  
  
    @Inject  
    private VenueService venueService;  
  
    @Test  
    public void testGetVenueById() {  
  
        // Test loading a single venue  
        Venue venue = venueService.getInstance(11);  
        assertNotNull(venue);  
        assertEquals("Roy Thomson Hall", venue.getName());  
    }  
}
```

In the class above we specify the deployment, and we define the test method. The test supports CDI injection - one of the strengths of Arquillian is the ability to inject the object being tested.

Now, we test a more complicated use cases, query parameters for pagination.

src/test/java/org/jboss/jdf/ticketmonster/test/rest/VenueServiceTest.java

```
...
@RunWith(Arquillian.class)
public class VenueServiceTest {

    ...

    @Test
    public void testPagination() {

        // Test pagination logic
        MultivaluedMap<String, String> queryParameters = new MultivaluedHashMap<String,
String>();

        queryParameters.add("first", "2");
        queryParameters.add("maxResults", "1");

        List<Venue> venues = venueService.getAll(queryParameters);
        assertNotNull(venues);
        assertEquals(1, venues.size());
        assertEquals("Sydney Opera House", venues.get(0).getName());
    }
}
```

We add another test method (`testPagination`), which tests the retrieval of all venues, passing the search criteria as parameters. We use a Map to simulate the passing of query parameters.

Now, we test more advanced use cases such as the creation of a new booking. We do so by adding a new test for bookings

src/test/java/org/jboss/jdf/ticketmonster/test/rest/BookingServiceTest.java

```
@RunWith(Arquillian.class)
public class BookingServiceTest {

    @Deployment
    public static WebArchive deployment() {
        return RESTDeployment.deployment();
    }

    @Inject
    private BookingService bookingService;

    @Inject
    private ShowService showService;

    @Test
    @InSequence(1)
    public void testCreateBookings() {
        BookingRequest br = createBookingRequest(11, 0, 0, 1, 3);
        bookingService.createBooking(br);

        BookingRequest br2 = createBookingRequest(21, 1, 2, 4, 9);
        bookingService.createBooking(br2);

        BookingRequest br3 = createBookingRequest(31, 0, 0, 1);
        bookingService.createBooking(br3);
    }

    @Test
    @InSequence(10)
    public void testGetBookings() {
        checkBooking1();
    }
}
```

```
        checkBooking2();
        checkBooking3();
    }

    private void checkBooking1() {
        Booking booking = bookingService.getInstance(11);
        assertNotNull(booking);
        assertEquals("Roy Thomson Hall",
            booking.getPerformance().getShow().getVenue().getName());
        assertEquals("Rock concert of the decade",
            booking.getPerformance().getShow().getEvent().getName());
        assertEquals("bob@acme.com", booking.getContactEmail());

        // Test the ticket requests created

        assertEquals(3 + 2 + 1, booking.getTickets().size());

        List<String> requiredTickets = new ArrayList<String>();
        requiredTickets.add("A @ 219.5 (Adult)");
        requiredTickets.add("A @ 219.5 (Adult)");
        requiredTickets.add("D @ 149.5 (Adult)");
        requiredTickets.add("C @ 179.5 (Adult)");
        requiredTickets.add("C @ 179.5 (Adult)");
        requiredTickets.add("C @ 179.5 (Adult)");

        checkTickets(requiredTickets, booking);
    }

    private void checkBooking2() {
        Booking booking = bookingService.getInstance(21);
        assertNotNull(booking);
        assertEquals("Sydney Opera House",
            booking.getPerformance().getShow().getVenue().getName());
        assertEquals("Rock concert of the decade",
            booking.getPerformance().getShow().getEvent().getName());
        assertEquals("bob@acme.com", booking.getContactEmail());

        assertEquals(3 + 2 + 1, booking.getTickets().size());

        List<String> requiredTickets = new ArrayList<String>();
        requiredTickets.add("S2 @ 197.75 (Adult)");
        requiredTickets.add("S6 @ 145.0 (Child 0-14yrs)");
        requiredTickets.add("S6 @ 145.0 (Child 0-14yrs)");
        requiredTickets.add("S4 @ 145.0 (Child 0-14yrs)");
        requiredTickets.add("S6 @ 145.0 (Child 0-14yrs)");
        requiredTickets.add("S4 @ 145.0 (Child 0-14yrs)");

        checkTickets(requiredTickets, booking);
    }

    private void checkBooking3() {
        Booking booking = bookingService.getInstance(31);
        assertNotNull(booking);
        assertEquals("Roy Thomson Hall",
            booking.getPerformance().getShow().getVenue().getName());
        assertEquals("Shane's Sock Puppets",
            booking.getPerformance().getShow().getEvent().getName());
        assertEquals("bob@acme.com", booking.getContactEmail());

        assertEquals(2 + 1, booking.getTickets().size());

        List<String> requiredTickets = new ArrayList<String>();
```

```
        requiredTickets.add("B @ 199.5 (Adult)");
        requiredTickets.add("D @ 149.5 (Adult)");
        requiredTickets.add("B @ 199.5 (Adult)");

        checkTickets(requiredTickets, booking);
    }

    @Test
    @InSequence(10)
    public void testPagination() {

        // Test pagination logic
        MultivaluedMap<String, String> queryParameters = new
        MultivaluedHashMap<java.lang.String, java.lang.String>();

        queryParameters.add("first", "2");
        queryParameters.add("maxResults", "1");

        List<Booking> bookings = bookingService.getAll(queryParameters);
        assertNotNull(bookings);
        assertEquals(1, bookings.size());
        assertEquals("Sydney Opera House",
bookings.get(0).getPerformance().getShow().getVenue().getName());
        assertEquals("Rock concert of the decade",
bookings.get(0).getPerformance().getShow().getEvent().getName());
    }

    @Test
    @InSequence(20)
    public void testDelete() {
        bookingService.deleteBooking(21);
        checkBooking1();
        checkBooking3();
        try {
            bookingService.getSingleInstance(21);
        } catch (Exception e) {
            if (e.getCause() instanceof NoResultException) {
                return;
            }
        }
        fail("Expected NoResultException did not occur.");
    }

    private BookingRequest createBookingRequest(Long showId, int performanceNo, int...
ticketPriceNos) {
        Show show = showService.getSingleInstance(showId);

        Performance performance = new
ArrayList<Performance>(show.getPerformances()).get(performanceNo);

        BookingRequest bookingRequest = new BookingRequest(performance, "bob@acme.com");

        List<TicketPrice> possibleTicketPrices = new
ArrayList<TicketPrice>(show.getTicketPrices());
        int i = 1;
        for (int index : ticketPriceNos) {
            bookingRequest.addTicketRequest(new
TicketRequest(possibleTicketPrices.get(index), i));
            i++;
        }

        return bookingRequest;
    }
}
```

```

    }

    private void checkTickets(List<String> requiredTickets, Booking booking) {
        List<String> bookedTickets = new ArrayList<String>();
        for (Ticket t : booking.getTickets()) {
            bookedTickets.add(new StringBuilder().append(t.getSeat().getSection()).append(" @
            ").append(t.getPrice()).append("
            ").append(t.getTicketCategory()).append(" ").toString());
        }
        System.out.println(bookedTickets);
        for (String requiredTicket : requiredTickets) {
            Assert.assertTrue("Required ticket not present: " + requiredTicket,
                bookedTickets.contains(requiredTicket));
        }
    }
}

```

First we test booking creation in a test method of its own (`testCreateBookings`). Then, we test that the previously created bookings are retrieved correctly (`testGetBookings` and `testPagination`). Finally, we test that deletion takes place correctly (`testDelete`).

The other tests in the application follow roughly the same pattern and are left as an exercise to the reader.

28.3 Running the tests

If you have followed the instructions in the introduction and used the Maven archetype to generate the project structure, you should have two profiles already defined in your application.

/pom.xml

```

<?xml version="1.0" encoding="UTF-8"?>
<project xmlns="http://maven.apache.org/POM/4.0.0"
    xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
    xsi:schemaLocation="http://maven.apache.org/POM/4.0.0
    http://maven.apache.org/maven-v4_0_0.xsd">
    <modelVersion>4.0.0</modelVersion>

    ...
    <profile>
        <!-- An optional Arquillian testing profile that executes tests
             in your JBoss AS instance -->
        <!-- This profile will start a new JBoss AS instance, and execute
             the test, shutting it down when done -->
        <!-- Run with: mvn clean test -Parq-jbossas-managed -->
        <id>arq-jbossas-managed</id>
        <dependencies>
            <dependency>
                <groupId>org.jboss.as</groupId>
                <artifactId>jboss-as-arquillian-container-managed</artifactId>
                <scope>test</scope>
            </dependency>
        </dependencies>
    </profile>

    <profile>
        <!-- An optional Arquillian testing profile that executes tests
             in a remote JBoss AS instance -->
        <!-- Run with: mvn clean test -Parq-jbossas-remote -->
        <id>arq-jbossas-remote</id>
    </profile>

```

```
        <dependencies>
          <dependency>
            <groupId>org.jboss.as</groupId>
            <artifactId>jboss-as-arquillian-container-remote</artifactId>
            <scope>test</scope>
          </dependency>
        </dependencies>
      </profile>

    </profiles>
  </project>
```

If you haven't used the archetype, or the profiles don't exist, create them.

Each profile defines a different Arquillian container. In both cases the tests execute in an application server instance. In one case (`arqu-jbossas-managed`) the server instance is started and stopped by the test suite, while in the other (`arqu-jbossas-remote`), the test suite expects an already started server instance.

Once these profiles are defined, we can execute the tests in two ways:

- from the command-line build
- from an IDE

28.3.1 Executing tests from the command line

You can now execute the test suite from the command line by running the Maven build with the appropriate target and profile, as in one of the following examples.

After ensuring that the `JBOSS_HOME` environment variable is set to a valid JBoss AS7 installation directory), you can run the following command:

```
mvn clean test -Parqu-jbossas-managed
```

Or, after starting a JBoss AS7 instance, you can run the following command

```
mvn clean test -Parqu-jbossas-remote
```

These tests execute as part of the Maven build and can be easily included in an automated build and test harness.

28.3.2 Running Arquillian tests from within Eclipse

Running the entire test suite as part of the build is an important part of the development process - you may want to make sure that everything is working fine before releasing a new milestone, or just before committing new code. However, running the entire test suite all the time can be a productivity drain, especially when you're trying to focus on a particular problem. Also, when debugging, you don't want to leave the comfort of your IDE for running the tests.

Running Arquillian tests from JBoss Developer Studio or JBoss tools is very simple as Arquillian builds on JUnit (or TestNG).

First enable one of the two profiles in the project. In Eclipse, open the project properties, and from the *Maven* tab, add the profile as shown in the picture below.

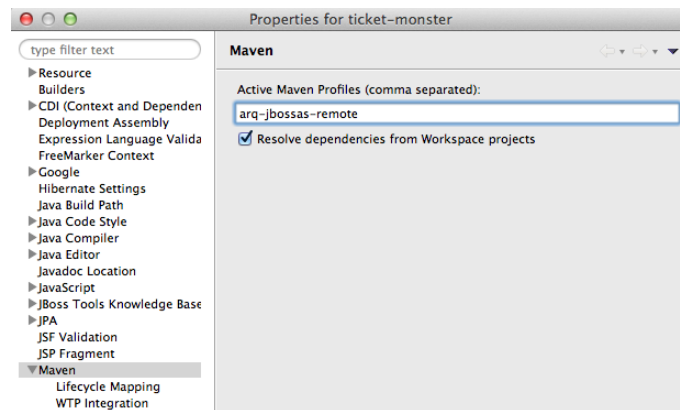


Figure 28.1: Update Maven profiles in Eclipse

The project configuration will be updated automatically.

Now, you can click right on one of your test classes, and select **Run As** → **JUnit Test**.

The test suite will run, deploying the test classes to the application server, executing the tests and finally producing the much coveted green bar.

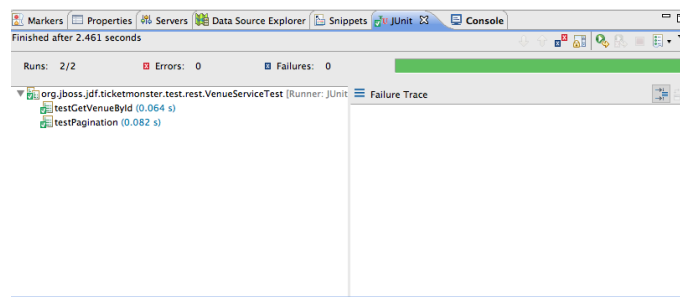


Figure 28.2: Running the tests

Part V

Building The User UI Using HTML5

Chapter 29

What Will You Learn Here?

We've just implemented the business services of our application, and exposed them through RESTful endpoints. Now we need to implement a flexible user interface that can be easily used with both desktop and mobile clients. After reading this tutorial, you will understand our front-end design and the choices that we made in its implementation. Topics covered include:

- Creating single-page applications using HTML5, JavaScript and JSON
- Using JavaScript frameworks for invoking RESTful endpoints and manipulating page content
- Feature and device detection
- Implementing a version of the user interface that is optimized for mobile clients using JavaScript frameworks such as jQuery mobile

The tutorial will show you how to perform all these steps in JBoss Developer Studio, including screenshots that guide you through.

Chapter 30

First, the basics

In this tutorial, we will build a single-page application. All the necessary code: HTML, CSS and JavaScript is retrieved within a single page load. Rather than refreshing the page every time the user changes a view, the content of the page will be redrawn by manipulating the DOM in JavaScript. The application uses REST calls to retrieve data from the server.



Figure 30.1: Single page application

30.1 Client-side MVC Support

Because this is a moderately complex example, which involves multiple views and different types of data, we will use a client-side MVC framework to structure the application, which provides amongst others:

- routing support within the single page application;
- event-driven interaction between views and data;
- simplified CRUD invocations on RESTful services.

In this application we use the client-side MVC framework "backbone.js".

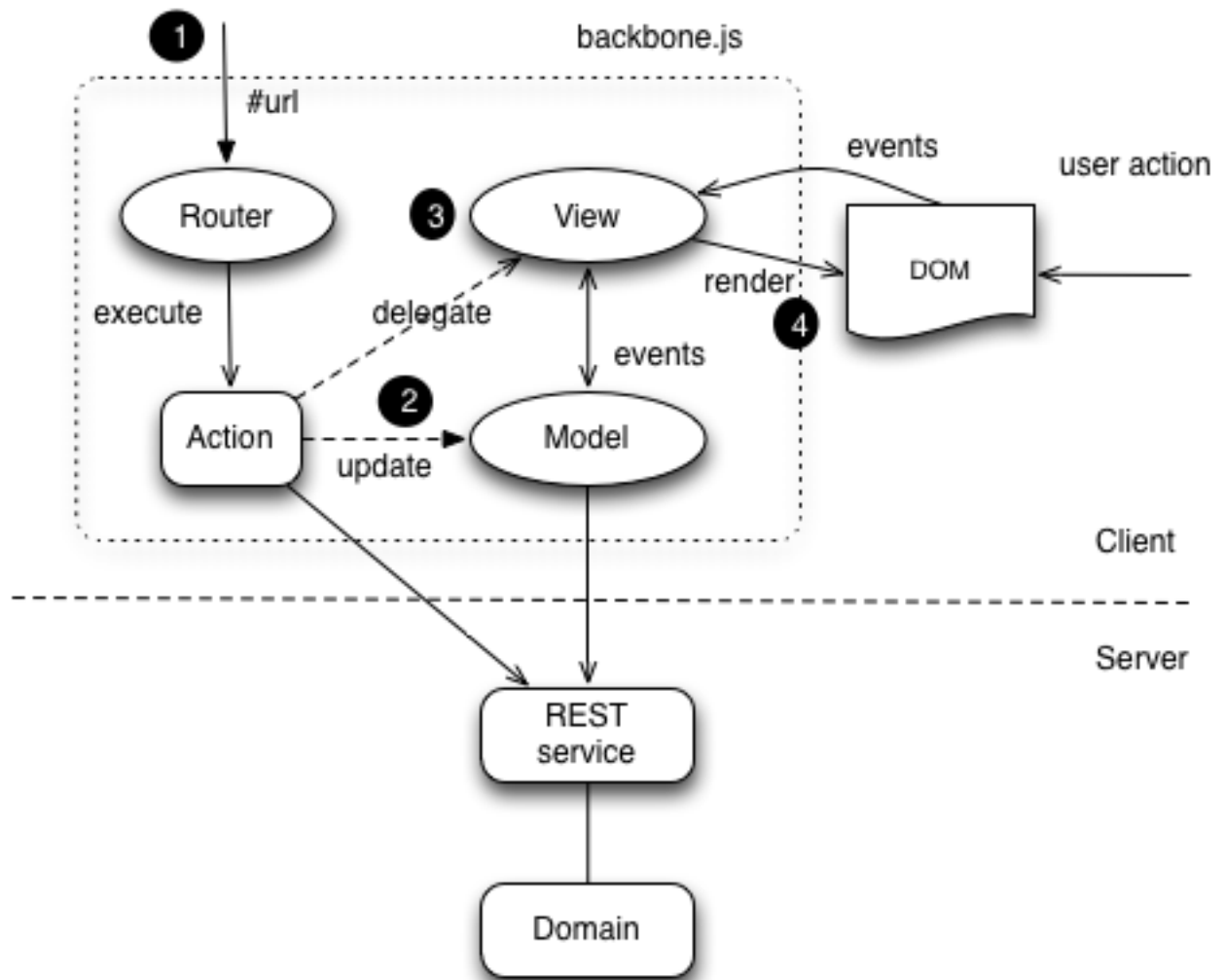


Figure 30.2: Backbone architecture

30.2 Modularity

In order to provide good separation of concerns, we split the JavaScript code into modules. Ensuring that all the modules of the application are loaded properly at runtime becomes a complex task, as the application size increases. To conquer this complexity, we use the Asynchronous Module Definition mechanism as implemented by the "require.js" library.

Asynchronous Module Definition

The Asynchronous Module Definition (AMD) API specifies a mechanism for defining modules such that the module, and its dependencies, can be asynchronously loaded. This is particularly well suited for the browser where synchronous loading of modules incurs performance, usability, debugging, and cross-domain access problems.

30.3 Templating

Instead of manipulating the DOM directly, and mixing up HTML with the JavaScript code, we create HTML markup fragments separately as templates which are applied when the application views are rendered.

In this application we use the templating support provided by "underscore.js".

30.4 Mobile and desktop versions

The page flow and structure, as well as feature set, are slightly different for mobile and desktop, and therefore we will build two variants of the single-page-application, one for desktop and one for mobile. As the application variants are very similar, we will cover the desktop version of the application first, and then we will explain what is different in the mobile version.

Chapter 31

Setting up the structure

Before we start developing the user interface, we need to set up the general application structure and add the JavaScript libraries. First, we create the directory structure:

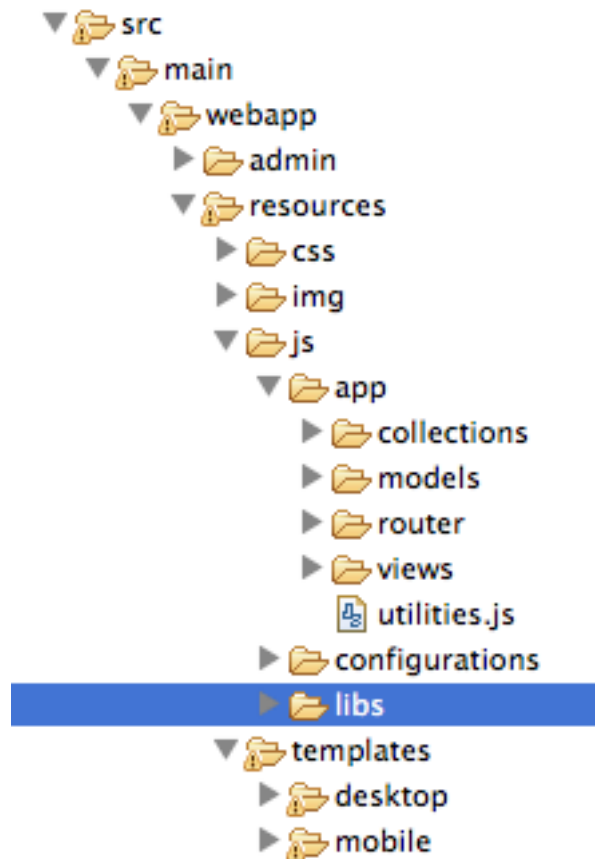


Figure 31.1: File structure for our web application

We put stylesheets in `resources/css` folder, images in `resources/img`, and HTML view templates in `resources/templates`. `resources/js` contains the JavaScript code, split between `resources/js/libs` - which contains the libraries used by the application, `resources/js/app` - which contains the application code, and `resources/js/configurations` which contains module definitions for the different versions of the application - i.e. mobile and desktop. The `resources/js/app` folder will contain the application modules, in subsequent subdirectories, for models, collections, routers and views.

The first step in implementing our solution is adding the stylesheets and JavaScript libraries to the `resources/css` and `resources/js/libs`:

require.js

AMD support, along with the plugin:

- text - for loading text files, in our case the HTML templates

jQuery

general purpose library for HTML traversal and manipulation

Underscore

JavaScript utility library (and a dependency of Backbone)

Backbone

Client-side MVC framework

Bootstrap

UI components and stylesheets for page structuring

Now, we create the main page of the application (which is the URL loaded by the browser):

src/main/webapp/index.html

```
<!DOCTYPE html>
<html>
<head>
  <title>Ticket Monster</title>
  <meta http-equiv="Content-Type" content="text/html; charset=utf-8"/>
  <meta name="viewport" content="width=device-width, initial-scale=1, user-scalable=0"/>

  <script type="text/javascript" src="resources/js/libs/modernizr-2.0.6.js"></script>
  <script type="text/javascript" src="resources/js/libs/require.js"
    data-main="resources/js/configurations/loader"></script>
</head>
<body>
</body>
</html>
```

As you can see, the page does not contain much. It loads Modernizr (for HTML5 and CSS3 feature detection) and RequireJS (for loading JavaScript modules in an asynchronous manner). Once RequireJS is loaded by the browser, it will configure itself to use a `baseUrl` of `resources/js/configurations` (specified via the `data-main` attribute on the script tag). All scripts loaded by RequireJS will use this `baseUrl` unless specified otherwise.

RequireJS will then load a script having a module ID of `loader` (again, specified via the `data-main` attribute):

src/main/webapp/resources/js/configurations/loader.js

```
//detect the appropriate module to load
define(function () {

  /*
   A simple check on the client. For touch devices or small-resolution screens)
   show the mobile client. By enabling the mobile client on a small-resolution screen
   we allow for testing outside a mobile device (like for example the Mobile Browser
   simulator in JBoss Tools and JBoss Developer Studio).
   */

  var environment;

  if (Modernizr.touch || Modernizr.mq("only all and (max-width: 480px)")) {
    environment = "mobile"
  } else {
```

```

        environment = "desktop"
    }

    require([environment]);
});

```

This script detects the current client (mobile or desktop) based on its capabilities (touch or not) and loads another JavaScript module (desktop or mobile) defined in the `resources/js/configurations` folder (aka the `baseUrl`) depending on the detected features. In the case of the desktop client, the code is loaded from `resources/js/configurations/desktop.js`.

src/main/webapp/resources/js/configurations/desktop.js

```

/**
 * Shortcut alias definitions - will come in handy when declaring dependencies
 * Also, they allow you to keep the code free of any knowledge about library
 * locations and versions
 */
requirejs.config({
    baseUrl: "resources/js",
    paths: {
        jquery: 'libs/jquery-1.9.1',
        underscore: 'libs/underscore',
        text: 'libs/text',
        bootstrap: 'libs/bootstrap',
        backbone: 'libs/backbone',
        utilities: 'app/utilities',
        router: 'app/router/desktop/router'
    },
    // We shim Backbone.js and Underscore.js since they don't declare AMD modules
    shim: {
        'backbone': {
            deps: ['jquery', 'underscore'],
            exports: 'Backbone'
        },
        'underscore': {
            exports: '_'
        }
    }
});

define("initializer", ["jquery"],
    function ($) {
        // Configure jQuery to append timestamps to requests, to bypass browser caches
        // Important for MSIE
        $.ajaxSetup({cache: false});
        $('head').append('<link type="text/css" rel="stylesheet" '
            href="resources/css/screen.css"/>');
        $('head').append('<link rel="stylesheet" href="resources/css/bootstrap.css" '
            type="text/css" media="all"/>');
        $('head').append('<link rel="stylesheet" href="resources/css/custom.css" type="text/css" '
            media="all"/>');
        $('head').append('<link href="http://fonts.googleapis.com/css?family=Rokkitt" '
            rel="stylesheet" type="text/css"/>');
    });

// Now we load the dependencies
// This loads and runs the 'initializer' and 'router' modules.
require([
    'initializer',
    'router'
], function () {

```

```
});  
  
define("configuration", {  
    baseUrl : ""  
});
```

The module loads all the utility libraries, converting them to AMD modules where necessary (like it is the case for Backbone). It also defines two modules of its own - an initializer that loads the application stylesheets for the page, and the `configuration` module that allows customizing the REST service URLs (this will become in handy in a further tutorial).

Before we add any functionality, let us create a first landing page. We will begin by setting up a critical piece of the application, the router.

31.1 Routing

The router allows for navigation in our application via bookmarkable URLs, and we will define it as follows:

src/main/webapp/resources/js/app/router/desktop/router.js

```
/**  
 * A module for the router of the desktop application  
 */  
define("router", [  
    'jquery',  
    'underscore',  
    'configuration',  
    'utilities',  
    'text!../templates/desktop/main.html'  
], function ($,  
    _/  
    config,  
    utilities,  
    MainTemplate) {  
  
    $(document).ready(new function() {  
        utilities.applyTemplate($('body'), MainTemplate)  
    })  
  
    /**  
     * The Router class contains all the routes within the application -  
     * i.e. URLs and the actions that will be taken as a result.  
     */  
    * @type {Router}  
    */  
  
    var Router = Backbone.Router.extend({  
        initialize: function() {  
            //Begin dispatching routes  
            Backbone.history.start();  
        },  
        routes:{  
        }  
    });  
  
    // Create a router instance  
    var router = new Router();  
  
    return router;  
});
```


Remember, this is a single page application. You can either navigate using urls such as `http://localhost:8080/ticket-monster` or using relative urls (from within the application, this being exactly what the main menu does). The fragment after the hash sign represents the url within the single page, on which the router will act, according to the mappings set up in the `routes` property.

The main module needs to load it. Because the router depends on all the other components (models, collections and views) of the application, directly or indirectly, it is the only component that is explicitly loaded in the `desktop` definition, which we change as follows:

src/main/webapp/resources/js/configurations/desktop.js

```
requirejs.config({
  baseUrl: "resources/js",
  paths: {
    jquery: 'libs/jquery-1.9.1',
    underscore: 'libs/underscore',
    text: 'libs/text',
    order: 'libs/order',
    bootstrap: 'libs/bootstrap',
    backbone: 'libs/backbone',
    utilities: 'app/utilities',
    router: 'app/router/desktop/router'
  },
  // We shim Backbone.js and Underscore.js since they don't declare AMD modules
  shim: {
    'backbone': {
      deps: ['jquery', 'underscore'],
      exports: 'Backbone'
    },
    'underscore': {
      exports: '_'
    }
  }
});
...

require([
  'order!initializer',
  'order!underscore',
  'order!backbone',
  'order!router'
], function() {
});
```

During the router set up, we load the page template for the entire application. TicketMonster uses a templating library in order to separate application logic from it's actual graphical content. The actual HTML is described in template files, which are applied by the application, when necessary, on a DOM element - effectively populating it's content. So the general content of the page, as described in the `body` element is described in a template file too. Let us define it.

/src/main/webapp/resources/templates/desktop/main.html

```
<!--
  The main layout of the page - contains the menu and the 'content' &lt;div/&gt; in which
  all the
  views will render the content.
-->
<div id="logo"><div class="wrap"><h1>Ticket Monster</h1></div></div>
<div id="container">
  <div id="menu">
    <div class="navbar">
      <div class="navbar-inner">
        <div class="container">
          <ul class="nav">
```

```
        <li><a href="#about">About</a></li>
        <li><a href="#events">Events</a></li>
        <li><a href="#venues">Venues</a></li>
        <li><a href="#bookings">Bookings</a></li>
        <li><a href="booking-monitor.html">Monitor</a></li>
        <li><a href="admin">Administration</a></li>
    </ul>
</div>
</div>
</div>
</div>
<div id="content" class="container-fluid">
</div>
</div>

<footer style="">
    <div style="text-align: center;"></div>
</footer>
```

The actual HTML code of the template contains a menu definition which will be present on all the pages, as well as an empty element named `content`, which is the placeholder for the application views. When a view is displayed, it will apply a template and populate the `content` element.

Chapter 32

Setting up the initial views

Let us complete our application setup by creating an initial landing page. The first thing that we will need to do is to add a view component.

src/main/resources/js/app/views/desktop/home.js

```
/**
 * The About view
 */
define([
    'utilities',
    'text!../../../../templates/desktop/home.html'
], function (utilities, HomeTemplate) {

    var HomeView = Backbone.View.extend({
        render: function () {
            utilities.applyTemplate($(this.el), HomeTemplate, {});
            return this;
        }
    });

    return HomeView;
});
```

Functionally, this is a very basic component - it only renders the splash page of the application, but it helps us introduce a new concept that will be heavily used throughout the application views. One main role of a view is to describe the logic for manipulating the page content. It will do so by defining a function named `render` which will be invoked by the application. In this very simple case, all that the view does is to create the content of the splash page. You can proceed by copying the content of `src/main/webapp/resources/templates/desktop/home.html` to your project.

Backbone Views

Views are logical representations of user interface elements that can interact with data components, such as models in an event-driven fashion. Apart from defining the logical structure of your user interface, views handle events resulting from the user interaction (e.g. clicking a DOM element or selecting an element into a list), translating them into logical actions inside the application.

Once we defined a view, we must tell the router to navigate to it whenever requested. We will add the following mapping to the router:

src/main/webapp/resources/js/app/router/desktop/router.js

```
...
var Router = Backbone.Router.extend({
```

```
...
routes : {
  "": "home",
  "about": "home"
},
home : function () {
  utilities.viewManager.showView(new HomeView({el:$("#content")}));
}
});
...
```

We have just told the router to invoke the `home` function whenever the user navigates to the root of the application or uses a `#about` hash. The method will simply cause the `HomeView` defined above to render.

Now you can navigate to `http://localhost:8080/ticket-monster/#about` or `http://localhost:8080/ticket-` and see the results.

Chapter 33

Displaying Events

The first use case that we implement is event navigation. The users will be able to view the list of events and select the one that they want to attend. After doing so, they will select a venue, and will be able to choose a performance date and time.

33.1 The Event model

We define a Backbone model for holding event data. Nearly all domain entities (booking, event, venue) are represented by a corresponding Backbone model:

`src/main/webapp/resources/js/app/models/event.js`

```
/**
 * Module for the Event model
 */
define([
  'configuration'
], function (config) {
  /**
   * The Event model class definition
   * Used for CRUD operations against individual events
   */
  var Event = Backbone.Model.extend({
    urlRoot: config.baseUrl + 'rest/events' // the URL for performing CRUD operations
  });
  // export the Event class
  return Event;
});
```

The `Event` model can perform CRUD operations against the REST services we defined earlier.

Backbone Models

Backbone models contain data as well as much of the logic surrounding it: conversions, validations, computed properties, and access control. They also perform CRUD operations with the REST service.

33.2 The Events collection

We define a Backbone collection for handling groups of events (like the events list):

`src/main/webapp/resources/js/app/collections/events.js`

```

/**
 * Module for the Events collection
 */
define([
  // The collection element type and configuration are dependencies
  'app/models/event',
  'configuration'
], function (Event, config) {
  /**
   * Here we define the Bookings collection
   * We will use it for CRUD operations on Bookings
   */
  var Events = Backbone.Collection.extend({
    url: config.baseUrl + "rest/events", // the URL for performing CRUD operations
    model: Event,
    id: "id", // the 'id' property of the model is the identifier
    comparator: function (model) {
      return model.get('category').id;
    }
  });
  return Events;
});

```

By mapping the model and collection to a REST endpoint you can perform CRUD operations without having to invoke the services explicitly. You will see how that works a bit later.

Backbone Collections

Collections are ordered sets of models. They can handle events which are fired as a result of a change to a individual member, and can perform CRUD operations for syncing up contents against RESTful services.

33.3 The EventsView view

Now that we have implemented the data components of the example, we need to create the view that displays them.

src/main/webapp/resources/js/app/views/desktop/events.js

```

define([
  'utilities',
  'text!../../../../templates/desktop/events.html'
], function (
  utilities,
  eventsTemplate) {

  var EventsView = Backbone.View.extend({
    events: {
      "click a": "update"
    },
    render: function () {
      var categories = _.uniq(
        _.map(this.model.models, function (model) {
          return model.get('category')
        }), false, function (item) {
          return item.id
        });
      utilities.applyTemplate($(this.el), eventsTemplate, {categories: categories,
        model: this.model});
      $(this.el).find('.item:first').addClass('active');
    }
  });

```

```

        $(".carousel").carousel();
        $(".collapse").collapse();
        $("a[rel='popover']").popover({trigger: 'hover', container: 'body'});
        return this;
    },
    update: function () {
        $("a[rel='popover']").popover('hide')
    }
});

return EventsView;
});

```

As we explained, earlier, the view is attached to a DOM element (the `el` property). When the `render` method is invoked, it manipulates the DOM and renders the view. We could have achieved this by writing these instructions directly in the method, but that would make it hard to change the page design later on. Instead, we create a template and apply it, thus separating the HTML view code from the view implementation.

src/main/webapp/resources/templates/desktop/events.html

```

<div class="row-fluid">
  <div class="span3">
    <div id="itemMenu">

      <%
        _.each(categories, function (category) {
      >
      <div class="accordion-group">
        <div class="accordion-heading">
          <a class="accordion-toggle"
            data-target="#category-<%=category.id%>-collapsible"
            data-toggle="collapse"
            data-parent="#itemMenu"><%= category.description %></a>
        </div>
        <div id="category-<%=category.id%>-collapsible" class="collapse in
          accordion-body">
          <div id="category-<%= category.id%>" class="accordion-inner">

            <%
              _.each(model.models, function (model) {
                if (model.get('category').id == category.id) {
              >
              <p><a href="#events/<%= model.attributes.id%>" rel="popover"
                data-content="<%= model.attributes.description%>"
                data-original-title="<%=
              model.attributes.name%>"><%=model.attributes.name%></a></p>
              <% }
            >
          </div>
        </div>
      </div>
      <div>
        <%= %>
      </div>
    </div>
  </div>

  <div id='itemSummary' class="span9">
    <div class="row-fluid">
      <div class="span11">
        <div id="eventCarousel" class="carousel">
          <!-- Carousel items -->
          <div class="carousel-inner">

```

```

        <%.each(model.models, function(model) { %>
        <div class="item">
            <img src='rest/media/<%=model.attributes.mediaItem.id%>' />

            <div class="carousel-caption">
                <h4><%=model.attributes.name%></h4>

                <p><%=model.attributes.description%></p>
                <a class="btn btn-danger" href="#events/<%=model.id%>">Book
tickets</a>

            </div>
        </div>
        <% }) %>
    </div>
    <!-- Carousel nav -->
    <a class="carousel-control left" href="#eventCarousel"
data-slide="prev">&lsaquo;</a>
    <a class="carousel-control right" href="#eventCarousel"
data-slide="next">&rsaquo;</a>
    </div>
</div>
</div>
</div>

```

As well as applying the template and preparing the data that will be used to fill it in (the categories and model entries in the map), the `render` method also performs the JavaScript calls that are required to initialize the UI components (in this case the Bootstrap carousel and popover).

A view can also listen to events fired by the children of it's root element (`el`). In this case, the `update` method is configured to listen to clicks on anchors. The configuration occurs within the `events` property of the class.

Now that the views are in place, we need to add another routing rule to the application.

src/main/webapp/resources/js/app/router/desktop/router.js

```

var Router = Backbone.Router.extend({
    ...
    routes : {
        ...,
        "events": "events"
    },
    ...,
    events: function () {
        var events = new Events();
        var eventsView = new EventsView({model:events, el:$("#content")});
        events.bind("reset",
            function () {
                utilities.viewManager.showView(eventsView);
            }).fetch();
    }
});

```

The `events` function handles the `#events` fragment and will retrieve the events in our application via a REST call. We don't manually perform the REST call as it is triggered the by invocation of `fetch` on the `Events` collection, as discussed earlier.

The `reset` event on the collection is invoked when the data from the server is received, and the collection is populated. This triggers the rendering of the events view (which is bound to the `#content` div).

The whole process is event orientated - the models, views and controllers interact through events.

Chapter 34

Viewing a single event

With the events list view now in place, we can add a view to display the details of each individual event, allowing the user to select a venue and performance time.

We already have the models in place so all we need to do is to create the additional view and expand the router. First, we'll implement the view:

src/main/webapp/resources/js/app/views/desktop/event-detail.js

```
define([
  'utilities',
  'require',
  'text!../../../../../templates/desktop/event-detail.html',
  'text!../../../../../templates/desktop/media.html',
  'text!../../../../../templates/desktop/event-venue-description.html',
  'configuration',
  'bootstrap'
], function (
  utilities,
  require,
  eventDetailTemplate,
  mediaTemplate,
  eventVenueDescriptionTemplate,
  config,
  Bootstrap) {

  var EventDetail = Backbone.View.extend({

    events:{
      "click input[name='bookButton']": "beginBooking",
      "change select[id='venueSelector']": "refreshShows",
      "change select[id='dayPicker']": "refreshTimes"
    },

    render: function () {
      $(this.el).empty()
      utilities.applyTemplate($(this.el), eventDetailTemplate, this.model.attributes);
      $("#bookingOption").hide();
      $("#venueSelector").attr('disabled', true);
      $("#dayPicker").empty();
      $("#dayPicker").attr('disabled', true)
      $("#performanceTimes").empty();
      $("#performanceTimes").attr('disabled', true)
      var self = this
      $.getJSON(config.baseUrl + "rest/shows?event=" + this.model.get('id'), function
      (shows) {
```

```

        self.shows = shows
        $("#venueSelector").empty().append("<option value='0' selected>Select a venue</option>");
        $.each(shows, function (i, show) {
            $("#venueSelector").append("<option value='" + show.id + "'>" +
            show.venue.address.city + " : " + show.venue.name + "</option>");
        });
        $("#venueSelector").removeAttr('disabled')
    })
    return this;
},
beginBooking:function () {
    require("router").navigate('/book/' + $("#venueSelector option:selected").val() +
    '/' + $("#performanceTimes").val(), true)
},
refreshShows:function (event) {
    event.stopPropagation();
    $("#dayPicker").empty();

    var selectedShowId = event.currentTarget.value;

    if (selectedShowId != 0) {
        var selectedShow = _.find(this.shows, function (show) {
            return show.id == selectedShowId
        });
        this.selectedShow = selectedShow;
        utilities.applyTemplate($("#eventVenueDescription"),
        eventVenueDescriptionTemplate, {venue:selectedShow.venue});
        var times = _.uniq(_.sortBy(_.map(selectedShow.performances, function
        (performance) {
            return (new Date(performance.date).withoutTimeOfDay()).getTime()
        }), function (item) {
            return item
        }));
        utilities.applyTemplate($("#venueMedia"), mediaTemplate, selectedShow.venue)
        $("#dayPicker").removeAttr('disabled')
        $("#performanceTimes").removeAttr('disabled')
        _.each(times, function (time) {
            var date = new Date(time)
            $("#dayPicker").append("<option value='" + date.toYMD() + "'>" +
            date.toPrettyStringWithoutTime() + "</option>")
        });
        this.refreshTimes()
        $("#bookingWhen").show(100)
    } else {
        $("#bookingWhen").hide(100)
        $("#bookingOption").hide()
        $("#dayPicker").empty()
        $("#venueMedia").empty()
        $("#eventVenueDescription").empty()
        $("#dayPicker").attr('disabled', true)
        $("#performanceTimes").empty()
        $("#performanceTimes").attr('disabled', true)
    }
},
refreshTimes:function () {
    var selectedDate = $("#dayPicker").val();
    $("#performanceTimes").empty()
    if (selectedDate) {
        $.each(this.selectedShow.performances, function (i, performance) {
            var performanceDate = new Date(performance.date);

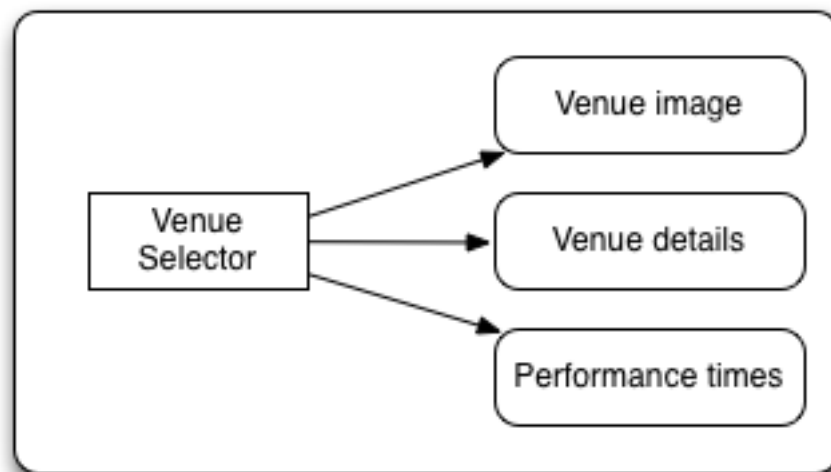
```

```
        if (_.isEqual(performanceDate.toYMD(), selectedDate)) {
            $("#performanceTimes").append("<option value='" + performance.id +
            "'>" + performanceDate.getHours().toZeroPaddedString(2) + ":" +
            performanceDate.getMinutes().toZeroPaddedString(2) + "</option>")
        }
    })
}
$("#bookingOption").show()
}

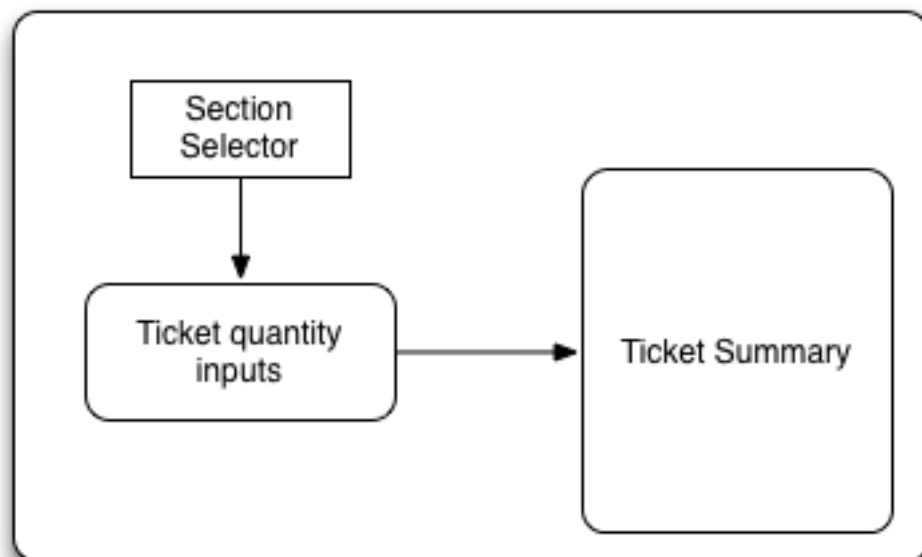
});

return EventDetail;
});
```

This view is more complex than the global events view, as portions of the page need to be updated when the user chooses a venue.



Event details



Create booking

Figure 34.1: On the event details page some fragments are re-rendered when the user selects a venue

The view responds to three different events:

- changing the current venue triggers a reload of the venue details and the venue image, as well as the performance times. The

application retrieves the performance times through a REST call.

- changing the day of the performance causes the performance time selector to reload.
- once the venue and performance date and time have been selected, the user can navigate to the booking page.

The corresponding templates for the three fragments rendered above are:

src/main/webapp/resources/templates/desktop/event-detail.html

```
<div class="row-fluid" xmlns="http://www.w3.org/1999/html">
  <h2 class="page-header special-title light-font"><%=name%></h2>
</div>
<div class="row-fluid">
  <div class="span4 well">
    <div class="row-fluid"><h3 class="page-header span6">What?</h3>
      <img width="100" src='rest/media/<%=mediaItem.id%>' /></div>
      <div class="row-fluid">
        <p>&nbsp;</p>

        <div class="span12"><%= description %></div>
      </div>
    </div>
    <div class="span4 well">
      <div class="row-fluid"><h3 class="page-header span6">Where?</h3>
        <div class="span6" id='venueMedia' />
      </div>
      <div class='row-fluid'><select id='venueSelector' />
        <div id="eventVenueDescription" />
      </div>
    </div>
    <div id='bookingWhen' style="display: none;" class="span4 well">
      <h3 class="page-header">When?</h3>
      <select class="span6" id="dayPicker" />
      <select class="span6" id="performanceTimes" />

      <div id='bookingOption'><input name="bookButton" class="btn btn-primary" type="button"
        value="Order tickets"></div>
    </div>
  </div>
```

src/main/webapp/resources/templates/desktop/event-venue-description.html

```
<address>
  <p><%= venue.description %></p>
  <p><strong>Address:</strong></p>
  <p><%= venue.address.street %></p>
  <p><%= venue.address.city %>, <%= venue.address.country %></p>
</address>
```

Now that the view exists, we add it to the router:

src/main/webapp/resources/js/app/router/desktop/router.js

```
/**
 * A module for the router of the desktop application
 */
define("router", [
  ...
  'app/models/event',
  ...
  'app/views/desktop/event-detail',
```

```
    ...
  ], function (
    ...
    Event,
    ...
    EventDetailView,
    ...) {

    var Router = Backbone.Router.extend({
      ...
      routes:{
        ...
        "events/:id":"eventDetail",
      },
      ...
      eventDetail:function (id) {
        var model = new Event({id:id});
        var eventDetailView = new EventDetailView({model:model, el:$("#content")});
        model.bind("change",
          function () {
            utilities.viewManager.showView(eventDetailView);
          }).fetch();
      }
    }
    ...
  );
```

As you can see, this is very similar to the previous view and route, except that now the application can accept parameterized URLs (e.g. <http://localhost:8080/ticket-monster/index#events/1>). This URL can be entered directly into the browser, or it can be navigated to as a relative path (e.g. [#events/1](#)) from within the application.

With this in place, all that remains is to implement the final view of this use case, creating the bookings.

Chapter 35

Creating Bookings

The user has chosen the event, the venue and the performance time, and must now create the booking. Users can select one of the available sections for the show's venue, and then enter the number of tickets required for each category available for this show (Adult, Child, etc.). They then add the tickets to the current order, which causes the summary view to be updated. Users can also remove tickets from the order. When the order is complete, they enter their contact information (e-mail address) and submit the order to the server.

First, we add the new view:

src/main/webapp/resources/js/app/views/desktop/create-booking.js

```
define([
    'utilities',
    'require',
    'configuration',
    'text!../../../../templates/desktop/booking-confirmation.html',
    'text!../../../../templates/desktop/create-booking.html',
    'text!../../../../templates/desktop/ticket-categories.html',
    'text!../../../../templates/desktop/ticket-summary-view.html',
    'bootstrap'
], function (
    utilities,
    require,
    config,
    bookingConfirmationTemplate,
    createBookingTemplate,
    ticketEntriesTemplate,
    ticketSummaryViewTemplate) {

    var TicketCategoriesView = Backbone.View.extend({
        id: 'categoriesView',
        intervalDuration : 100,
        formValues : [],
        events: {
            "change input": "onChange"
        },
        render: function () {
            if (this.model != null) {
                var ticketPrices = _.map(this.model, function (item) {
                    return item.ticketPrice;
                });
                utilities.applyTemplate($(this.el), ticketEntriesTemplate,
                    {ticketPrices:ticketPrices});
            } else {
                $(this.el).empty();
            }
        }
    });
```

```

    }
    this.watchForm();
    return this;
  },
  onChange: function (event) {
    var value = event.currentTarget.value;
    var ticketPriceId = $(event.currentTarget).data("tm-id");
    var modifiedModelEntry = _.find(this.model, function (item) {
      return item.ticketPrice.id == ticketPriceId
    });
    // update model
    if ($.isNumeric(value) && value > 0) {
      modifiedModelEntry.quantity = parseInt(value);
    }
    else {
      delete modifiedModelEntry.quantity;
    }
    // display error messages
    if (value.length > 0 &&
      (!$.isNumeric(value) // is a non-number, other than empty string
      || value <= 0 // is negative
      || parseFloat(value) != parseInt(value))) { // is not an integer
      $("#error-input-"+ticketPriceId).empty().append("Please enter a positive integer value");
      $("#ticket-category-fieldset-"+ticketPriceId).addClass("error")
    } else {
      $("#error-input-"+ticketPriceId).empty();
      $("#ticket-category-fieldset-"+ticketPriceId).removeClass("error")
    }
    // are there any outstanding errors after this update?
    // if yes, disable the input button
    if (
      $("div[id^='ticket-category-fieldset-']").hasClass("error") ||
      _.isUndefined(modifiedModelEntry.quantity) ) {
      $("input[name='add']").attr("disabled", true)
    } else {
      $("input[name='add']").removeAttr("disabled")
    }
  },
  watchForm: function () {
    if ($("#sectionSelectorPlaceholder").length) {
      var self = this;
      $("input[name*='tickets']").each( function(index,element) {
        if(element.value !== self.formValues[element.name]) {
          self.formValues[element.name] = element.value;
          $("input[name='"+element.name+"'").change();
        }
      });
      this.timerObject = setTimeout(function () {
        self.watchForm();
      }, this.intervalDuration);
    } else {
      this.onClose();
    }
  },
  onClose: function () {
    if(this.timerObject) {
      clearTimeout(this.timerObject);
      delete this.timerObject;
    }
  }
});

```



```
var TicketSummaryView = Backbone.View.extend({
  tagName: 'tr',
  events: {
    "click i": "removeEntry"
  },
  render: function () {
    var self = this;
    utilities.applyTemplate($(this.el), ticketSummaryViewTemplate,
    this.model.bookingRequest);
  },
  removeEntry: function () {
    this.model.bookingRequest.tickets.splice(this.model.index, 1);
  }
});

var CreateBookingView = Backbone.View.extend({

  intervalDuration : 100,
  formValues : [],
  events: {
    "click input[name='submit']": "save",
    "change select[id='sectionSelect']": "refreshPrices",
    "keyup #email": "updateEmail",
    "change #email": "updateEmail",
    "click input[name='add']": "addQuantities",
    "click i": "updateQuantities"
  },
  render: function () {

    var self = this;
    $.getJSON(config.baseUrl + "rest/shows/" + this.model.showId, function
(selectedShow) {

      self.currentPerformance = _.find(selectedShow.performances, function (item) {
        return item.id == self.model.performanceId;
      });

      var id = function (item) {return item.id;};
      // prepare a list of sections to populate the dropdown
      var sections = _.uniq(_.sortBy(_.pluck(selectedShow.ticketPrices, 'section'),
id), true, id);
      utilities.applyTemplate($(self.el), createBookingTemplate, {
        sections: sections,
        show: selectedShow,
        performance: self.currentPerformance});
      self.ticketCategoriesView = new TicketCategoriesView({model: {},
el: $("#ticketCategoriesViewPlaceholder") });
      self.ticketSummaryView = new TicketSummaryView({model: self.model,
el: $("#ticketSummaryView")});
      self.show = selectedShow;
      self.ticketCategoriesView.render();
      self.ticketSummaryView.render();
      $("#sectionSelector").change();
      self.watchForm();
    });
    return this;
  },
  refreshPrices: function (event) {
    var ticketPrices = _.filter(this.show.ticketPrices, function (item) {
      return item.section.id == event.currentTarget.value;
    });
  }
});
```

```

        var sortedTicketPrices = _.sortBy(ticketPrices, function(ticketPrice) {
            return ticketPrice.ticketCategory.description;
        });
        var ticketPriceInputs = new Array();
        _.each(sortedTicketPrices, function(ticketPrice) {
            ticketPriceInputs.push({ticketPrice:ticketPrice});
        });
        this.ticketCategoriesView.model = ticketPriceInputs;
        this.ticketCategoriesView.render();
    },
    save:function(event){
        var bookingRequest = {ticketRequests:[]};
        var self = this;
        bookingRequest.ticketRequests = _.map(this.model.bookingRequest.tickets, function
(ticket){
            return {ticketPrice:ticket.ticketPrice.id, quantity:ticket.quantity}
        });
        bookingRequest.email = this.model.bookingRequest.email;
        bookingRequest.performance = this.model.performanceId
        $("input[name='submit']").attr("disabled", true)
        $.ajax({url: (config.baseUrl + "rest/bookings"),
            data:JSON.stringify(bookingRequest),
            type:"POST",
            dataType:"json",
            contentType:"application/json",
            success:function(booking){
                this.model = {}
                $.getJSON(config.baseUrl + 'rest/shows/performance/' +
booking.performance.id, function(retrievedPerformance){
                    utilities.applyTemplate($(self.el), bookingConfirmationTemplate,
{booking:booking, performance:retrievedPerformance})
                });
            }).error(function(error){
                if (error.status == 400 || error.status == 409) {
                    var errors = $.parseJSON(error.responseText).errors;
                    _.each(errors, function(errorMessage){
                        $("#request-summary").append('<div class="alert alert-error"><a
class="close" data-dismiss="alert">$\times$</a><strong>Error!</strong> ' + errorMessage +
'</div>')
                    });
                } else {
                    $("#request-summary").append('<div class="alert alert-error"><a
class="close" data-dismiss="alert">$\times$</a><strong>Error! </strong>An error has
occured</div>')
                }
                $("input[name='submit']").removeAttr("disabled");
            })
    },
    addQuantities:function(){
        var self = this;
        _.each(this.ticketCategoriesView.model, function(model){
            if (model.quantity != undefined) {
                var found = false;
                _.each(self.model.bookingRequest.tickets, function(ticket){
                    if (ticket.ticketPrice.id == model.ticketPrice.id) {
                        ticket.quantity += model.quantity;
                        found = true;
                    }
                });
            }
            if (!found) {

```

```

self.model.bookingRequest.tickets.push({ticketPrice:model.ticketPrice,
quantity:model.quantity});
    }
    });
    this.ticketCategoriesView.model = null;
    $('option:selected', 'select').removeAttr('selected');
    this.ticketCategoriesView.render();
    this.updateQuantities();
},
updateQuantities:function () {
    // make sure that tickets are sorted by section and ticket category
    this.model.bookingRequest.tickets.sort(function (t1, t2) {
        if (t1.ticketPrice.section.id != t2.ticketPrice.section.id) {
            return t1.ticketPrice.section.id - t2.ticketPrice.section.id;
        }
        else {
            return t1.ticketPrice.ticketCategory.id -
t2.ticketPrice.ticketCategory.id;
        }
    });

    this.model.bookingRequest.totals = _.reduce(this.model.bookingRequest.tickets,
function (totals, ticketRequest) {
    return {
        tickets:totals.tickets + ticketRequest.quantity,
        price:totals.price + ticketRequest.quantity *
ticketRequest.ticketPrice.price
    };
}, {tickets:0, price:0.0});

    this.ticketSummaryView.render();
    this.setCheckoutStatus();
},
updateEmail:function (event) {
    if ($(event.currentTarget).is(':valid')) {
        this.model.bookingRequest.email = event.currentTarget.value;
        $("#error-email").empty();
    } else {
        $("#error-email").empty().append("Please enter a valid e-mail address");
        delete this.model.bookingRequest.email;
    }
    this.setCheckoutStatus();
},
setCheckoutStatus:function () {
    if (this.model.bookingRequest.totals != undefined &&
this.model.bookingRequest.totals.tickets > 0 && this.model.bookingRequest.email !=
undefined && this.model.bookingRequest.email != '') {
        $('input[name="submit"]').removeAttr('disabled');
    }
    else {
        $('input[name="submit"]').attr('disabled', true);
    }
},
watchForm: function() {
    if($("#email").length) {
        var self = this;
        var element = $("#email");
        if(element.val() !== self.formValues["email"]) {
            self.formValues["email"] = element.val();
            $("#email").change();
        }
    }
}

```

```

        this.timerObject = setTimeout(function() {
            self.watchForm();
        }, this.intervalDuration);
    } else {
        this.onClose();
    }
},
onClose: function() {
    if(this.timerObject) {
        clearTimeout(this.timerObject);
        delete this.timerObject;
    }
    this.ticketCategoriesView.close();
}
});

return CreateBookingView;
});

```

The code above may be surprising! After all, we said that we were going to add a single view, but instead, we added three! This view makes use of two subviews (`TicketCategoriesView` and `TicketSummaryView`) for re-rendering parts of the main view. Whenever the user changes the current section, the list of available tickets is updated. Whenever the user adds the tickets to the booking, the booking summary is re-rendered. Changes in quantities or the target email may enable or disable the submission button - the booking is validated whenever changes to it are made. We do not create separate modules for the subviews, since they are not referenced outside the module itself.

The booking submission is handled by the `save` method which constructs a JSON object, as required by a POST to `http://localhost` and performs the AJAX call. In case of a successful response, a confirmation view is rendered. On failure, a warning is displayed and the user may continue to edit the form.

The corresponding templates for the views above are shown below:

src/main/webapp/resources/templates/desktop/booking-confirmation.html

```

<div class="row-fluid">
    <h2 class="special-title light-font">Booking #<%=booking.id%> confirmed!</h2>
</div>
<div class="row-fluid">
    <div class="span5 well">
        <h4 class="page-header">Checkout information</h4>
        <p><strong>Email: </strong><%= booking.contactEmail %></p>
        <p><strong>Event: </strong> <%= performance.event.name %></p>
        <p><strong>Venue: </strong><%= performance.venue.name %></p>
        <p><strong>Date: </strong><%= new Date(booking.performance.date).toPrettyString()
%></p>
        <p><strong>Created on: </strong><%= new Date(booking.createdOn).toPrettyString()
%></p>
    </div>
    <div class="span5 well">
        <h4 class="page-header">Ticket allocations</h4>
        <table class="table table-striped table-bordered" style="background-color: #fffffa;">
            <thead>
                <tr>
                    <th>Ticket #</th>
                    <th>Category</th>
                    <th>Section</th>
                    <th>Row</th>
                    <th>Seat</th>
                </tr>
            </thead>
            <tbody>
                <% $.each(_.sortBy(booking.tickets, function(ticket) {return ticket.id}),
function (i, ticket) { %>

```

```

        <tr>
            <td><%= ticket.id %></td>
            <td><%=ticket.ticketCategory.description%></td>
            <td><%=ticket.seat.section.name%></td>
            <td><%=ticket.seat.rowNumber%></td>
            <td><%=ticket.seat.number%></td>
        </tr>
        <% }) %>
    </tbody>
</table>
</div>
</div>
<div class="row-fluid" style="padding-bottom:30px;">
    <div class="span2"><a href="#">Home</a></div>
</div>

```

src/main/webapp/resources/templates/desktop/create-booking.html

```

<div class="row-fluid">
    <div class="span12">
        <h2 class="special-title light-font"><%=show.event.name%>
        <small><%=show.venue.name%>, <%=new
        Date(performance.date).toPrettyString()%></p></small>
        </h2>
    </div>
</div>
<div class="row-fluid">
    <div class="span6 well">
        <h3 class="page-header">Select tickets</h3>
        <form class="form-horizontal">
            <div id="sectionSelectorPlaceholder">
                <div class="control-group">
                    <label class="control-label"
                    for="sectionSelect"><strong>Section</strong></label>
                    <div class="controls">
                        <select id="sectionSelect">
                            <option value="-1" selected="true">Choose a section</option>
                            <% _.each(sections, function(section) { %>
                                <option value="<%=section.id%>"><%=section.name%> -
                                <%=section.description%></option>
                            <% }) %>
                        </select>
                    </div>
                </div>
            </div>
        </form>
        <div id="ticketCategoriesViewPlaceholder"></div>
    </div>
    <div id="request-summary" class="span5 offset1 well">
        <h3 class="page-header">Order summary</h3>
        <div id="ticketSummaryView" class="row-fluid"/>
        <h3 class="page-header">Checkout</h3>
        <div class="row-fluid">
            <form class="form-search">
                <input type='email' id="email" placeholder="Email" required/>
                <input type='button' class="btn btn-primary" name="submit" value="Checkout"
                disabled="true"/>
                <p class="help-block error-notification" id="error-email"></p>
            </form>
        </div>
    </div>
</div>
</div>

```

src/main/webapp/resources/templates/desktop/ticket-categories.html

```

<% if (ticketPrices.length > 0) { %>
<form class="form-horizontal">
  <% _.each(ticketPrices, function(ticketPrice) { %>
    <div class="control-group" id="ticket-category-fieldset-<%=ticketPrice.id%>">
      <label
        class="control-label"><strong><%=ticketPrice.ticketCategory.description%></strong></label>

      <div class="controls">
        <div class="input-append">
          <input class="span6" rel="tooltip" title="Enter value"
            data-tm-id="<%=ticketPrice.id%>"
            placeholder="Number of tickets"
            name="tickets-<%=ticketPrice.ticketCategory.id%>" />
          <span class="add-on">@ $<%=ticketPrice.price%></span>

          <p class="help-block" id="error-input-<%=ticketPrice.id%>"></p>
        </div>
      </div>
    </div>
  </div>
  <% }) %>

<p>&nbsp;</p>

<div class="control-group">
  <label class="control-label"/>

  <div class="controls">
    <input type="button" class="btn btn-primary" disabled="true" name="add" value="Add
tickets"/>
  </div>
</div>
</div>
</form>
<% } %>

```

src/main/webapp/resources/templates/desktop/ticket-summary-view.html

```

<div class="span12">
  <% if (tickets.length>0) { %>
  <table class="table table-bordered table-condensed row-fluid" style="background-color:
#ffffffa;">
    <thead>
      <tr>
        <th colspan="5"><strong>Requested tickets</strong></th>
      </tr>
      <tr>
        <th>Section</th>
        <th>Category</th>
        <th>Quantity</th>
        <th>Price</th>
        <th></th>
      </tr>
    </thead>
    <tbody id="ticketRequestSummary">
      <% _.each(tickets, function (ticketRequest, index, tickets) { %>
      <tr>
        <td><%= ticketRequest.ticketPrice.section.name %></td>
        <td><%= ticketRequest.ticketPrice.ticketCategory.description %></td>
        <td><%= ticketRequest.quantity %></td>
        <td>$<%=ticketRequest.ticketPrice.price%></td>

```

```

        <td><i class="icon-trash"/></td>
    </tr>
    <% }>; %>
</tbody>
</table>
<p/>
<div class="row-fluid">
    <div class="span5"><strong>Total ticket count:</strong> <%= totals.tickets %></div>
    <div class="span5"><strong>Total price:</strong> $<%=totals.price%></div></div>
    <% } else { %>
    No tickets requested.
    <% } %>
</div>

```

Finally, once the view is available, we can add it's corresponding routing rule:

src/main/webapp/resources/js/app/router/desktop/router.js

```

/**
 * A module for the router of the desktop application
 */
define("router", [
    ...
    'app/views/desktop/create-booking',
    ...
], function (
    ...
    CreateBooking
    ...
) {

    var Router = Backbone.Router.extend({
        ...
        routes:{
            ...
            "book/:showId/:performanceId":"bookTickets",
        },
        ...
        bookTickets:function (showId, performanceId) {
            var createBookingView =
                new CreateBookingView({
                    model:{ showId:showId,
                        performanceId:performanceId,
                        bookingRequest:{tickets:[]}},
                    el:$("#content")
                });
            utilities.viewManager.showView(createBookingView);
        }
    });
    ...
});

```

This concludes the implementation of the booking use case. We started by listing the available events, continued by selecting a venue and performance time, and ended by choosing tickets and completing the order.

The other use cases: a booking starting from venues and view existing bookings are conceptually similar, so you can just copy the remaining files in the `src/main/webapp/resources/js/app/models`, `src/main/webapp/resources/js/app/col`, `src/main/webapp/resources/js/app/views/desktop` and the remainder of `src/main/webapp/resources/js/a`

Chapter 36

Mobile view

The mobile version of the application uses approximately the same architecture as the desktop version. Any differences are due to the functional changes in the mobile version and the use of jQuery mobile.

36.1 Setting up the structure

The first step in implementing our solution is to copy the CSS and JavaScript libraries to `resources/css` and `resources/js/libs`.

require.js

AMD support, along with the plugin:

- text - for loading text files, in our case the HTML templates

jQuery

general purpose library for HTML traversal and manipulation

Underscore

JavaScript utility library (and a dependency of Backbone)

Backbone

Client-side MVC framework

jQuery Mobile

user interface system for mobile devices;

(If you have already built the desktop application, some files may already be in place.)

For mobile clients, the main page will display the mobile version of the application, by loading the mobile AMD module of the application. Let us create it.

/src/main/webapp/resources/js/configurations/mobile.js

```
/**
 * Shortcut alias definitions - will come in handy when declaring dependencies
 * Also, they allow you to keep the code free of any knowledge about library
 * locations and versions
 */
require.config({
  baseUrl: "resources/js",
  paths: {
    jquery: 'libs/jquery-1.9.1',
    jquerymobile: 'libs/jquery.mobile-1.3.2',
    text: 'libs/text',
```



```

        underscore: 'libs/underscore',
        backbone: 'libs/backbone',
        order: 'libs/order',
        utilities: 'app/utilities',
        router: 'app/router/mobile/router'
    },
    // We shim Backbone.js and Underscore.js since they don't declare AMD modules
    shim: {
        'backbone': {
            deps: ['underscore', 'jquery'],
            exports: 'Backbone'
        },

        'underscore': {
            exports: '_'
        }
    }
});

define("configuration", function() {
    if (window.TicketMonster != undefined && TicketMonster.config != undefined) {
        return {
            baseUrl: TicketMonster.config.baseRESTUrl
        };
    } else {
        return {
            baseUrl: ""
        };
    }
});

define("initializer", [
    'jquery',
    'utilities',
    'text!../templates/mobile/main.html'
], function ($,
    utilities,
    MainTemplate) {
    // Configure jQuery to append timestamps to requests, to bypass browser caches
    // Important for MSIE
    $.ajaxSetup({cache: false});
    $('head').append('<link rel="stylesheet" href="resources/css/jquery.mobile-1.3.2.css"/>');
    $('head').append('<link rel="stylesheet" href="resources/css/m.screen.css"/>');
    // Bind to mobileinit before loading jQueryMobile
    $(document).bind("mobileinit", function () {
        // Prior to creating and starting the router, we disable jQuery Mobile's own routing
        mechanism
        $.mobile.hashListeningEnabled = false;
        $.mobile.linkBindingEnabled = false;
        $.mobile.pushStateEnabled = false;
        utilities.applyTemplate($('body'), MainTemplate);
    });
    // Then (load jQueryMobile and) start the router to finally start the app
    require(['router']);
});

// Now we declare all the dependencies
// This loads and runs the 'initializer' module.
require(['initializer']);

```

In this application, we combine Backbone and jQuery Mobile. Each framework has its own strengths; jQuery Mobile provides

UI components and touch support, whilst Backbone provides MVC support. There is some overlap between the two, as jQuery Mobile provides its own navigation mechanism which we disable.

We also define a `configuration` module which allows the customization of the base URLs for RESTful invocations. This module does not play any role in the mobile web version. We will come to it, however, when discussing hybrid applications.

We also define a special initializer module (`initializer`) that, when loaded, adds the stylesheets and applies the template for the general structure of the page in the `body` element. In the initializer module we make customizations in order to get the two frameworks working together - disabling the jQuery Mobile navigation. Let us add the template definition for the template loaded by the initializer module.

src/main/webapp/resources/templates/mobile/main.html

```
<!--
  The main layout of the page - contains the menu and the 'content' &lt;div/&gt; in which
  all the
  views will render the content.
-->
<div id="container" data-role="page" data-ajax="false"></div>
```

Next, we create the application router.

src/main/webapp/resources/js/app/router/mobile/router.js

```
/**
 * A module for the router of the mobile application.
 *
 */
define("router", [
    'jquery',
    'jquerymobile',
    'underscore',
    'utilities',
    'text!../templates/mobile/home-view.html'
], function ($,
    jqm,
    _,
    utilities,
    HomeViewTemplate) {

    /**
     * The Router class contains all the routes within the application - i.e. URLs and the
     * actions
     * that will be taken as a result.
     *
     * @type {Router}
     */
    var Router = Backbone.Router.extend({
        initialize: function () {
            //Begin dispatching routes
            Backbone.history.start();
        },
        defaultHandler: function (actions) {
            if (" " != actions) {
                $.mobile.changePage("#" + actions, {transition:'slide', changeHash:false,
                allowSamePageTransition:true});
            }
        }
    });

    // Create a router instance
    var router = new Router();
```

```
    return router;
  });
```

In the router code we add the `defaultHandler` to the router for handling jQuery Mobile transitions between internal pages (such as the ones generated by a nested listview).

Next, we need to create a first page.

36.2 The landing page

The first page in our application is the landing page. First, we add the template for it:

src/main/webapp/resources/templates/mobile/home-view.html

```
<div data-role="header">
  <h3>Ticket Monster</h3>
</div>
<div data-role="content" align="center">
  
  <h4 align="left">Find events</h4>
  <ul data-role="listview">
    <li>
      <a href="#events">By Category</a>
    </li>
    <li>
      <a href="#venues">By Location</a>
    </li>
  </ul>
</div>
```

Now we have to add the page to the router:

src/main/webapp/resources/js/app/router/mobile/router.js

```
/**
 * A module for the router of the mobile application.
 *
 */
define("router", [
  ...
  'text!../templates/mobile/home-view.html'
], function (
  ...
  HomeViewTemplate) {
  ...
  var Router = Backbone.Router.extend({
    ...
    routes:{
      "": "home"
    },
    ...
    home: function () {
      utilities.applyTemplate($("#container"), HomeViewTemplate);
      try {
        $("#container").trigger('pagecreate');
      } catch (e) {
        // workaround for a spurious error thrown when creating the page initially
      }
    }
  });
```

```
...
});
```

Because jQuery Mobile navigation is disabled, we must tell jQuery Mobile explicitly to enhance the page content in order to create the mobile view. Here, we trigger the jQuery Mobile `pagecreate` event explicitly to ensure that the page gets the appropriate look and feel.

36.3 The events view

First, we display a list of events (just as in the desktop view). Since mobile interfaces are more constrained, we will just show a simple list view:

src/main/webapp/resources/js/app/views/mobile/events.js

```
define([
  'utilities',
  'text!../../../../templates/mobile/events.html'
], function (
  utilities,
  eventsView) {

  var EventsView = Backbone.View.extend({
    render:function () {
      var categories = _.uniq(
        _.map(this.model.models, function(model) {
          return model.get('category')
        }), false, function(item) {
          return item.id
        });
      utilities.applyTemplate($(this.el), eventsView, {categories:categories,
        model:this.model});
      $(this.el).trigger('pagecreate');
      return this;
    }
  });

  return EventsView;
});
```

As you can see, the view is very similar to the desktop view, the main difference being the explicit hint to jQuery mobile through the `pagecreate` event invocation.

Next, we add the template for rendering the view:

src/main/webapp/resources/templates/mobile/events.html

```
<div data-role="header">
  <a data-role="button" data-icon="home" href="#">Home</a>
  <h3>Categories</h3>
</div>
<div data-role="content" id='itemMenu'>
  <div id='categoryMenu' data-role='listview' data-filter='true'
    data-filter-placeholder='Event category name ...'>
    <%
      _.each(categories, function (category) {
    %>
    <li>
      <a href="#"><%= category.description %></a>
      <ul id="category-<%=category.id%">
        <%
          _.each(model.models, function (model) {
```

```

        if (model.get('category').id == category.id) {
        %>
        <li>
            <a href="#events/<%=model.attributes.id%>"><%=model.attributes.name%></a>
        </li>
        <% }
        });
        %>
    </ul>
</li>
<% }> %>
</div>
</div>

```

And finally, we need to instruct the router to invoke the page:

src/main/webapp/resources/js/app/router/mobile/router.js

```

/**
 * A module for the router of the desktop application.
 *
 */
define("router", [
    ...
    'app/collections/events',
    ...
    'app/views/mobile/events'
    ...
], function (
    ...,
    Events,
    ...,
    EventsView,
    ...) {

    ...
    var Router = Backbone.Router.extend({
        ...
        routes: {
            ...
            "events": "events"
            ...
        },
        ...
        events: function () {
            var events = new Events;
            var eventsView = new EventsView({model: events, el: $("#container")});
            events.bind("reset",
                function () {
                    utilities.viewManager.showView(eventsView);
                }).fetch();
        }
        ...
    });
    ...
});

```

Just as in the case of the desktop application, the list of events will be accessible at #events (i.e. <http://localhost:8080/ticket-monster/#events>).

36.4 Displaying an individual event

Now, we create the view to display an event:

src/main/webapp/resources/js/app/views/mobile/event-detail.js

```
define([
  'utilities',
  'require',
  'configuration',
  'text!../../../../templates/mobile/event-detail.html',
  'text!../../../../templates/mobile/event-venue-description.html'
], function (
  utilities,
  require,
  config,
  eventDetail,
  eventVenueDescription) {

  var EventDetailView = Backbone.View.extend({
    events: {
      "click a[id='bookButton']": "beginBooking",
      "change select[id='showSelector']": "refreshShows",
      "change select[id='performanceTimes']": "performanceSelected",
      "change select[id='dayPicker']": "refreshTimes"
    },
    render: function () {
      $(this.el).empty()
      utilities.applyTemplate($(this.el), eventDetail, this.model.attributes)
      $(this.el).trigger('create')
      $("#bookButton").addClass("ui-disabled")
      var self = this;
      $.getJSON(config.baseUrl + "rest/shows?event=" + this.model.get('id'), function
(shows) {
        self.shows = shows;
        $("#showSelector").empty().append("<option data-placeholder='true'>Choose a
venue ...</option>");
        $.each(shows, function (i, show) {
          $("#showSelector").append("<option value='" + show.id + "'>" +
show.venue.address.city + " : " + show.venue.name + "</option>");
        });
        $("#showSelector").selectmenu('refresh', true)
        $("#dayPicker").selectmenu('disable')
        $("#dayPicker").empty().append("<option data-placeholder='true'>Choose a show
date ...</option>")
        $("#performanceTimes").selectmenu('disable')
        $("#performanceTimes").empty().append("<option data-placeholder='true'>Choose
a show time ...</option>")
      });
      $("#dayPicker").empty();
      $("#dayPicker").selectmenu('disable');
      $("#performanceTimes").empty();
      $("#performanceTimes").selectmenu('disable');
      $(this.el).trigger('pagecreate');
      return this;
    },
    performanceSelected: function () {
      if ($("#performanceTimes").val() != 'Choose a show time ...') {
        $("#bookButton").removeClass("ui-disabled")
      } else {
        $("#bookButton").addClass("ui-disabled")
      }
    }
  })
})
```

```

    },
    beginBooking: function () {
        require('router').navigate('book/' + $("#showSelector option:selected").val() +
        '/' + $("#performanceTimes").val(), true)
    },
    refreshShows: function (event) {

        var selectedShowId = event.currentTarget.value;

        if (selectedShowId !== 'Choose a venue ...') {
            var selectedShow = _.find(this.shows, function (show) {
                return show.id == selectedShowId
            });
            this.selectedShow = selectedShow;
            var times = _.uniq(_.sortBy(_.map(selectedShow.performances, function
(performance) {
                return (new Date(performance.date).withoutTimeOfDay()).getTime()
            }), function (item) {
                return item
            }));
            utilities.applyTemplate($("#eventVenueDescription"), eventVenueDescription,
            {venue:selectedShow.venue});
            $("#detailsCollapsible").show()
            $("#dayPicker").removeAttr('disabled')
            $("#performanceTimes").removeAttr('disabled')
            $("#dayPicker").empty().append("<option data-placeholder='true'>Choose a show
            date ...</option>")
            _.each(times, function (time) {
                var date = new Date(time)
                $("#dayPicker").append("<option value='" + date.toYMD() + "'>" +
            date.toPrettyStringWithoutTime() + "</option>")
            });
            $("#dayPicker").selectmenu('refresh')
            $("#dayPicker").selectmenu('enable')
            this.refreshTimes()
        } else {
            $("#detailsCollapsible").hide()
            $("#eventVenueDescription").empty()
            $("#dayPicker").empty()
            $("#dayPicker").selectmenu('disable')
            $("#performanceTimes").empty()
            $("#performanceTimes").selectmenu('disable')
        }
    },

    refreshTimes: function () {
        var selectedDate = $("#dayPicker").val();
        $("#performanceTimes").empty().append("<option data-placeholder='true'>Choose a
            show time ...</option>")
        if (selectedDate) {
            $.each(this.selectedShow.performances, function (i, performance) {
                var performanceDate = new Date(performance.date);
                if (_.isEqual(performanceDate.toYMD(), selectedDate)) {
                    $("#performanceTimes").append("<option value='" + performance.id +
                    "'>" + performanceDate.getHours().toZeroPaddedString(2) + ":" +
                    performanceDate.getMinutes().toZeroPaddedString(2) + "</option>")
                }
            })
            $("#performanceTimes").selectmenu('enable')
        }
        $("#performanceTimes").selectmenu('refresh')
    }

```

```

        this.performanceSelected()
    }

    });

    return EventDetailView;
});

```

Once again, this is very similar to the desktop version. Now we add the page templates:

src/main/webapp/resources/templates/mobile/event-detail.html

```

<div data-role="header">
    <h3>Book tickets</h3>
</div>
<div data-role="content">
    <h3><%=name%></h3>
    <img width='100px' src='rest/media/<%=mediaItem.id%>' />
    <p><%=description%></p>
    <div data-role="fieldcontain">
        <label for="showSelector"><strong>Where</strong></label>
        <select id='showSelector' data-mini='true' />
    </div>

    <div data-role="collapsible" data-content-theme="c" style="display: none;"
        id="detailsCollapsible">
        <h3>Venue details</h3>

        <div id="eventVenueDescription">
            <div>

                <div data-role='fieldcontain'>
                    <fieldset data-role='controlgroup'>
                        <legend><strong>When</strong></legend>
                        <label for="dayPicker">When:</label>
                        <select id='dayPicker' data-mini='true' />

                        <label for="performanceTimes">When:</label>
                        <select id="performanceTimes" data-mini='true' />

                    </fieldset>
                </div>

            </div>
        </div>

    <div data-role="footer" class="ui-bar ui-grid-c">
        <div class="ui-block-a"></div>
        <div class="ui-block-b"></div>
        <div class="ui-block-c"></div>
        <a id='bookButton' class="ui-block-e" data-theme='b' data-role="button"
            data-icon="check">Book</a>
    </div>

```

src/main/webapp/resources/templates/mobile/event-venue-description.html

```

</p>
<%= venue.description %>
<address>
    <p><strong>Address:</strong></p>
    <p><%= venue.address.street %></p>
    <p><%= venue.address.city %>, <%= venue.address.country %></p>
</address>

```


Finally, we add this to the router, explicitly indicating to jQuery Mobile that a transition has to take place after the view is rendered - in order to allow the page to render correctly after it has been invoked from the listview.

src/main/webapp/resources/js/app/router/mobile/router.js

```
/**
 * A module for the router of the desktop application.
 */
define("router", [
    ...
    'app/model/event',
    ...
    'app/views/mobile/event-detail'
    ...
], function (
    ...,
    Event,
    ...,
    EventDetailView,
    ...) {

    ...
    var Router = Backbone.Router.extend({
        ...
        routes: {
            ...
            "events/:id": "eventDetail",
            ...
        },
        ...
        eventDetail: function (id) {
            var model = new Event({id:id});
            var eventDetailView = new EventDetailView({model:model, el:$("#container")});
            model.bind("change",
                function () {
                    utilities.viewManager.showView(eventDetailView);
                    $.mobile.changePage($("#container"), {transition:'slide',
changeHash:false});
                }).fetch();
            }
            ...
        });
        ...
    });
```

Just as the desktop version, the mobile event detail view allows users to choose a venue and a performance time. The next step is to allow the user to book some tickets.

36.5 Booking tickets

The views to book tickets are simpler than the desktop version. Users can select a section and enter the number of tickets for each category however, there is no way to add or remove tickets from an order. Once the form is filled out, the user can only submit it.

First, we create the views:

src/main/webapp/resources/js/app/views/mobile/create-booking.js

```
define([
    'utilities',
```

```

    'configuration',
    'require',
    'text!../../../../../templates/mobile/booking-details.html',
    'text!../../../../../templates/mobile/create-booking.html',
    'text!../../../../../templates/mobile/confirm-booking.html',
    'text!../../../../../templates/mobile/ticket-entries.html',
    'text!../../../../../templates/mobile/ticket-summary-view.html'
], function (
    utilities,
    config,
    require,
    bookingDetailsTemplate,
    createBookingTemplate,
    confirmBookingTemplate,
    ticketEntriesTemplate,
    ticketSummaryViewTemplate) {

    var TicketCategoriesView = Backbone.View.extend({
        id: 'categoriesView',
        events: {
            "change input": "onChange"
        },
        render: function () {
            var views = {};

            if (this.model != null) {
                var ticketPrices = _.map(this.model, function (item) {
                    return item.ticketPrice;
                });
                utilities.applyTemplate($(this.el), ticketEntriesTemplate,
                    {ticketPrices: ticketPrices});
            } else {
                $(this.el).empty();
            }
            $(this.el).trigger('pagecreate');
            return this;
        },
        onChange: function (event) {
            var value = event.currentTarget.value;
            var ticketPriceId = $(event.currentTarget).data("tm-id");
            var modifiedModelEntry = _.find(this.model, function (item) { return
            item.ticketPrice.id == ticketPriceId});
            if ($.isNumeric(value) && value > 0) {
                modifiedModelEntry.quantity = parseInt(value);
            }
            else {
                delete modifiedModelEntry.quantity;
            }
        }
    });

    var TicketSummaryView = Backbone.View.extend({
        render: function () {
            utilities.applyTemplate($(this.el), ticketSummaryViewTemplate,
            this.model.bookingRequest)
        }
    });

    var ConfirmBookingView = Backbone.View.extend({
        events: {
            "click a[id='saveBooking']": "save",
            "click a[id='goBack']": "back"
        }
    });

```

```

    },
    render: function () {
        utilities.applyTemplate($(this.el), confirmBookingTemplate, this.model)
        this.ticketSummaryView = new TicketSummaryView({model: this.model,
el: $("#ticketSummaryView")});
        this.ticketSummaryView.render();
        $(this.el).trigger('pagecreate')
    },
    back: function () {
        require("router").navigate('book/' + this.model.bookingRequest.show.id + '/' +
this.model.bookingRequest.performance.id, true)

    }, save: function (event) {
        var bookingRequest = {ticketRequests: []};
        var self = this;
        _.each(this.model.bookingRequest.tickets, function (collection) {
            _.each(collection, function (model) {
                if (model.quantity != undefined) {
                    bookingRequest.ticketRequests.push({ticketPrice: model.ticketPrice.id,
quantity: model.quantity})
                }
            })
        });

        bookingRequest.email = this.model.email;
        bookingRequest.performance = this.model.performanceId;
        $.ajax({url: (config.baseUrl + "rest/bookings"),
            data: JSON.stringify(bookingRequest),
            type: "POST",
            dataType: "json",
            contentType: "application/json",
            success: function (booking) {
                utilities.applyTemplate($(self.el), bookingDetailsTemplate, booking)
                $(self.el).trigger('pagecreate');
            }, error: function (error) {
                alert(error);
            }
        });
        this.model = {};
    }
});

var CreateBookingView = Backbone.View.extend({
    events: {
        "click a[id='confirmBooking']": "checkout",
        "change select": "refreshPrices",
        "blur input[type='number']": "updateForm",
        "blur input[name='email']": "updateForm"
    },
    render: function () {

        var self = this;

        $.getJSON(config.baseUrl + "rest/shows/" + this.model.showId, function
(selectedShow) {
            self.model.performance = _.find(selectedShow.performances, function (item) {
                return item.id == self.model.performanceId;
            });
            var id = function (item) {return item.id;};
            // prepare a list of sections to populate the dropdown
            var sections = _.uniq(_.sortBy(_.pluck(selectedShow.ticketPrices, 'section'),

```

```

    id), true, id);

    utilities.applyTemplate($(self.el), createBookingTemplate, {
show:selectedShow,
    performance:self.model.performance,
    sections:sections});
    $(self.el).trigger('pagecreate');
    self.ticketCategoriesView = new TicketCategoriesView({model:{},
el:$("#ticketCategoriesViewPlaceholder") });
    self.model.show = selectedShow;
    self.ticketCategoriesView.render();
    $('a[id="confirmBooking"]').addClass('ui-disabled');
    $("#sectionSelector").change();
    });

    },
    refreshPrices:function (event) {
        if (event.currentTarget.value != "Choose a section") {
            var ticketPrices = _.filter(this.model.show.ticketPrices, function (item) {
                return item.section.id == event.currentTarget.value;
            });
            var ticketPriceInputs = new Array();
            _.each(ticketPrices, function (ticketPrice) {
                var model = {};
                model.ticketPrice = ticketPrice;
                ticketPriceInputs.push(model);
            });
            $("#ticketCategoriesViewPlaceholder").show();
            this.ticketCategoriesView.model = ticketPriceInputs;
            this.ticketCategoriesView.render();
            $(this.el).trigger('pagecreate');
        } else {
            $("#ticketCategoriesViewPlaceholder").hide();
            this.ticketCategoriesView.model = new Array();
            this.updateForm();
        }
    },
    checkout:function () {
        this.model.bookingRequest.tickets.push(this.ticketCategoriesView.model);
        this.model.performance = new ConfirmBookingView({model:this.model,
el:$("#container")}).render();
        $("#container").trigger('pagecreate');
    },
    updateForm:function () {

        var totals = _.reduce(this.ticketCategoriesView.model, function (partial, model) {
            if (model.quantity != undefined) {
                partial.tickets += model.quantity;
                partial.price += model.quantity * model.ticketPrice.price;
                return partial;
            }
        }, {tickets:0, price:0.0});
        this.model.email = $("input[type='email']").val();
        this.model.bookingRequest.totals = totals;
        if (totals.tickets > 0 && $("input[type='email']").val()) {
            $('a[id="confirmBooking"]').removeClass('ui-disabled');
        } else {
            $('a[id="confirmBooking"]').addClass('ui-disabled');
        }
    }
    });
    return CreateBookingView;

```

```
});
```

The views follow the structure the desktop application, except that the summary view is not rendered inline but after a page transition.

Next, we create the page fragment templates. First, the actual page:

src/main/webapp/resources/templates/mobile/create-booking.html

```
<div data-role="header">
  <h1>Book tickets</h1>
</div>
<div data-role="content">
  <p>
    <h3><%=show.event.name%></h3>
  </p>
  <p>
    <%=show.venue.name%>
  </p>

  <p>
    <small><%=new Date(performance.date).toPrettyString()%></small>
  </p>
  <div id="sectionSelectorPlaceholder">
    <div data-role="fieldcontain">
      <label for="sectionSelect">Section</label>
      <select id="sectionSelect">
        <option value="-1" selected="true">Choose a section</option>
        <% _.each(sections, function(section) { %>
          <option value="<%=section.id%>"><%=section.name%> -
            <%=section.description%></option>
        <% }) %>
      </select>
    </div>
    <div id="ticketCategoriesViewPlaceholder" style="display:none;" />

    <div class="fieldcontain">
      <label>Contact email</label>
      <input type="email" name="email" placeholder="Email"/>
    </div>
  </div>

  <div data-role="footer" class="ui-bar">
    <a href="#" data-role="button" data-icon="delete">Cancel</a>
    <a id="confirmBooking" data-icon="check" data-role="button" disabled>Checkout</a>
  </div>
```

Next, the fragment that contains the input form for tickets, which is re-rendered whenever the section is changed:

src/main/webapp/resources/templates/mobile/ticket-entries.html

```
<% if (ticketPrices.length > 0) { %>
  <form name="ticketCategories">
    <h4>Select tickets by category</h4>
    <% _.each(ticketPrices, function(ticketPrice) { %>
      <div id="ticket-category-input-<%=ticketPrice.id%>" />

      <fieldset data-role="fieldcontain">
        <label
          for="ticket-<%=ticketPrice.id%>"><%=ticketPrice.ticketCategory.description%> ($<%=ticketPrice.pric
```

```

        <input id="ticket-<%=ticketPrice.id%>" data-tm-id="<%=ticketPrice.id%>"
            type="number" placeholder="Enter value"
                name="tickets"/>
    </fieldset>
<% }) %>
</form>
<% } %>

```

Before submitting the request to the server, the order is confirmed:

src/main/webapp/resources/templates/mobile/confirm-booking.html

```

<div data-role="header">
    <h1>Confirm order</h1>
</div>
<div data-role="content">
    <h3><%=show.event.name%></h3>
    <p><%=show.venue.name%></p>
    <p><small><%=new Date(performance.date).toPrettyString()%></small></p>
    <p><strong>Buyer:</strong> <em><%=email%></em></p>
    <div id="ticketSummaryView"/>
</div>

<div data-role="footer" class="ui-bar">
    <div class="ui-grid-b">
        <div class="ui-block-a"><a id="cancel" href="#" data-role="button"
            data-icon="delete">Cancel</a></div>
        <div class="ui-block-b"><a id="goBack" data-role="button"
            data-icon="back">Back</a></div>
        <div class="ui-block-c"><a id="saveBooking" data-icon="check"
            data-role="button">Buy!</a></div>
    </div>
</div>

```

The confirmation page contains a summary subview:

src/main/webapp/resources/templates/mobile/ticket-summary-view.html

```

<table>
    <thead>
        <tr>
            <th>Section</th>
            <th>Category</th>
            <th>Price</th>
            <th>Quantity</th>
        </tr>
    </thead>
    <tbody>
        <% __.each(tickets, function(ticketRequest) { %>
        <% __.each(ticketRequest, function(model) { %>
        <% if (model.quantity != undefined) { %>
        <tr>
            <td><%= model.ticketPrice.section.name %></td>
            <td><%= model.ticketPrice.ticketCategory.description %></td>
            <td><%= model.ticketPrice.price %></td>
            <td><%= model.quantity %></td>
        </tr>
        <% } %>
        <% }) %>
        <% }) %>
    </tbody>
</table>

```

```
<div data-theme="c">
  <h4>Totals</h4>
  <p><strong>Total tickets: </strong><%= totals.tickets %></p>
  <p> <strong>Total price: $</strong><%= totals.price %></p>
</div>
```

Finally, we create the page that displays the booking confirmation:

src/main/webapp/resources/templates/mobile/booking-details.html

```
<div data-role="header">
  <h1>Booking complete</h1>
</div>
<div data-role="content">
  <table id="confirm_tbl">
    <thead>
      <tr>
        <td colspan="5" align="center"><strong>Booking <%=id%></strong></td>
      <tr>
      <tr>
        <th>Ticket #</th>
        <th>Category</th>
        <th>Section</th>
        <th>Row</th>
        <th>Seat</th>
      </tr>
    </thead>
    <tbody>
      <% $.each(_.sortBy(tickets, function(ticket) {return ticket.id})), function (i,
ticket) { %>
        <tr>
          <td><%= ticket.id %></td>
          <td><%=ticket.ticketCategory.description%></td>
          <td><%=ticket.seat.section.name%></td>
          <td><%=ticket.seat.rowNumber%></td>
          <td><%=ticket.seat.number%></td>
        </tr>
      <% }) %>
    </tbody>
  </table></div>
<div data-role="footer" class="ui-bar">

  <div class="ui-block-b"><a id="back" href="#" data-role="button"
  data-icon="back">Back</a></div>

</div>
```

The last step is registering the view with the router:

src/main/webapp/resources/js/app/router/desktop/router.js

```
/**
 * A module for the router of the desktop application
 */
define("router", [
  ...
  'app/views/mobile/create-booking',
  ...
], function (
  ...
  CreateBookingView
  ...) {
```

```
var Router = Backbone.Router.extend({
  ...
  routes:{
    ...
    "book/:showId/:performanceId":"bookTickets",
    ...
  },
  ...
  bookTickets:function (showId, performanceId) {
    var createBookingView =
      new CreateBookingView(
        { model: {
          showId:showId,
          performanceId:performanceId,
          bookingRequest:{tickets:[]}},
          el:$("#container")
        });
    utilities.viewManager.showView(createBookingView);
  },
  ...
});
...
});
```


Chapter 37

More Resources

To learn more about writing HTML5 + REST applications with JBoss, take a look at the [Aerogear](#) project.

Part VI

Building the Administration UI using Forge

Chapter 38

What Will You Learn Here?

You've just defined the domain model of your application, and all the entities managed directly by the end-users. Now it's time to build an administration GUI for the TicketMonster application using JAX-RS and AngularJS. After reading this guide, you'll understand how to use JBoss Forge to create the JAX-RS resources from the entities and how to create an AngularJS based UI.

We'll round out the guide by revealing the required, yet short and sweet, configuration.

The tutorial will show you how to perform all these steps in JBoss Developer Studio, including screenshots that guide you through.

Chapter 39

Setting up Forge

39.1 JBoss Enterprise Application Platform 6

If you are using JBoss Enterprise Application Platform 6, Forge is available in JBoss Developer Studio 7.

To show the Forge Console, navigate to *Window* → *Show View* → *Other*, locate *Forge Console* and click *OK*. Then click the *Start* button in top right corner of the view.

39.2 JBoss AS 7

If you are using JBoss AS 7, you should install JBoss Forge version 1.4.0.Final or higher. Follow the instructions at [Installing Forge](#).

Open a command line and navigate to the root directory of this quickstart.

Launch Forge by typing the following command:

```
forge
```

39.3 Required Forge Plugins

Forge comes with a number of built in plugins, including the "scaffold-x" plugin, which is able to generate a full CRUD UI from JPA entities. The generated UI uses AngularJS as the view layer, with JAX-RS resources providing the backend services. Internally, Forge uses [Metawidget](#) to create the CRUD screens.

Forge also includes a powerful plugin management system. The AngularJS scaffolding plugin isn't bundled with Forge, but it's easy to install. First use the `forge find-plugin` command to locate it

```
forge find-plugin angularjs
```

In this case, the plugin is just called `angularjs` - easy! We can install it using the `forge install-plugin` command:

```
forge install-plugin angularjs
```

This will download, compile and install the RichFaces plugin.

Chapter 40

Getting started with Forge

Forge is a powerful rapid application development (aimed at Java EE 6) and project comprehension tool. It can operate both on projects it creates, and on existing projects, such as TicketMonster. If you want to learn more about Forge ...

When you `cd` into a project with Forge, it inspects the project, and detects what technologies you are using in the project. Let's see this in action:

```
project list-facets
```

Those facets detected are colored green.

```
[ticket-monster] ticket-monster $ project list-facets
NOT INSTALLED
- forge.spec.jaxrs.webxml [org.jboss.forge.spec.javaee.rest.RestWebXmlFacetImpl]
- forge.spec.jms [org.jboss.forge.spec.javaee.jms.JmsFacetImpl]
- angularjs [org.jboss.forge.scaffold.angularjs.AngularScaffold]
- forge.spec.validation [org.jboss.forge.spec.javaee.validation.ValidationFacetImpl]
- forge.spec.jaxws [org.jboss.forge.spec.javaee.soap.SoapFacetImpl]
- faces [org.jboss.forge.scaffoldx.faces.FacesScaffold]
- forge.spec.jstl [org.jboss.forge.spec.javaee.jstl.JSTLFacetImpl]
- faces [org.jboss.forge.scaffold.faces.FacesScaffold]
- forge.vcs.git [org.jboss.forge.git.GitFacet]
- forge.configuration.facet [org.jboss.forge.env.ConfigurationFacet]
- forge.vcs.git.api [org.jboss.forge.git.GitAPIFacet]
- forge.spec.jpa.metamodel [org.jboss.forge.spec.javaee.jpa.PersistenceMetaModelFacetImpl]
- forge.api [org.jboss.forge.dev.ForgeAPIFacet]
- forge.maven.scaffold.TemplateFacet [org.jboss.forge.scaffoldx.facets.MavenScaffoldTemplateFacet]
- forge.vcs.git.ignore [org.jboss.forge.git.gitignore.GitIgnoreFacet]

INSTALLED
+ forge.maven.JavaExecutionFacet [org.jboss.forge.maven.facets.JavaExecutionFacetImpl]
+ forge.spec.jaxrs [org.jboss.forge.spec.javaee.rest.RestFacetImpl]
+ forge.spec.jaxrs.applicationclass [org.jboss.forge.spec.javaee.rest.RestApplicationFacetImpl]
+ forge.maven.ResourceFacet [org.jboss.forge.maven.facets.MavenResourceFacet]
+ forge.maven.JavaSourceFacet [org.jboss.forge.maven.facets.MavenJavaSourceFacet]
+ forge.maven.MavenCoreFacet [org.jboss.forge.maven.facets.MavenCoreFacetImpl]
+ forge.spec.jsf.api [org.jboss.forge.spec.javaee.jsf.FacesAPIFacetImpl]
+ forge.spec.jpa [org.jboss.forge.spec.javaee.jpa.PersistenceFacetImpl]
+ forge.spec.jsf [org.jboss.forge.spec.javaee.jsf.FacesFacetImpl]
+ forge.spec.jta [org.jboss.forge.spec.javaee.jta.JTAFacetImpl]
+ forge.maven.MavenPluginFacet [org.jboss.forge.maven.facets.MavenPluginFacetImpl]
+ forge.maven.WebResourceFacet [org.jboss.forge.maven.facets.MavenWebResourceFacet]
+ forge.maven.MetadataFacet [org.jboss.forge.maven.facets.MavenMetadataFacet]
+ forge.maven.PackagingFacet [org.jboss.forge.maven.facets.MavenPackagingFacet]
+ forge.spec.ejb [org.jboss.forge.spec.javaee.ejb.EJBFacetImpl]
+ forge.maven.MavenDependencyFacet [org.jboss.forge.maven.facets.MavenDependencyFacet]
+ forge.spec.servlet [org.jboss.forge.spec.javaee.servlet.ServletFacetImpl]
+ forge.spec.cdi [org.jboss.forge.spec.javaee.cdi.CDIFacetImpl]
[ticket-monster] ticket-monster $ █
```

Figure 40.1: Output of `project list-facets`

As you can see, Forge has detected all the technologies we are using, such as JPA, JAX-RS, CDI and Bean Validation.

Chapter 41

Generating the CRUD UI

Forge Scripts

Forge supports the execution of scripts. The generation of the CRUD UI is provided as a Forge script in TicketMonster, so you don't need to type the commands everytime you want to regenerate the Admin UI. The script will also prompt you to apply all changes to the generated CRUD UI that listed later in this chapter. This would relieve us of the need to manually type in the changes.

To run the script:

```
run admin_layer.fsh
```

41.1 Generate the REST resources from the JPA entities

First, we need to generate REST resources for the entities. Run:

```
rest endpoint-from-entity --contentType application/json  
org.jboss.jdf.example.ticketmonster.model.* --strategy ROOT_AND_NESTED.DTO
```

to instruct Forge to generate JAX-RS resources for all the JPA entities in the project. The resources would be represented in JSON to enable the AngularJS-based front-end to communicate with the backend services. Each resource representation is structured to contain the representation of the corresponding JPA entity (the root) and any associated entities (that are represented as nested objects).

Note

The `ROOT_AND_NESTED.DTO` resource representation enables Forge to create REST resources for complex object graphs without adding Jackson annotations to avoid cycles in the graph. Without this constrained representation, one would have to add annotations like `@JsonIgnore` (to ignore certain undesirable object properties), or `@JsonIdentity` (to represent cycles in JSON without succumbing to `StackOverflowErrors` or similar such errors/exceptions).

41.2 Update the project

Next, we need to setup the AngularJS Scaffold in the project. Run:

```
scaffold-x setup --scaffoldType angularjs --targetDir admin
```

to instruct Forge to generate the css, images and JavaScript libraries used by the scaffold.

```
[ticket-monster] ticket-monster $ scaffold-x setup --scaffoldType angularjs --targetDir admin
? Scaffold provider [angularjs] is not installed. Install it? [Y/n]
***SUCCESS*** Installed [angularjs] successfully.
Wrote /home/vineet/ticket-monster/src/main/webapp/admin/styles/bootstrap.css
Wrote /home/vineet/ticket-monster/src/main/webapp/admin/styles/main.css
Wrote /home/vineet/ticket-monster/src/main/webapp/admin/styles/bootstrap-responsive.css
Wrote /home/vineet/ticket-monster/src/main/webapp/admin/scripts/vendor/jquery-1.9.1.js
Wrote /home/vineet/ticket-monster/src/main/webapp/admin/scripts/vendor/angular.js
Wrote /home/vineet/ticket-monster/src/main/webapp/admin/scripts/vendor/angular-resource.js
Wrote /home/vineet/ticket-monster/src/main/webapp/admin/img/forge-logo.png
Wrote /home/vineet/ticket-monster/src/main/webapp/admin/img/glyphicons-halflings.png
Wrote /home/vineet/ticket-monster/src/main/webapp/admin/img/glyphicons-halflings-white.png
[ticket-monster] ticket-monster $
```

Figure 41.1: Output of `scaffold setup`

41.3 Scaffold the AngularJS UI from the JPA entities

You can either scaffold the entities one-by-one, which allows you to control which UIs are generated, or you can generate a CRUD UI for all the entities. We'll do the latter:

```
scaffold-x from src/main/java/org/jboss/jdf/example/ticketmonster/model/* --targetDir admin
--overwrite
```

Forge asks us whether we want to overwrite every file - which gets a bit tedious! Specifying `--overwrite` allows Forge to overwrite files without prompt - much better!

Note

Forge will prompt you for additional information when creating the scaffold. For example, you may be prompted to provide information about how different objects should be displayed in the UI. You may also be prompted to specify a different URL for the REST resources used by the AngularJS-based UI. The defaults are sufficient since this is a convenience offered by Forge to provide a different value. Forge inspects the project for existing REST resources conforming to a convention and uses it as the default. Likewise, Forge inspects JPA entities and chooses the first displayable value as the default.

We now have a CRUD UI for all the entities used in TicketMonster!

Chapter 42

Test the CRUD UI

Let's test our UI on our local JBoss AS instance. As usual, we'll build and deploy using Maven:

```
mvn clean package jboss-as:deploy
```

Chapter 43

Make some changes to the UI

Let's add support for images to the Admin UI. `Events` and `Venues` have `MediaItem`'s associated with them, but they're only displayed as URLs. Let's display the corresponding images in the AngularJS views, by adding the required bindings:

src/main/webapp/admin/views/Event/detail.html

```
...
<div id="mediaItemControls" class="controls">
  <select id="mediaItem" name="mediaItem" ng-model="mediaItemSelection"
ng-options="m.text for m in mediaItemSelectionList" >
    <option value="">Choose a Media Item</option>
  </select>
  <br/>
  
</div>
...
```

src/main/webapp/admin/views/Venue/detail.html

```
...
<div id="mediaItemControls" class="controls">
  <select id="mediaItem" name="mediaItem" ng-model="mediaItemSelection"
ng-options="m.text for m in mediaItemSelectionList" >
    <option value="">Choose a Media Item</option>
  </select>
  <br/>
  
</div>
...
```

The admin site will now display the corresponding image if a media item is associated with the venue or event.

Tip

The location of the `MediaItem` is present in the `text` property of the `mediaItemSelection` object. The parameter to the `ngSrc` directive is set to this value. This ensures that the browser fetches the image present at this location. The expression `src={{mediaItemSelection.text}}` should be avoided since the browser would attempt to fetch the URL with the literal text `{{hash}}` before AngularJS replaces the expression with the actual URL.

Let's also modify the UI to make it more user-friendly. `Shows` and `Performances` are displayed in a non-intuitive manner at the moment. `Shows` are displayed as their object identities, while `performances` are displayed as date-time values. This makes it difficult to identify them in the views. Let's modify the UI to display more semantically useful values.

These values will be computed at the server-side, since these are already available in the `toString()` implementations of these classes. This would be accomplished by adding a read-only property `displayTitle` to the `Show` and `Performance` REST resource representations:

src/main/java/org/jboss/jdf/example/ticketmonster/rest/dto/ShowDTO.java

```
...
private Set<NestedPerformanceDTO> performances = new HashSet<NestedPerformanceDTO>();
private NestedVenueDTO venue;
private String displayTitle;

public ShowDTO()
{
    ...
    this.venue = new NestedVenueDTO(entity.getVenue());
    this.displayTitle = entity.toString();
}
...
public String getDisplayTitle()
{
    return this.displayTitle;
}
}
```

src/main/java/org/jboss/jdf/example/ticketmonster/rest/dto/PerformanceDTO.java

```
...
private NestedShowDTO show;
private Date date;
private String displayTitle;

public PerformanceDTO()
{
    ...
    this.show = new NestedShowDTO(entity.getShow());
    this.date = entity.getDate();
    this.displayTitle = entity.toString();
}
...
public String getDisplayTitle()
{
    return this.displayTitle;
}
}
```

And let us do the same for the nested representations:

src/main/java/org/jboss/jdf/example/ticketmonster/rest/dto/NestedPerformanceDTO.java

```
...
private Long id;
private Date date;
private String displayTitle;

public NestedPerformanceDTO()
{
    ...
    this.id = entity.getId();
    this.date = entity.getDate();
    this.displayTitle = entity.toString();
}
...
}
```

```
public String getDisplayTitle()
{
    return this.displayTitle;
}
```

src/main/java/org/jboss/jdf/example/ticketmonster/rest/dto/NestedShowDTO.java

```
...
private Long id;
private String displayTitle;

public NestedShowDTO()
{
    ...
    {
        this.id = entity.getId();
        this.displayTitle = entity.toString();
    }
}
...
public String getDisplayTitle()
{
    return this.displayTitle;
}
}
```

We shall now proceed to modify the AngularJS views to use the new properties in the resource representations:

src/main/webapp/admin/scripts/controllers/editPerformanceController.js

```
...
var labelObject = {
    value : item.id,
    text : item.displayTitle
};
if($scope.performance.show && item.id == $scope.performance.show.id) {
    ...
}
```

src/main/webapp/admin/scripts/controllers/editSectionAllocationController.js

```
...
var labelObject = {
    value : item.id,
    text : item.displayTitle
};
if($scope.sectionAllocation.performance && item.id ==
$scope.sectionAllocation.performance.id) {
    ...
}
```

src/main/webapp/admin/scripts/controllers/editShowController.js

```
...
var labelObject = {
    value : item.id,
    text : item.displayTitle
};
if($scope.show.performances) {
    ...
}
```

src/main/webapp/admin/scripts/controllers/editTicketPriceController.js

```
...
var labelObject = {
  value : item.id,
  text : item.displayTitle
};
if($scope.ticketPrice.show && item.id == $scope.ticketPrice.show.id) {
...

```

src/main/webapp/admin/scripts/controllers/newPerformanceController.js

```
...
$scope.showSelectionList = $.map(items, function(item) {
  return ( {
    value : item.id,
    text : item.displayTitle
  });
});
...

```

src/main/webapp/admin/scripts/controllers/newSectionAllocationController.js

```
...
$scope.performanceSelectionList = $.map(items, function(item) {
  return ( {
    value : item.id,
    text : item.displayTitle
  });
});
...

```

src/main/webapp/admin/scripts/controllers/newShowController.js

```
...
$scope.performancesSelectionList = $.map(items, function(item) {
  return ( {
    value : item.id,
    text : item.displayTitle
  });
});
...

```

src/main/webapp/admin/scripts/controllers/newTicketPriceController.js

```
...
$scope.showSelectionList = $.map(items, function(item) {
  return ( {
    value : item.id,
    text : item.displayTitle
  });
});
...

```

src/main/webapp/admin/views/Performance/search.html

```
<label for="show" class="control-label">Show</label>
<div class="controls">
  <select id="show" name="show" ng-model="search.show" ng-options="s as
s.displayTitle for s in showList">
    <option value="">Choose a Show</option>
  </select>
...

```

```

<tbody id="search-results-body">
  <tr ng-repeat="result in searchResults | searchFilter:searchResults |
startFrom:currentPage*pageSize | limitTo:pageSize">
    <td><a
href="#/Performances/edit/{{result.id}}">{{result.show.displayTitle}}</a></td>
    <td><a href="#/Performances/edit/{{result.id}}">{{result.date|
date:'yyyy-MM-dd HH:mm:ss Z'}}</a></td>
  </tr>

```

src/main/webapp/admin/views/SectionAllocation/search.html

```

<label for="performance" class="control-label">Performance</label>
<div class="controls">
  <select id="performance" name="performance" ng-model="search.performance"
ng-options="p as p.displayTitle for p in performanceList">
    <option value="">Choose a Performance</option>
  </select>
  ...
  <tbody id="search-results-body">
    <tr ng-repeat="result in searchResults | searchFilter:searchResults |
startFrom:currentPage*pageSize | limitTo:pageSize">
      <td><a
href="#/SectionAllocations/edit/{{result.id}}">{{result.occupiedCount}}</a></td>
      <td><a
href="#/SectionAllocations/edit/{{result.id}}">{{result.performance.displayTitle}}</a></td>
      <td><a
href="#/SectionAllocations/edit/{{result.id}}">{{result.section.name}}</a></td>
    </tr>

```

src/main/webapp/admin/views/TicketPrice/search.html

```

<label for="show" class="control-label">Show</label>
<div class="controls">
  <select id="show" name="show" ng-model="search.show" ng-options="s as
s.displayTitle for s in showList">
    <option value="">Choose a Show</option>
  </select>
  ...
  <tbody id="search-results-body">
    <tr ng-repeat="result in searchResults | searchFilter:searchResults |
startFrom:currentPage*pageSize | limitTo:pageSize">
      <td><a
href="#/TicketPrices/edit/{{result.id}}">{{result.show.displayTitle}}</a></td>
      <td><a
href="#/TicketPrices/edit/{{result.id}}">{{result.section.name}}</a></td>
      <td><a
href="#/TicketPrices/edit/{{result.id}}">{{result.ticketCategory.description}}</a></td>

```

We can test these changes by running

```
mvn clean package jboss-as:deploy
```

as usual.

Part VII

Building The Statistics Dashboard Using HTML5 and JavaScript

Chapter 44

What Will You Learn Here?

You've just built the administration view, and would like to collect real-time information about ticket sales and attendance. Now it would be good to implement a dashboard that can collect data and receive real-time updates. After reading this tutorial, you will understand our dashboard design and the choices that we made in its implementation. Topics covered include:

- Adding a RESTful API to your application for obtaining metrics
- Adding a non-RESTful API to your application for controlling a bot
- Creating Backbone.js models and views to interact with a non-RESTful service

In this tutorial, we will create a booking monitor using Backbone.js, and add it to the TicketMonster application. It will show live updates on the booking status of all performances and shows. These live updates are powered by a short polling solution that pings the server on regular intervals to obtain updated metrics.

Chapter 45

Implementing the Metrics API

The Metrics service publishes metrics for every show. These metrics include the capacity of the venue for the show, as well as the occupied count. Since these metrics are computed from persisted data, we'll not create any classes to represent them in the data model. We shall however create new classes to serve as their representations for the REST APIs:

src/main/java/org/jboss/jdf/example/ticketmonster/rest/ShowMetric.java

```
package org.jboss.jdf.example.ticketmonster.rest;

import java.util.ArrayList;
import java.util.List;
import java.util.Map;
import java.util.Set;

import org.jboss.jdf.example.ticketmonster.model.Performance;
import org.jboss.jdf.example.ticketmonster.model.Show;

/**
 * Metric data for a Show. Contains the identifier for the Show to identify it,
 * in addition to the event name, the venue name and capacity, and the metric
 * data for the performances of the Show.
 */
class ShowMetric {

    private Long show;
    private String event;
    private String venue;
    private int capacity;
    private List<PerformanceMetric> performances;

    // Constructor to populate the instance with data
    public ShowMetric(Show show, Map<Long, Long> occupiedCounts) {
        this.show = show.getId();
        this.event = show.getEvent().getName();
        this.venue = show.getVenue().getName();
        this.capacity = show.getVenue().getCapacity();
        this.performances = convertFrom(show.getPerformances(), occupiedCounts);
    }

    private List<PerformanceMetric> convertFrom(Set<Performance> performances,
        Map<Long, Long> occupiedCounts) {
        List<PerformanceMetric> result = new ArrayList<PerformanceMetric>();
        for (Performance performance : performances) {
            Long occupiedCount = occupiedCounts.get(performance.getId());
            result.add(new PerformanceMetric(performance, occupiedCount));
        }
    }
}
```

```
        return result;
    }

    // Getters for Jackson
    // NOTE: No setters and default constructors are defined since
    // deserialization is not required.

    public Long getShow() {
        return show;
    }

    public String getEvent() {
        return event;
    }

    public String getVenue() {
        return venue;
    }

    public int getCapacity() {
        return capacity;
    }

    public List<PerformanceMetric> getPerformances() {
        return performances;
    }
}
```

The ShowMetric class is used to represent the structure of a Show in the metrics API. It contains the show identifier, the Event name for the Show, the Venue name for the Show, the capacity of the Venue and a collection of PerformanceMetric instances to represent metrics for individual Performance's for the Show.

The PerformanceMetric is represented as:

src/main/java/org/jboss/jdf/example/ticketmonster/rest/PerformanceMetric.java

```
package org.jboss.jdf.example.ticketmonster.rest;

import java.util.Date;

import org.jboss.jdf.example.ticketmonster.model.Performance;

/**
 * Metric data for a Performance. Contains the datetime for the performance to
 * identify the performance, as well as the occupied count for the performance.
 */
class PerformanceMetric {

    private Date date;
    private Long occupiedCount;

    // Constructor to populate the instance with data
    public PerformanceMetric(Performance performance, Long occupiedCount) {
        this.date = performance.getDate();
        this.occupiedCount = (occupiedCount == null ? 0 : occupiedCount);
    }

    // Getters for Jackson
    // NOTE: No setters and default constructors are defined since
    // deserialization is not required.

    public Date getDate() {
        return date;
    }
}
```

```
}

    public Long getOccupiedCount() {
        return occupiedCount;
    }

}
```

This class represents the date-time instance of Performance in addition to the count of occupied seats for the venue.

The next class we need is the MetricsService class that responds with representations of ShowMetric instances in response to HTTP GET requests:

src/main/java/org/jboss/jdf/example/ticketmonster/rest/MetricsService.java

```
package org.jboss.jdf.example.ticketmonster.rest;

import java.util.ArrayList;
import java.util.HashMap;
import java.util.List;
import java.util.Map;

import javax.ejb.Stateless;
import javax.inject.Inject;
import javax.persistence.EntityManager;
import javax.persistence.Query;
import javax.persistence.TypedQuery;
import javax.ws.rs.GET;
import javax.ws.rs.Path;
import javax.ws.rs.Produces;
import javax.ws.rs.core.MediaType;

import org.jboss.jdf.example.ticketmonster.model.Show;

/**
 * A read-only REST resource that provides a collection of metrics for shows occurring in the
 * future. Updates to metrics via
 * POST/PUT etc. are not allowed, since they are not meant to be computed by consumers.
 */
@Path("/metrics")
@Stateless
public class MetricsService {

    @Inject
    private EntityManager entityManager;

    /**
     * Retrieves a collection of metrics for Shows. Each metric in the collection contains
     * <ul>
     * <li>the show id,</li>
     * <li>the event name of the show,</li>
     * <li>the venue for the show,</li>
     * <li>the capacity for the venue</li>
     * <li>the performances for the show,
     * <ul>
     * <li>the timestamp for each performance,</li>
     * <li>the occupied count for each performance</li>
     * </ul>
     * </li>
     * </ul>
     *
     * @return A JSON representation of metrics for shows.
     */
}
```

```
    */
    @GET
    @Produces(MediaType.APPLICATION_JSON)
    public List<ShowMetric> getMetrics() {
        return retrieveMetricsFromShows(retrieveShows(),
            retrieveOccupiedCounts());
    }

    private List<ShowMetric> retrieveMetricsFromShows(List<Show> shows,
        Map<Long, Long> occupiedCounts) {
        List<ShowMetric> metrics = new ArrayList<ShowMetric>();
        for (Show show : shows) {
            metrics.add(new ShowMetric(show, occupiedCounts));
        }
        return metrics;
    }

    private List<Show> retrieveShows() {
        TypedQuery<Show> showQuery = entityManager
            .createQuery("select DISTINCT s from Show s JOIN s.performances p WHERE p.date >
current_timestamp", Show.class);
        return showQuery.getResultList();
    }

    private Map<Long, Long> retrieveOccupiedCounts() {
        Map<Long, Long> occupiedCounts = new HashMap<Long, Long>();

        Query occupiedCountsQuery = entityManager
            .createQuery("select b.performance.id, SIZE(b.tickets) from Booking b "
                + "WHERE b.performance.date > current_timestamp GROUP BY b.performance.id");

        List<Object[]> results = occupiedCountsQuery.getResultList();
        for (Object[] result : results) {
            occupiedCounts.put((Long) result[0],
                ((Integer) result[1]).longValue());
        }

        return occupiedCounts;
    }
}
```

This REST resource responds to a GET request by querying the database to retrieve all the shows and the performances associated with each show. The metric for every performance is also obtained; the performance metric is simply the sum of all tickets booked for the performance. This query result is used to populate the `ShowMetric` and `PerformanceMetric` representation instances that are later serialized as JSON responses by the JAX-RS provider.

Chapter 46

Creating the Bot service

We'd also like to implement a `Bot` service that would mimic a set of real users. Once started, the `Bot` would attempt to book tickets at periodic intervals, until it is ordered to stop. The `Bot` should also be capable of deleting all `Bookings` so that the system could be returned to a clean state.

We will implement the `Bot` as an EJB that will utilize the container-provided `TimerService` to periodically perform bookings of a random number of tickets on randomly selected performances:

`src/main/java/org/jboss/jdf/example/ticketmonster/service/Bot.java`

```
package org.jboss.jdf.example.ticketmonster.service;

import java.util.ArrayList;
import java.util.Collection;
import java.util.Date;
import java.util.List;
import java.util.Map;
import java.util.Random;
import java.util.concurrent.TimeUnit;

import javax.annotation.Resource;
import javax.ejb.Stateless;
import javax.ejb.Timeout;
import javax.ejb.Timer;
import javax.ejb.TimerConfig;
import javax.ejb.TimerService;
import javax.enterprise.event.Event;
import javax.inject.Inject;
import javax.ws.rs.core.Response;

import org.jboss.jdf.example.ticketmonster.model.Performance;
import org.jboss.jdf.example.ticketmonster.model.Show;
import org.jboss.jdf.example.ticketmonster.model.TicketPrice;
import org.jboss.jdf.example.ticketmonster.rest.*;
import org.jboss.jdf.example.ticketmonster.util.MultivaluedHashMap;
import org.jboss.jdf.example.ticketmonster.util.qualifier.BotMessage;

@Stateless
public class Bot {

    private static final Random random = new Random(System.nanoTime());

    /** Frequency with which the bot will book */
    public static final long DURATION = TimeUnit.SECONDS.toMillis(3);

    /** Maximum number of ticket requests that will be filed */
```

```
public static int MAX_TICKET_REQUESTS = 100;

/** Maximum number of tickets per request */
public static int MAX_TICKETS_PER_REQUEST = 100;

public static String [] BOOKERS = {"anne@acme.com", "george@acme.com",
    "william@acme.com", "victoria@acme.com", "edward@acme.com", "elizabeth@acme.com",
    "mary@acme.com", "charles@acme.com", "james@acme.com", "henry@acme.com",
    "richard@acme.com", "john@acme.com", "stephen@acme.com"};

@Inject
private ShowService showService;

@Inject
private BookingService bookingService;

@Inject @BotMessage
Event<String> event;

@Resource
private TimerService timerService;

public Timer start() {
    String startMessage = new StringBuilder("=====\n")
        .append("Bot started at ").append(new Date().toString()).append("\n")
        .toString();
    event.fire(startMessage);
    return timerService.createIntervalTimer(0, DURATION, new TimerConfig(null, false));
}

public void stop(Timer timer) {
    String stopMessage = new StringBuilder("=====\n")
        .append("Bot stopped at ").append(new Date().toString()).append("\n")
        .toString();
    event.fire(stopMessage);
    timer.cancel();
}

@Timeout
public void book(Timer timer) {
    // Select a show at random
    Show show = selectAtRandom(showService.getAll(MultivaluedHashMap.<String,
String>empty()));

    // Select a performance at random
    Performance performance = selectAtRandom(show.getPerformances());

    String requestor = selectAtRandom(BOOKERS);

    BookingRequest bookingRequest = new BookingRequest(performance, requestor);

    List<TicketPrice> possibleTicketPrices = new
ArrayList<TicketPrice>(show.getTicketPrices());

    List<Integer> indicies = selectAtRandom(MAX_TICKET_REQUESTS <
possibleTicketPrices.size() ? MAX_TICKET_REQUESTS : possibleTicketPrices.size());

    StringBuilder message = new StringBuilder("=====\n")
        .append("Booking by ")
        .append(requestor)
        .append(" at ")
        .append(new Date().toString())
```

```

        .append("\n")
        .append(performance)
        .append("\n")
        .append("~~~~~\n");

    for (int index : indicies) {
        int no = random.nextInt(MAX_TICKETS_PER_REQUEST);
        TicketPrice price = possibleTicketPrices.get(index);
        bookingRequest.addTicketRequest(new TicketReservationRequest(price.getId(), no));
        message
            .append(no)
            .append(" of ")
            .append(price.getSection())
            .append("\n");
    }
    Response response = bookingService.createBooking(bookingRequest);
    if (response.getStatus() == Response.Status.OK.getStatusCode()) {
        message.append("SUCCESSFUL\n")
            .append("~~~~~\n");
    }
    else {
        message.append("FAILED:\n")
            .append(((Map<String, Object>) response.getEntity()).get("errors"))
            .append("~~~~~\n");
    }
    event.fire(message.toString());
}

private <T> T selectAtRandom(List<T> list) {
    int i = random.nextInt(list.size());
    return list.get(i);
}

private <T> T selectAtRandom(T[] array) {
    int i = random.nextInt(array.length);
    return array[i];
}

private <T> T selectAtRandom(Collection<T> collection) {
    int item = random.nextInt(collection.size());
    int i = 0;
    for (T obj : collection) {
        if (i == item)
            return obj;
        i++;
    }
    throw new IllegalStateException();
}

private List<Integer> selectAtRandom(int max) {
    List<Integer> indicies = new ArrayList<Integer>();
    for (int i = 0; i < max; i++) {
        int r = random.nextInt(max);
        if (!indicies.contains(r)) {
            indicies.add(r);
            i++;
        }
    }
}

```

```

        return indicies;
    }
}

```

The `start()` and `stop(Timer timer)` methods are used to control the lifecycle of the Bot. When invoked, the `start()` method creates an interval timer that is scheduled to execute every 3 seconds. The complementary `stop(Timer timer)` method accepts a `Timer` handle, and cancels the associated interval timer. The `book(Timer timer)` is the callback method invoked by the container when the interval timer expires; it is therefore invoked every 3 seconds. The callback method selects a show at random, an associated performance for the chosen show at random, and finally attempts to perform a booking of a random number of seats.

The Bot also fires CDI events containing log messages. To qualify the `String` messages produced by the Bot, we'll use the `BotMessage` qualifier:

src/main/java/org/jboss/jdf/example/ticketmonster/util/qualifier/BotMessage.java

```

package org.jboss.jdf.example.ticketmonster.util.qualifier;

import java.lang.annotation.Documented;
import java.lang.annotation.Retention;
import java.lang.annotation.Target;

import javax.inject.Qualifier;

import static java.lang.annotation.ElementType.FIELD;
import static java.lang.annotation.ElementType.METHOD;
import static java.lang.annotation.ElementType.PARAMETER;
import static java.lang.annotation.ElementType.TYPE;
import static java.lang.annotation.RetentionPolicy.RUNTIME;

@Qualifier
@Target({ TYPE, METHOD, PARAMETER, FIELD })
@Retention(RUNTIME)
@Documented
public @interface BotMessage {
}

```

The next step is to create a facade for the Bot that invokes the Bot's `start` and `stop` methods:

src/main/java/org/jboss/jdf/example/ticketmonster/service/BotService.java

```

package org.jboss.jdf.example.ticketmonster.service;

import java.util.List;
import java.util.logging.Logger;

import javax.ejb.Asynchronous;
import javax.ejb.Singleton;
import javax.ejb.Timer;
import javax.enterprise.event.Event;
import javax.enterprise.event.Observes;
import javax.inject.Inject;

import org.jboss.jdf.example.ticketmonster.model.Booking;
import org.jboss.jdf.example.ticketmonster.rest.BookingService;
import org.jboss.jdf.example.ticketmonster.util.CircularBuffer;
import org.jboss.jdf.example.ticketmonster.util.MultivaluedHashMap;
import org.jboss.jdf.example.ticketmonster.util.qualifier.BotMessage;

/**
 * A Bot service that acts as a Facade for the Bot, providing methods to control the Bot
 * state as well as to obtain the current

```



```
* state of the Bot.
*/
@Singleton
public class BotService {

    private static final int MAX_LOG_SIZE = 50;

    private CircularBuffer<String> log;

    @Inject
    private Bot bot;

    @Inject
    private BookingService bookingService;

    @Inject
    private Logger logger;

    @Inject
    @BotMessage
    private Event<String> event;

    private Timer timer;

    public BotService() {
        log = new CircularBuffer<String>(MAX_LOG_SIZE);
    }

    public void start() {
        synchronized (bot) {
            if (timer == null) {
                logger.info("Starting bot");
                timer = bot.start();
            }
        }
    }

    public void stop() {
        synchronized (bot) {
            if (timer != null) {
                logger.info("Stopping bot");
                bot.stop(timer);
                timer = null;
            }
        }
    }

    @Asynchronous
    public void deleteAll() {
        synchronized (bot) {
            stop();
            for (Booking booking : bookingService.getAll(MultivaluedHashMap
                .<String, String> empty())) {
                bookingService.deleteBooking(booking.getId());
                event.fire("Deleted booking " + booking.getId() + " for "
                    + booking.getContactEmail() + "\n");
            }
        }
    }

    public void newBookingRequest(@Observes @BotMessage String bookingRequest) {
        log.add(bookingRequest);
    }
}
```

```

    }

    public List<String> fetchLog() {
        return log.getContents();
    }

    public boolean isBotActive() {
        return (timer != null);
    }
}

```

The start and stop methods of this facade wrap calls to the start and stop methods of the Bot. These methods are synchronous by nature. The deleteAll method is an asynchronous business method in this EJB. It first stops the Bot, and then proceeds to delete all Bookings. Bookings can take quite a while to be deleted depending on the number of existing ones, and hence declaring this method as `@Asynchronous` would be appropriate in this situation.

This facade also exposes the log messages produced by the Bot via the `fetchLog()` method. The contents of the log are backed by a `CircularBuffer`. The facade observes all `@BotMessage` events and adds the contents of each event to the buffer.

Finally, the facade also provides an interface to detect if the bot is active or not: `isBotActive` that returns true if a `Timer` handle is present.

We shall now proceed to create a `BotStatusService` class that exposes the operations on the Bot as a web-service. The `BotStatusService` will always return the current status of the Bot - whether the Bot has been started or stopped, and the messages in the Bot's log. The service also allows the client to change the state of the bot - to start the bot, or to stop it, or even delete all the bookings.

The `BotState` is just an enumeration:

src/main/java/org/jboss/jdf/example/ticketmonster/rest/BotState.java

```

package org.jboss.jdf.example.ticketmonster.rest;

/**
 * An enumeration that represents the possible states for the Bot.
 */
public enum BotState {
    RUNNING, NOT_RUNNING, RESET
}

```

The `RUNNING` and `NOT_RUNNING` values are obvious. The `RESET` value is used to represent the state where the Bot will be stopped and the Bookings would be deleted. Quite naturally, the Bot will eventually enter the `NOT_RUNNING` state after it is `RESET`.

The `BotStatusService` will be located at the `/bot` path. It would respond to GET requests at the `/messages` sub-path with the contents of the Bot's log. It will respond to GET requests at the `/status` sub-path with the JSON representation of the current `BotState`. And finally, it will respond to PUT requests containing the JSON representation of the `BotState`, provided to the `/status` sub-path, by triggering a state change; a HTTP 204 response is returned in this case.

src/main/java/org/jboss/jdf/example/ticketmonster/rest/BotStatusService.java

```

package org.jboss.jdf.example.ticketmonster.rest;

import java.util.List;

import javax.inject.Inject;
import javax.ws.rs.GET;
import javax.ws.rs.PUT;
import javax.ws.rs.Path;
import javax.ws.rs.Produces;
import javax.ws.rs.core.MediaType;
import javax.ws.rs.core.Response;

```

```
import org.jboss.jdf.example.ticketmonster.service.BotService;

/**
 * A non-RESTful service for providing the current state of the Bot. This service also allows
 * the bot to be started, stopped or
 * the existing bookings to be deleted.
 */
@Path("/bot")
public class BotStatusService {

    @Inject
    private BotService botService;

    /**
     * Produces a JSON representation of the bot's log, containing a maximum of 50 messages
     logged by the Bot.
     *
     * @return The JSON representation of the Bot's log
     */
    @Path("messages")
    @GET
    @Produces(MediaType.APPLICATION_JSON)
    public List<String> getMessages() {
        return botService.fetchLog();
    }

    /**
     * Produces a representation of the bot's current state. This is a string - "RUNNING" or
     "NOT_RUNNING" depending on whether
     * the bot is active.
     *
     * @return The representation of the Bot's current state.
     */
    @Path("status")
    @GET
    @Produces(MediaType.APPLICATION_JSON)
    public Response getBotStatus() {
        BotState state = botService.isBotActive() ? BotState.RUNNING
            : BotState.NOT_RUNNING;
        return Response.ok(state).build();
    }

    /**
     * Updates the state of the Bot with the provided state. This may trigger the bot to
     start itself, stop itself, or stop and
     * delete all existing bookings.
     *
     * @param updatedStatus The new state of the Bot. Only the state property is considered;
     any messages provided are ignored.
     * @return An empty HTTP 201 response.
     */
    @Path("status")
    @PUT
    public Response updateBotStatus(BotState updatedState) {
        if (updatedState.equals(BotState.RUNNING)) {
            botService.start();
        } else if (updatedState.equals(BotState.NOT_RUNNING)) {
            botService.stop();
        } else if (updatedState.equals(BotState.RESET)) {
            botService.deleteAll();
        }
    }
}
```

```
        return Response.noContent().build();  
    }  
}
```

Should the BotStatusService use JAX-RS?



The `BotStatusService` appears to be a RESTful service, but on closer examination it does not obey the constraints of such a service. It represents a single resource - the `Bot` and not a collection of resources where each item in the collection is uniquely identified. In other words, no resource like `/bot/1` exists, and neither does a HTTP POST to `/bot` create a new bot. This affects the design of the Backbone.js models in the client, as we shall later see.

Therefore, it is not necessary to use JAX-RS in this scenario. JAX-RS certainly makes it easier, since we can continue to use the same programming model with minor changes. There is no need to parse requests or serialize responses or lookup EJBs; JAX-RS does this for us. The alternative would be to use a Servlet or a JSON-RPC endpoint.

We would recommend adoption alternatives in real-life scenarios should they be more suitable.

Chapter 47

Displaying Metrics

We are set up now and ready to start coding the client-side section of the dashboard. The users will be able to view the list of performances and view the occupied count for that performance.

47.1 The Metrics model

We'll define a Backbone model to represent the metric data for an individual show.

src/main/webapp/resources/js/app/models/metric.js

```
/**
 * Module for the Metric model
 */
define([
  // Configuration is a dependency
  'configuration',
  'backbone'
], function (config) {

  /**
   * The Metric model class definition
   * Used for CRUD operations against individual Metric
   */
  var Metric = Backbone.Model.extend({
    idAttribute: "show"
  });

  return Metric;

});
```

We've specified the `show` property as the `idAttribute` for the model. This is necessary since every resource in the collection is uniquely identified by the `show` property in the representation. Also note that the Backbone model does not define a `urlRoot` property unlike other Backbone models. The representation for an individual metric resource cannot be obtained by navigating to `/metrics/X`, but the metrics for all shows can be obtained by navigating to `/metrics`.

47.2 The Metrics collection

We now define a Backbone collection for handling the metrics collection:

src/main/webapp/resources/js/app/collections/metrics.js

```
/**
 * The module for a collection of Metrics
 */
define([
  'app/models/metric',
  'configuration',
  'backbone'
], function (Metric, config) {

  // Here we define the Metrics collection
  // We will use it for CRUD operations on Metrics

  var Metrics = Backbone.Collection.extend({
    url: config.baseUrl + 'rest/metrics',
    model: Metric
  });

  return Metrics;
});
```

We have thus mapped the collection to the MetricsService REST resource, so we can perform CRUD operations against this resource. In practice however, we'll need to only query this resource.

47.3 The MetricsView view

Now that we have the model and the collection, let's create the view to display the metrics:

src/main/webapp/resources/js/app/views/desktop/metrics.js

```
define([
  'backbone',
  'configuration',
  'utilities',
  'text!../../../../templates/desktop/metrics.html'
], function (
  Backbone,
  config,
  utilities,
  metricsTemplate) {

  var MetricsView = Backbone.View.extend({
    intervalDuration : 3000,
    initialize : function() {
      _.bind(this.render, this);
      _.bind(this.liveUpdate, this);
      this.collection.on("add remove change", this.render, this);
      var self = this;
      $.when(this.collection.fetch())
        .done(function() {
          self.liveUpdate();
        });
    },
    liveUpdate : function() {
      this.collection.fetch();
      var self = this;
      this.timerObject = setTimeout(function() {
        self.liveUpdate();
      }, this.intervalDuration);
    },
  },
```

```

    render : function () {
        utilities.applyTemplate($(this.el), metricsTemplate,
        {collection:this.collection});
        return this;
    },
    onClose : function() {
        if(this.timerObject) {
            clearTimeout(this.timerObject);
            delete this.timerObject;
        }
    }
});

return MetricsView;
});

```

Like other Backbone views, the view is attached to a DOM element (the `el` property). When the render method is invoked, it manipulates the DOM and renders the view. The `metricsTemplate` template is used to structure the HTML, thus separating the HTML view code from the view implementation.

The render method is invoked whenever the underlying collection is modified. The view is associated with a timer that is executed repeatedly with a predetermined interval of 3 seconds. When the timer is triggered, it fetches the updated state of the collection (the metrics) from the server. Any change in the collection at this point, now triggers a refresh of the view as pointed out earlier.

When the view is closed/destroyed, the associated timer if present is cleared.

src/main/webapp/resources/templates/desktop/metrics.html

```

<div class="span7">
  <h3 class="page-header light-font special-title">Booking status</h3>
  <div id="status-content">
    <%
    _.each(collection.models, function (show) {
    %>
    <div class="show-status">
      <div class="show-status-header"><%=show.get('event')%> @ <%=show.get('venue')%></div>
      <%.each(show.get('performances'), function (performance) {%>
      <div class="performance-status">
        <div class="pull-left"><%=new Date(performance.date).toLocaleString()%></div>
        <div class="pull-left performance-status-progress progress progress-success">
          <div style="width:
          <%= (performance.occupiedCount) / (show.get('capacity')) * 100%>%;" class="bar"></div>
          </div>
          <div><%=performance.occupiedCount%> of <%=show.get('capacity')%> tickets
          booked</div>
        </div>
      <% }); %>
    </div>
    <% }); %>
  </div>
</div>

```

The HTML for the view groups the metrics by show. Every performance associated with the show is displayed in this group, with the occupied count used to populate a Bootstrap progress bar. The width of the bar is computed with the occupied count for the performance and the capacity for the show (i.e. capacity for the venue hosting the show).

Chapter 48

Displaying the Bot interface

48.1 The Bot model

We'll define a plain JavaScript object to represent the Bot on the client-side. Recalling the earlier discussion, the Bot service at the server is not a RESTful service. Since it cannot be identified uniquely, it would require a few bypasses in a Backbone model (like overriding the `url` property) to communicate correctly with the service. Additionally, obtaining the Bot's log messages would require using jQuery since the log messages also cannot be represented cleanly as a REST resource. Given all these factors, it would make sense to use a plain JavaScript object to represent the Bot model.

src/main/webapp/resources/js/app/models/bot.js

```
/**
 * Module for the Bot model
 */
define([
  'jquery',
  'configuration',
], function ($, config) {

  /**
   * The Bot model class definition
   * Used perform operations on the Bot.
   * Note that this is not a Backbone model.
   */
  var Bot = function() {
    this.statusUrl = config.baseUrl + 'rest/bot/status';
    this.messagesUrl = config.baseUrl + 'rest/bot/messages';
  }

  /**
   * Start the Bot by sending a request to the Bot resource
   * with the new status of the Bot set to "RUNNING".
   */
  Bot.prototype.start = function() {
    $.ajax({
      type: "PUT",
      url: this.statusUrl,
      data: "\"RUNNING\"",
      dataType: "json",
      contentType: "application/json"
    });
  }

  /**
```



```

    * Stop the Bot by sending a request to the Bot resource
    * with the new status of the Bot set to "NOT_RUNNING".
    */
    Bot.prototype.stop = function() {
        $.ajax({
            type: "PUT",
            url: this.statusUrl,
            data: "\"NOT_RUNNING\"",
            dataType: "json",
            contentType: "application/json"
        });
    }

    /*
    * Stop the Bot and delete all bookings by sending a request to the Bot resource
    * with the new status of the Bot set to "RESET".
    */
    Bot.prototype.reset = function() {
        $.ajax({
            type: "PUT",
            url: this.statusUrl,
            data: "\"RESET\"",
            dataType: "json",
            contentType: "application/json"
        });
    }

    /*
    * Fetch the log messages of the Bot and invoke the callback.
    * The callback is provided with the log messages (an array of Strings).
    */
    Bot.prototype.fetchMessages = function(callback) {
        $.get(this.messagesUrl, function(data) {
            if(callback) {
                callback(data);
            }
        });
    }

    return Bot;
});

```

The start, stop and rest methods issue HTTP requests to the Bot service at the `rest/bot/status` URL with jQuery. The `fetchMessages` method issues a HTTP request to the Bot service at the `rest/bot/messages` URL with jQuery; it accepts a callback method as a parameter and invokes the callback once it receives a response from the server.

48.2 The BotView view

Now that we have the model, let's create the view to control the Bot:

src/main/webapp/resources/js/app/views/desktop/bot.js

```

define([
    'jquery',
    'underscore',
    'backbone',
    'configuration',
    'utilities',
    'text!../../../../templates/desktop/bot.html'

```

```
], function (
  $,
  _,
  Backbone,
  config,
  utilities,
  botTemplate) {

  var BotView = Backbone.View.extend({
    intervalDuration : 3000,
    initialize : function() {
      _.bind(this.liveUpdate, this);
      _.bind(this.startBot, this);
      _.bind(this.stopBot, this);
      _.bind(this.resetBot, this);
      utilities.applyTemplate($(this.el), botTemplate, {});
      this.liveUpdate();
    },
    events: {
      "click #start-bot" : "startBot",
      "click #stop-bot" : "stopBot",
      "click #reset" : "resetBot"
    },
    liveUpdate : function() {
      this.model.fetchMessages(this.renderMessages);
      var self = this;
      this.timerObject = setTimeout(function() {
        self.liveUpdate();
      }, this.intervalDuration);
    },
    renderMessages : function(data) {
      var displayMessages = data.reverse();
      var botLog = $("textarea").get(0);
      // The botLog textarea element may have been removed if the user navigated to a
      different view
      if(botLog) {
        botLog.value = displayMessages.join("");
      }
    },
    onClose : function() {
      if(this.timerObject) {
        clearTimeout(this.timerObject);
        delete this.timerObject;
      }
    },
    startBot : function() {
      this.model.start();
      // Refresh the log immediately without waiting for the live update to trigger.
      this.model.fetchMessages(this.renderMessages);
    },
    stopBot : function() {
      this.model.stop();
      // Refresh the log immediately without waiting for the live update to trigger.
      this.model.fetchMessages(this.renderMessages);
    },
    resetBot : function() {
      this.model.reset();
      // Refresh the log immediately without waiting for the live update to trigger.
      this.model.fetchMessages(this.renderMessages);
    }
  });
});
```

```
    return BotView;  
  });
```

This view is similar to other Backbone views in most aspects, except for a few. When the view is initialized, it manipulates the DOM and renders the view; this is unlike other views that are not rendered on initialization. The `botTemplate` template is used to structure the HTML. An interval timer with a pre-determined duration of 3 seconds is also created when the view is initialized. When the view is closed/destroyed, the timer if present is cleared out.

When the timer is triggered, it fetches the Bot's log messages. The `renderMessages` method is provided as the callback to the `fetchMessages` invocation. The `renderMessages` callback method is provided with the log messages from the server, and it proceeds to update a textarea with these messages.

The `startBot`, `stopBot` and `resetBot` event handlers are setup to handle click events on the associated buttons in the view. They merely delegate to the model to perform the actual operations.

src/main/webapp/resources/templates/desktop/bot.html

```
<div class="span5">  
  <h3 class="page-header light-font special-title">Bot</h3>  
  <div id="bot-content">  
    <div class="btn-group">  
      <button id="start-bot" type="button" class="btn btn-danger" title="Start the bot">Start  
bot</button>  
      <button id="stop-bot" type="button" class="btn btn-danger">Stop bot</button>  
      <button id="reset" type="button" class="btn btn-danger" title="Delete all bookings  
(stops the bot first)">Delete all bookings</button>  
    </div>  
    <div class="bot-console">  
      <div class="bot-label">Bot Log</div>  
      <textarea style="width: 400px; height: 300px;" readonly=""></textarea>  
    </div>  
  </div>  
</div>
```

The HTML for the view creates a button group for the actions possible on the Bot. It also carries a text area for displaying the Bot's log messages.

Chapter 49

Creating the dashboard

Now that we have the constituent views for the dashboard, let's wire it up into the application.

49.1 Creating a composite Monitor view

Let's create a composite Backbone view to hold the MetricsView and BotView as it's constituent sub-views.

src/main/webapp/resources/js/app/router/desktop/router.js

```
define([
  'backbone',
  'configuration',
  'utilities',
  'app/models/bot',
  'app/collections/metrics',
  'app/views/desktop/bot',
  'app/views/desktop/metrics',
  'text!../../templates/desktop/monitor.html'
], function (
  Backbone,
  config,
  utilities,
  Bot,
  Metrics,
  BotView,
  MetricsView,
  monitorTemplate) {

  var MonitorView = Backbone.View.extend({
    render : function () {
      utilities.applyTemplate($(this.el), monitorTemplate, {});
      var metrics = new Metrics();
      this.metricsView = new MetricsView({collection:metrics, el:$("#metrics-view")});
      var bot = new Bot();
      this.botView = new BotView({model:bot,el:$("#bot-view")});
      return this;
    },
    onClose : function() {
      if(this.botView) {
        this.botView.close();
      }
      if(this.metricsView) {
        this.metricsView.close();
      }
    }
  });
```

```
    }  
  });  
  
  return MonitorView;  
});
```

The render method of this Backbone view creates the two sub-views and renders them. It also initializes the necessary models and collections required by the sub-views. All other aspects of the view like event handling and updates to the DOM are handled by the sub-views. When the composite view is destroyed, it also closes the sub-views gracefully.

The HTML template used by the composite just lays out a structure for the sub-views to control two distinct areas of the DOM - a div with id `metrics-view` for displaying the metrics, and another div with id `bot-view` to control the bot:

src/main/webapp/resources/templates/desktop/monitor.html

```
<div class="container-fluid">  
  <div class="row">  
    <div id="metrics-view" class="span7"></div>  
    <div id="bot-view" class="span5"></div>  
  </div>  
</div>
```

49.2 Configure the router

Finally, let us wire up the router to display the monitor when the user navigates to the `monitor` route in the Backbone application:

src/main/webapp/resources/js/app/router/desktop/router.js

```
define("router", [  
  ...  
  'app/views/desktop/monitor',  
  ...  
], function (...  
  MonitorView,  
  ...) {  
  
  ...  
  
  var Router = Backbone.Router.extend({  
    ...  
    routes : {  
      ...  
      "monitor": "displayMonitor"  
    },  
    ...  
    displayMonitor: function() {  
      var monitorView = new MonitorView({el: $("#content")});  
      utilities.viewManager.showView(monitorView);  
    },  
  });
```

With this configuration, the user can now navigate to the monitor section of the application, where the metrics and the bot controls would be displayed. The underlying sub-views would poll against the server to update themselves in near real-time offering a dashboard solution to TicketMonster.

Part VIII

Creating hybrid mobile versions of the application with Apache Cordova

Chapter 50

What will you learn here?

You finished creating the front-end for your application, and it has mobile support. You would now like to provide native client applications that your users can download from an application store. After reading this tutorial, you will understand how to reuse the existing HTML5 code for create native mobile clients for each target platform with Apache Cordova.

You will learn how to:

- make changes to an existing web application to allow it to be deployed as a hybrid mobile application;
 - create a native application for Android with Apache Cordova;
 - create a native application for iOS with Apache Cordova;
-

Chapter 51

What are hybrid mobile applications?

Hybrid mobile applications are developed in HTML5 - unlike native applications that are compiled to platform-specific binaries. The client code - which consists exclusively of HTML, CSS, and JavaScript - is packaged and installed on the client device just as any native application, and executes in a browser process created by a surrounding native shell.

Besides wrapping the browser process, the native shell also allows access to native device capabilities, such as the accelerometer, GPS, contact list, etc., made available to the application through JavaScript libraries.

In this example, we use Apache Cordova to implement a hybrid application using the existing HTML5 mobile front-end for TicketMonster, interacting with the RESTful services of a TicketMonster deployment running on JBoss A7 or JBoss EAP.

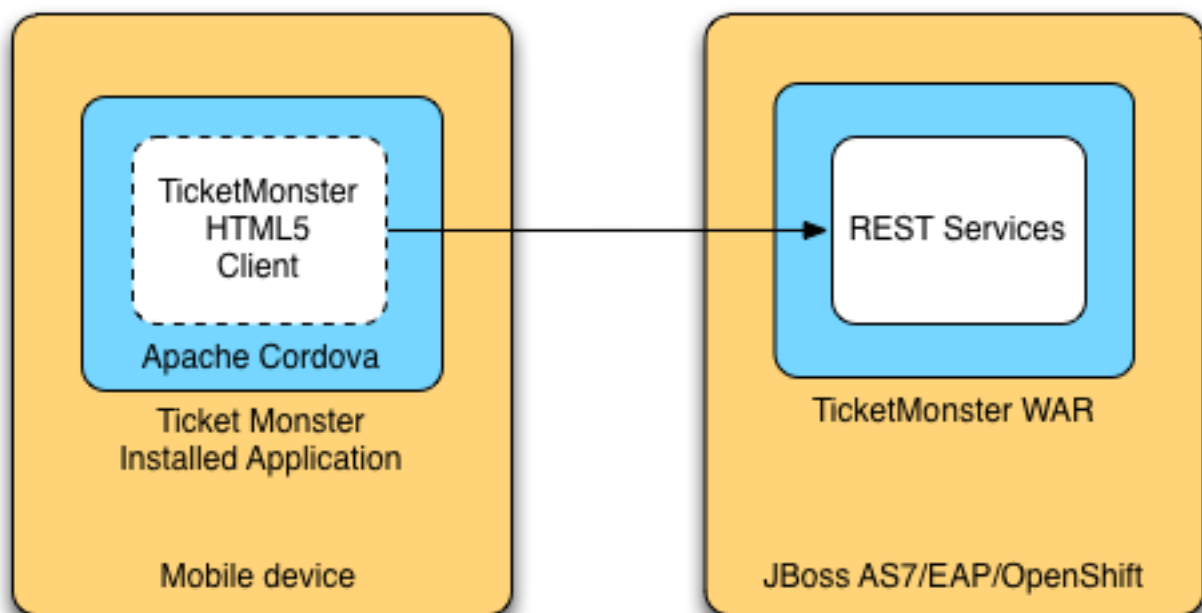


Figure 51.1: Architecture of hybrid TicketMonster

Chapter 52

Tweak your application for remote access

Before we make the application hybrid, we need to make some changes in the way in which it accesses remote services. Note that the changes have already been implemented in the user front end, here we show you the code that we needed to modify.

In the web version of the application the client code is deployed together with the server-side code, so the models and collections (and generally any piece of code that will perform REST service invocations) can use URLs relative to the root of the application: all resources are serviced from the same server, so the browser will do the correct invocation. This also respects the same origin policy enforced by default by browsers, to prevent cross-site scripting attacks.

If the client code is deployed separately from the services, the REST invocations must use absolute URLs (we will cover the impact on the same-origin policy later). Furthermore, since we want to be able to deploy the application to different hosts without rebuilding the source, it must be configurable.

You already caught a glimpse of this in the user front end chapter, where we defined the `configuration` module for the mobile version of the application.

src/main/webapp/resources/js/configurations/mobile.js

```
...
define("configuration", function() {
    if (window.TicketMonster != undefined && TicketMonster.config != undefined) {
        return {
            baseUrl: TicketMonster.config.baseRESTUrl
        };
    } else {
        return {
            baseUrl: ""
        }
    }
})
...
```

This module has a `baseUrl` property that is either set to an empty string for relative URLs or to a prefix, such as a domain name, depending on whether a global variable named `TicketMonster` has already been defined, and it has a `baseRESTUrl` property.

All our code that performs REST services invocations depends on this module, thus the base REST URL can be configured in a single place and injected throughout the code, as in the following code example:

src/main/webapp/resources/js/app/models/event.js

```
/**
 * Module for the Event model
 */
define([
    'configuration',
    'backbone'
```

```
], function (config) {  
  /**  
   * The Event model class definition  
   * Used for CRUD operations against individual events  
   */  
  var Event = Backbone.Model.extend({  
    urlRoot: config.baseUrl + 'rest/events' // the URL for performing CRUD operations  
  });  
  // export the Event class  
  return Event;  
});
```

The prefix is used in a similar fashion by all the other modules that perform REST service invocations. You don't need to do anything right now, because the code we created in the user front end tutorial was written like this originally. Be warned, if you have a mobile web application that uses any relative URLs, you will need to refactor them to include some form of URL configuration.

Chapter 53

Downloading Apache Cordova

The next step is downloading and installing Apache Cordova. Download the distribution from <http://phonegap.com/download> and unzip it.

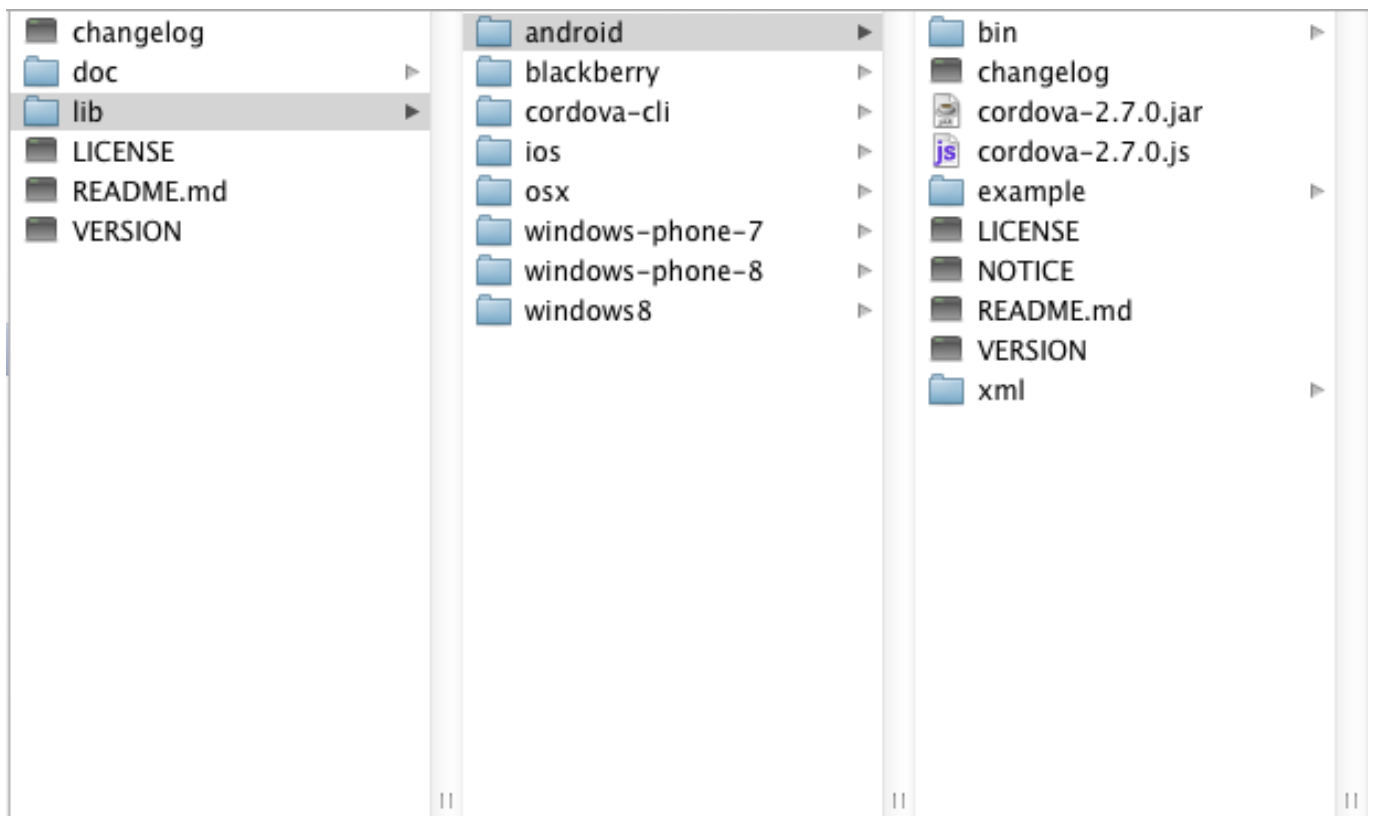


Figure 53.1: Apache Cordova distribution

While migrating TicketMonster, we will work with the files in the `lib` directory. They contain native libraries for each of the supported platforms, as well JavaScript libraries. We have highlighted the contents of the `android` folder. The folders for the other platforms have similar content.

Chapter 54

Creating an Android hybrid mobile application

What do you need for Android?

For building the Android version of the application you need to install the Android Developer Tools, which require an Eclipse instance (3.6.2 or later), and can run on Windows (XP, Vista, 7), Mac OS X (10.5.8 or later), Linux (with GNU C Library - glibc 2.7 or later, 64-bit distributions having installed the libraries for running 32-bit applications).

54.1 Creating an Android project using Apache Cordova

First, we will create an Android project in JBDS. The prerequisites for that are having the Android SDK installed locally, as well as the Android (ADT) plugin for Eclipse installed in JBDS.

For the former, download the Android SDK from <http://developer.android.com/sdk/index.html> and unzip it in a directory of your choice, remembering its location.

For the latter, select *Help* → *Install New Software* from the menu, using the URL <https://dl-ssl.google.com/android/ecl> and selecting the **Developer Tools** option. Restart Eclipse.

Now we can create a new Android project.

1. Select *File* → *New* → *Other* and selecting *Android Application Project*.
2. Enter the project information: application name, project name, package.

Application Name

TicketMonster

Project Name

TicketMonster

package

org.jboss.jdf.ticketmonster.android

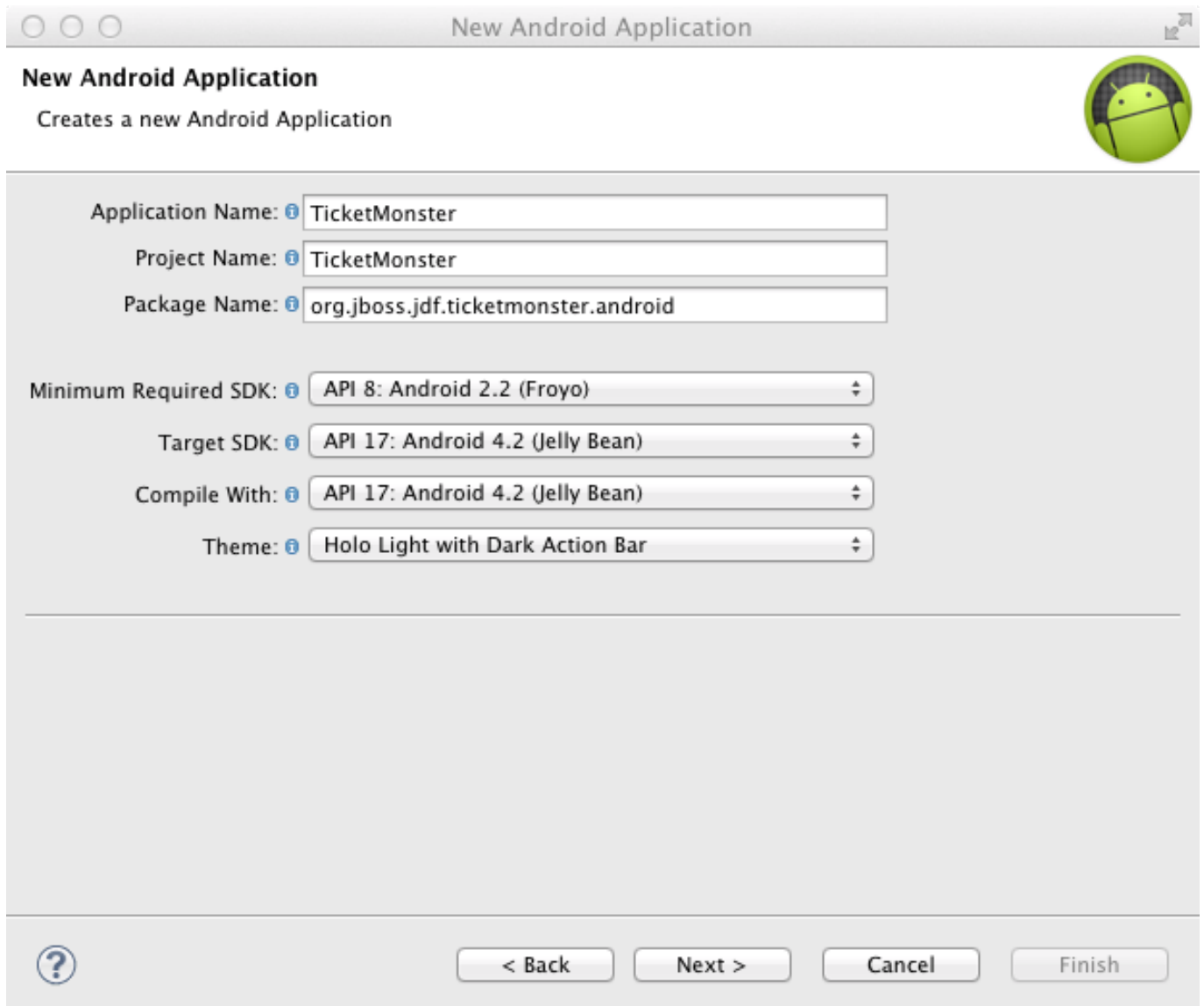


Figure 54.1: Entering the application name, project name and package

3. Select default values for the next couple of screens (*Configure New Project, Launcher icon*).
4. Select `BlankActivity` as the activity type.

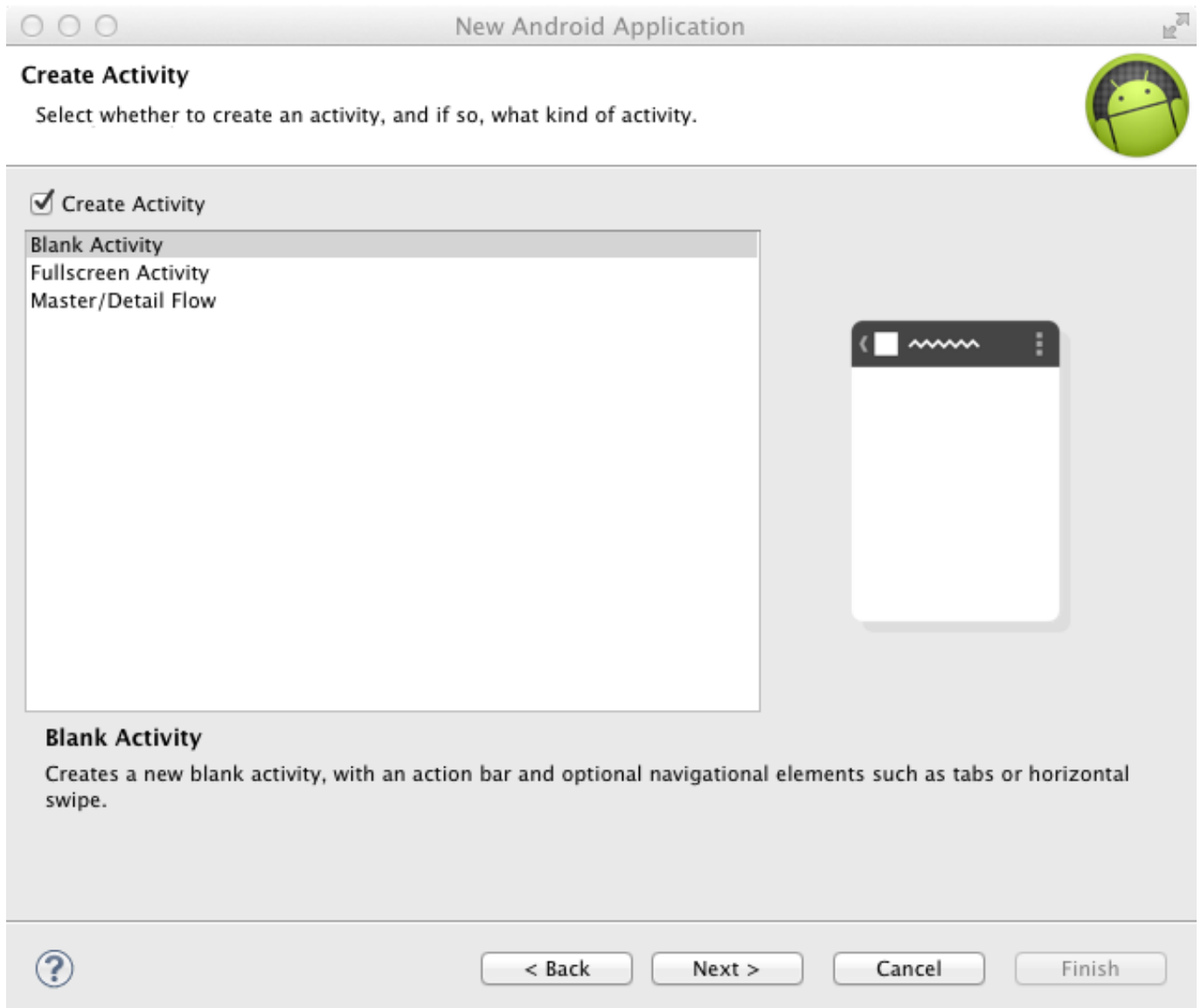


Figure 54.2: Select activity type

5. Name the newly created activity `TicketMonsterActivity`.

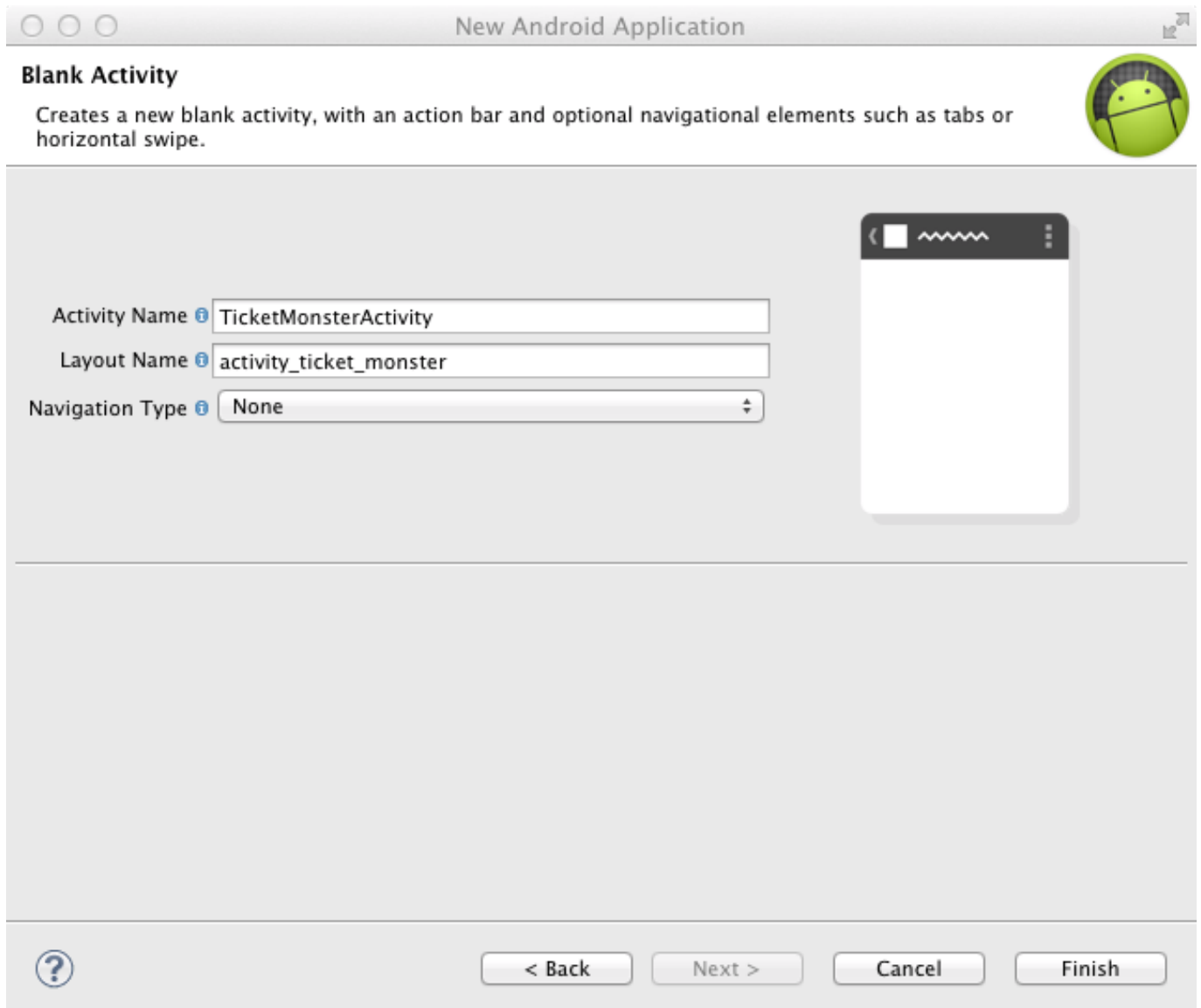


Figure 54.3: Name the new activity

A final step involves adding the Apache Cordova library to the project. Copy the `lib/android/cordova-2.7.0.jar` file from the Cordova distribution into the `libs` folder of the project.

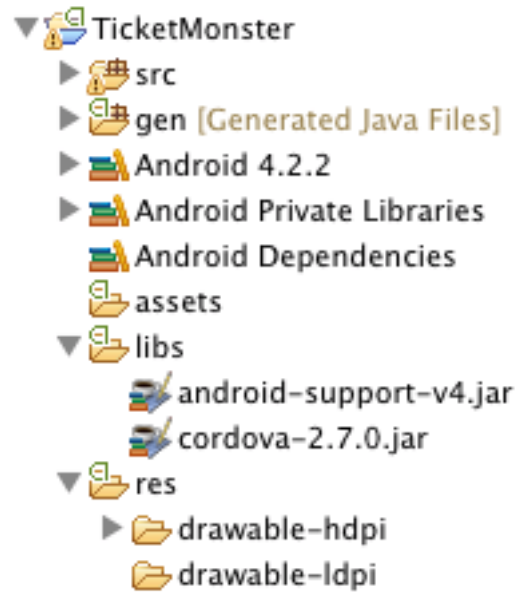


Figure 54.4: Add the Cordova jar

Once you have finished creating the project, navigate to the `assets` directory. Now we need to create a `www` directory, that will contain the HTML5 code of the application. Since we are reusing the TicketMonster code you can simply create a symbolic link to the `webapp` directory of TicketMonster. Alternatively, you can copy the code of TicketMonster and make all necessary changes there (however, in that case you will have to maintain the code of the application).

```
$ ln -s $TICKET_MONSTER_HOME/demo/src/main/webapp www
```

Inside the Android project, modify permissions and additional configurations to `AndroidManifest.xml` to look as follows

AndroidManifest.xml

```
<manifest xmlns:android="http://schemas.android.com/apk/res/android"
    package="org.jboss.jdf.ticketmonster.android"
    android:versionCode="1"
    android:versionName="1.0" >

    <uses-sdk
        android:minSdkVersion="8"
        android:targetSdkVersion="17" />

    <supports-screens
        android:anyDensity="true"
        android:largeScreens="true"
        android:normalScreens="true"
        android:resizeable="true"
        android:smallScreens="true" />

    <uses-permission android:name="android.permission.VIBRATE" />
    <uses-permission android:name="android.permission.ACCESS_COARSE_LOCATION" />
    <uses-permission android:name="android.permission.ACCESS_FINE_LOCATION" />
    <uses-permission android:name="android.permission.ACCESS_LOCATION_EXTRA_COMMANDS" />
    <uses-permission android:name="android.permission.READ_PHONE_STATE" />
    <uses-permission android:name="android.permission.INTERNET" />
    <uses-permission android:name="android.permission.RECEIVE_SMS" />
    <uses-permission android:name="android.permission.RECORD_AUDIO" />
    <uses-permission android:name="android.permission.MODIFY_AUDIO_SETTINGS" />
    <uses-permission android:name="android.permission.READ_CONTACTS" />
```



```
<uses-permission android:name="android.permission.WRITE_CONTACTS" />
<uses-permission android:name="android.permission.WRITE_EXTERNAL_STORAGE" />
<uses-permission android:name="android.permission.ACCESS_NETWORK_STATE" />
<uses-permission android:name="android.permission.GET_ACCOUNTS" />
<uses-permission android:name="android.permission.BROADCAST_STICKY" />

<application
    android:icon="@drawable/ic_launcher"
    android:label="@string/app_name"
    android:theme="@style/AppTheme"
    android:configChanges="orientation|keyboardHidden|keyboard|screenSize|locale">
    <activity
        android:name=".TicketMonsterActivity"
        android:label="@string/title_activity_ticket_monster" >
        <intent-filter>
            <action android:name="android.intent.action.MAIN" />

            <category android:name="android.intent.category.LAUNCHER" />
        </intent-filter>
    </activity>
</application>

</manifest>
```

We also need to copy the `xml` directory containing the Cordova project configuration file - `config.xml`, from the Cordova distribution to the `res` directory of the project.

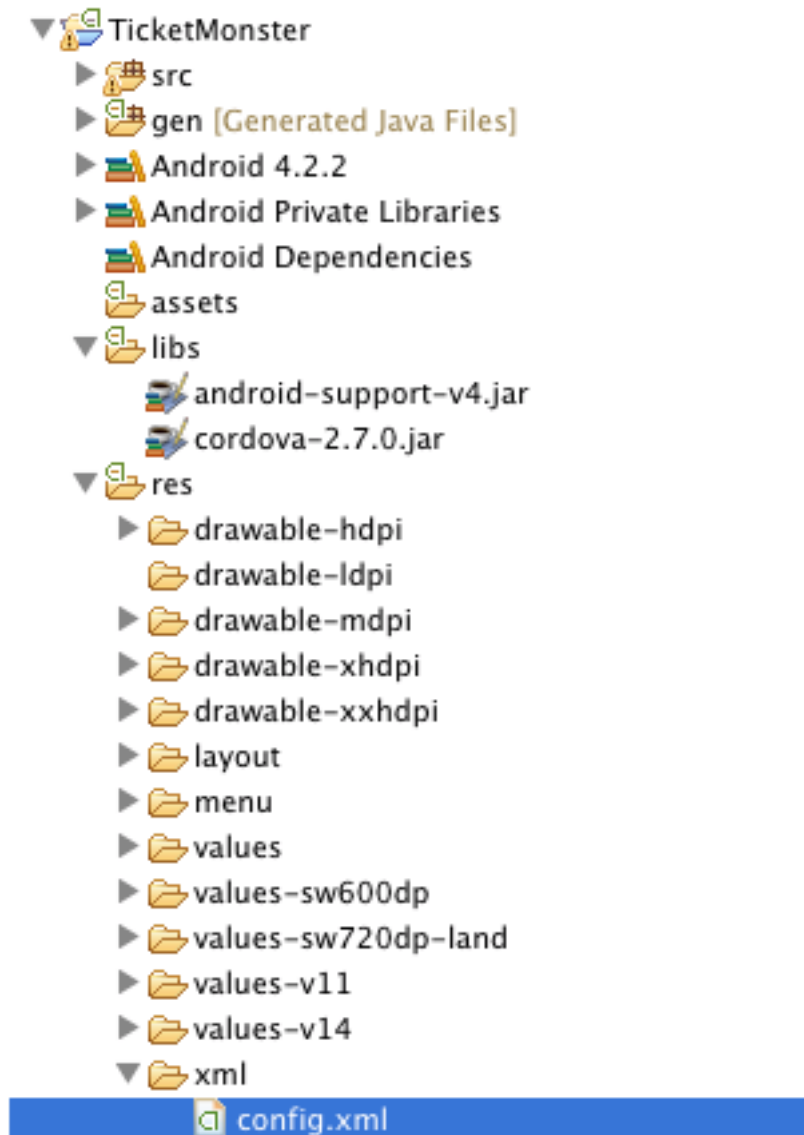


Figure 54.5: Add the Cordova project configuration file

We will add our REST service URL to the domain whitelist in the config.xml file (you can use "*" too, for simplicity, during development) :

res/xml/config.xml

```
<?xml version="1.0" encoding="utf-8"?>
<cordova>

    ...

    <!--
    access elements control the Android whitelist.
    Domains are assumed blocked unless set otherwise
    -->

    <access origin="http://localhost"/> <!-- allow local pages -->
    <access origin="http://ticketmonster-jdf.rhcloud.com"/>

    ...
</cordova>
```

```
</cordova>
```

Finally, we will update the Android `TicketMonsterActivity` class, the entry point of our Android application.

src/org/jboss/jdf/ticketmonster/android/TicketMonsterActivity.java

```
package org.jboss.jdf.ticketmonster.android;

import org.apache.cordova.DroidGap;

import android.os.Bundle;
import android.webkit.WebSettings;

public class TicketMonsterActivity extends DroidGap {

    @Override
    public void onCreate(Bundle savedInstanceState) {
        super.onCreate(savedInstanceState);
        super.loadUrl("file:///android_asset/www/index.html");
    }

    @Override
    public void init() {
        super.init();

        WebSettings settings = this.appView.getSettings();
        settings.setUserAgentString("TicketMonster Cordova Webview Android");
    }
}
```

Note how we customize the user agent information for the wrapped browser. This will allow us to identify that the application runs in Cordova, on an Android platform, which will be useful later on.

54.2 Adding Apache Cordova to TicketMonster

First, we will copy the Apache Cordova JavaScript library to the project. From the directory where you unzipped the distribution, copy the `lib\android\cordova-2.7.0.js` file to the `src/main/webapp/resources/js/libs` folder, renaming it to `cordova-android-2.7.0.js`, to avoid naming conflicts with other platforms (such as iOS which we will also implement as part of this tutorial).

Next, we need to load the library in the application. We will create a separate module, that will load the rest of the mobile application, as well as the Apache Cordova JavaScript library for Android. We also need to configure a base URL for the application. For this example, we will use the URL of the cloud deployment of TicketMonster.

src/main/webapp/resources/js/libs/hybrid-android.js

```
// override configuration for RESTful services
var TicketMonster = {
    config:{
        baseRESTUrl:"http://ticketmonster-jdf.rhcloud.com/"
    }
}

require(["resources/js/libs/cordova-android-2.7.0.js", "mobile"], function() {
});
```

The final step will involve adjusting `src/main/webapp/resources/js/configurations/loader.js` to load this module when running on Android, using the user agent setting we have already configured in the project.

src/main/webapp/resources/js/configurations/loader.js

```
//detect the appropriate module to load
define(function () {

    /*
     * A simple check on the client. For touch devices or small-resolution screens)
     * show the mobile client. By enabling the mobile client on a small-resolution screen
     * we allow for testing outside a mobile device (like for example the Mobile Browser
     * simulator in JBoss Tools and JBoss Developer Studio).
     */

    var environment;

    if (navigator.userAgent.indexOf("TicketMonster Cordova Webview Android") > -1) {
        environment = "hybrid-android"
    }
    else if (Modernizr.touch || Modernizr.mq("only all and (max-width: 480px)")) {
        environment = "mobile"
    } else {
        environment = "desktop"
    }

    require([environment]);
});
```

Now you are ready to run the application. Right-click on project *Run as*→*Android Application*.

Chapter 55

Creating an iOS hybrid mobile application

In order to create the iOS hybrid mobile version of the application make you sure you have the following software installed:

- Xcode 4.5+
- XCode Command Line Tools

You need a Mac OS X for this

Creating the iOS hybrid mobile version of the application requires a system running Mac OS X Lion or later (10.7+), mainly for running Xcode.

Also, we assume that you have installed and extracted Apache Cordova already as described in a previous section.

55.1 Creating an iOS project using Apache Cordova

First, we need to create an iOS project. In order to do so we run the `create` command, to be found in the `lib/ios/bin` of your Apache Cordova distribution. Run the command with the following parameters:

```
$ $LIB_IOS_BIN/create $TICKET_MONSTER_HOME/cordova/ios org.jboss.ticketmonster.cordova.ios
TicketMonster
```

For the purpose of this tutorial, we assume that the *cordova* directory which is the parent of the *ios* directory where the project is created, is at the same level as the directory where the original project exists.

Note

The `create` script for Cordova/iOS will create a `www` sub-directory in the *ios* directory. This `www` sub-directory will need to be deleted since we're sharing the sources from the TicketMonster project.

Delete the `www` sub-directory under the TicketMonster, since we will not be using the underlying sources

```
$ rm -rf $TICKET_MONSTER_HOME/cordova/ios/www
```

We then create a symbolic link inside the *ios* directory to the original TicketMonster project, with the name `www`.

```
$ ln -s $TICKET_MONSTER_HOME/demo/src/main/webapp www
```

Now we open the created project in Xcode.

Just as in the case of the Android application, we customize the user agent information that gets passed on to the browser. We will use this information to load the proper JavaScript library. So we will adjust the `initialize` method in the generated code to that effect.

Classes/AppDelegate.m

```
...  
  
+ (void)initialize {  
    // Set user agent  
    NSDictionary *dictionary = [[NSDictionary alloc]  
                               initWithObjectsAndKeys:@"TicketMonster Cordova Webview iOS",  
    @"UserAgent", nil];  
    [[NSUserDefaults standardUserDefaults] registerDefaults:dictionary];  
    [dictionary release];  
}  
  
...
```

The Cordova library for iOS is already included in the generated project.

55.2 Adding Apache Cordova for iOS to TicketMonster

First, we copy the Apache Cordova JavaScript library to the project. From the directory where you unzipped the distribution, copy the `lib\ios\CordovaLib\cordova.ios.js` file to the `src/main/webapp/resources/js/libs` folder, renaming it to `cordova-ios-2.7.0.js`, to avoid naming conflicts with other platforms (such as Android which we already implemented as part of this tutorial).

Next, we need to load the library in the application. We will create a separate module, that will load the rest of the mobile application, as well as the Apache Cordova JavaScript library for iOS. We also need to configure a base URL for the application. For this example, we will use the URL of the cloud deployment of TicketMonster.

Note

The `cordova.io.js` is typically present as `cordova-2.7.0.js` in Cordova/iOS projects. The aforementioned Cordova create script renames the file during project creation to `cordova-2.7.0.js`. This is why we propose renaming it to avoid potential conflicts.

src/main/webapp/resources/js/libs/hybrid-ios.js

```
// override configuration for RESTful services  
var TicketMonster = {  
    config:{  
        baseRESTUrl:"http://ticketmonster-jdf.rhcloud.com/"  
    }  
}  
  
require (["resources/js/libs/cordova-ios-2.7.0.js","mobile"], function() {  
  
});
```

Finally, we once again edit the JavaScript loader module to add support for iOS.

src/main/webapp/resources/js/configurations/loader.js

```
//detect the appropriate module to load  
define(function () {
```

```
/*
  A simple check on the client. For touch devices or small-resolution screens)
  show the mobile client. By enabling the mobile client on a small-resolution screen
  we allow for testing outside a mobile device (like for example the Mobile Browser
  simulator in JBoss Tools and JBoss Developer Studio).
*/

var environment;

if (navigator.userAgent.indexOf("TicketMonster Cordova Webview iOS") > -1) {
  environment = "hybrid-ios"
}
else if (navigator.userAgent.indexOf("TicketMonster Cordova Webview Android") > -1) {
  environment = "hybrid-android"
}
else if (Modernizr.touch || Modernizr.mq("only all and (max-width: 480px)")) {
  environment = "mobile"
} else {
  environment = "desktop"
}

require([environment]);
});
```

Now you are ready to run the application. Select a simulator and run (Cmd-R).

Chapter 56

Conclusion

This concludes our tutorial for building a hybrid application with Apache Cordova. You have seen how we have turned a working HTML5 web application into one that can run natively on Android and iOS.

For more details, as well as an example of deploying to a physical device, consult the [Aerogear tutorial on the same topic](#).

Part IX

Adding a data grid

Chapter 57

What Will You Learn Here?

You've just finished implementing TicketMonster, and are wondering how can you improve its concurrency and scalability. One possible solution is to reconsider the storage strategy and use a data grid, at least for a part of your application data. In this tutorial, you will learn how to:

- Add JBoss Data Grid to your web application;
 - Configure caches programmatically;
 - Use caches to implement scalable server-side stateful components such as shopping carts;
 - Use caches to implement a highly-concurrent data access mechanism for seat allocations.
-

Chapter 58

The problem at hand

When it comes to performance, TicketMonster has a few special requirements:

High concurrency

tickets will sell out very fast, maybe in 5 minutes;

High volume

there may be thousands of shows with thousands of tickets to sell, each;

Location awareness

shows can take place all around the world, and we'd like the data to be available in the same region where the show takes place.

So far, in the tutorial we have used exclusively a database. While it works as an initial implementation, we plan to address the concerns above with a better-suited solution. We will do this by adding Infinispan to our project, thus addressing the above concerns as follows:

High concurrency

In-memory data access and optimized locking;

High volume

The application can handle increasingly large data amounts by adding new data grid nodes;

Location awareness

A multi-node data grid can be configured so that data is stored on specific nodes.

What is a data grid? What is Infinispan?

A data grid is a cluster of (typically commodity) servers, normally residing on a single local-area network, connected to each other using IP based networking. Data grids behave as a single resource, exposing the aggregate storage capacity of all servers in the cluster. Data stored in the grid is usually partitioned, using a variety of techniques, to balance load across all servers in the cluster as evenly as possible. Data is often redundantly stored in the grid to provide resilience to individual servers in the grid failing i.e. more than one copy is stored in the grid, transparently to the application.

Infinispan is an extremely scalable, highly available key/value NoSQL datastore and distributed data grid platform - 100% open source, and written in Java. The purpose of Infinispan is to expose a data structure that is highly concurrent, designed ground-up to make the most of modern multi-processor/multi-core architectures while at the same time providing distributed cache capabilities.

[link](#)

Chapter 59

Adding Infinispan

First, you need to decide how you will use Infinispan in the project. You can opt between two access patterns:

Library

The data grid nodes are embedded in the application. In this case, we need to add the core data grid libraries as a dependency to the project.

Remote client-server

The data grid nodes are started separately and accessed through a client library. Only the client library is added as a dependency.

For TicketMonster, we will use the library access pattern, as in this particular case we can benefit from the simpler setup. For a more detailed description of the pros and cons of each access pattern, you can read a more detailed explanation in [the product documentation](#). In any case, switching from one mode to the other is non-intrusive, the only major difference being the infrastructure setup.

Next, we will begin by adding the JBoss Developer Framework Bill of Materials (BOM) that describes the correct version for the Infinispan artifacts.

pom.xml

```
<project ...>
  ...
  <dependencyManagement>
    <dependencies>
      ...
      <dependency>
        <groupId>org.jboss.bom</groupId>
        <artifactId>jboss-javaee-6.0-with-infinispan</artifactId>
        <version>${jboss.bom.version}</version>
        <type>pom</type>
        <scope>import</scope>
      </dependency>
    </dependencies>
  </dependencyManagement>
</project>
```

Next, we will add the `infinispan-core` library to the project.

Next, we will include the Infinispan library in the project.

pom.xml

```
<project ...>
  ...
  <dependencies>
```

```
<!-- This is the dependency for Infinispan, which we use for carts and
      seat reservation
-->
<dependency>
  <groupId>org.infinispan</groupId>
  <artifactId>infinispan-core</artifactId>
</dependency>
</dependencies>
...
</project>
```

Chapter 60

Configuring the infrastructure

First, we will create a producer and disposer for the Infinispan cache manager, where we define the global cache configuration and set up default options for the caches used in the application. The cache manager is unique for the application and to the data grid node, so we will create it as an application scoped bean.

src/main/org/jboss/jdf/example/ticketmonster/util/CacheProducer.java

```
/**
 * Producer for the {@link EmbeddedCacheManager} instance used by the application. Defines
 * the default configuration for caches.
 */
@ApplicationScoped
public class CacheProducer {

    @Inject @DataDir
    private String dataDir;

    @Produces
    @ApplicationScoped
    public EmbeddedCacheManager getCacheContainer() {
        GlobalConfiguration glob = new GlobalConfigurationBuilder()
            .nonClusteredDefault() //Helper method that gets you a default constructed
            GlobalConfiguration, preconfigured for use in LOCAL mode
            .globalJmxStatistics().enable() //This method allows enables the jmx
            statistics of the global configuration.
            .build(); //Builds the GlobalConfiguration object
        ConfigurationBuilder loc = new ConfigurationBuilder()
            .jmxStatistics().enable() //Enable JMX statistics
            .clustering().cacheMode(CacheMode.LOCAL) //Set Cache mode to LOCAL - Data is
            not replicated.
            .transaction().transactionMode(TransactionMode.TRANSACTIONAL)
            .transactionManagerLookup(new GenericTransactionManagerLookup())
            .lockingMode(LockingMode.PESSIMISTIC)
            .locking().isolationLevel(IsolationLevel.REPEATABLE_READ) //Sets the
            isolation level of locking
            .eviction().maxEntries(4).strategy(EvictionStrategy.LIRS) //Sets 4 as
            maximum number of entries in a cache instance and uses the LIRS strategy - an efficient
            low inter-reference recency set replacement policy to improve buffer cache performance
            .loaders().passivation(false).addFileCacheStore().location(dataDir +
            File.separator + "TicketMonster-CacheStore").purgeOnStartup(true) //Disable passivation
            and adds a FileCacheStore that is Purged on Startup
            .build(); //Builds the Configuration object
        return new DefaultCacheManager(glob, loc, true);
    }
}
```

```
public void cleanUp(@Disposes EmbeddedCacheManager manager) {  
    manager.stop();  
}  
}
```

We will inject the cache manager instance in various services that use the data grid, which will use it in turn to get access to application caches.

Chapter 61

Using caches for seat reservations

First, we are going to change the existing implementation of the `SeatAllocationService` to use the Infinispan datagrid. Rather than storing the seat allocations in a database, we will store them as data grid entries.

This requires a few changes to our existing classes. If in the database implementation we used properties of the `SectionAllocation` class to identify the entity that corresponds to a given `Section` and `Performance`, for the datagrid implementation we will create a key class, making sure that its `equals()` and `hashCode()` methods are implemented correctly.

`src/main/java/org/jboss/jdf/example/ticketmonster/service/SectionAllocationKey.java`

```
public class SectionAllocationKey implements Serializable {

    private final Section section;
    private final Performance performance;

    private SectionAllocationKey(Section section, Performance performance) {

        this.section = section;
        this.performance = performance;
    }

    public static SectionAllocationKey of (Section section, Performance performance) {
        return new SectionAllocationKey(section, performance);
    }

    public Section getSection() {
        return section;
    }

    public Performance getPerformance() {
        return performance;
    }

    @Override
    public boolean equals(Object o) {
        if (this == o) return true;
        if (o == null || getClass() != o.getClass()) return false;

        SectionAllocationKey that = (SectionAllocationKey) o;

        if (performance != null ? !performance.equals(that.performance) : that.performance !=
            null) return false;
        if (section != null ? !section.equals(that.section) : that.section != null) return
            false;
    }
}
```



```

        return true;
    }

    @Override
    public int hashCode() {
        int result = section != null ? section.hashCode() : 0;
        result = 31 * result + (performance != null ? performance.hashCode() : 0);
        return result;
    }
}

```

Now we can proceed with modifying the `SeatAllocationService`. Since we are not persisting seat allocations in the database, we will remove the `EntityManager` reference and use a cache acquired from the cache manager. We inject the cache manager instance produced previously and create a `SeatAllocation`-specific cache in the constructor.

src/main/java/org/jboss/jdf/example/ticketmonster/service/SeatAllocationService.java

```

public class SeatAllocationService {

    public static final String ALLOCATIONS = "TICKETMONSTER_ALLOCATIONS";

    private Cache<SectionAllocationKey, SectionAllocation> cache;

    /**
     * We inject the {@link EmbeddedCacheManager} and retrieve a {@link Cache} instance.
     *
     * @param manager
     */
    @Inject
    public SeatAllocationService(EmbeddedCacheManager manager) {
        Configuration allocation = new ConfigurationBuilder()
            .transaction().transactionMode(TransactionMode.TRANSACTIONAL)
            .transactionManagerLookup(new JBossTransactionManagerLookup())
            .lockingMode(LockingMode.PESSIMISTIC)
            .loaders().addFileCacheStore().purgeOnStartup(true)
            .build();
        manager.defineConfiguration(ALLOCATIONS, allocation);
        this.cache = manager.getCache(ALLOCATIONS);
    }

    ....
}

```

Now, we can proceed with changing the implementation of the rest of the class.

src/main/java/org/jboss/jdf/example/ticketmonster/service/SeatAllocationService.java

```

public class SeatAllocationService {

    ....

    public AllocatedSeats allocateSeats(Section section, Performance performance,
                                       int seatCount, boolean contiguous) {
        SectionAllocationKey sectionAllocationKey = SectionAllocationKey.of(section,
performance);
        SectionAllocation allocation = getSectionAllocation(sectionAllocationKey);
        ArrayList<Seat> seats = allocation.allocateSeats(seatCount, contiguous);
        cache.replace(sectionAllocationKey, allocation);
        return new AllocatedSeats(allocation, seats);
    }

    public void deallocateSeats(Section section, Performance performance, List<Seat> seats) {

```

```

        SectionAllocationKey sectionAllocationKey = SectionAllocationKey.of(section,
performance);
        SectionAllocation sectionAllocation = getSectionAllocation(sectionAllocationKey);
        for (Seat seat : seats) {
            if (!seat.getSection().equals(section)) {
                throw new SeatAllocationException("All seats must be in the same section!");
            }
            sectionAllocation.deallocate(seat);
        }
        cache.replace(sectionAllocationKey, sectionAllocation);
    }

    /**
     * Mark the seats as being allocated
     * @param allocatedSeats
     */
    public void finalizeAllocation(AllocatedSeats allocatedSeats) {
        allocatedSeats.markOccupied();
    }

    /**
     * Mark the seats as being allocated
     * @param performance
     * @param allocatedSeats
     */
    public void finalizeAllocation(Performance performance, List<Seat> allocatedSeats) {
        SectionAllocation sectionAllocation = cache.get(
            SectionAllocationKey.of(allocatedSeats.get(0).getSection(), performance));
        sectionAllocation.markOccupied(allocatedSeats);
    }

    /**
     * Retrieve a {@link SectionAllocation} instance for a given {@link Performance} and
     * {@link Section} (embedded in the {@link SectionAllocationKey}). Lock it for the scope
     * of the current transaction.
     *
     * @param sectionAllocationKey - wrapper for a {@link Performance} and {@link Section}
     pair
     *
     * @return the corresponding {@link SectionAllocation}
     */
    private SectionAllocation getSectionAllocation(SectionAllocationKey
sectionAllocationKey) {
        SectionAllocation newAllocation = new
SectionAllocation(sectionAllocationKey.getPerformance(),
            sectionAllocationKey.getSection());
        SectionAllocation sectionAllocation = cache.putIfAbsent(sectionAllocationKey,
            newAllocation);
        cache.getAdvancedCache().lock(sectionAllocationKey);
        return sectionAllocation == null ? newAllocation : sectionAllocation;
    }
}

```

Chapter 62

Implementing carts

Once we have stored our allocation status in the data grid, we can move on to implementing a cart system for TicketMonster. Rather than composing the orders on the client and sending the entire order as a single requests, users will be able to add and remove seats to their orders while they're shopping.

We will store the carts in the datagrid, thus ensuring that they're accessible across the cluster, without the complications of using a web session.

src/main/java/org/jboss/jdf/example/ticketmonster/model/Cart.java

```
public class Cart implements Serializable {

    private String id;

    private Performance performance;

    private ArrayList<SeatAllocation> seatAllocations = new ArrayList<SeatAllocation>();

    /**
     * Constructor for deserialization
     */
    private Cart() {
    }

    private Cart(String id) {
        this.id = id;
    }

    public static Cart initialize() {
        return new Cart(UUID.randomUUID().toString());
    }

    public String getId() {
        return id;
    }

    public Performance getPerformance() {
        return performance;
    }

    public void setPerformance(Performance performance) {
        this.performance = performance;
    }

    public ArrayList<SeatAllocation> getSeatAllocations() {
        return seatAllocations;
    }
}
```

```

    }
}

```

A Cart contains `SeatAllocation`'s - collections of `Seats`'s corresponding to a particular `Ticket` (which represents a number of seats requested for a particular performance).

src/main/java/org/jboss/jdf/example/ticketmonster/model/SeatAllocation.java

```

public class SeatAllocation {

    private TicketRequest ticketRequest;

    private ArrayList<Seat> allocatedSeats;

    public SeatAllocation(TicketRequest ticketRequest, ArrayList<Seat> allocatedSeats) {
        this.ticketRequest = ticketRequest;
        this.allocatedSeats = allocatedSeats;
    }

    public TicketRequest getTicketRequest() {
        return ticketRequest;
    }

    public ArrayList<Seat> getAllocatedSeats() {
        return allocatedSeats;
    }
}

```

We use this structure so that we can easily add or update seats to the cart, when the client issues a new request.

We will update the `SectionAllocation` class, introducing an expiration time for each allocated seat. With this implementation, seats can have three different states:

free

The seat has not been allocated;

allocated permanently

The seat has been sold and remains allocated until the ticket is canceled;

allocated temporarily

The seat is allocated, but can be re-allocated after a specific time.

So, when a cart expires and is removed from the cache, the seats it held become available again. With these changes, the updated implementation of the `SectionAllocation` class will be as follows:

src/main/java/org/jboss/jdf/example/ticketmonster/model/SectionAllocation.java

```

@Entity
@Table(uniqueConstraints = @UniqueConstraint(columnNames = { "performance_id", "section_id"
}))
public class SectionAllocation implements Serializable {
    public static final int EXPIRATION_TIME = 60 * 1000;

    /* Declaration of fields */

    /**
     * The synthetic id of the object.
     */
    @Id
    @GeneratedValue(strategy = IDENTITY)
    private Long id;
}

```

```
/**
 * <p>
 * The version used to optimistically lock this entity.
 * </p>
 *
 * <p>
 * Adding this field enables optimistic locking. As we don't access this field in the
 application, we need to suppress the
 * warnings the java compiler gives us about not using the field!
 * </p>
 */
@SuppressWarnings("unused")
@Version
private long version;

/**
 * <p>
 * The performance to which this allocation relates. The <code>@ManyToOne</code> JPA
 mapping establishes this relationship.
 * </p>
 *
 * <p>
 * The performance must be specified, so we add the Bean Validation constrain
 <code>@NotNull</code>
 * </p>
 */
@ManyToOne
@NotNull
private Performance performance;

/**
 * <p>
 * The section to which this allocation relates. The <code>@ManyToOne</code> JPA mapping
 establishes this relationship.
 * </p>
 *
 * <p>
 * The section must be specified, so we add the Bean Validation constrain
 <code>@NotNull</code>
 * </p>
 */
@ManyToOne
@NotNull
private Section section;

/**
 * <p>
 * A two dimensional matrix of allocated seats in a section, represented by a 2
 dimensional array.
 * </p>
 *
 * <p>
 * A two dimensional array doesn't have a natural RDBMS mapping, so we simply store this
 a binary object in the database, an
 * approach which requires no additional mapping logic. Any analysis of which seats
 within a section are allocated is done
 * in the business logic, below, not by the RDBMS.
 * </p>
 *
 * <p>
 * <code>@Lob</code> instructs JPA to map this a large object in the database

```

```
* </p>
*/
@Lob
private long[][] allocated;

/**
 * <p>
 * The number of occupied seats in a section. It is updated whenever tickets are sold
 * or canceled.
 * </p>
 *
 * <p>
 * This field contains a summary of the information found in the
 * <code>allocated</code> fields, and
 * it is intended to be used for analytics purposes only.
 * </p>
 */
private int occupiedCount = 0;

/**
 * Constructor for persistence
 */
public SectionAllocation() {

public SectionAllocation(Performance performance, Section section) {
    this.performance = performance;
    this.section = section;
    this.allocated = new long[section.getNumberOfRows()][section.getRowCapacity()];
    for (long[] seatStates : allocated) {
        Arrays.fill(seatStates, 0);
    }
}

/**
 * Post-load callback method initializes the allocation table if it not populated already
 * for the entity
 */
@PostLoad
void initialize() {
    if (this.allocated == null) {
        this.allocated = new
long[this.section.getNumberOfRows()][this.section.getRowCapacity()];
        for (long[] seatStates : allocated) {
            Arrays.fill(seatStates, 0);
        }
    }
}

/**
 * Check if a particular seat is allocated in this section for this performance.
 *
 * @return true if the seat is allocated, otherwise false
 */
public boolean isAllocated(Seat s) {
    // Examine the allocation matrix, using the row and seat number as indices
    return allocated[s.getRowNumber() - 1][s.getNumber() - 1] != 0;
}

/**
 * Allocate the specified number seats within this section for this performance.
 * Optionally allocate them in a contiguous
```

```

    * block.
    *
    * @param seatCount the number of seats to allocate
    * @param contiguous whether the seats must be allocated in a contiguous block or not
    * @return the allocated seats
    */
    public ArrayList<Seat> allocateSeats(int seatCount, boolean contiguous) {
        // The list of seats allocated
        ArrayList<Seat> seats = new ArrayList<Seat>();

        // The seat allocation algorithm starts by iterating through the rows in this section
        for (int rowCounter = 0; rowCounter < section.getNumberOfRows(); rowCounter++) {

            if (contiguous) {
                // identify the first block of free seats of the requested size
                int startSeat = findFreeGapStart(rowCounter, 0, seatCount);
                // if a large enough block of seats is available
                if (startSeat >= 0) {
                    // Create the list of allocated seats to return
                    for (int i = 1; i <= seatCount; i++) {
                        seats.add(new Seat(section, rowCounter + 1, startSeat + i));
                    }
                    // Seats are allocated now, so we can stop checking rows
                    break;
                }
            } else {
                // As we aren't allocating contiguously, allocate each seat needed, one at a
time
                int startSeat = findFreeGapStart(rowCounter, 0, 1);
                // if a seat is found
                if (startSeat >= 0) {
                    do {
                        // Create the seat to return to the user
                        seats.add(new Seat(section, rowCounter + 1, startSeat + 1));
                        // Find the next free seat in the row
                        startSeat = findFreeGapStart(rowCounter, startSeat, 1);
                    } while (startSeat >= 0 && seats.size() < seatCount);
                    if (seats.size() == seatCount) {
                        break;
                    }
                }
            }
        }

        // Simple check to make sure we could actually allocate the required number of seats

        if (seats.size() == seatCount) {
            for (Seat seat : seats) {
                allocate(seat.getRowNumber() - 1, seat.getNumber() - 1, 1,
expirationTimestamp());
            }
            return seats;
        } else {
            return new ArrayList<Seat>(0);
        }
    }

    public void markOccupied(List<Seat> seats) {
        for (Seat seat : seats) {
            allocate(seat.getRowNumber() - 1, seat.getNumber() - 1, 1, -1);
        }
    }
}

```

```
/**
 * Helper method which can locate blocks of seats
 *
 * @param row The row number to check
 * @param startSeat The seat to start with in the row
 * @param size The size of the block to locate
 * @return
 */
private int findFreeGapStart(int row, int startSeat, int size) {

    // An array of occupied seats in the row
    long[] occupied = allocated[row];
    int candidateStart = -1;

    // Iterate over the seats, and locate the first free seat block
    for (int i = startSeat; i < occupied.length; i++) {
        // if the seat isn't allocated
        long currentTimeStamp = System.currentTimeMillis();
        if (occupied[i] >= 0 && currentTimeStamp > occupied[i]) {
            // then set this as a possible start
            if (candidateStart == -1) {
                candidateStart = i;
            }
            // if we've counted out enough seats since the possible start, then we are
done
            if ((size == (i - candidateStart + 1))) {
                return candidateStart;
            }
        } else {
            candidateStart = -1;
        }
    }
    return -1;
}

/**
 * Helper method to allocate a specific block of seats
 *
 * @param row the row in which the seat should be allocated
 * @param start the seat number to start allocating from
 * @param size the size of the block to allocate
 * @throws SeatAllocationException if less than 1 seat is to be allocated
 * @throws SeatAllocationException if the first seat to allocate is more than the number
of seats in the row
 * @throws SeatAllocationException if the last seat to allocate is more than the number
of seats in the row
 * @throws SeatAllocationException if the seats are already occupied.
 */
private void allocate(int row, int start, int size, long finalState) throws
SeatAllocationException {
    long[] occupied = allocated[row];
    if (size <= 0) {
        throw new SeatAllocationException("Number of seats must be greater than zero");
    }
    if (start < 0 || start >= occupied.length) {
        throw new SeatAllocationException("Seat number must be between 1 and " +
occupied.length);
    }
    if ((start + size) > occupied.length) {
        throw new SeatAllocationException("Cannot allocate seats above row capacity");
    }
}
```



```

        // Now that we know we can allocate the seats, set them to occupied in the allocation
        matrix
        for (int i = start; i < (start + size); i++) {
            occupied[i] = finalState;
            occupiedCount++;
        }
    }

    /**
     * Deallocate a seat within this section for this performance.
     *
     * @param seat the seats that need to be deallocated
     */
    public void deallocate(Seat seat) {
        if (!isAllocated(seat)) {
            throw new SeatAllocationException("Trying to deallocate an unallocated seat!");
        }
        this.allocated[seat.getRowNumber()-1][seat.getNumber()-1] = 0;
        occupiedCount--;
    }

    /* Boilerplate getters and setters */

    public int getOccupiedCount() {
        return occupiedCount;
    }

    public Performance getPerformance() {
        return performance;
    }

    public Section getSection() {
        return section;
    }

    public Long getId() {
        return id;
    }

    private long expirationTimestamp() {
        return System.currentTimeMillis() + EXPIRATION_TIME;
    }
}

```

Next, we will implement a cart store service for cart CRUD operations. Since users may open as many carts as they want, but not complete the purchase, we will store them as temporary entries, with an expiration time, leaving the job of removing them automatically to the data grid middleware itself. Thus, you don't have to worry about cleaning up your data.

src/main/java/org/jboss/jdf/example/ticketmonster/service/CartStore.java

```

public class CartStore {

    public static final String CARTS_CACHE = "TICKETMONSTER_CARTS";

    private final Cache<String, Cart> cartsCache;

    @Inject
    public CartStore(EmbeddedCacheManager manager) {
        this.cartsCache = manager.getCache(CARTS_CACHE);
    }
}

```

```
public Cart getCart(String cartId) {
    return this.cartsCache.get(cartId);
}

/**
 * Saves or updates a cart, setting an expiration time.
 *
 * @param cart - the cart to be saved
 */
public void saveCart(Cart cart) {
    this.cartsCache.put(cart.getId(), cart, 10, TimeUnit.MINUTES);
}

/**
 * Removes a cart
 *
 * @param cart - the cart to be removed
 */
public void delete(Cart cart) {
    this.cartsCache.remove(cart.getId());
}
}
```

Now we can go on and implement the RESTful service for managing carts.

First, we will implement the CRUD operations - adding and reading carts, as a thin layer on top of the `CartStore`. Because cart data is not tied to a web session, users can create as many carts as they want without having to worry about cleaning up the web session. Moreover, the web component of the application has a stateless architecture, which means that it can scale elastically across multiple machines - the responsibility of distributing data across nodes falling to the data grid itself.

src/main/java/org/jboss/jdf/example/ticketmonster/rest/CartService.java

```
@Path("/carts")
@Stateless
public class CartService {

    public static final String CARTS_CACHE = "CARTS";

    @Inject
    private CartStore cartStore;

    /**
     * Creates a new cart for a given performance, passed in as a JSON document.
     *
     * @param data
     * @return
     */
    @POST
    public Cart openCart(Map<String, String> data) {
        Cart cart = Cart.initialize();
        cart.setPerformance(entityManager.find(Performance.class,
            Long.parseLong(data.get("performance"))));
        cartStore.saveCart(cart);
        return cart;
    }

    /**
     * Retrieves a cart by its id.
     *
     * @param id
     * @return
     */
}
```

```

@GET
@Path("/{id}")
public Cart getCart(String id) {
    Cart cart = cartStore.getCart(id);
    if (cart != null) {
        return cart;
    } else {
        throw new RestServiceException(Response.Status.NOT_FOUND);
    }
}
}

```

The `openCart` method allows opening a cart by posting a simple JSON document containing the reference to an existing performance to `http://localhost:8080/ticket-monster/rest/carts`. The `getCart` method allows accessing the cart contents from an URL of the form `http://localhost:8080/ticket-monster/rest/carts/<cartId>`. Thus, the carts themselves become web resources. In true RESTful fashion, if the cart cannot be found, a "Resource Not Found" error will be thrown by the server.

Next, we will add the ability of adding or removing seats from a cart. This will be done as an additional RESTful endpoint, that allows user to post ticket (or seat) requests to an existing cart, at the URL `http://localhost:8080/ticket-monster/rest/carts/<cartId>`. Whenever such a POST request is received, the `CartService` will delegate to the `SeatAllocationService` to adjust the current allocation, returning the cart contents (including the temporarily assigned seats) at the end.

src/main/java/org/jboss/jdf/example/ticketmonster/rest/CartService.java

```

@Path("/carts")
@Stateless
public class CartService {

    // already added code omitted

    @Inject
    private EntityManager entityManager;

    @Inject
    private SeatAllocationService seatAllocationService;

    // already added code omitted

    /**
     * Add or remove tickets to the cart. Also reserves and frees seats as tickets are added
     * and removed.
     *
     * @param id
     * @param ticketRequests
     * @return
     */
    @POST
    @Path("/{id}")
    @Consumes(MediaType.APPLICATION_JSON)
    public Cart addTicketRequest(@PathParam("id") String id, TicketReservationRequest...
    ticketRequests) {
        Cart cart = cartStore.getCart(id);

        for (TicketReservationRequest ticketRequest : ticketRequests) {
            TicketPrice ticketPrice = entityManager.find(TicketPrice.class,
            ticketRequest.getTicketPrice());
            Iterator<SeatAllocation> iterator = cart.getSeatAllocations().iterator();
            while (iterator.hasNext()) {
                SeatAllocation seatAllocation = iterator.next();
                if
                (seatAllocation.getTicketRequest().getTicketPrice().getId().equals(ticketRequest.getTicketPrice().getId()))
            }
        }
    }
}

```

```

        seatAllocationService.deallocateSeats(ticketPrice.getSection(),
        cart.getPerformance(), seatAllocation.getAllocatedSeats());
        ticketRequest.setQuantity(ticketRequest.getQuantity() +
        seatAllocation.getTicketRequest().getQuantity());
        iterator.remove();
    }
    if (ticketRequest.getQuantity() > 0 ) {
        AllocatedSeats allocatedSeats =
        seatAllocationService.allocateSeats(ticketPrice.getSection(), cart.getPerformance(),
        ticketRequest.getQuantity(), true);
        cart.getSeatAllocations().add(new SeatAllocation(new TicketRequest(ticketPrice,
        ticketRequest.getQuantity()), allocatedSeats.getSeats()));
    }
    }
    return cart;
}
}

```

Finally, when the user has finished reserving seats, they must complete the purchase. To that end, you will add another RESTful endpoint, at the URL `http://localhost:8080/ticket-monster/rest/carts/<cartId>/checkout`. Posting the final purchase data (like e-mail, and in the future, payment information) will trigger the checkout process, ticket allocation and making the seat reservations permanent.

src/main/java/org/jboss/jdf/example/ticketmonster/rest/CartService.java

```

@Path("/carts")
@Stateless
public class CartService {
    /**
     * <p>
     * Create a booking.
     * </p>
     *
     * @param cartId
     * @param data
     * @return
     */
    @SuppressWarnings("unchecked")
    @POST
    /**
     * <p> Data is received in JSON format. For easy handling, it will be unmarshalled in the
     * support
     * {@link BookingRequest} class.
     * </p>
     */
    @Consumes(MediaType.APPLICATION_JSON)
    @Path("/{id}/checkout")
    public Response createBookingFromCart(@PathParam("id") String cartId, Map<String, String>
    data) {
        try {
            // identify the ticket price categories in this request

            Cart cart = cartStore.getCart(cartId);

            // load the entities that make up this booking's relationships

            // Now, start to create the booking from the posted data
            // Set the simple stuff first!
            Booking booking = new Booking();
            booking.setContactEmail(data.get("email"));

```

```

        booking.setPerformance(cart.getPerformance());
        booking.setCancellationCode("abc");

        for (SeatAllocation seatAllocation : cart.getSeatAllocations()) {
            for (Seat seat : seatAllocation.getAllocatedSeats()) {
                TicketPrice ticketPrice =
                    seatAllocation.getTicketRequest().getTicketPrice();
                booking.getTickets().add(new Ticket(seat,
                    ticketPrice.getTicketCategory(), ticketPrice.getPrice()));
            }
            seatAllocationService.finalizeAllocation(cart.getPerformance(),
                seatAllocation.getAllocatedSeats());
        }

        booking.setCancellationCode("abc");
        entityManager.persist(booking);
        cartStore.delete(cart);
        newBookingEvent.fire(booking);
        return
    }
    Response.ok().entity(booking).type(MediaType.APPLICATION_JSON_TYPE).build();

    } catch (ConstraintViolationException e) {
        // If validation of the data failed using Bean Validation, then send an error
        Map<String, Object> errors = new HashMap<String, Object>();
        List<String> errorMessages = new ArrayList<String>();
        for (ConstraintViolation<?> constraintViolation : e.getConstraintViolations()) {
            errorMessages.add(constraintViolation.getMessage());
        }
        errors.put("errors", errorMessages);
        // A WebApplicationException can wrap a response
        // Throwing the exception causes an automatic rollback
        throw new
    }
    RestServiceException(Response.status(Response.Status.BAD_REQUEST).entity(errors).build());
    } catch (Exception e) {
        // Finally, handle unexpected exceptions
        Map<String, Object> errors = new HashMap<String, Object>();
        errors.put("errors", Collections.singletonList(e.getMessage()));
        // A WebApplicationException can wrap a response
        // Throwing the exception causes an automatic rollback
        throw new
    }
    RestServiceException(Response.status(Response.Status.BAD_REQUEST).entity(errors).build());
    }
}

```

Now, all that remains is modifying the client side of the application to adapt the changes in the web service structure. During the ticket booking process, as tickets are added and removed to the cart, the `CreateBookingView` will invoke the RESTful endpoints to allocate seats and will display the outcome to the user in the updated `TicketSummaryView`. Here is how the JavaScript code will change.

src/main/webapp/resources/js/app/views/desktop/create-booking.js

```

define([
    'utilities',
    'require',
    'configuration',
    'text!../../../../templates/desktop/booking-confirmation.html',
    'text!../../../../templates/desktop/create-booking.html',
    'text!../../../../templates/desktop/ticket-categories.html',
    'text!../../../../templates/desktop/ticket-summary-view.html',
    'bootstrap'
], function (
    utilities,

```

```
require,
config,
bookingConfirmationTemplate,
createBookingTemplate,
ticketEntriesTemplate,
ticketSummaryViewTemplate){

var TicketCategoriesView = Backbone.View.extend({
  id: 'categoriesView',
  intervalDuration : 100,
  formValues : [],
  events: {
    "change input": "onChange"
  },
  render: function () {
    if (this.model != null) {
      var ticketPrices = _.map(this.model, function (item) {
        return item.ticketPrice;
      });
      utilities.applyTemplate($(this.el), ticketEntriesTemplate,
{ticketPrices:ticketPrices});
    } else {
      $(this.el).empty();
    }
    this.watchForm();
    return this;
  },
  onChange: function (event) {
    var value = event.currentTarget.value;
    var ticketPriceId = $(event.currentTarget).data("tm-id");
    var modifiedModelEntry = _.find(this.model, function (item) {
      return item.ticketPrice.id == ticketPriceId
    });
    // update model
    if ($.isNumeric(value) && value > 0) {
      modifiedModelEntry.quantity = parseInt(value);
    }
    else {
      delete modifiedModelEntry.quantity;
    }
    // display error messages
    if (value.length > 0 &&
      (!$.isNumeric(value) // is a non-number, other than empty string
      || value <= 0 // is negative
      || parseFloat(value) != parseInt(value))) { // is not an integer
      $("#error-input-"+ticketPriceId).empty().append("Please enter a positive
integer value");
      $("#ticket-category-fieldset-"+ticketPriceId).addClass("error")
    } else {
      $("#error-input-"+ticketPriceId).empty();
      $("#ticket-category-fieldset-"+ticketPriceId).removeClass("error")
    }
    // are there any outstanding errors after this update?
    // if yes, disable the input button
    if (
      $("div[id^='ticket-category-fieldset-']").hasClass("error") ||
      _.isUndefined(modifiedModelEntry.quantity) ) {
      $("input[name='add']").attr("disabled", true)
    } else {
      $("input[name='add']").removeAttr("disabled")
    }
  }
});
```

```

    },
    watchForm: function() {
        if($("#sectionSelectorPlaceholder").length) {
            var self = this;
            $("input[name*='tickets']").each(function(index,element) {
                if(element.value !== self.formValues[element.name]) {
                    self.formValues[element.name] = element.value;
                    $("input[name='"+element.name+"']").change();
                }
            });
            this.timerObject = setTimeout(function() {
                self.watchForm();
            }, this.intervalDuration);
        } else {
            this.onClose();
        }
    },
    onClose: function() {
        if(this.timerObject) {
            clearTimeout(this.timerObject);
            delete this.timerObject;
        }
    }
});

var TicketSummaryView = Backbone.View.extend({
    tagName: 'tr',
    events: {
        "click i": "removeEntry"
    },
    render: function () {
        var self = this;
        utilities.applyTemplate($(this.el), ticketSummaryViewTemplate,
this.model.bookingRequest);
    },
    removeEntry: function (event) {
        var index = $(event.currentTarget).data("index");
        var ticketPriceId =
this.model.bookingRequest.seatAllocations[index].ticketRequest.ticketPrice.id;
        var self = this;
        $.ajax({url: (config.baseUrl + "rest/carts/" + this.model.cartId),
            data: JSON.stringify([{"ticketPrice":ticketPriceId, quantity:-1}],
            type: "POST",
            dataType: "json",
            contentType: "application/json",
            success: function(cart) {
                self.owner.refreshSummary(cart, self.owner)
            }
        });
    }
});

var CreateBookingView = Backbone.View.extend({
    intervalDuration : 100,
    formValues : [],
    events: {
        "click input[name='submit']": "save",
        "change select[id='sectionSelect']": "refreshPrices",
        "change #email": "updateEmail",
        "click input[name='add']": "addQuantities"
    },

```

```

render:function () {

    var self = this;
    $.ajax({url: (config.baseUrl + "rest/carts"),
            data:JSON.stringify({performance:this.model.performanceId}),
            type:"POST",
            dataType:"json",
            contentType:"application/json",
            success: function (cart) {
                self.model.cartId = cart.id;
                $.getJSON(config.baseUrl + "rest/shows/" + self.model.showId,
function (selectedShow) {

                    self.currentPerformance = _.find(selectedShow.performances,
function (item) {

                        return item.id == self.model.performanceId;
                    });

                    var id = function (item) {return item.id;};
                    // prepare a list of sections to populate the dropdown
                    var sections = _.uniq(_.sortBy(_.pluck(selectedShow.ticketPrices,
'section'), id), true, id);
                    utilities.applyTemplate($(self.el), createBookingTemplate, {
                        sections:sections,
                        show:selectedShow,
                        performance:self.currentPerformance});
                    self.ticketCategoriesView = new TicketCategoriesView({model:{},
el:$("#ticketCategoriesViewPlaceholder")});
                    self.ticketSummaryView = new TicketSummaryView({model:self.model,
el:$("#ticketSummaryView")});
                    self.ticketSummaryView.owner = self;
                    self.show = selectedShow;
                    self.ticketCategoriesView.render();
                    self.ticketSummaryView.render();
                    $("#sectionSelect").change();
                    self.watchForm();
                });
            });
    });
    return this;
},
refreshPrices:function (event) {
    var ticketPrices = _.filter(this.show.ticketPrices, function (item) {
        return item.section.id == event.currentTarget.value;
    });
    var sortedTicketPrices = _.sortBy(ticketPrices, function(ticketPrice) {
        return ticketPrice.ticketCategory.description;
    });
    var ticketPriceInputs = new Array();
    _.each(sortedTicketPrices, function (ticketPrice) {
        ticketPriceInputs.push({ticketPrice:ticketPrice});
    });
    this.ticketCategoriesView.model = ticketPriceInputs;
    this.ticketCategoriesView.render();
},
save:function (event) {
    var bookingRequest = {ticketRequests:[]};
    var self = this;
    bookingRequest.email = this.model.bookingRequest.email;
    bookingRequest.performance = this.model.performanceId
    $("input[name='submit']").attr("disabled", true)

```



```

$.ajax({url: (config.baseUrl + "rest/carts/" + this.model.cartId + "/checkout"),
  data:JSON.stringify({email:this.model.bookingRequest.email}),
  type:"POST",
  dataType:"json",
  contentType:"application/json",
  success:function (booking) {
    this.model = {}
    $.getJSON(config.baseUrl + 'rest/shows/performance/' +
booking.performance.id, function (retrievedPerformance) {
      utilities.applyTemplate($(self.el), bookingConfirmationTemplate,
{booking:booking, performance:retrievedPerformance })
    });
  }).error(function (error) {
    if (error.status == 400 || error.status == 409) {
      var errors = $.parseJSON(error.responseText).errors;
      _.each(errors, function (errorMessage) {
        $("#request-summary").append('<div class="alert alert-error"><a
class="close" data-dismiss="alert">$\times$</a><strong>Error!</strong> ' + errorMessage +
'</div>')
      });
    } else {
      $("#request-summary").append('<div class="alert alert-error"><a
class="close" data-dismiss="alert">$\times$</a><strong>Error! </strong>An error has
occured</div>')
    }
    $("input[name='submit']").removeAttr("disabled");
  })
},
calculateTotals:function () {
  // make sure that tickets are sorted by section and ticket category
  this.model.bookingRequest.seatAllocations.sort(function (t1, t2) {
    if (t1.ticketRequest.ticketPrice.section.id !=
t2.ticketRequest.ticketPrice.section.id) {
      return t1.ticketRequest.ticketPrice.section.id -
t2.ticketRequest.ticketPrice.section.id;
    }
    else {
      return t1.ticketRequest.ticketPrice.ticketCategory.id -
t2.ticketRequest.ticketPrice.ticketCategory.id;
    }
  });

  this.model.bookingRequest.totals =
_.reduce(this.model.bookingRequest.seatAllocations, function (totals, seatAllocation) {
    var ticketRequest = seatAllocation.ticketRequest;
    return {
      tickets:totals.tickets + ticketRequest.quantity,
      price:totals.price + ticketRequest.quantity *
ticketRequest.ticketPrice.price
    };
  }, {tickets:0, price:0.0});
},
addQuantities:function () {
  var self = this;
  var ticketRequests = [];
  _.each(this.ticketCategoriesView.model, function (model) {
    if (model.quantity != undefined) {
      ticketRequests.push({ticketPrice:model.ticketPrice.id,
quantity:model.quantity})
    }
  });
};

```

```

$.ajax({url: (config.baseUrl + "rest/carts/" + this.model.cartId),
  data:JSON.stringify(ticketRequests),
  type:"POST",
  dataType:"json",
  contentType:"application/json",
  success: function(cart) {
    self.refreshSummary(cart, self)
  }}
);
},
refreshSummary: function(cart, view) {
  view.model.bookingRequest.seatAllocations = cart.seatAllocations;
  view.ticketCategoriesView.model = null;
  $('option:selected', 'select').removeAttr('selected');
  view.calculateTotals();
  view.ticketCategoriesView.render();
  view.ticketSummaryView.render();
  view.setCheckoutStatus();
},
updateEmail:function (event) {
  // jQuery 1.9 does not handle pseudo CSS selectors like :valid :invalid, anymore
  var validElements;
  try {
    validElements = $(".form-search").get(0).querySelectorAll(":valid");
    for (var ctr=0; ctr < validElements.length; ctr++) {
      if (event.currentTarget === validElements[ctr]) {
        this.model.bookingRequest.email = event.currentTarget.value;
        $("#error-email").empty();
      } else {
        $("#error-email").empty().append("Please enter a valid e-mail
address");
        delete this.model.bookingRequest.email;
      }
    }
  }
  catch(e) {
    // For browsers like IE9 that do fail on querySelectorAll for CSS pseudo
selectors,
    // we use the regex defined in the HTML5 spec.
    var emailRegex = new
RegExp("[a-zA-Z0-9.!#$%&'*/+=?^_`{|}~-]+@[a-zA-Z0-9-]+(?:\\.[a-zA-Z0-9-]+)*");
    if(emailRegex.test(event.currentTarget.value)) {
      this.model.bookingRequest.email = event.currentTarget.value;
      $("#error-email").empty();
    } else {
      $("#error-email").empty().append("Please enter a valid e-mail address");
      delete this.model.bookingRequest.email;
    }
  }
  this.setCheckoutStatus();
},
setCheckoutStatus:function () {
  if (this.model.bookingRequest.totals != undefined &&
this.model.bookingRequest.totals.tickets > 0 && this.model.bookingRequest.email !=
undefined && this.model.bookingRequest.email != '') {
    $('input[name="submit"]').removeAttr('disabled');
  }
  else {
    $('input[name="submit"]').attr('disabled', true);
  }
},
watchForm: function() {

```

```

        if($("#email").length) {
            var self = this;
            var element = $("#email");
            if(element.val() !== self.formValues["email"]) {
                self.formValues["email"] = element.val();
                $("#email").change();
            }
            this.timerObject = setTimeout(function() {
                self.watchForm();
            }, this.intervalDuration);
        } else {
            this.onClose();
        }
    },
    onClose: function() {
        if(this.timerObject) {
            clearTimeout(this.timerObject);
            delete this.timerObject;
        }
        this.ticketCategoriesView.close();
    }
});

return CreateBookingView;
});

```

Also, we need to update the router code as well.

src/main/webapp/resources/js/app/router/desktop/router.js

```

/**
 * A module for the router of the desktop application
 */
define("router", [
    'jquery',
    'underscore',
    'configuration',
    'utilities',
    'app/models/booking',
    'app/models/event',
    'app/models/venue',
    'app/collections/bookings',
    'app/collections/events',
    'app/collections/venues',
    'app/views/desktop/home',
    'app/views/desktop/events',
    'app/views/desktop/venues',
    'app/views/desktop/create-booking',
    'app/views/desktop/bookings',
    'app/views/desktop/event-detail',
    'app/views/desktop/venue-detail',
    'app/views/desktop/booking-detail',
    'text!../templates/desktop/main.html'
], function ($,
    _,
    config,
    utilities,
    Booking,
    Event,
    Venue,
    Bookings,
    Events,

```

```
Venues,
HomeView,
EventsView,
VenuesView,
CreateBookingView,
BookingsView,
EventDetailView,
VenueDetailView,
BookingDetailView,
MainTemplate) {

$(document).ready(new function() {
    utilities.applyTemplate($('body'), MainTemplate)
})

/**
 * The Router class contains all the routes within the application -
 * i.e. URLs and the actions that will be taken as a result.
 *
 * @type {Router}
 */

var Router = Backbone.Router.extend({
    routes:{
        "": "home",
        "about": "home",
        "events": "events",
        "events/:id": "eventDetail",
        "venues": "venues",
        "venues/:id": "venueDetail",
        "book/:showId/:performanceId": "bookTickets",
        "bookings": "listBookings",
        "bookings/:id": "bookingDetail",
        "ignore": "ignore",
        "*actions": "defaultHandler"
    },
    events:function () {
        var events = new Events();
        var eventsView = new EventsView({model:events, el:$("#content")});
        events.bind("reset",
            function () {
                utilities.viewManager.showView(eventsView);
            }).fetch();
    },
    venues:function () {
        var venues = new Venues;
        var venuesView = new VenuesView({model:venues, el:$("#content")});
        venues.bind("reset",
            function () {
                utilities.viewManager.showView(venuesView);
            }).fetch();
    },
    home:function () {
        utilities.viewManager.showView(new HomeView({el:$("#content")}));
    },
    bookTickets:function (showId, performanceId) {
        var createBookingView =
            new CreateBookingView({
                model:{ showId:showId,
                    performanceId:performanceId,
                    bookingRequest:{seatAllocations:[]}},
                el:$("#content")
            })
    }
});
```

```
        });
        utilities.viewManager.showView(createBookingView);
    },
    listBookings:function () {
        $.get(
            config.baseUrl + "rest/bookings/count",
            function (data) {
                var bookings = new Bookings;
                var bookingsView = new BookingsView({
                    model:{bookings: bookings},
                    el:$("#content"),
                    pageSize: 10,
                    page: 1,
                    count:data.count});

                bookings.bind("destroy",
                    function () {
                        bookingsView.refreshPage();
                    });
                bookings.fetch({data:{first:1, maxResults:10},
                    processData:true, success:function () {
                        utilities.viewManager.showView(bookingsView);
                    }
                });
            }
        );
    },
    eventDetail:function (id) {
        var model = new Event({id:id});
        var eventDetailView = new EventDetailView({model:model, el:$("#content")});
        model.bind("change",
            function () {
                utilities.viewManager.showView(eventDetailView);
            }).fetch();
    },
    venueDetail:function (id) {
        var model = new Venue({id:id});
        var venueDetailView = new VenueDetailView({model:model, el:$("#content")});
        model.bind("change",
            function () {
                utilities.viewManager.showView(venueDetailView);
            }).fetch();
    },
    bookingDetail:function (id) {
        var bookingModel = new Booking({id:id});
        var bookingDetailView = new BookingDetailView({model:bookingModel,
            el:$("#content")});
        bookingModel.bind("change",
            function () {
                utilities.viewManager.showView(bookingDetailView);
            }).fetch();
    }
});

// Create a router instance
var router = new Router();

//Begin routing
Backbone.history.start();

return router;
```

```
});
```

Finally, we need to update a few templates to account for the changes in code. First, we will allow for displaying the seats in the ticket summary view as they are allocated.

src/main/webapp/resources/templates/desktop/ticket-summary-view.html

```
<div class="span12">
  <% if (seatAllocations.length>0) { %>
    <table class="table table-bordered table-condensed row-fluid" style="background-color:
    #ffffff;">
      <thead>
        <tr>
          <th colspan="7"><strong>Requested tickets</strong></th>
        </tr>
        <tr>
          <th>Section</th>
          <th>Category</th>
          <th>Quantity</th>
          <th>Price</th>
          <th>Row</th>
          <th>Seat</th>
          <th></th>
        </tr>
      </thead>
      <tbody id="ticketRequestSummary">
        <% _.each(seatAllocations, function (seatAllocation, index, seatAllocations) { %>
          <tr>
            <td><%= seatAllocation.ticketRequest.ticketPrice.section.name %></td>
            <td><%= seatAllocation.ticketRequest.ticketPrice.ticketCategory.description
            %></td>
            <td><%= seatAllocation.ticketRequest.quantity %></td>
            <td>$<%= seatAllocation.ticketRequest.ticketPrice.price%></td>
            <td><%= seatAllocation.allocatedSeats[0].rowNumber %></td>
            <td><% _.each(seatAllocation.allocatedSeats, function (ticketRequest, index,
            seat) { %>
              <% if (index > 0) { %><p/><% } %><%=
            seatAllocation.allocatedSeats[index].number%>
              <% }>;%></td>
            <td><i class="icon-trash" data-index='<%= index %>' /></td>
          </tr>
        <% }>; %>
      </tbody>
    </table>
    <p/>
    <div class="row-fluid">
      <div class="span5"><strong>Total ticket count:</strong> <%= totals.tickets %></div>
      <div class="span5"><strong>Total price:</strong> $<%=totals.price%></div></div>
    <% } else { %>
      No tickets requested.
    <% } %>
  </div>
```

Next, we will update the booking details view template.

src/main/webapp/resources/templates/desktop/booking-details.html

```
<div class="row-fluid">
  <h2 class="page-header light-font special-title">Booking #<%=booking.id%> details</h2>
</div>
<div class="row-fluid">
  <div class="span5 well">
    <h4 class="page-header">Checkout information</h4>
```

```

<p><strong>Email: </strong><%= booking.contactEmail %></p>

<p><strong>Event: </strong> <%= performance.event.name %></p>

<p><strong>Venue: </strong><%= performance.venue.name %></p>

<p><strong>Date: </strong><%= new Date(booking.performance.date).toPrettyString()
%></p>

<p><strong>Created on: </strong><%= new Date(booking.createdOn).toPrettyString()
%></p>
</div>
<div class="span5 well">
  <h4 class="page-header">Ticket allocations</h4>
  <table class="table table-striped table-bordered" style="background-color: #ffffffa;">
    <thead>

      <tr>
        <th>Ticket #</th>
        <th>Category</th>
        <th>Section</th>
        <th>Row</th>
        <th>Seat</th>
      </tr>
    </thead>
    <tbody>
      <% $.each(_.sortBy(booking.tickets, function(ticket) {return
ticket.seat.section.id*1000
                                + ticket.seat.rowNumber*100
                                + ticket.seat.number})), function (i, ticket) { %>

        <tr>
          <td><%= ticket.id %></td>
          <td><%=ticket.ticketCategory.description%></td>
          <td><%=ticket.seat.section.name%></td>
          <td><%=ticket.seat.rowNumber%></td>
          <td><%=ticket.seat.number%></td>
        </tr>
      <% }) %>
    </tbody>
  </table>
</div>
</div>
<div class="row-fluid" style="padding-bottom:30px;">
  <div class="span2"><a href="#bookings">Back</a></div>
</div>

```

Finally, we will need to update the booking confirmation page.

src/main/webapp/resources/templates/desktop/booking-confirmation.html

```

<div class="row-fluid">
  <h2 class="special-title light-font">Booking #<%=booking.id%> confirmed!</h2>
</div>
<div class="row-fluid">
  <div class="span5 well">
    <h4 class="page-header">Checkout information</h4>
    <p><strong>Email: </strong><%= booking.contactEmail %></p>
    <p><strong>Event: </strong> <%= performance.event.name %></p>
    <p><strong>Venue: </strong><%= performance.venue.name %></p>
    <p><strong>Date: </strong><%= new Date(booking.performance.date).toPrettyString()
%></p>

```

```
<p><strong>Created on: </strong><%= new Date(booking.createdOn).toPrettyString()
%></p>
</div>
<div class="span5 well">
  <h4 class="page-header">Ticket allocations</h4>
  <table class="table table-striped table-bordered" style="background-color: #ffffffa;">
    <thead>
      <tr>
        <th>Ticket #</th>
        <th>Category</th>
        <th>Section</th>
        <th>Row</th>
        <th>Seat</th>
      </tr>
    </thead>
    <tbody>
      <% $.each(_.sortBy(booking.tickets, function(ticket) {return
ticket.seat.section.id*1000
+ ticket.seat.rowNumber*100
+ ticket.seat.number}), function (i, ticket) { %>
        <tr>
          <td><%= ticket.id %></td>
          <td><%=ticket.ticketCategory.description%></td>
          <td><%=ticket.seat.section.name%></td>
          <td><%=ticket.seat.rowNumber%></td>
          <td><%=ticket.seat.number%></td>
        </tr>
      <% }) %>
    </tbody>
  </table>
</div>
</div>
<div class="row-fluid" style="padding-bottom:30px;">
  <div class="span2"><a href="#">Home</a></div>
</div>
```

This is it!

Chapter 63

Conclusion

You have successfully converted your application from one that relies exclusively on relational persistence to using a NoSQL (key-value) data store for a part of its data. You have identified the use cases where the switch is mostly likely to result in performance improvements, including the changes in application functionality that can benefit from this conversion. You have learned how to set up the infrastructure, distinguish between the different configuration options, and use the API.

Part X

Adding a full-text search engine

Chapter 64

What will you learn here?

You have a functional TicketMonster but the ability to find the right ticket is a bit limited. You would like to add a search engine to make show discovery much easier. In this tutorial, you will learn how to:

- Add Hibernate Search to your web application
- Index your entities and build the search engine to retrieve your data
- Add faceting i.e. the ability to filter results by price range, categories etc
- Offer the ability to search around the user's location (geolocation or spatial search)

What is Hibernate Search?

Hibernate Search indexes objects into Lucene, a full-text search engine and offer an object-oriented API to query those objects using full-text search, spatial queries and more.

It integrates transparently with Hibernate ORM by listening to entity changes and updating the Lucene index accordingly. Finally Hibernate Search implements several strategies to cluster indexes very easily.

Chapter 65

Setting up the infrastructure

We just need to add Hibernate Search in our classpath and add a few configuration options in `persistence.xml`.

Our first task is to add Hibernate Search as a dependency to our application. There are two ways to do it. For now we will use the JBoss Modules approach where Hibernate Search is installed on JBoss EAP or JBoss AS.

65.1 Set up the dependencies

Download the [Hibernate Search module](#) and copy its content into JBoss EAP or JBoss AS's `modules` directory.

Next update `jboss-deployment-structure.xml` to include the ORM module of Hibernate Search. This module is necessary to import the Hibernate Search engine as well as the integration code with Hibernate ORM.

src/main/webapp/WEB_INF/jboss-deployment-structure.xml

```
<jboss-deployment-structure>
  <deployment>
    <exclusions>
    </exclusions>
    <!-- This allows you to define additional dependencies, it is the same
         as using the Dependencies: manifest attribute -->
    <dependencies>
      <module name="org.jboss.as.naming" />
      <module name="org.jboss.as.server" />
      <module name="org.jboss.msc" />
      <module name="org.hibernate.search.orm" services="export" />
    </dependencies>
  </deployment>
</jboss-deployment-structure>
```

Note

`services="export"` lets Hibernate Search use the service locator pattern to integrate with Hibernate ORM

Finally, we need to add Hibernate Search as a `provided` dependency in our `pom.xml`.

pom.xml

```
<project ...>
  ...
  <properties>
    ...
```

```

    <!-- Hibernate Search version -->
    <hibernate.search.version>4.4.0.Final</hibernate.search.version>
    ...
</properties>
...
<dependencies>
  <!-- Add Hibernate Search as a dependency -->
  <dependency>
    <groupId>org.hibernate</groupId>
    <artifactId>hibernate-search-orm</artifactId>
    <version>${hibernate.search.version}</version>
    <scope>provided</scope>
  </dependency>

  <dependency>
    <groupId>org.hibernate</groupId>
    <artifactId>hibernate-search-engine</artifactId>
    <version>${hibernate.search.version}</version>
    <scope>provided</scope>
  </dependency>

  <dependency>
    <groupId>org.hibernate</groupId>
    <artifactId>hibernate-search-analyzers</artifactId>
    <version>${hibernate.search.version}</version>
    <scope>provided</scope>
  </dependency>
</dependencies>
...
</project>

```

65.2 Add some configuration

Hibernate Search needs a few extra settings in `persistence.xml`. You can store the indexes either in RAM or on the file system. We will start with an in-memory storage to keep things simple.

src/main/resources/META-INF/persistence.xml

```

<persistence ...>
  <persistence-unit name="primary">
    ...
    <properties>
      ...
      <property name="hibernate.search.default.directory_provider" value="ram"/>

      <!-- Alternatively store the index on the file system
      <property name="hibernate.search.default.directory_provider" value="filesystem"/>
      <property name="hibernate.search.default.indexBase"
value="/var/data/ticket-monster/indexes"/>
      -->
    </properties>
  </persistence-unit>
</persistence>

```

Chapter 66

Build the core search engine

We are now ready to start our search engine. Let's first see how we decide what to index before building the right queries.

66.1 Indexing the domain model

Marking entities and properties as indexed is as simple as adding annotations. But we need to properly understand the kind of queries we wish to build. We want our users to be able to search for:

- a given `Event` by name and description
- at a given `Venue` by name and possibly by location
- filtering by category, price and date would be nice too

66.1.1 Adding the metadata to our domain model

You cannot do joins in a full-text index. Instead, we cheat by denormalizing the information and indexing the associated objects we want to query by in the same entry. For that, we need to be able to navigate to all of the entities we are interested in.

Let's look at our domain model once again.

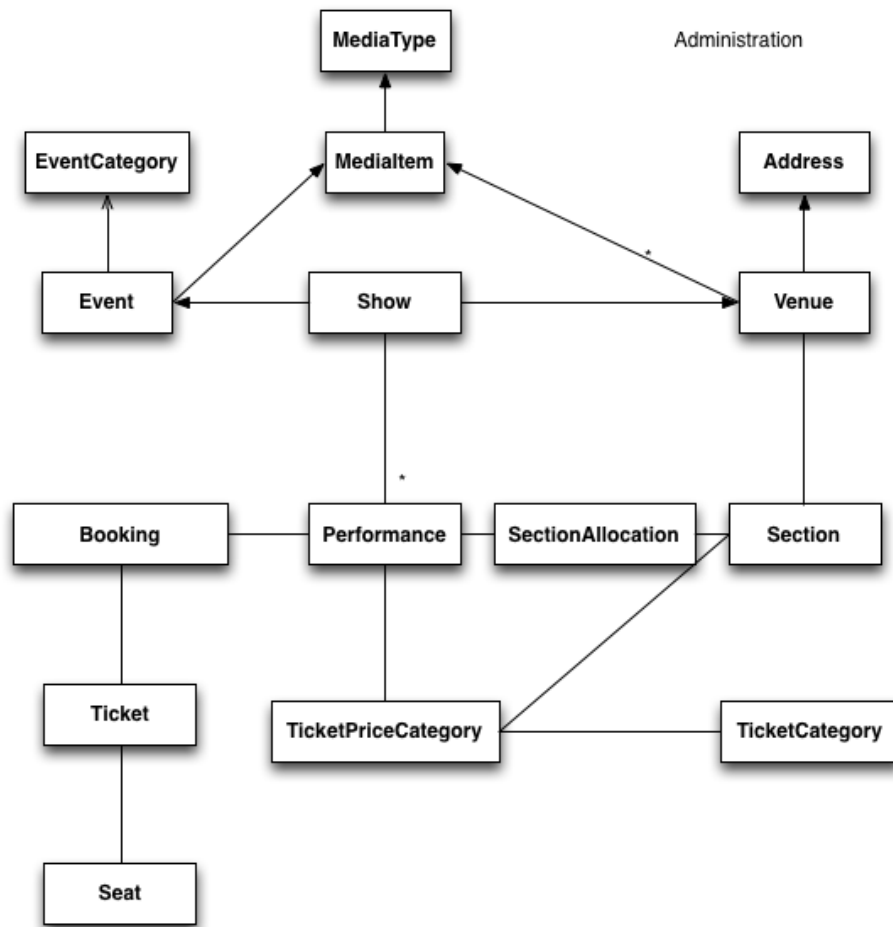


Figure 66.1: Entity-Relationship Diagram

Show happens to be the central entity from which we can reach Event, Venue as well as price and date information for each Performance. That will be the entity we will start indexing from.

Let's make Show indexed by adding an `@Indexed` annotation. We also want to index the associated Event and Venue when a given Show is indexed. For that, we will mark each association as `@IndexedEmbedded`.

src/main/java/org/jboss/jdf/example/ticketmonster/model/Show.java

```
...

@SuppressWarnings("serial")
@Entity
@Table(uniqueConstraints = @UniqueConstraint(columnNames = { "event_id", "venue_id" }))
@Indexed
public class Show implements Serializable {

    /* Declaration of fields */

    /**
     * The synthetic id of the object.
     */
    @Id
    @GeneratedValue(strategy = IDENTITY)
    private Long id;
```

```
/**
 * <p>
 * The event of which this show is an instance. The <code>@ManyToOne<code> JPA mapping
 establishes this relationship.
 * </p>
 *
 * <p>
 * The <code>@NotNull</code> Bean Validation constraint means that the event must be
 specified.
 * </p>
 */
@ManyToOne
@NotNull
@IndexedEmbedded
private Event event;

/**
 * <p>
 * The venue where this show takes place. The <code>@ManyToOne<code> JPA mapping
 establishes this relationship.
 * </p>
 *
 * <p>
 * The <code>@NotNull</code> Bean Validation constraint means that the venue must be
 specified.
 * </p>
 */
@ManyToOne
@NotNull
@IndexedEmbedded
private Venue venue;

...
}
```

Next, we need to index the Event name and description. To make a property as indexed, use the @Field annotation.

src/main/java/org/jboss/jdf/example/ticketmonster/model/Event.java

```
...

@SuppressWarnings("serial")
@Entity
public class Event implements Serializable {

    ...

    @Column(unique = true)
    @NotNull
    @Size(min = 5, max = 50, message = "An event's name must contain between 5 and 50
 characters")
    @Field
    private String name;

    ...

    @NotNull
    @Size(min = 20, max = 1000, message = "An event's description must contain between 20 and
 1000 characters")
    @Field
    private String description;
```



```
    ...
}
```

What's in a name?

By default, each entity type is indexed in a dedicated Apache Lucene *index*. An index is made of a set of *documents*. Each document contains *fields* which are made of a name and a value. You can think of a document as a `Map<String, String>`. Of course the structure of the index is vastly different to make searches fast. Now you understand where `@Indexed` and `@Field` come from.

Do the same for `Venue` and mark the `name` attribute as `@Field`. Now when a `Show` is created or modified, the index will be updated and will contain the show's event name and description as well as the venue name.

But what about existing shows in our database? How can we index them?

66.1.2 Indexing existing data

For initial indexing (or reindexing), Hibernate Search offers an API: `MassIndexer`. It reindexes all entities of a given type quickly. Let's create a service that will call `MassIndexer` to reindex our data when the application starts. That is convenient during development time.

src/main/java/org/jboss/jdf/example/ticketmonster/service/Bootstrap.java

```
@Singleton
@Startup
public class Bootstrap {
    @Inject private EntityManager em;
    @Inject private Logger logger;

    @PostConstruct
    public void onStartup() {
        try {
            logger.info("Indexing entities");
            FullTextEntityManager ftem = Search.getFullTextEntityManager(em);
            ftem.createIndexer().purgeAllOnStart(true).startAndWait();
        } catch (InterruptedException e) {
            logger.severe("Unable to index data with Hibernate Search");
        }
    }
}
```

The Hibernate Search APIs are accessible via `FullTextEntityManager`, a simpler wrapper around the `EntityManager` you use to manage the entities. The `MassIndexer` API is a fluent API letting you refine what entities you want to reindex, with how many threads, synchronously or asynchronously etc. But the simple usage is good enough for most cases.

We now have indexed entities, it is time to write our query engine.

66.2 Writing the search engine

Since the application makes use of rich clients, we will expose our search service via a REST endpoint. In it, we will retrieve a `FullTextEntityManager` - the entry point for Hibernate Search and our way to write the search engine.

src/main/java/org/jboss/jdf/example/ticketmonster/rest/search/SearchService.java

```
@Stateless
@Path("/search")
public class SearchService {
```

```
@Inject
EntityManager em;
@Inject
Logger logger;

@GET
@Produces(MediaType.APPLICATION_JSON)
public ShowResults search(@QueryParam("query") String searchString) {
    FullTextEntityManager ftem = Search.getFullTextEntityManager(em);
    return null;
}
}
```

src/main/java/org/jboss/jdf/example/ticketmonster/rest/search/ShowResults.java

```
public class ShowResults {
    private List<ShowView> results;

    public ShowResults(List<ShowView> results) {
        this.results = results;
    }

    public List<ShowView> getResults() {
        return results;
    }
}
```

src/main/java/org/jboss/jdf/example/ticketmonster/rest/search/ShowView.java

```
public class ShowView {
    private Long eventId;
    private String eventName;
    private String eventDescription;
    private String eventCategory;
    private String venueName;

    public ShowView(Show show) {
        this.eventId = show.getEvent().getId();
        this.eventName = show.getEvent().getName();
        this.eventDescription = show.getEvent().getDescription();
        this.eventCategory = show.getEvent().getCategory().getDescription();
        this.venueName = show.getVenue().getName();
    }

    public Long getEventId() {
        return eventId;
    }

    public String getEventName() {
        return eventName;
    }

    public String getEventDescription() {
        return eventDescription;
    }

    public String getEventCategory() {
        return eventCategory;
    }

    public String getVenueName() {
```

```
        return venueName;
    }
}
```

We could have returned a list of `Show` to our endpoint but since `Show` is linked to many other entities, we will instead return a list of `ShowView` only containing the relevant information. We will save bandwidth, database load and increase responsiveness. We could also return a simple list of `ShowView` but preparing for the future extension of our search engine, we will wrap than list in a `ShowResults` object.

Writing a full-text query is composed of a few phases:

- build an Apache Lucene query
- build an object query wrapping the Lucene query
- execute the query

66.2.1 Build the Apache Lucene query

Our first step is to write the core full-text query. We will use Hibernate Search query DSL for this. Every query starts from a `QueryBuilder` for a given entity type. From a `QueryBuilder` we can define a specific query (keyword, phrase, range etc) on one or several fields and a few options (boost, fuzziness etc).

By default, a property annotated `@Field` has a corresponding field named after the property. When embedding associations in the index, you can use the usual dot notation: starting from a `Show`, you can look for the event name via the following path `event.name`.

Here we will focus on keyword queries - queries looking for specific terms - on a few fields of event and venue. Since a matching term on an event name seems more important than on an event description, we use different boost values to give them different weight in the ranking system. And if the query string provided by the user is empty, we will return all elements.

src/main/java/org/jboss/jdf/example/ticketmonster/rest/search/SearchService.java

```
...

@GET
@Produces(MediaType.APPLICATION_JSON)
public ShowResults search(@QueryParam("query") String searchString) {
    FullTextEntityManager ftem = Search.getFullTextEntityManager(em);

    QueryBuilder qb = ftem.getSearchFactory()
        .buildQueryBuilder()
        .forEntity>Show.class)
        .get();

    Query luceneQuery = buildLuceneQuery(searchString, qb);

    ...
}

private Query buildLuceneQuery(String searchString, QueryBuilder qb) {
    Query luceneQuery;
    if (searchString.isEmpty()) {
        // Return all terms
        luceneQuery = qb.all().createQuery();
    }
    else {
        // Find the terms of searchString with terms in event.name (weight of 10),
        // event.description (weight of 1) and venue.name (weight of 5)
        luceneQuery = qb
            .keyword()
            .onField("event.name").boostedTo(10f)
    }
}
```

```

        .andField("event.description")
        .andField("venue.name").boostedTo(5f)
        .matching(searchString)
        .createQuery();
    }
    return luceneQuery;
}
...

```

Different ways to write a Lucene query

There are several ways to express the core of your full-text query:

- native Lucene query APIs
- Lucene query parser
- Hibernate Search query DSL

The Hibernate Search query DSL has several advantages:

- it is easy to use, easier to write
- it offers a great deal of query expressiveness
- it generates raw Lucene queries that can be combined
- it is at the domain object level (not the index level) and thus deals with analyzers and property value conversion transparently

Next we need to wrap that query into the Hibernate Search full-text query.

66.2.2 Build the object query

Hibernate ORM offers several ways of querying your database (JP-QL, native SQL queries, criteria query). Think of Hibernate Search full-text queries as another approach. Even the API is similar and interchangeable. Objects returned by Hibernate Search queries are managed objects just like object returned by a JP-QL query.

The object query is created from the `FullTextEntityManager.createQuery()` passing the Lucene query and the (list of) entity type we are interested in. Our query would return a list of `Show` out of the box, but we really want a list of `ShowResult`. To do that, we use an Hibernate ORM `ResultTransformer` and apply it to the query.

src/main/java/org/jboss/jdf/example/ticketmonster/rest/search/SearchService.java

```

...

@GET
@Produces(MediaType.APPLICATION_JSON)
public ShowResults search(@QueryParam("query") String searchString) {
    FullTextEntityManager ftem = Search.getFullTextEntityManager(em);
    QueryBuilder qb = ftem.getSearchFactory()
        .buildQueryBuilder()
        .forEntity>Show.class)
        .get();

    Query luceneQuery = buildLuceneQuery(searchString, qb);

    FullTextQuery objectQuery = ftem.createQuery(luceneQuery,>Show.class);
    objectQuery.setResultTransformer>ShowViewResultTransformer.INSTANCE);
}

```

```

        List<ShowResult> results = (List<ShowResult>) objectQuery.getResultList();
        return new ShowResults(results);
    }

    ...

```

src/main/java/org/jboss/jdf/example/ticketmonster/rest/search/ShowViewResultTransformer.java

```

/**
 * Converts a list of Show into a list of ShowView.
 *
 * @author Emmanuel Bernard
 */
public class ShowViewResultTransformer implements ResultTransformer {
    public static ShowViewResultTransformer INSTANCE = new ShowViewResultTransformer();

    @Override
    public Object transformTuple(Object[] tuple, String[] aliases) {
        return tuple;
    }

    @Override
    public List transformList(List collection) {
        List<ShowView> results = new ArrayList<ShowView>(collection.size());
        for (Show show : (List<Show>) collection) {
            results.add(new ShowView(show));
        }
        return results;
    }
}

```

That's it! We have a fully functional search engine. Now it is time to expose it to our user.

What's in a query?

A `FullTextQuery` is literally a subclass of the `JPA Query` class. You have access to all of its capability, in particular pagination!

It also offers additional methods. To name a few:

- `getResultSize()`: get the number of matching elements (regardless of pagination) ; this operation is very efficient.
- `getSort()`: sort results explicitly instead of by relevance.
- `setProjection()`: return projected fields instead of managed entities ; this does not hit the database at all.

66.3 Exposing search to the UI

We have seen previously in this tutorial how to write the UI part of a backbone.js application. So this section will go a tiny bit faster and give you the end result.

Let's first define a model for the results we will receive from the search REST endpoint. This model will also be responsible for computing the application URL exposed for bookmarkability.

src/main/webapp/resources/js/app/models/results.js

```

/**
 * Module for the query results model
 */
define([

```

```

    'configuration',
    'backbone'
], function (config) {
    /**
     * The Results model class definition
     */
    var Results = Backbone.Model.extend({
        urlRoot: config.baseUrl + 'rest/search', // the URL for performing CRUD operations
        initialize : function() {
            _.bindAll(this, "fetch");
            _.bindAll(this, "appUrl");
        },

        // the URL with params to reach the REST endpoint
        url: function() {
            params = '?query=' + encodeURIComponent(this.get("query"));
            return this.urlRoot + params;
        },

        // the application URL as exposed by the application for bookmarkability
        appUrl: function() {
            result = "search/anywhere/";
            var query = this.get("query");
            result += encodeURIComponent(query);
            return result;
        }
    });

    // export the Results class
    return Results;
});

```

Now that we have a model bound to our backend, we need a view to expose the results to the user.

src/main/webapp/resources/js/app/views/results.js

```

define([
    'utilities',
    'require',
    'text!../../../../templates/desktop/results.html',
    'configuration',
    'bootstrap'
], function (
    utilities,
    require,
    resultsTemplate,
    config,
    Bootstrap) {

    var ResultsView = Backbone.View.extend({

        events:{
        },

        initialize:function () {
            this.model.bind('change', this.render, this);
        },

        render:function () {
            $(this.el).empty();
            this.delegateEvents();
            utilities.applyTemplate($(this.el), resultsTemplate, {model:this.model,
            query:this.model.get("query")});
        }
    });

```

```

        return this;
    }
    });
    return ResultsView;
});

```

src/main/webapp/resources/templates/desktop/results.html

```

<h3 class="page-header light-font special-title">Results for <%=query%></h3>
<div class="row-fluid">
  <div class='span12'>
    <table class='table table-bordered' style="background: #ffffffa;">
      <thead>
        <tr>
          <th>Event</th>
          <th>Venue</th>
        </tr>
      </thead>
      <tbody id='bookingList'>
        <% _.each(model.get("results"), function (result) { %>
          <tr>
            <td><a href="#events/<%=result.eventId%>"><%=result.eventName%></a></td>
            <td><%=result.venueName%></td>
          </tr>
        <% }); %>
      </tbody>
    </table>
  </div>
</div>

```

Note that we do retrieve the actual query from the model (query parameter) and pass it to the template for display. We will need to fill query from the router. Speaking of the devil, let's add the necessary routes to trigger a query.

src/main/webapp/resources/js/app/router/desktop/router.js

```

...
define("router", [
  ...,
  'app/models/results',
  ...,
  'app/views/desktop/results',
  'text!../templates/desktop/main.html'
], function ($,
  ...,
  Results,
  ...,
  ResultsView,
  MainTemplate) {

  ...

  var Router = Backbone.Router.extend({
    routes:{
      ...,
      "search/anywhere/:query": "results",
      ...
    },
    ...,
    results:function (query) {
      var model = new Results();
      model.set("query", decodeURIComponent(query));
      var resultsView = new ResultsView({model:model, el:$("#content"), router:this});
    }
  });
}

```

```

        model.bind("change",
            function () {
                utilities.viewManager.showView(resultsView);
            }).fetch();
    }
});

...

return router;
});

```

We need to do one more thing. Somehow the query URL (e.g. #search/anywhere/morrison) needs to be called. Let's add a search box in the top menu and have it call that URL.

src/main/webapp/resources/templates/desktop/main.html

```

...

<ul class="nav">
    <li><a href="#about">About</a></li>
    <li><a href="#events">Events</a></li>
    <li><a href="#venues">Venues</a></li>
    <li><a href="#bookings">Bookings</a></li>
    <li><a href="#monitor">Monitor</a></li>
    <li><a href="#admin">Administration</a></li>
</ul>
<script type="text/javascript">
    //
        function get_results(event)
        {
            event.preventDefault();
            location.href = "#search/anywhere/" +
escape(document.searchbox.query.value);
            return false;
        }
    //]]&gt;
&lt;/script&gt;
&lt;form id="searchbox" name="searchbox" class="navbar-search pull-right"
onsubmit="return get_results(event)"&gt;
    &lt;input id="query" name="query" class="search-query" type="text"
placeholder="Search"/&gt;
&lt;/form&gt;
...
</pre>
</div>
<div data-bbox="90 673 654 689" data-label="Text">
<p>This concludes our work to get the core search engine built and exposed via the UI.</p>
</div>
<div data-bbox="90 694 800 710" data-label="Text">
<p>Our next step is to improve the search results by offering the ability to filter results by the user's location.</p>
</div>
```


Chapter 67

Filter results by location

Let's face it, driving more than 50 kilometers - or 30 miles for our imperial friends - to go to an event is quite uncommon. We will offer the ability to filter results to venues within a given radius and luckily for us, Hibernate Search offer such functionality very easily. Let's first work on the backend from the REST endpoint down to the actual Hibernate Search query. But first, let's make sure we index the geographical position of a venue.

Coordinates are provided as doubles representing the latitude and longitude hosted on the `Address` object associated with a venue. To make sure it is indexed, we need to add a spatial index field, link it to the coordinate properties and make sure `Address` is indexed when `Venue` is. `@Spatial` is the annotation describing a spatial field while `@Latitude` and `@Longitude` link properties to a spatial field.

src/main/java/org/jboss/jdf/example/ticketmonster/model/Venue.java

```
@SuppressWarnings("serial")
@Entity
public class Venue implements Serializable {
    ...

    /**
     * The address of the venue
     */
    @IndexedEmbedded
    private Address address = new Address();

    ...
}
```

src/main/java/org/jboss/jdf/example/ticketmonster/model/Address.java

```
@SuppressWarnings("serial")
@Embeddable
@Spatial(name="coordinates", spatialMode=SpatialMode.GRID)
public class Address implements Serializable {

    /* Declaration of fields */
    private String street;
    private String city;
    private String country;
    @Latitude(of="coordinates")
    private double latitude;
    @Longitude(of="coordinates")
    private double longitude;

    ...
}
```

The `@Spatial` field is named `coordinates` and the name is used to match the corresponding `@Latitude` and `@Longitude`.

Types of spatial indexes

You can index and query spatial data in two fashions:

`SpatialMode.RANGE` index latitude and longitude and use two combined range queries

`SpatialMode.GRID` use a grid index which translates latitude and longitude into a grid number and use a simple term query

The former is fine as long as you have less than 100k point of interests. The latter will scale better but take a bit more space in your index. You can get more information from the [Hibernate Search documentation](#).

Now that the location is indexed, let's receive the user location from the REST endpoint and adjust our Hibernate Search query to restrict results to a specific area. The Hibernate Search query DSL offers the tools to write the geolocalized - or spatial - queries as well as the ability to compose bits of queries together.

src/main/java/org/jboss/jdf/example/ticketmonster/rest/search/SearchService.java

```
@Stateless
@Path("/search")
public class SearchService {

    ...

    @GET
    @Produces(MediaType.APPLICATION_JSON)
    public ShowResults search(@QueryParam("query") String searchString,
        @QueryParam("latitude") Double latitude, @QueryParam("longitude") Double longitude) {

        ...

        Query luceneQuery = buildLuceneQuery(searchString, latitude, longitude, qb);

        ...

    }

    private Query buildLuceneQuery(String searchString, Double latitude, Double longitude,
        QueryBuilder qb) {
        Query luceneQuery;
        Query termsQuery;
        if (searchString.isEmpty()) {
            // Return all terms
            termsQuery = qb.all().createQuery();
        }
        else {
            // Find the terms of searchString with terms in event.name (weight of 10),
            // event.description (weight of 1) and venue.name (weight of 3)
            termsQuery = qb.keyword()
                .onField("event.name").boostedTo(10f)
                .andField("event.description")
                .andField("venue.name").boostedTo(5f)
                .matching(searchString)
                .createQuery();
        }
        if (latitude != null && longitude != null) {
            Query localQuery = qb.spatial()
                .onCoordinates("venue.address.coordinates")
```

```

        .within(50, Unit.KM)
        .ofLatitude(latitude).andLongitude(longitude)
        .createQuery();
    luceneQuery = qb.bool()
        .must(termsQuery)
        .must(localQuery)
        .createQuery();
    }
    else {
        luceneQuery = termsQuery;
    }
    return luceneQuery;
}
}

```

Only the lucene query has changed, the rest of the code remains as it is. If `latitude` and `longitude` are provided, we create a `localQuery` which restricts results to 50 kilometers of the provided coordinates and we use the field hosted on the venue address. The next step is to combine this local query with the term query previously build thanks to a boolean query.

Let's retrieve the latitude and longitude from the user's browser and pass it along to our REST service.

src/main/webapp/resources/js/app/models/results.js

```

...

// the URL with params to reach the REST endpoint
url: function() {
    params = '?query=' + encodeURIComponent(this.get("query"));
    if (typeof this.get("lat") != 'undefined' && typeof this.get("lng") !=
'undefined') {
        params = params + '&latitude=' + encodeURIComponent(this.get("lat")) +
'&longitude=' + encodeURIComponent(this.get("lng"));
    }
    return this.urlRoot + params;
},

// the application URL as exposed by the application for bookmarkability
appUrl: function() {
    result = "search/";
    var query = this.get("query");
    var lat = this.get("lat");
    var lng = this.get("lng");
    if (typeof lat != 'undefined' && typeof lng != 'undefined') {
        result += "around/" + lat + "/" + lng + "/";
    }
    else {
        result += "anywhere/";
    }
    result += encodeURIComponent(query);
    return result;
}

...

```

The `url` function is the URL that calls the REST endpoint while the `appUrl` function is the bookmarkable URL as displayed by the application for a search:

- `search/anywhere/morisson` looks for events all around the world mentioning "morisson"
- `search/around/48.8534100/2.3488000/morisson` looks for events around Paris mentioning "morisson"

Let's add the necessary route corresponding to the local search. The router also needs to set in the model the `lat` and `lng` attributes used by the URL builder methods above.

src/main/webapp/resources/js/app/router/desktop/router.js

```
...

var Router = Backbone.Router.extend({
  routes:{
    ...,
    "search/anywhere/:query":"results",
    "search/around/:lat/:lng/:query":"localResults",
    ...
  },
  ...,
  results:function (query, categoryId, minPriceId) {
    this.localResults(null, null, query);
  },
  localResults:function (lat, lng, query) {
    var model = new Results();
    model.set("query", decodeURIComponent(query));
    if (lat != null) {
      model.set("lat", lat);
    }
    if (lng != null) {
      model.set("lng", lng);
    }
    var resultsView = new ResultsView({model:model, el:$("#content"), router:this});
    model.bind("change",
      function () {
        utilities.viewManager.showView(resultsView);
      }).fetch();
  }
});

...
```

Finally let's retrieve the user coordinates from the user's browser and use it in our queries if the user ticks the *around me* checkbox. This is fairly easy and standard to do in JavaScript. The example here is a bit verbose as we made sure to have proper fallback to a generic query if the browser does not give us the coordinates (inability to find them, user does not accept to be geolocalized, etc.).

src/main/webapp/resources/templates/desktop/main.html

```
...

<ul class="nav">
  <li><a href="#about">About</a></li>
  <li><a href="#events">Events</a></li>
  <li><a href="#venues">Venues</a></li>
  <li><a href="#bookings">Bookings</a></li>
  <li><a href="#monitor">Monitor</a></li>
  <li><a href="admin">Administration</a></li>
</ul>
<script type="text/javascript">
  <![CDATA[
    function get_results(event)
    {
      event.preventDefault();
      if (document.searchbox.local.checked && navigator.geolocation)
      {
        options = {
          maximumAge: 6000000 // milliseconds (100 minutes)
        }
      }
    }
  ]]>
</script>
```

```
        navigator.geolocation.getCurrentPosition(handlePosition,
handleError, options);
        return false;
    }
    else {
        return queryAnywhere();
    }
    function handlePosition(pos)
    {
        return queryLocal(pos.coords);
    }
    function handleError(error)
    {
        return queryAnywhere();
    }
}
function queryAnywhere()
{
    location.href = "#search/anywhere/" +
escape(document.searchbox.query.value);
    return false;
}
function queryLocal(coords)
{
    location.href = "#search/around/" + coords.latitude + '/' +
coords.longitude + '/' + escape(document.searchbox.query.value);
    return false;
}
//]]>
</script>
<form id="searchbox" name="searchbox" class="navbar-search pull-right"
onsubmit="return get_results(event)">
    <input id="query" name="query" class="search-query" type="text"
placeholder="Search"/>
    <input name="local" type="checkbox">around me</input>
</form>
...

```

Chapter 68

Enable and expose navigation by facets

This feature is by far the most complex to add but brings a significant boost to usability. The user will be able to refine a query with facets automatically computed and suggested. In practice, it helps a user to refine a query to find what he is looking for.

What is a facet?

Faceting offers a way to categorize the results of a query based on selected dimensions:

- by price range
- by average comment notes
- by brand
- ...

A facet is a given brand, a given price range and each facet can display the number of matching results.

In our case, we want to see our results:

- by category (concert, etc)
- by minimum price range

Let's split our work in a few steps:

- indexing the necessary data
- create the faceting requests
- return the list of facets for the UI to expose them
- upon user selection further filter results by a given facet

68.1 Indexing data for faceting

A facet is aggregated by its exact value so no string tokenization should take place. By default, strings are *analyzed* and split into tokens often corresponding to individual words. For a field used in faceting, we need to disable the analyzing phase. Let's do that for the category description.

`src/main/java/org/jboss/jdf/example/ticketmonster/model/EventCategory.java`

```

...
@SuppressWarnings("serial")
@Entity
public class EventCategory implements Serializable {

    ...

    @Column(unique=true)
    @NotEmpty
    @Field(analyze=Analyze.NO)
    private String description;

    ....
}

```

Also add `@IndexedEmbedded` on `Event.category`.

Next, we want to index the minimum price for a given `Show`. Since shows only contain a set of `TicketPrice`, we need to apply some transformation before indexing the information. Hibernate Search's field bridges are a way to massage your data before indexing. They take a property value and describe how the data is ultimately indexed. In our case, we will take the set of prices, find the minimum price and index it. A field bridge is declared with a `@FieldBridge` annotation. Since our field is not represented by the object model, we will give it an artificial name: `ticketPrices.min`. We will use this later in our query.

src/main/java/org/jboss/jdf/example/ticketmonster/model/Show.java

```

...

@OneToMany(mappedBy = "show", cascade = ALL, fetch = EAGER)
@Field(name="ticketPrices.min", analyze=Analyze.NO,
      bridge=@FieldBridge(impl=PriceMinBridge.class))
private Set<TicketPrice> ticketPrices = new HashSet<TicketPrice>();

...

```

src/main/java/org/jboss/jdf/example/ticketmonster/model/search/PriceMinBridge.java

```

/**
 * Find the minimum price for a give show and index it.
 *
 * @author Emmanuel Bernard <emmanuel@hibernate.org>
 */
public class PriceMinBridge extends NumericFieldBridge {

    @Override
    public Object get(String name, Document document) {
        return Float.valueOf( document.getFieldable( name ).stringValue() );
    }

    @Override
    public void set(String name, Object value, Document document, LuceneOptions
luceneOptions) {
        if (value != null) {
            float min = Float.MAX_VALUE;
            for (TicketPrice price : (Set<TicketPrice>) value) {
                float current = price.getPrice();
                if (current < min) {
                    min = current;
                }
            }
            luceneOptions.addNumericFieldToDocument(name, min, document);
        }
    }
}

```

```
}
```

Since we want to store a numerical value, we did extend `NumericFieldBridge`. Check out the [Hibernate Search documentation](#) for more details on field bridges.

Now is the time to look at our faceting query.

68.2 Create the faceting requests

Expressing the faceting requests is easy. We will use the query DSL to create a faceting request for each facet group, and then associate each faceting request to the Hibernate Search query.

Faceting groups can be of two types:

discrete	each value found for a given field are considered a facet value
range	a pre-defined set of ranges are created and results are broken down by them

You can refine facet groups a bit, for example:

- should facets with zero results be returned
- how facets should be ordered for a given facet group (by field value, by range definition etc)

src/main/java/org/jboss/jdf/example/ticketmonster/rest/search/SearchService.java

```
...

@Produces(MediaType.APPLICATION_JSON)
public ShowResults search(@QueryParam("query") String searchString,
    @QueryParam("latitude") Double latitude, @QueryParam("longitude") Double longitude) {
    ...

    Query luceneQuery = buildLuceneQuery(searchString, latitude, longitude, qb);
    FullTextQuery objectQuery = ftem.createFullTextQuery(luceneQuery, Show.class);

    enableFaceting(qb, objectQuery);

    objectQuery.setResultTransformer(ShowViewResultTransformer.INSTANCE);

    ShowResults results = buildResultObject(objectQuery);
    return results;
}

private void enableFaceting(QueryBuilder qb, FullTextQuery objectQuery) {
    FacetingRequest categoryFaceting = qb.facet()
        .name("category")
        .onField("event.category.description")
        .discrete()
        .includeZeroCounts(true)
        .orderBy(FacetSortOrder.FIELD_VALUE)
        .createFacetingRequest();
    FacetingRequest priceFaceting = qb.facet()
        .name("price")
        .onField("ticketPrices.min")
        .range()
        .below(50f).excludeLimit()
```



```

        .from(50f).to(100f).excludeLimit()
        .from(100f).to(200f).excludeLimit()
        .above(200f)
        .includeZeroCounts(true)
        .orderBy(FacetSortOrder.RANGE_DEFINITION_ORDER)
        .createFacetingRequest();

objectQuery.getFacetManager().enableFaceting(categoryFaceting).enableFaceting(priceFaceting);
}

...

```

68.3 Return the faceting information

Our next step is to expose the facets to the UI by adding `FacetGroupView` and `FacetView` representations to the returned `ShowResults` and fill these structures with the faceting information provided by Hibernate Search. From an Hibernate Search query, we can access `FacetManager` containing all faceting related information. In particular:

- `FacetManager.getFacets(String)` provides the list of `Facet` for a given group
- `FacetManager.getFacetGroup(String)` offers ways to select / unselect and query selected facets for a given group

Our `FacetView` knows whether or not it has been selected. We do compute that state from the `FacetManager`.

src/main/java/org/jboss/jdf/example/ticketmonster/rest/search/FacetGroupView.java

```

/**
 * Represent a facet group exposing its facial name, its identifier
 * and the list of associated facet values.
 *
 * @author Emmanuel Bernard
 */
public class FacetGroupView {
    private String name;
    private String id;
    private List<FacetView> facets = new ArrayList<FacetView>();

    public FacetGroupView(String name, FacetManager fm, String facetingName) {
        this.name = name;
        this.id = facetingName;
        for(Facet facet : fm.getFacets(facetingName)) {
            boolean selected =
fm.getFacetGroup(facetingName).getSelectedFacets().contains(facet);
            facets.add(new FacetView(facet, selected));
        }
    }

    public String getName() {
        return name;
    }

    public List<FacetView> getFacets() {
        return facets;
    }

    public void addFacet(FacetView facet) {
        facets.add(facet);
    }
}

```

```
public String getId() {
    return id;
}

public boolean isWithSelectedFacet() {
    for(FacetView facet : facets) {
        if (facet.isSelected()) {
            return true;
        }
    }
    return false;
}
}
```

src/main/java/org/jboss/jdf/example/ticketmonster/rest/search/FacetView.java

```
/**
 * Represent a facet with its value, the number of matching results and
 * whether or not the user has selected it.
 *
 * @author Emmanuel Bernard
 */
public class FacetView {
    private String value;
    private int count;
    private boolean selected;

    public FacetView(Facet facet, boolean selected) {
        this.value = facet.getValue();
        this.count = facet.getCount();
        this.selected = selected;
    }

    public String getValue() {
        return value;
    }

    public void overrideValue(String value) {
        this.value = value;
    }

    public int getCount() {
        return count;
    }

    public boolean isSelected() {
        return selected;
    }
}
```

src/main/java/org/jboss/jdf/example/ticketmonster/rest/search/SearchService.java

```
...

private ShowResults buildResultObject(FullTextQuery objectQuery) {
    ShowResults results = new ShowResults(objectQuery.getResultList());
    FacetManager fm = objectQuery.getFacetManager();
    FacetGroupView facetGroup = new FacetGroupView("Category", fm, "category");
    results.addFacetGroup(facetGroup);
    facetGroup = new FacetGroupView("Starting price", fm, "price");
    for(int index = 0 ; index < facetGroup.getFacets().size() ; index++) {
        FacetView facet = facetGroup.getFacets().get(index);
    }
}
```

```

        facet.overrideValue(PRICE_FACET_VALUES[index]);
    }
    results.addFacetGroup(facetGroup);
    return results;
}

private static String[] PRICE_FACET_VALUES = new String[] { "below $50", "$50 to $100",
"$100 to $200", "above $200" };

...

```

Since we want to control how price range is displayed in the UI, we have created an array representing the target text (PRICE_FACET_VALUES). Expect something integrated in Hibernate Search in the near future.

68.4 Selecting a facet

To make faceting fully functional, the user needs to be able to select one or several facets. Let's add the ability to pass the selected facets to our REST endpoint and act upon it.

src/main/java/org/jboss/jdf/example/ticketmonster/rest/search/SearchService.java

```

...

@GET
@Produces(MediaType.APPLICATION_JSON)
public ShowResults search(@QueryParam("query") String searchString,
    @QueryParam("latitude") Double latitude, @QueryParam("longitude") Double longitude,
    @QueryParam("categoryfacet") Integer categoryFacetId, @QueryParam("minpricefacet")
Integer minPriceFacetId) {
    FullTextEntityManager ftem = Search.getFullTextEntityManager(em);
    QueryBuilder qb =
ftem.getSearchFactory().buildQueryBuilder().forEntity(Show.class).get();

    Query luceneQuery = buildLuceneQuery(searchString, latitude, longitude, qb);

    FullTextQuery objectQuery = ftem.createFullTextQuery(luceneQuery, Show.class);

    enableFaceting(qb, objectQuery);
    enableFacetRestriction(objectQuery, categoryFacetId, minPriceFacetId);

    objectQuery.setResultTransformer(ShowViewResultTransformer.INSTANCE);

    ShowResults results = buildResultObject(objectQuery);
    return results;
}

...

private void enableFacetRestriction(FullTextQuery objectQuery, Integer categoryFacetId,
Integer minPriceFacetId) {
    FacetManager fm = objectQuery.getFacetManager();
    if (categoryFacetId != null) {
        Facet selectedFacet = fm.getFacets("category").get(categoryFacetId);
        fm.getFacetGroup("category").selectFacets(selectedFacet);
    }
    if (minPriceFacetId != null) {
        Facet selectedFacet = fm.getFacets("price").get(minPriceFacetId);
        fm.getFacetGroup("price").selectFacets(selectedFacet);
    }
}
}

```

...

We are done on the backend side. Let's look at `SearchService` in its entirety as it is the core of our search engine.

src/main/java/org/jboss/jdf/example/ticketmonster/rest/search/SearchService.java

```
/**
 * Service exposed as a REST endpoint and offering full-text search, geolocalized search
 * as well as faceting using Hibernate Search.
 *
 * @author Emmanuel Bernard
 */
@Stateless
@Path("/search")
public class SearchService {
    @Inject
    EntityManager em;
    @Inject
    Logger logger;

    /**
     * REST endpoint for the search engine
     *
     * @param searchString contains the words to search
     * @param latitude (optional) search restricted around latitude
     * @param longitude (optional) search restricted around longitude
     * @param categoryFacetId (optional) selected category facet
     * @param minPriceFacetId (optional) selected price facet
     * @return ShowResults containing the results and the faceting data
     */
    @GET
    @Produces(MediaType.APPLICATION_JSON)
    public ShowResults search(@QueryParam("query") String searchString,
        @QueryParam("latitude") Double latitude, @QueryParam("longitude") Double longitude,
        @QueryParam("categoryfacet") Integer categoryFacetId, @QueryParam("minpricefacet")
        Integer minPriceFacetId) {
        FullTextEntityManager ftem = Search.getFullTextEntityManager(em);
        QueryBuilder qb =
            ftem.getSearchFactory().buildQueryBuilder().forEntity(Show.class).get();

        Query luceneQuery = buildLuceneQuery(searchString, latitude, longitude, qb);

        FullTextQuery objectQuery = ftem.createFullTextQuery(luceneQuery, Show.class);

        enableFaceting(qb, objectQuery);
        enableFacetRestriction(objectQuery, categoryFacetId, minPriceFacetId);

        objectQuery.setResultTransformer(ShowViewResultTransformer.INSTANCE);

        ShowResults results = buildResultObject(objectQuery);
        return results;
    }

    private Query buildLuceneQuery(String searchString, Double latitude, Double longitude,
        QueryBuilder qb) {
        Query luceneQuery;
        Query termsQuery;
        if (searchString.isEmpty()) {
            // Return all terms
            termsQuery = qb.all().createQuery();
        }
    }
}
```

```

    else {
        // Find the terms of searchString with terms in event.name (weight of 10),
        // event.description (weight of 1) and venue.name (weight of 3)
        termsQuery = qb.keyword()
            .onField("event.name").boostedTo(10f)
            .andField("event.description")
            .andField("venue.name").boostedTo(5f)
            .matching(searchString)
            .createQuery();
    }
    if (latitude != null && longitude != null) {
        Query localQuery = qb.spatial()
            .onCoordinates("venue.address.coordinates")
            .within(50, Unit.KM)
            .ofLatitude(latitude).andLongitude(longitude)
            .createQuery();
        luceneQuery = qb.bool()
            .must(termsQuery)
            .must(localQuery)
            .createQuery();
    }
    else {
        luceneQuery = termsQuery;
    }
    return luceneQuery;
}

private ShowResults buildResultObject(FullTextQuery objectQuery) {
    ShowResults results = new ShowResults(objectQuery.getResultList());
    FacetManager fm = objectQuery.getFacetManager();
    FacetGroupView facetGroup = new FacetGroupView("Category", fm, "category");
    results.addFacetGroup(facetGroup);
    facetGroup = new FacetGroupView("Starting price", fm, "price");
    for(int index = 0 ; index < facetGroup.getFacets().size() ; index++) {
        FacetView facet = facetGroup.getFacets().get(index);
        facet.overrideValue(PRICE_FACET_VALUES[index]);
    }
    results.addFacetGroup(facetGroup);
    return results;
}

private void enableFaceting(QueryBuilder qb, FullTextQuery objectQuery) {
    FacetingRequest categoryFaceting = qb.facet()
        .name("category")
        .onField("event.category.description")
        .discrete()
        .includeZeroCounts(true)
        .orderBy(FacetSortOrder.FIELD_VALUE)
        .createFacetingRequest();
    FacetingRequest priceFaceting = qb.facet()
        .name("price")
        .onField("ticketPrices.min")
        .range()
        .below(50f).excludeLimit()
        .from(50f).to(100f).excludeLimit()
        .from(100f).to(200f).excludeLimit()
        .above(200f)
        .includeZeroCounts(true)
        .orderBy(FacetSortOrder.RANGE_DEFINITION_ORDER)
        .createFacetingRequest();

    objectQuery.getFacetManager().enableFaceting(categoryFaceting).enableFaceting(priceFaceting);
}

```

```

private static String[] PRICE_FACET_VALUES = new String[] { "below $50", "$50 to $100",
"$100 to $200", "above $200" };

private void enableFacetRestriction(FullTextQuery objectQuery, Integer categoryFacetId,
Integer minPriceFacetId) {
    FacetManager fm = objectQuery.getFacetManager();
    if (categoryFacetId != null) {
        Facet selectedFacet = fm.getFacets("category").get(categoryFacetId);
        fm.getFacetGroup("category").selectFacets(selectedFacet);
    }
    if (minPriceFacetId != null) {
        Facet selectedFacet = fm.getFacets("price").get(minPriceFacetId);
        fm.getFacetGroup("price").selectFacets(selectedFacet);
    }
}
}

```

We are now ready to expose facets in the UI.

68.5 Exposing faceting to the UI

Integrating faceting and the UI is two-fold:

- display the facets on the query result screen
- re-execute the query if the user has select one or more facets and offer some bookmarkable URL for queries with facet selection

The optionally selected `category` and `price` facet are stored in the model and influence both the REST endpoint URL and the bookmarkable application URL (e.g. `#search/anywhere/morisson/category/all/minprice/1`).

`src/main/webapp/resources/js/app/models/results.js`

```

...

// the URL with params to reach the REST endpoint
url: function() {
    params = '?query=' + encodeURIComponent(this.get("query"));
    if (typeof this.get("lat") != 'undefined' && typeof this.get("lng") !=
'undefined') {
        params = params + '&latitude=' + encodeURIComponent(this.get("lat")) +
'&longitude=' + encodeURIComponent(this.get("lng"));
    }
    if (typeof this.get("category") != 'undefined') {
        params = params + '&categoryfacet=' + this.get("category");
    }
    if (typeof this.get("price") != 'undefined') {
        params = params + '&minpricefacet=' + this.get("price");
    }
    return this.urlRoot + params;
},

// the application URL as exposed by the application for bookmarkability
appUrl: function() {
    result = "search/";
    var query = this.get("query");
    var lat = this.get("lat");
    var lng = this.get("lng");
    var category = this.get("category");

```

```

    var minprice = this.get("price");
    if (typeof lat != 'undefined' && typeof lng != 'undefined') {
        result += "around/" + lat + "/" + lng + "/";
    }
    else {
        result += "anywhere/";
    }
    result += encodeURIComponent(query);
    result += "/category/"
    if (typeof category != 'undefined') {
        result += category;
    }
    else {
        result += 'all';
    }
    result += "/minprice/"
    if (typeof minprice != 'undefined') {
        result += minprice;
    }
    else {
        result += 'all';
    }
    return result;
}

...

```

The view needs to react to clicks on the faceting links and properly update the model before navigating to the appropriate URL
<src/main/webapp/resources/js/app/views/results.js>

```

...

events:{
    "click .faceting": "enableFaceting"
},

initialize:function () {
    this.model.bind('change', this.render, this);
},

render:function () {
    $(this.el).empty();
    this.delegateEvents();
    utilities.applyTemplate($(this.el), resultsTemplate, {model:this.model,
query:this.model.get("query")});
    return this;
},

//called when the user clicks on a faceting link and refresh the model and
application URL
enableFaceting:function (e) {
    var id = $(e.currentTarget).data("id");
    var faceting = id.substring(0, id.lastIndexOf('-'));
    var index = id.substring(id.lastIndexOf('-') + 1);
    if (index == 'all') {
        this.model.unset(faceting);
    }
    else {
        this.model.set(faceting, index);
    }
    this.model.fetch();
}

```

```

        this.options.router.navigate(this.model.appUrl());
        return false;
    }

    ...

```

Let's now display the faceting information as a left sidebar. For each facet group we expose the list of facets, their count and add a link triggering the result refresh when a facet is selected (or cleared).

src/main/webapp/resources/templates/desktop/results.html

```

<h3 class="page-header light-font special-title">Results for <%=query%></h3>
<div class="row-fluid">
    <div class='span3'>
        <div id="itemMenu">
            <% _.each(model.get("facetGroups"), function (facetGroup) { %>
                <div class="facets-group">
                    <div class="facets-heading">
                        <a class="facets-toggle"><%=facetGroup.name%></a>
                    </div>
                    <div class="facets-body in" style="height: auto;">
                        <div class="facets-inner">
                            <%if (facetGroup.withSelectedFacet) { %>
                                <p><a href="#search" class='faceting'
data-id='<%=facetGroup.id%>-all'>(Clear)</a></p>
                                <% } %>
                                <% _.each(facetGroup.facets, function (facet, index, facets) { %>
                                    <% if (facet.selected == true) { %>
                                        <p class='muted'><%=facet.value%> <span
class='badge'><%=facet.count%></span></p>
                                    <% } else { %>
                                        <p><a href="#search" class='faceting'
data-id='<%=facetGroup.id%>-<%=index%>'><%=facet.value%> <span
class='badge'><%=facet.count%></span></a></p>
                                    <% } %>
                                <% }); %>
                            </div>
                        </div>
                    </div>
                <% }); %>
            </div>
        </div>
        <div class='span9'>
            <table class='table table-bordered' style="background: #ffffffa;">
                <thead>
                    <tr>
                        <th>Event</th>
                        <th>Venue</th>
                    </tr>
                </thead>
                <tbody id='bookingList'>
                    <% _.each(model.get("results"), function (result) { %>
                    <tr>
                        <td><a href="#events/<%=result.eventId%>"><%=result.eventName%></a></td>
                        <td><%=result.venueName%></td>
                    </tr>
                    <% }); %>
                </tbody>
            </table>
        </div>
    </div>

```


Let's finally add the necessary routes corresponding to the facet filtering and update the action methods to update the model with the facets selected.

src/main/webapp/resources/js/app/router/desktop/router.js

```
...

routes:{
    ...,
    "search/anywhere/:query":"results",
    "search/anywhere/:query/category/:categoryId/minprice/:priceId":"results",
    "search/around/:lat/:lng/:query":"localResults",

    "search/around/:lat/:lng/:query/category/:categoryId/minprice/:priceId":"localResults",
    ...
},

...,

results:function (query, categoryId, minPriceId) {
    this.localResults(null, null, query, categoryId, minPriceId);
},
localResults:function (lat, lng, query, categoryId, minPriceId) {
    var model = new Results();
    model.set("query", decodeURIComponent(query));
    if (lat != null) {
        model.set("lat", lat);
    }
    if (lng != null) {
        model.set("lng", lng);
    }
    if (typeof(categoryId) != 'undefined' && categoryId != 'all') {
        model.set("category", categoryId);
    }
    if (typeof(minPriceId) != 'undefined' && minPriceId != 'all') {
        model.set("price", minPriceId);
    }
    var resultsView = new ResultsView({model:model, el:$("#content"), router:this});
    model.bind("change",
        function () {
            utilities.viewManager.showView(resultsView);
        }).fetch();
}

...
```

With minimal work, we have added a powerful search engine with geolocalized queries and faceting improve further customer's navigation.

Chapter 69

More resources

To learn more about search and Hibernate Search in particular, take a look at the [Hibernate Search](#) project and its documentation.