

JBoss Forge Hands on Lab

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Introduction

JBoss Forge

It's not so easy to explain what Forge is in a few paragraphs, so we will quote the introduction from [Continuous Enterprise Development](#) (a book):

If you've spent any time developing Java EE-based projects (or any nontrivial application, for that matter!), you've likely invested a good amount of energy in creating the project layout, defining dependencies, and informing the build system of the relevant class paths to be used in compilation and execution. Although Maven enables us to reduce that load as compared with undertaking project setup manually, there's typically quite a bit of boilerplate involved in the *pom.xml* defining your requirements.

JBoss Forge offers an incremental project enhancement for Java EE. Implemented as a command shell and integration with some IDE, Forge gives us the ability to alter project files and folders. Some concrete tasks we might use Forge to handle are:

- Adding Java Persistence API (JPA) entities and describing their model
- Configuring Maven dependencies
- Setting up project scaffolding
- Generating a view layer, reverse-engineered from a domain model
- Deploying to an application server

Because Forge is built atop a modular, plug-in-based architecture, it's extensible to additional tasks that may be specific to your application. Overall, the goal of Forge is to ease project setup at all stages of development, so we'll be employing it in this guide to speed along the construction of our examples.

— Continuous Enterprise Development

What's this lab about?

This hands-on-lab (HoL) should give you a good practical introduction to [JBoss Forge](#). You will first install JBoss Forge, use it and then develop an entire Java EE application and create addons to extend the capabilities of Forge. Forge can either be used within an IDE, or directly in the system

terminal via a command line interface (CLI).

The idea is that you leave this hands on lab (HoL) with a good understanding of what JBoss Forge is, what it is not, and how it can help you in your projects. Then, you'll be prepared to investigate a bit more and, hopefully, [contribute](#).

NOTE | Get this tutorial from <https://github.com/forge/docs/tree/master/tutorials/forge-hol>

How does this lab work?

You have this material in your hands (either [electronically](#) or printed) and you can now follow it step by step or choose any section "à la carte". The structure of this hands on lab is as follow :

- *Installing Forge* : in this section you will install JBoss Forge, either on a standalone mode, or with JBDS (JBoss Developer Studio)
- *Using Forge* : in this section you will play with Forge, create a project, add entities, scaffold a JSF web application, REST endpoints, generate some Arquillian tests and deploy them on WildFly
- *Developing Forge* : in this section you will quickly create a full web application, build forge addons, and use these addons in the application

If you have Forge already installed, skip to the *Using Forge* section and start using it. If you already know JBoss Forge a bit, jump to the section on *Developing Forge* and start hacking some addons. This "à la carte" mode allows you to make the most of this 3 hours long hands on lab.

What do you have to do?

This lab should be as self explanatory as possible. So your job is to follow the instructions by yourself, do what you are supposed to do, and do not hesitate to ask for any clarification or assistance, that's why the team is here. Make sure you have the required software installed (see below) and be ready to have some fun!

Software requirements

The following software needs to be downloaded and installed:

- [JDK 8](#)
- [Maven 3.2.x](#)
- [JBoss Forge 3.0.0.Beta3](#) or higher
- [WildFly 9.0.x](#)

Installing Forge

Installing Forge is a relatively short process, and this section will take you through the fundamentals (providing links to external materials if required); however, if you encounter any issues with this process, please ask in the team.

If you are a command line addict or are more comfortable with a Eclipse, you can choose to install JBoss Forge CLI or JBDS.

Installing Forge CLI

Follow these steps to install a Forge distribution:

- Ensure that you have already installed a [Java 8+ JDK](#).
- [Download](#) and Un-zip Forge into a folder on your hard-disk, this folder will be your `FORGE_HOME`
- Add `$FORGE_HOME/bin` to your path (windows, linux, mac osx)
- Run JBoss Forge by typing the `forge` command in your system terminal.

Windows

Extract the distribution archive, to the directory you wish to install Forge.
Add the `FORGE_HOME` environment variable.

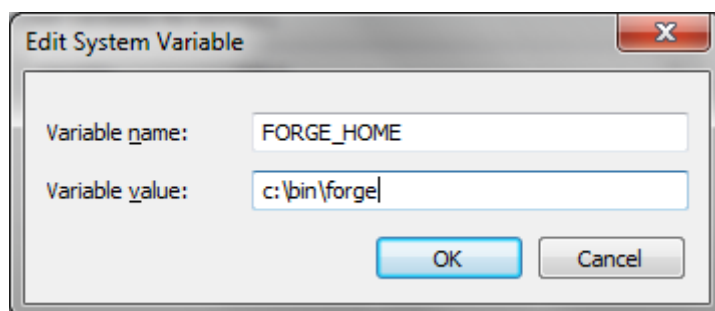


Figure 1. Installing Forge CLI Step 1

In the same dialog, add `%FORGE_HOME%\bin` to the system path.

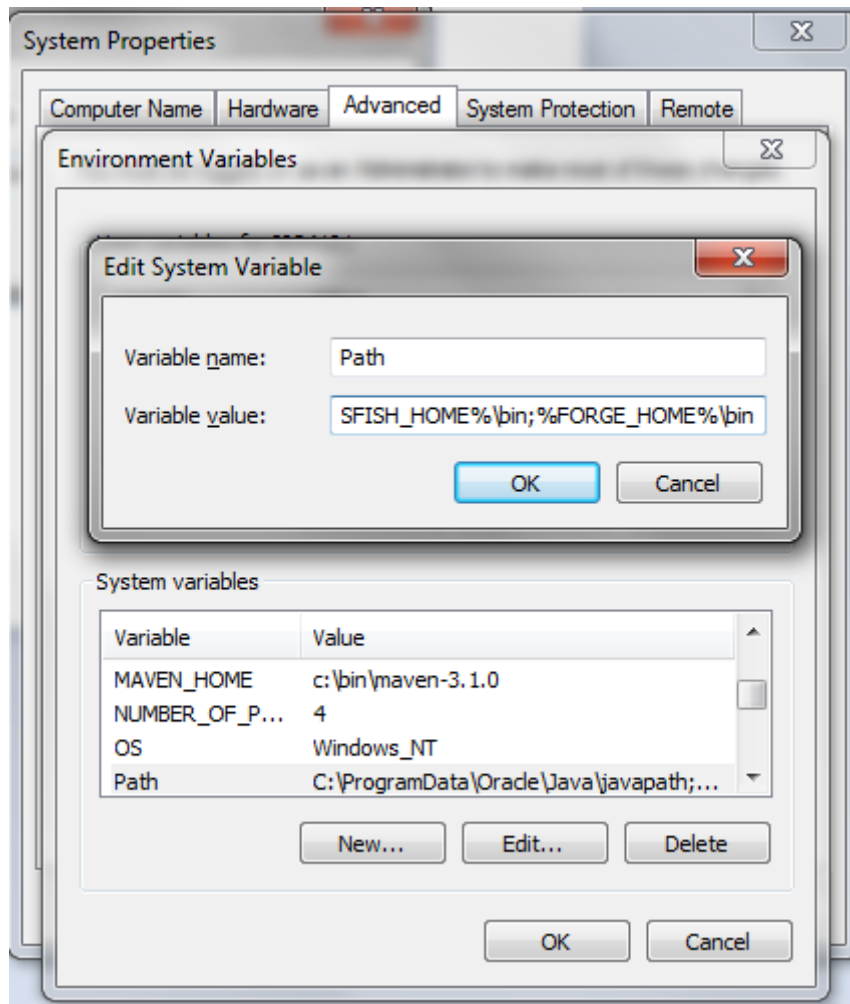


Figure 2. Installing Forge CLI Step 2

Now open a system **cmd** or **command** prompt and run JBoss Forge by typing the **forge** command.

TIP If you have installed Forge 1.x before, make sure to remove all the files from the `~/.forge` directory

Mac OS X or Linux

The easiest way to install Forge is to extract the distribution archive, to the directory you wish to install Forge. In a command terminal, add the **FORGE_HOME** environment variable, e.g:

```
export FORGE_HOME=/usr/local/jboss/forge-distribution-3.0.0.Beta2
```

Add **FORGE_HOME/bin** environment variable to your path, e.g:

```
export PATH=$FORGE_HOME/bin:$PATH
```

You can also install Forge via **cURL**

```
curl http://forge.jboss.org/sh | sh
```

or use Homebrew to install Forge natively, via:

```
brew install jboss-forge
```

Run JBoss Forge by typing the **forge** command in your system terminal.

Installing JBDS 9.0 with EAP

Installing JBDS is a piece of cake. Just download the installer from the [JBoss website](#) and in the target folder you enter:

```
java -jar jboss-devstudio-<version>-installer-eap.jar
```

This will launch the installation process for your platform (Windows, Linux and OSX are supported). The wizard will take you through a number of consecutive steps that are illustrated using screenshots below.

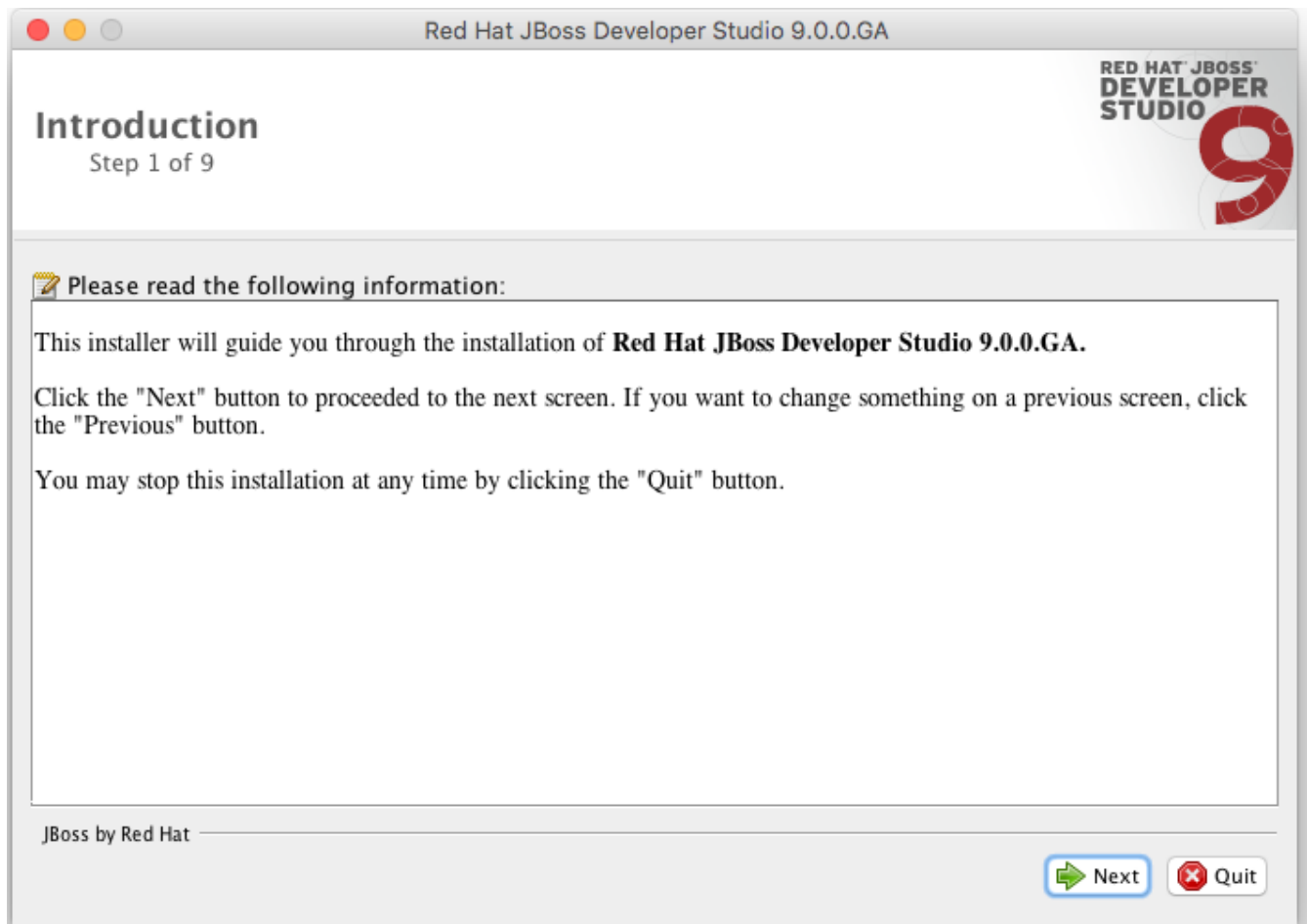


Figure 3. JBDS Installation Step 1



Figure 4. JBDS Installation Step 2

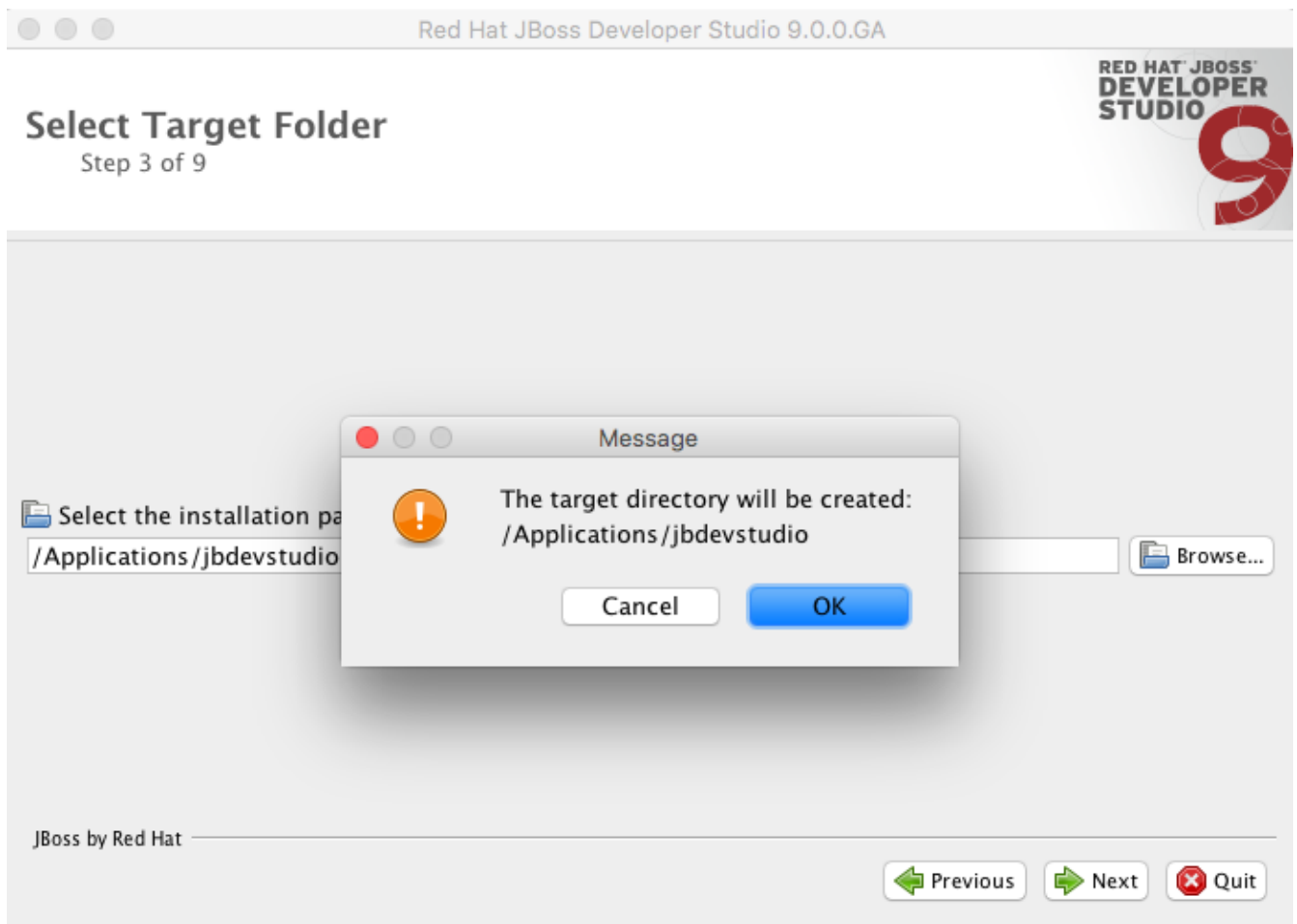


Figure 5. JBDS Installation Step 3



Figure 6. JBDS Installation Step 4

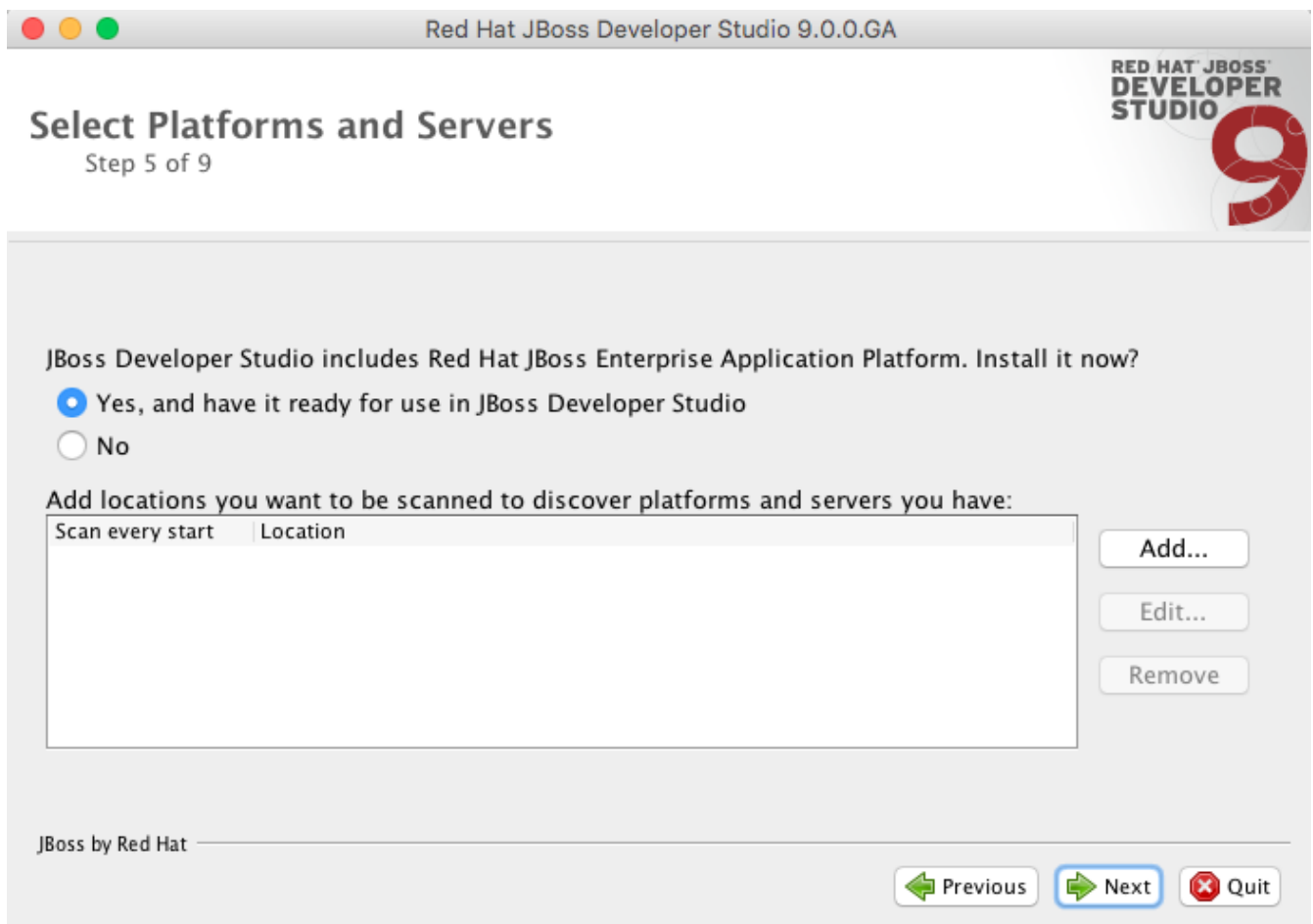


Figure 7. JBDS Installation Step 5



Figure 8. JBDS Installation Step 6

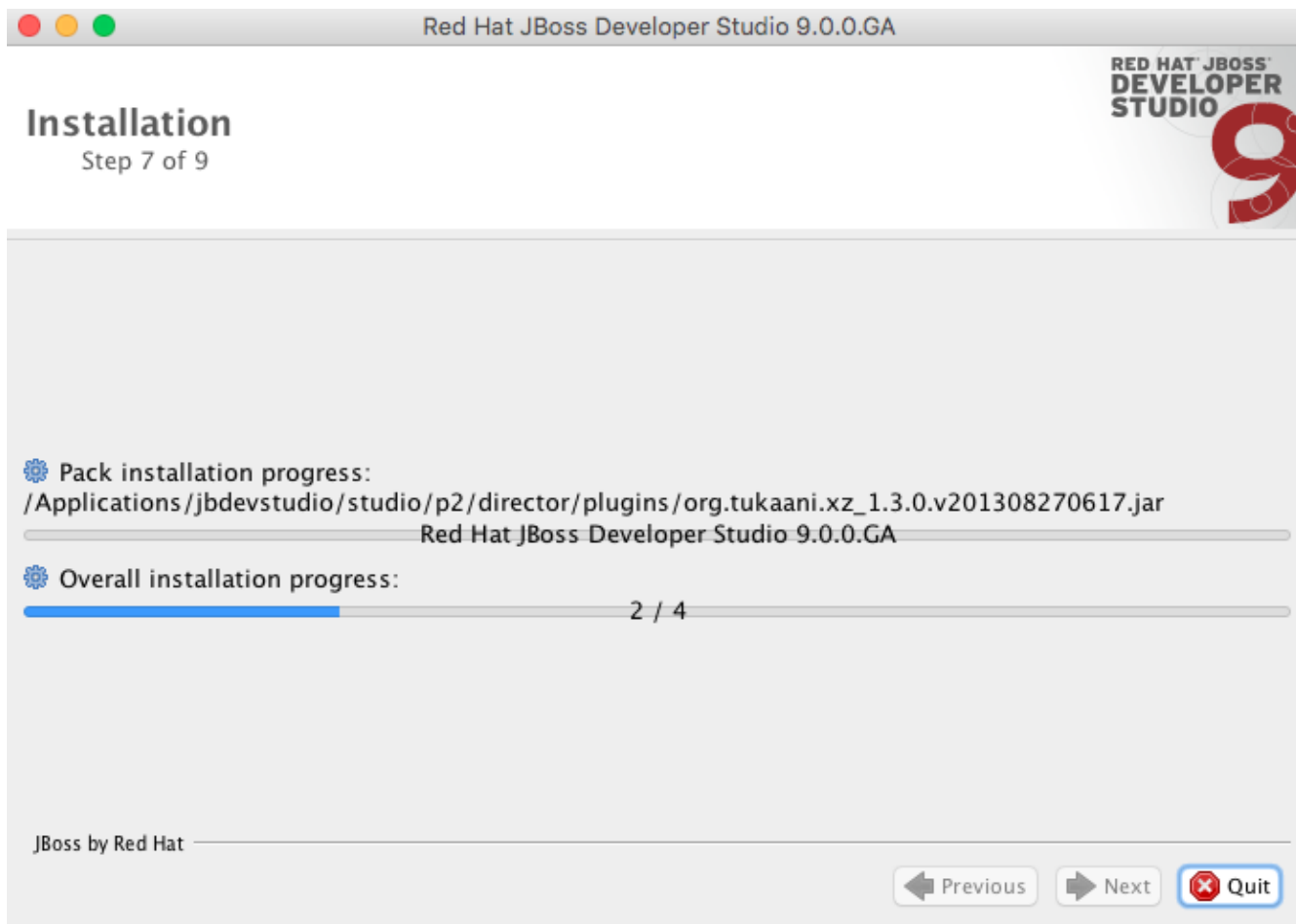


Figure 9. JBDS Installation Step 7

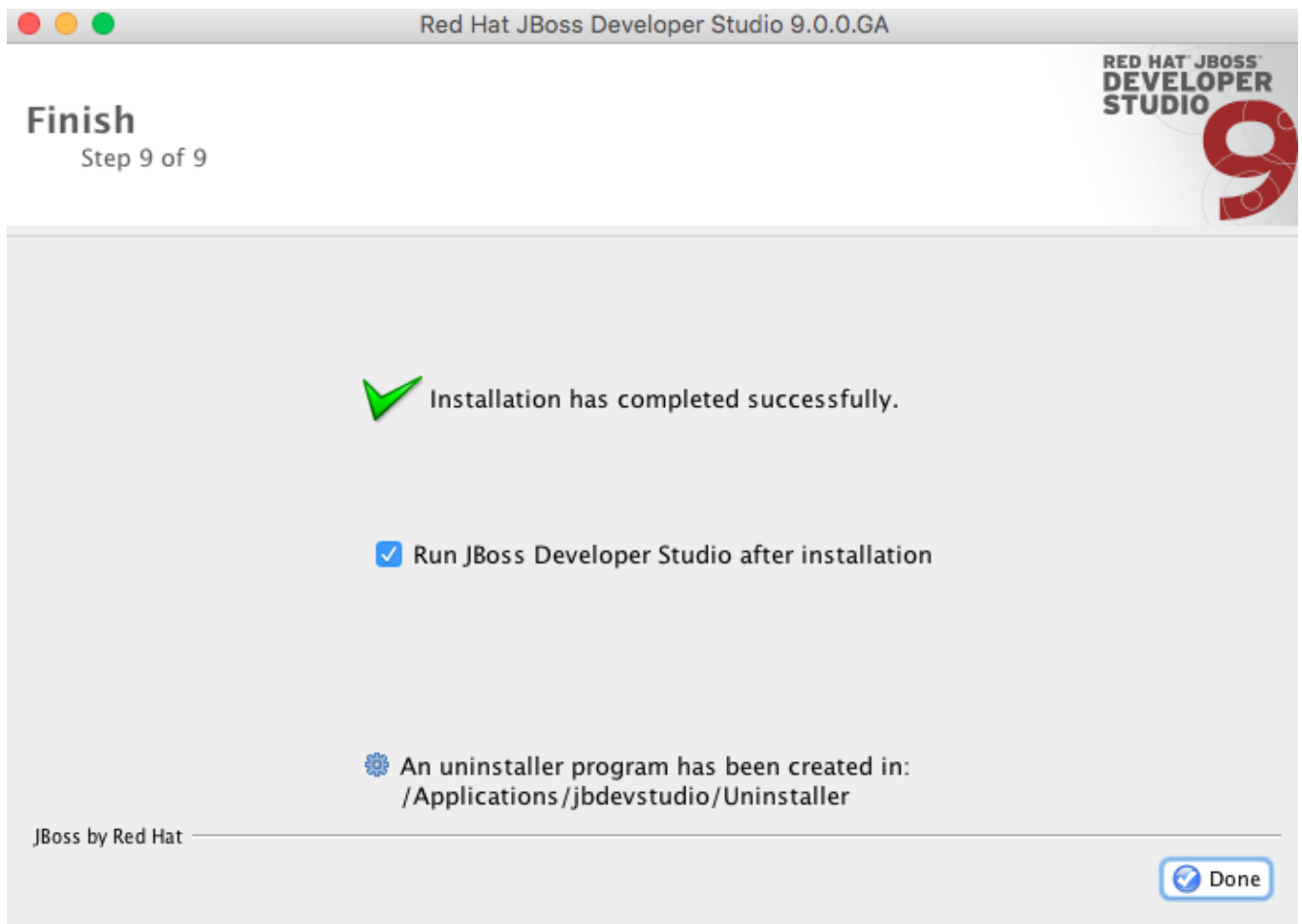


Figure 10. JBDS Installation Step 9

Congratulations! Now you are all set! Pressing **Done** will automatically launch JBDS.

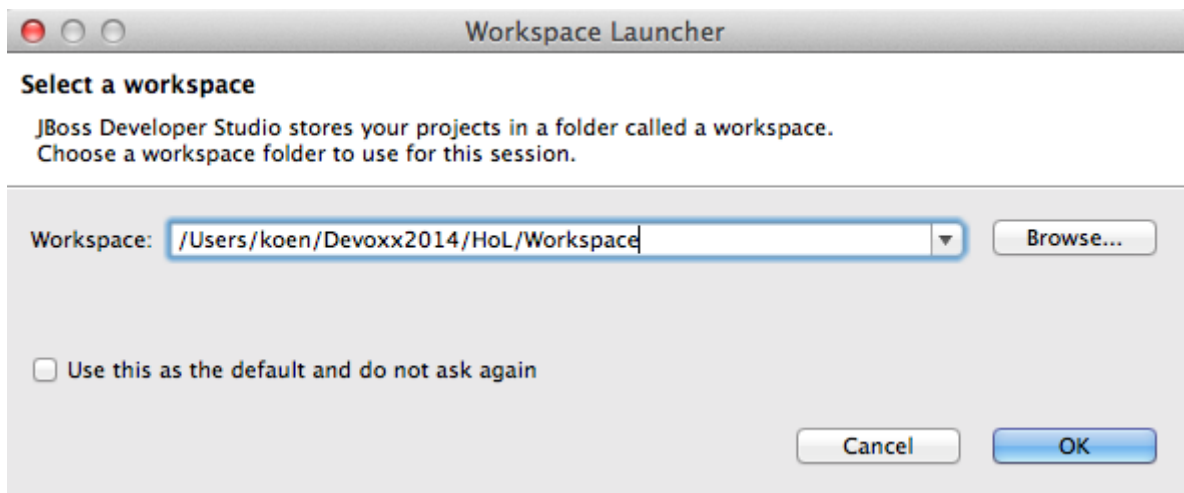


Figure 11. Choose Workspace

Choose an appropriate workspace and press **OK** to see JBDS in all its glory.

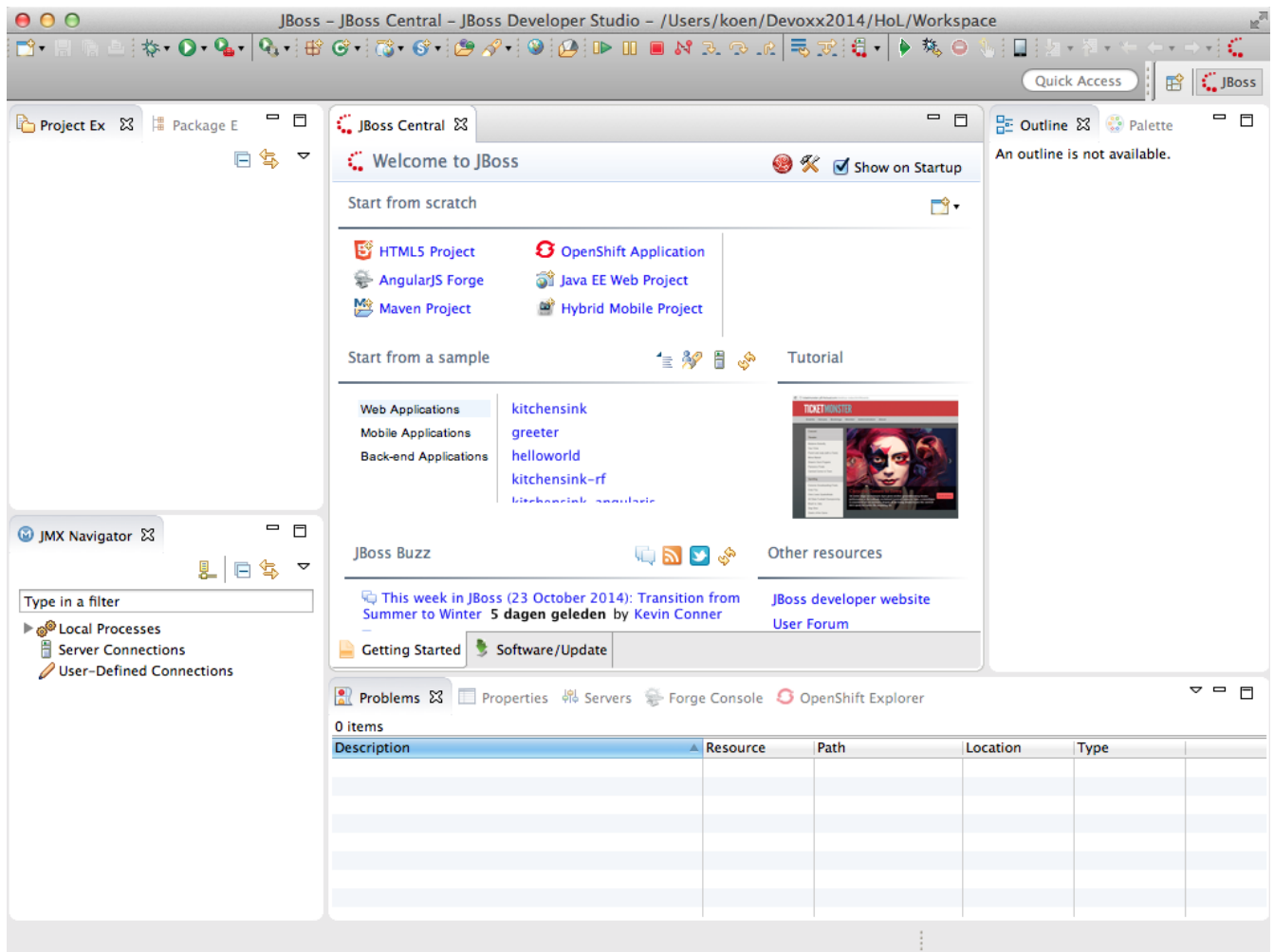


Figure 12. JBDS Welcome

Using Forge

Forge can be used as a code generation engine, and can be accessed through multiple user interfaces (UIs) such as:

- Command Line Interface (CLI)
- JBoss Developer Studio (JBDS)
- IntelliJ IDEA (not shown in this lab)
- NetBeans (not shown in this lab)
- Web (not shown in this lab)

In this section you will be getting used to Forge by performing small tasks, either with CLI, JBDS, or both. It is worth noting that JBoss Forge doesn't introduce any special or proprietary dependencies in your code, it just generates a functional starting point and lets you continue as needed. This means you can switch from CLI, to JBDS, to your own IDE (unrelated to Forge) without getting in Forge's way, and without Forge getting in the way of your IDE.

NOTE

In this section and the following sections, We will assume that you have already installed JBoss Forge.

Let's get started!

Creating a new project

Setting up a new project can involve quite a few activities. Typically, projects require a build and dependency management framework such as Maven, or Gradle. Even if you feel comfortable reading the respective configuration files, i.e. `pom.xml` or `build.gradle`, it takes some time to create them from scratch. What you usually do is consulting manuals or textbooks, look in internet or most often - copy and paste from one of your recent projects. Some of you may decide to use archetypes or IDE wizards, but you will soon realize that these generate too much garbage in your project configuration - garbage that you will usually delete.

CLI

The `project-new` command is what we will use to quick start a project :

```
$ project-new --named cdbookstore --stack JAVA_EE_7
```

This will create an empty Maven project structure and a `pom.xml` file. The default `groupId` is `org.cdbookstore`, `artifactId` is `cdbookstore` and version number `1.0.0-SNAPSHOT`. Also, the default project created is a web application, that's why you can see a `packaging` of type `war` and `maven-war-plugin` defined. The `stack` command option will automatically install the JavaEE 7 dependencies in your `pom.xml`. If you want to change any of these options, just press `TAB` after a command and you will get all the command options:

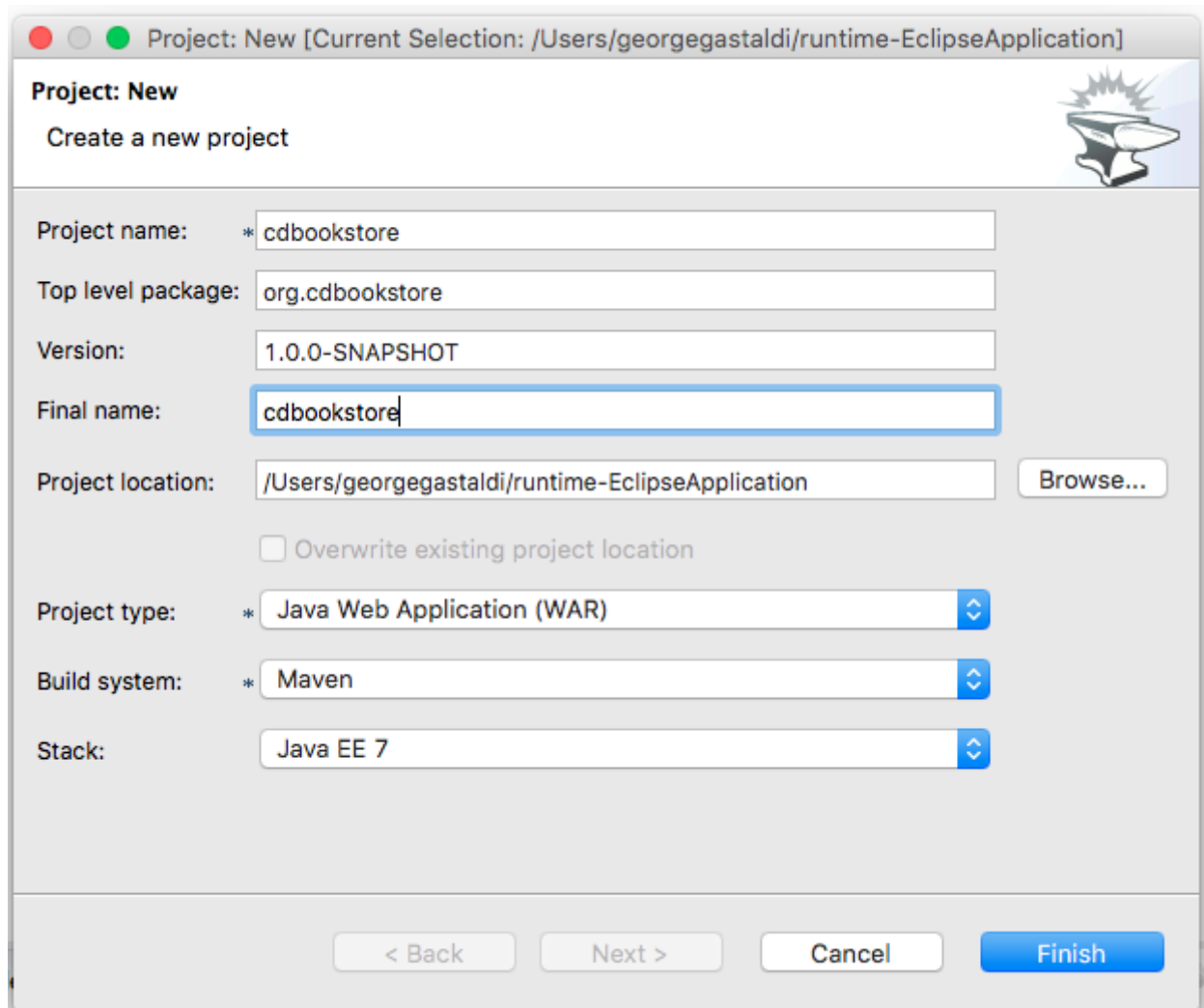

```
$ project-new --named cdbookstore --top-level-package org.cdbookstore --target  
-location /directory/path --final-name cdbookstore --version 1.0.0.Final --stack  
JAVA_EE_7
```

IMPORTANT

You don't need to specify any stack when creating a project, however choosing one will automatically add the necessary dependencies in your `pom.xml` and save you the trouble of choosing a specification version when configuring JPA, for example.

JBDS

If you run Forge from JBDS, open the Forge wizard (Ctrl + 4 or CMD + 4 on Mac) then select Project: New and specify *cdbookstore* as project name, *com.example* as top level package, enter project location per your preference:



The screenshot shows the 'Project: New' dialog box in Eclipse IDE. The title bar reads 'Project: New [Current Selection: /Users/georgegastaldi/runtime-EclipseApplication]'. The dialog has a header 'Project: New' and a sub-header 'Create a new project'. The fields are as follows:

- Project name: * cdbookstore
- Top level package: org.cdbookstore
- Version: 1.0.0-SNAPSHOT
- Final name: cdbookstore
- Project location: /Users/georgegastaldi/runtime-EclipseApplication (with a 'Browse...' button)
- ☐ Overwrite existing project location
- Project type: * Java Web Application (WAR)
- Build system: * Maven
- Stack: Java EE 7

At the bottom, there are four buttons: '< Back', 'Next >', 'Cancel', and 'Finish' (which is highlighted in blue).

Figure 13. Creating new project

Setting up persistence and validation

Most of the Java EE applications need a relational database, map entities to it and do some sort of validation. Again, with JBoss Forge it is very easy to setup the persistence configuration, create an

entity (or an embeddable), add fields to it and Bean Validation constraints.

CLI

To set up JPA and create a new JPA entity, let's use the `jpa-new-entity` command :

```
[cdbookstore]$ jpa-new-entity --named Book
```

This command has several effects. First of all, it has created a `persistence.xml` file in the right place (under the `META-INF` directory) with all the default configuration for Hibernate. Then, it has created a `Book` entity under the subpackage `model`. Notice that this entity already has an `id` and `version` with its getters/setters. As you can see, the good thing with Forge is that with only one command all is setup and ready to go.

If you do not wish to use the Java EE container default data-source, you can also specify additional connection options such as JNDI data-source names, JDBC connection information, and data-source types. Note, however, that this means you will probably need to configure your application server to provide this new data-source and/or database connection.

```
[cdbookstore]$ jpa-setup --provider Eclipse\ Link --db-type POSTGRES --data-source  
-name java:comp/DefaultDataSource
```

If you have executed the `jpa-setup` command, you've noticed that the prompt has changed: you went from `[cdbookstore]` to `[persistence.xml]`. In Forge, the prompt always tells you where you are. You can even enter the command `pwd` or `ls`. For now, let's go back into the `Book` entity: enter `cd~~` brings you to the root directory, and then `cd src/main/java/org/cdbookstore/model/Book.java`.

So, let's create a few fields in the `Book` entity. Again, one single command and Forge will do its best to simplify our lives:

```
[Book.java]$ jpa-new-field --named title
```

This creates an attribute called `title` of type `String` with get/set methods. Notice that Forge has also updated the `toString` method. Let's add more commands with different options (remember to press `TAB` to get the options) :

```
[Book.java]$ jpa-new-field --named description --length 2000  
[Book.java]$ jpa-new-field --named price --type java.lang.Float  
[Book.java]$ jpa-new-field --named nbOfPages --type java.lang.Integer  
[Book.java]$ jpa-new-field --named publicationDate --type java.util.Date  
--temporalType DATE
```

As you can see, Forge has a set of options to quickly create attributes and customize their JPA mappings. Now let's say we want to specify that a book is written in a certain language. We can use Forge to quickly create a Java enum and then have it as a JPA Enumerated in the `Book` entity :

```
[Book.java]$ java-new-enum --named Language --target-package org.cdbookstore.model
[Language.java]$ java-add-enum-const --named ENGLISH FRENCH
```

This creates a Java enum, but notice the path on the left side : Forge CLI was set on the **Book** class (that's why you could read **[Book.java]\$**). When we created the enum, the path changed to **[Language.java]\$**. Like any other shell script, Forge has a certain number of commands to navigate between directories, classes or files (you will find the full list of commands in the Appendix). So, to go back to the **Book** entity we just use the **cd** command :

```
[Language.java]$ cd ..
[model]$ cd Book.java
[Book.java]$
```

Now that we are in the **Book** entity, we can create a new enum field with the following command :

```
[Book.java]$ jpa-new-field --named language --type org.cdbookstore.model.Language
```

By default, a JPA field is of type **String**. With the **--type** option we can choose from basic datatypes (**int**, **byte**, **char**...), enum, or from other entities and entity cardinality (One-to-One, One-to-Many, Many-to-One, Many-to-Many). So let's create a new **Author** entity, and add a Many-to-One relationship with **Book** :

```
[Book.java]$ jpa-new-entity --named Author
[Author.java]$ jpa-new-field --named firstName
[Author.java]$ cd ../Book.java
[Book.java]$ jpa-new-field --named author --type org.cdbookstore.model.Author
--relationship-type Many-to-One
```

Forge takes care of all the JPA relational mapping between both entities. Now, on an entity, we can add Bean Validation constraints on properties with the **constraint-add** command.

```
[Book.java]$ constraint-add --constraint NotNull --on-property title
[Book.java]$ constraint-add --constraint Past --on-property publicationDate
[Book.java]$ constraint-add --on-property description --constraint Size --max 3000
```

Behind the scenes Forge has created a **validation.xml** file, added the Bean Validation dependency and the needed constraints. If you want to take a glance at the code, and see a summary of progress, you can use the **more** command or even **ls** your class :

```
[Book.java]$ ls
```

```
[fields]
```

```
author::org.cdbookstore.model.Author      language::org.cdbookstore.model.Language
publicationDate::java.lang.String
description::java.lang.String              nbOfPages::java.lang.Integer
title::java.lang.String
id::java.lang.Long                        price::java.lang.Float
version::int
```

```
[methods]
```

```
equals(java.lang.Object)::boolean
getPublicationDate()::java.lang.String
setLanguage(org.cdbookstore.model.Language)::void
getAuthor()::org.cdbookstore.model.Author    getTitle()::java.lang.String
setNbOfPages(java.lang.Integer)::void
getDescription()::java.lang.String            getVersion()::int
setPrice(java.lang.Float)::void
getId()::java.lang.Long                      hashCode()::int
setPublicationDate(java.lang.String)::void
getLanguage()::org.cdbookstore.model.Language
setAuthor(org.cdbookstore.model.Author)::void setTitle(java.lang.String)::void
getNbOfPages()::java.lang.Integer
setDescription(java.lang.String)::void       setVersion(int)::void
getPrice()::java.lang.Float                  setId(java.lang.Long)::void
toString()::java.lang.String
```

JBoss Developer Studio (JBDS)

While working from JBoss Developer Studio (JBDS), after opening the Forge wizard (Ctrl + 4 or CMD + 4 on Mac), you should choose *JPA: New Entity* and you'll see a JPA configuration window. This window provides default values for the Java EE container default data-source, but if you not do wish to use it, you can change your configuration as specified before with CLI.

In the first step you need to setup JPA in your project:

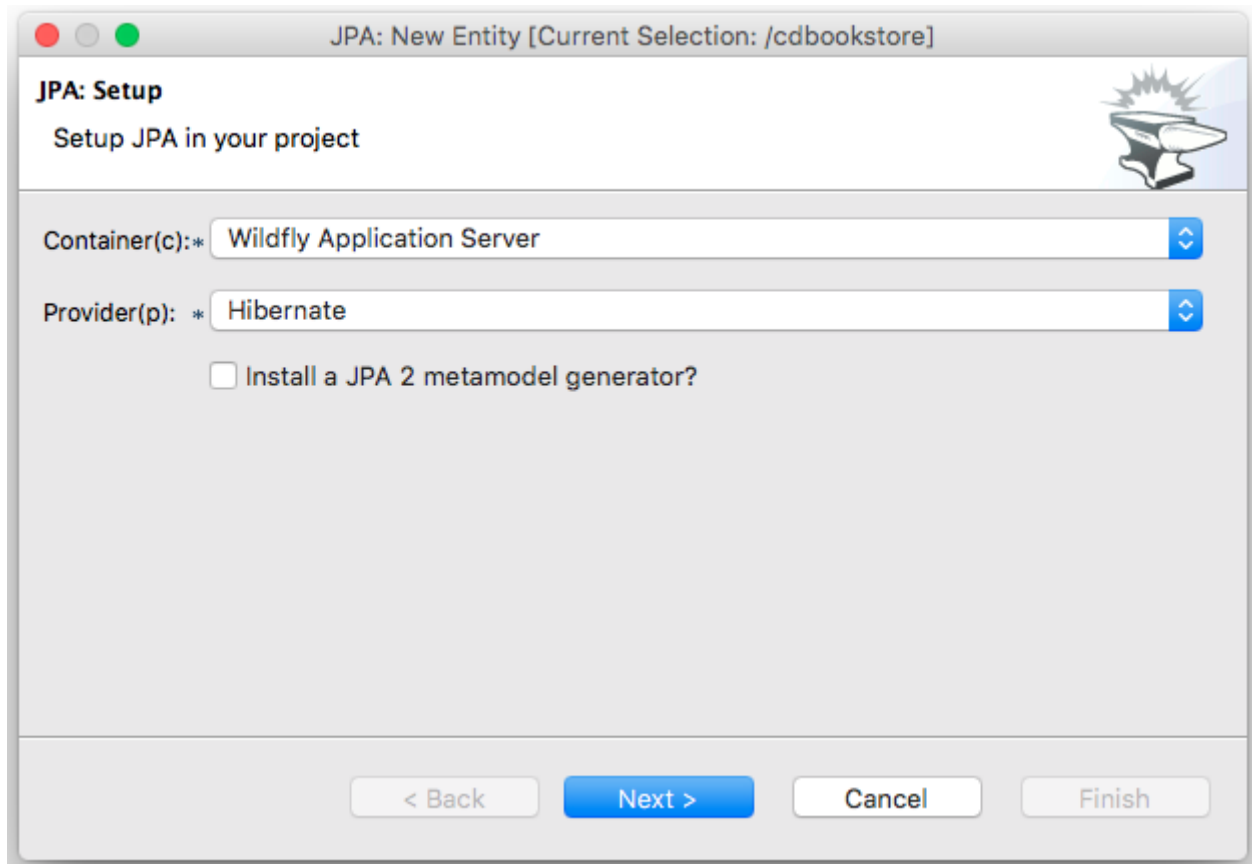


Figure 14. Setup JPA

The next step you need to configure your connection settings:

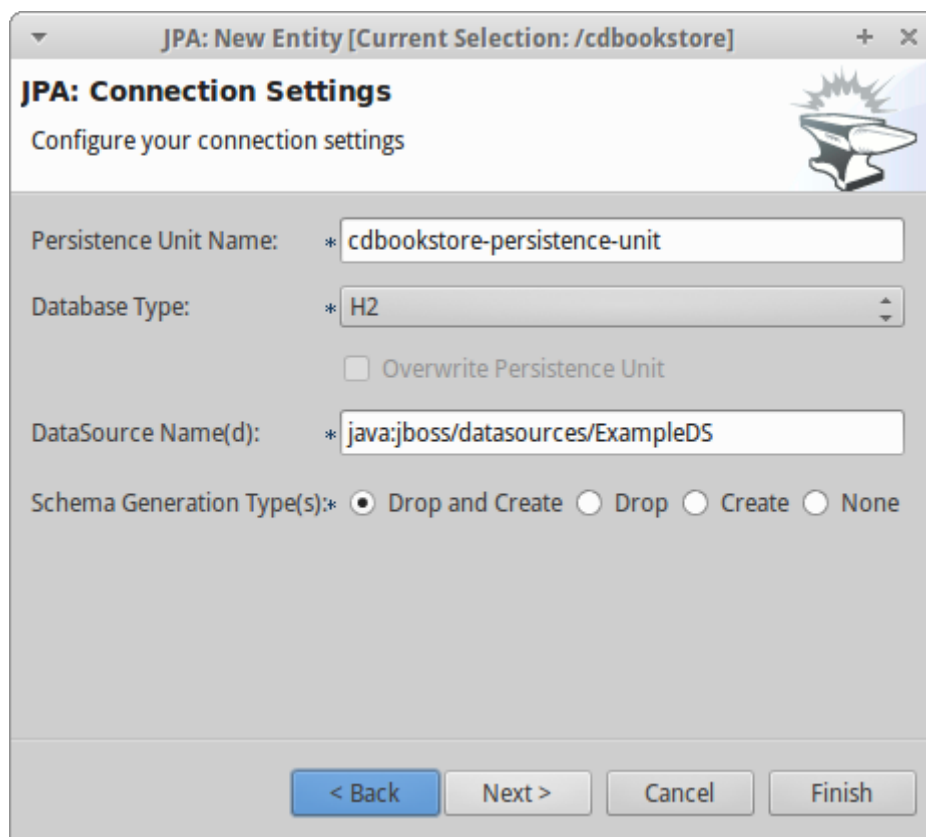


Figure 15. Configuring Connection Settings

After the configuration step, you can create your first entity.

Enter *Book* as Entity name, *org.cdbookstore.model* in Target package and click Finish.

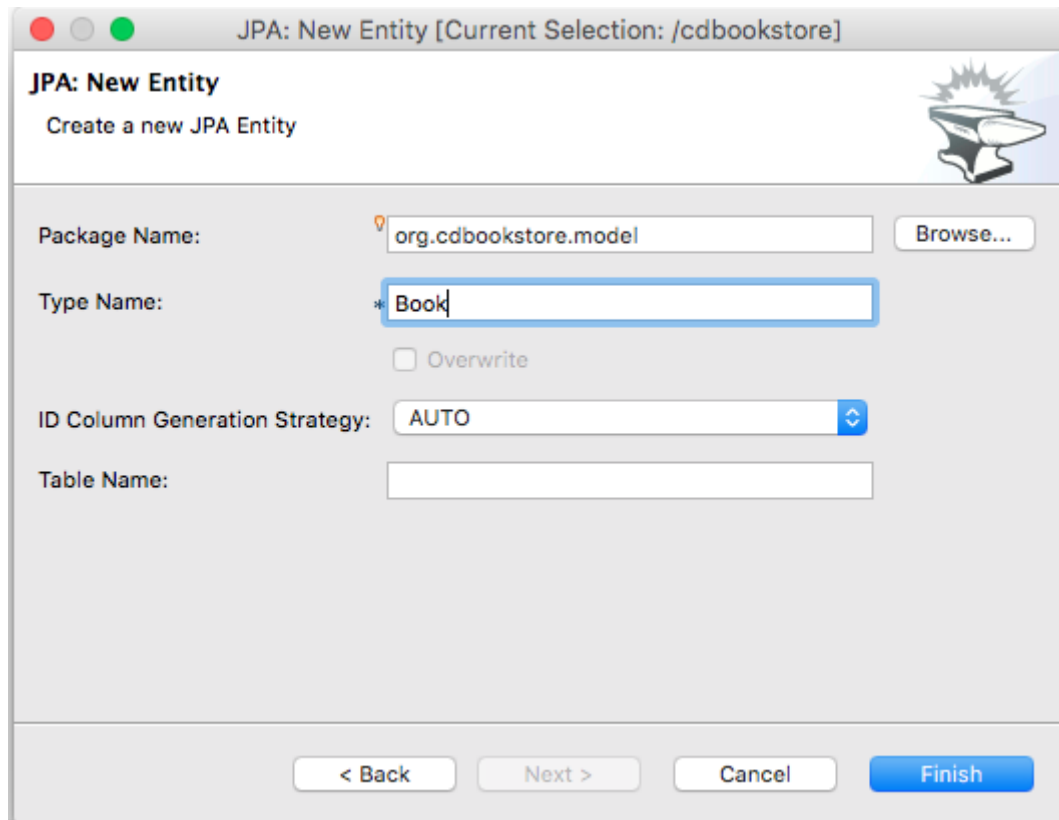
The image shows a Java IDE dialog box titled "JPA: New Entity [Current Selection: /cdbookstore]". The dialog has a header bar with standard window controls (red, yellow, green buttons) and a title bar. Below the title bar, the text "JPA: New Entity" is followed by "Create a new JPA Entity" and a small icon of a hammer and anvil. The main area contains four labeled fields: "Package Name:" with a text box containing "org.cdbookstore.model" and a "Browse..." button; "Type Name:" with a text box containing "*Book" and a blue border; an "Overwrite" checkbox which is unchecked; and "ID Column Generation Strategy:" with a dropdown menu set to "AUTO". At the bottom, there is a "Table Name:" text box. The footer contains four buttons: "< Back", "Next >", "Cancel", and "Finish".

Figure 16. Creating a new Entity

Then you need add fields to your Entity. After opening the Forge wizard (Ctrl + 4 or CMD + 4 on Mac), you should choose *JPA: New Field* and select the *Book* as Target entity, *title* as Field Name, *String* as Type and click Finish:

JPA: New Field [Current Selection: /cdbookstore/src/main/java/org/cdbookstore/model/Book.java]

JPA: New Field
Create a new field

Target Entity: * org.cdbookstore.model.Book

Field Name: * title

Field Type: * String Browse...

Temporal Type: ☒ DATE ☐ TIME ☐ TIMESTAMP

Column Name:

Length: 255

☐ Not Nullable
☐ Not Insertable
☐ Not Updatable

Relationship Type: ☒ Basic ☐ Embedded ☐ One-to-One ☐ One-to-Many ☐ Many-to-One ☐ Many-to-Many

☐ Is LOB?
☐ Is Transient?

Enum Type: ☒ ORDINAL ☐ STRING

< Back Next > Cancel Finish

Figure 17. Creating a new field in Entity

Repeat these steps to create the following fields in the Book class:

Field name: description | Type: java.lang.String | Length: 2000
 Field name: price | Type: java.lang.Float
 Field name: nbOfPages | Type: java.lang.Integer
 Field name: publicationDate | Type java.util.Date | Temporal Type: DATE

Now you need to specify that a book is written in a certain language. We'll create a Java enum and then have it as a JPA Enumerated in the Book entity. After opening the Forge wizard (Ctrl + 4 or CMD + 4 on Mac), you should choose *Java: New Enum* and enter *org.cdbookstore.model* in Package name and *Language* in Type Name:

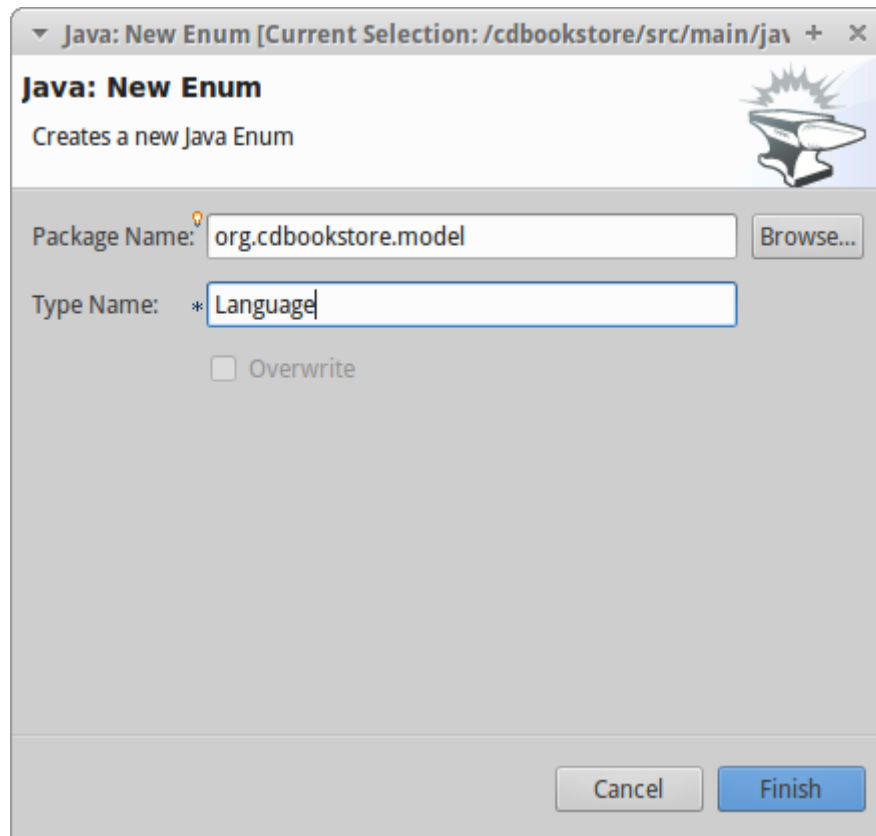


Figure 18. Creating a new Enum

Now you need to add new constants to it. After opening the Forge wizard (Ctrl + 4 or CMD + 4 on Mac) you should choose *Java: New Enum Const* and add all constants, in this case:

ENGLISH
FRENCH

and click Finish:

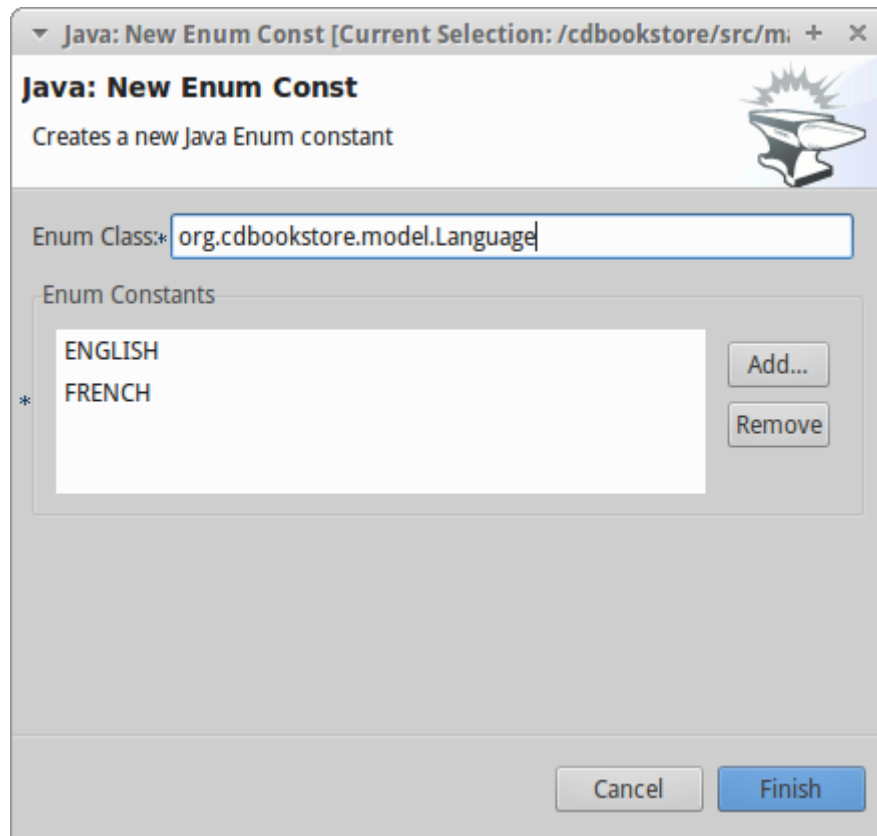


Figure 19. Creating a new Enum Constant

Now, you need add this enum as a field in Book. After opening the Forge wizard (Ctrl + 4 or CMD + 4 on Mac) you should choose *JPA: New Field* and select the *Book* as Target Entity, enter *language* as Field name and select *org.cdbookstore.model.Language* as Field Type:

JPA: New Field
Create a new field

Target Entity: *

Field Name: *

Field Type: *

Temporal Type: ☒ DATE ☐ TIME ☐ TIMESTAMP

Column Name:

Length:

☐ Not Nullable
☐ Not Insertable
☐ Not Updatable

Relationship Type: ☒ Basic ☐ Embedded ☐ One-to-One ☐ One-to-Many ☐ Many-to-One ☐ Many-to-Many

☐ Is LOB?
☐ Is Transient?

Enum Type: ☒ ORDINAL ☐ STRING

Figure 20. Creating a new Enum field in Entity

Now you need to create a new Entity (Same that you did with Book):

Entity Name: Author

and create a new field to it (Same that you did in Book):

Field Name: firstName | Type: String

Now you need to add a Many-to-One relationship with **Book**.

Open the Forge wizard (Ctrl + 4 or CMD + 4 on Mac) and choose *JPA: New Field*, select the *Book* as Target Entity. Enter *author* as Field name, select *org.cdbookstore.model.Author* as Field Type and mark *Many-to-One* as Relationship Type and click Finish (or Next):

JPA: New Field [Current Selection: /cdbookstore/src/main/java/org/cdbookstore/model/Book.java]

JPA: New Field
Create a new field

Target Entity: * org.cdbookstore.model.Book

Field Name: * author

Field Type: * org.cdbookstore.model.Author Browse...

Temporal Type: ☒ DATE ☐ TIME ☐ TIMESTAMP

Column Name:

Length: 255

☐ Not Nullable
☐ Not Insertable
☐ Not Updatable

Relationship Type: ☐ Basic ☐ Embedded ☐ One-to-One ☐ One-to-Many ☒ Many-to-One ☐ Many-to-Many

☐ Is LOB?
☐ Is Transient?

Enum Type: ☒ ORDINAL ☐ STRING

< Back Next > Cancel Finish

Figure 21. Creating a new relationship

If you choose Next instead of Finish, You can configure your relationship:

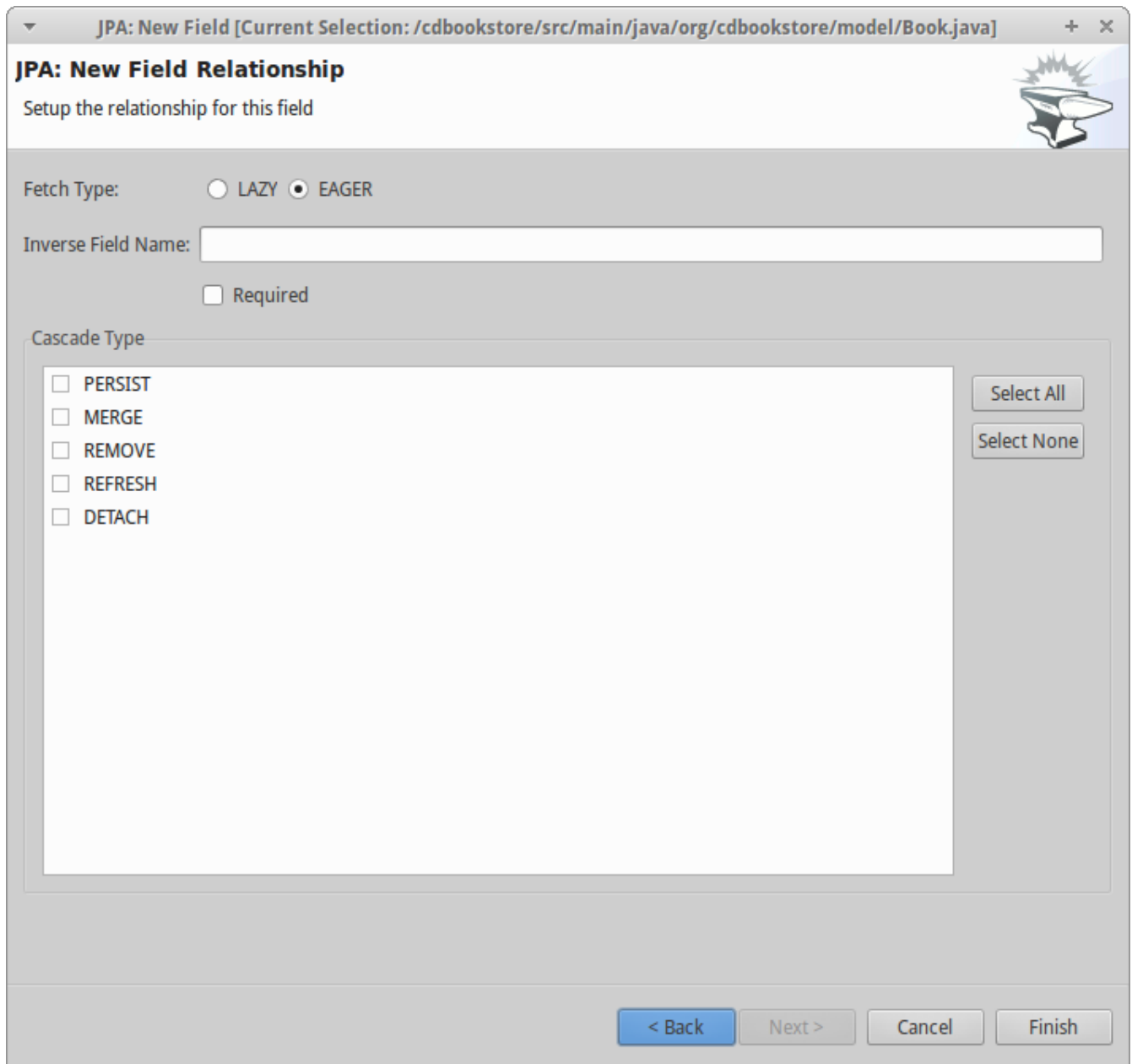


Figure 22. Configuring relationship

Forge takes care of all the JPA relational mapping between both entities.

Now, on an entity, we can add Bean Validation constraints. Open the Forge wizard (Ctrl + 4 or CMD + 4 on Mac) and choose *Constraint: Add*. You'll see a configuration window, just like first step of the *JPA: New Entity* that you executed before:

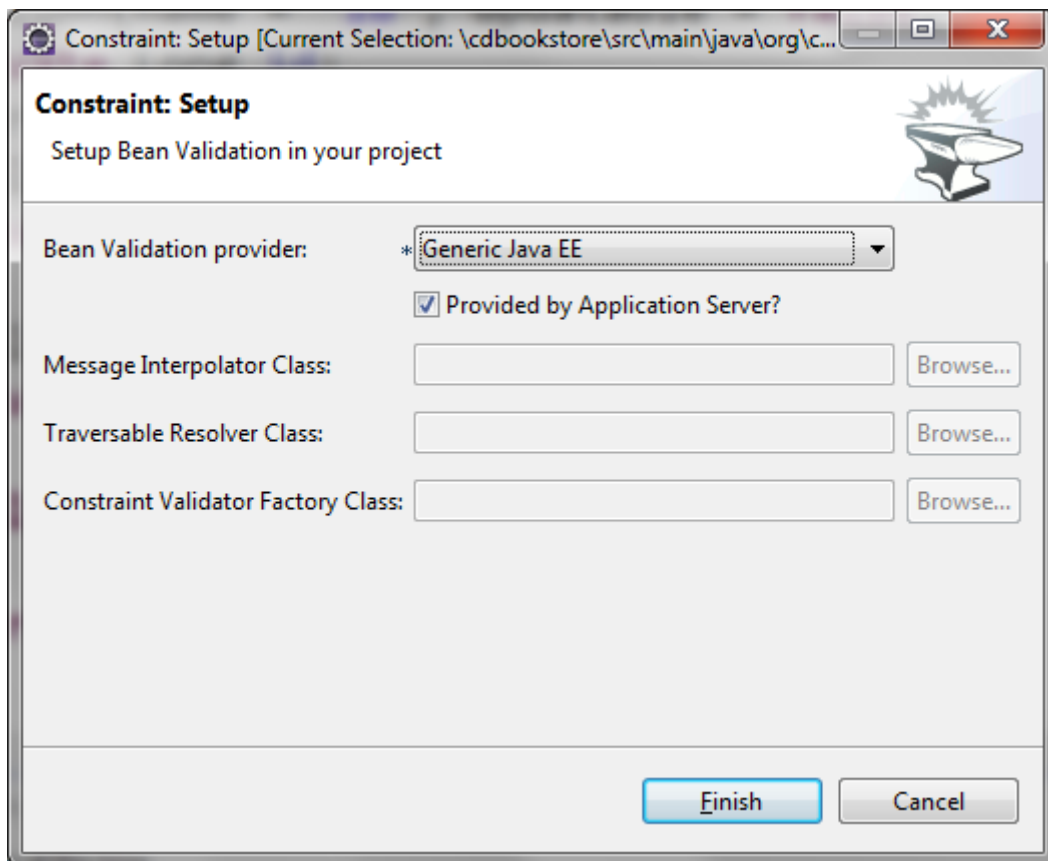


Figure 23. Setup Bean Validation

You should choose the *Generic Java EE* as Bean Validation provider and check "Provided by Application Server?". If you don't want the default configuration provided by Application Server you are free to change your configurations. Click Next, and choose *org.cdbookstore.model.Book* as Class:

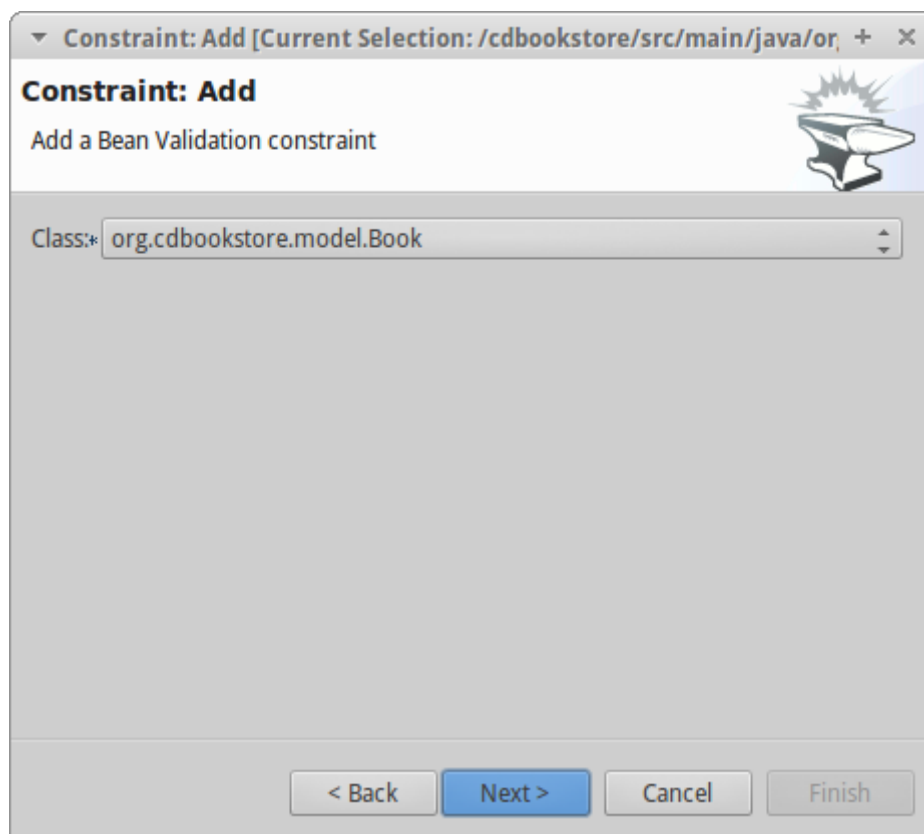


Figure 24. Adding Constraint

In the next step you need to specify the property *Property* and the *Constraint* to configure. In this case, let's add @NotNull on the *title* property:

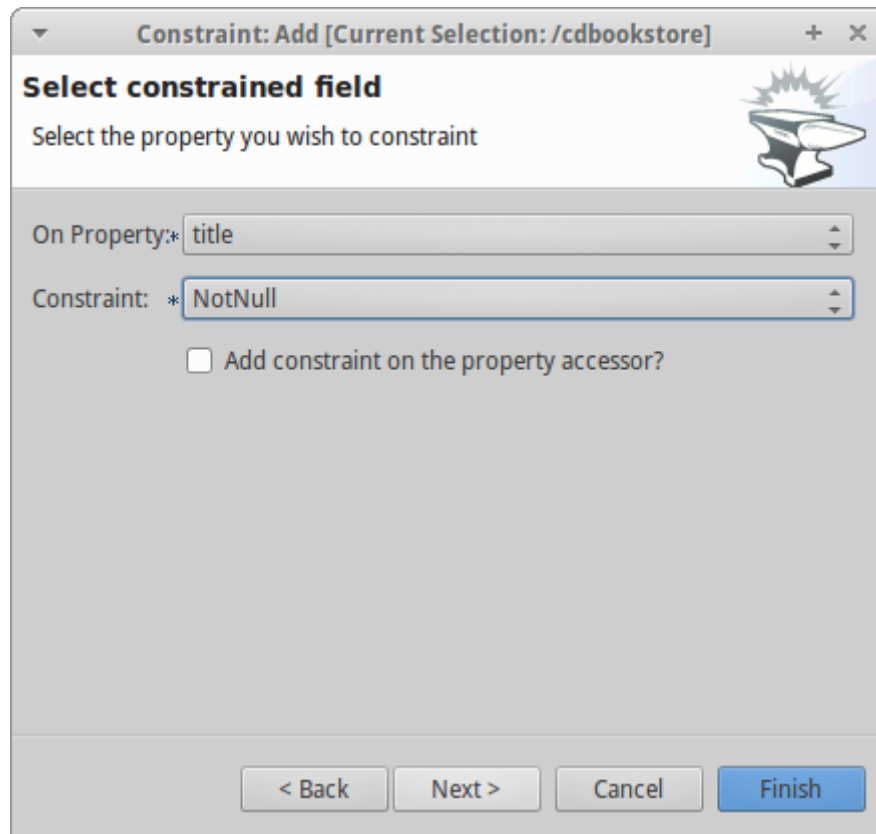


Figure 25. Adding NotNull Constraint

Once the constraint is selected, you can also specify if you want the constraint to appear on the property itself, or on the property accessor (getter method).

Click Next to configure *payload*, *groups* and *message*:

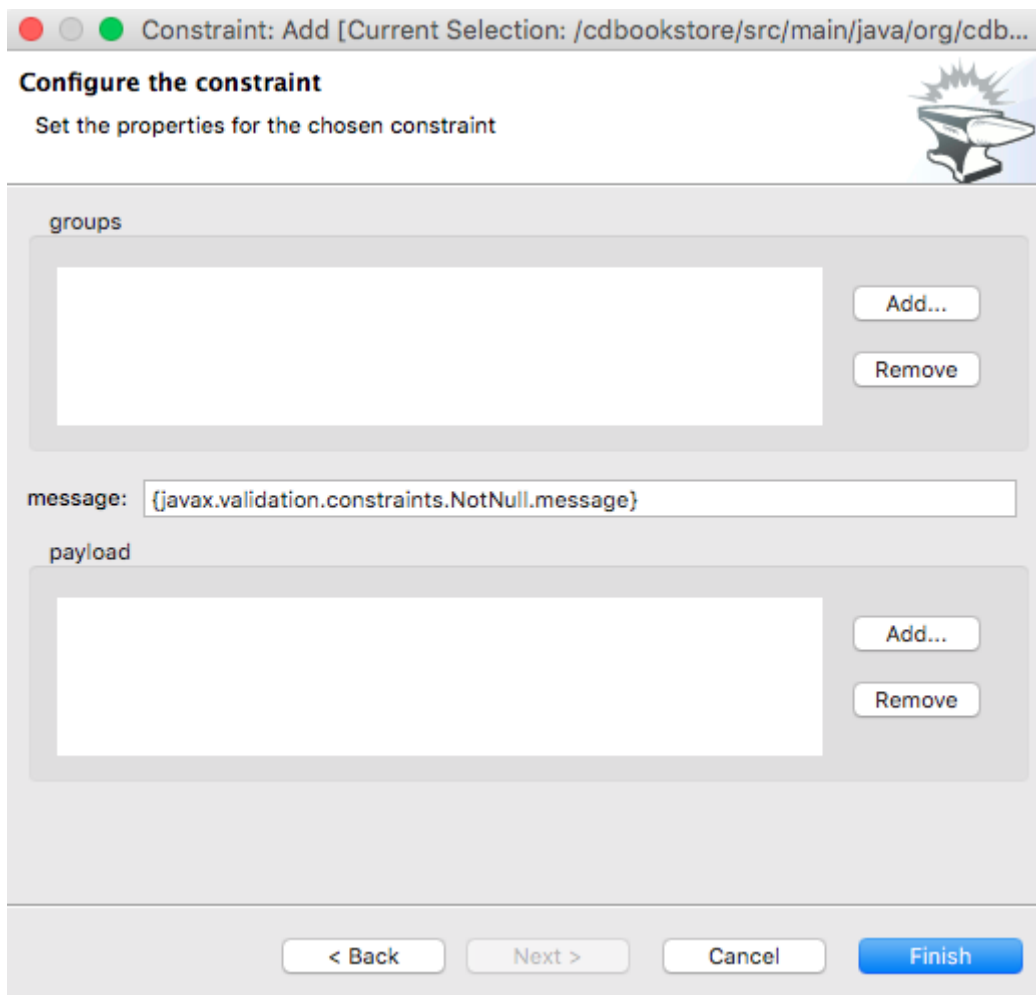


Figure 26. Configuring Constraint

Click Finish.

Now add two more constraints to the Book class:

```
Property: publicationDate | Constraint: Past
Property: description | Constraint: Size | Max: 3000
```

Scaffolding JSF (Java Server Faces)

JSF is the default Java EE user interface framework, and consequently JBoss Forge has a great support for it. In fact, Forge can scaffold an entire CRUD web application from JPA entities very easily, with only a single command. The JSF generated application follows several patterns and best practices: usage of CDI conversation scope, the extended persistence context, JSF converters and so on. If you don't believe it, just try it.

CLI

Now that we have created fields in the entities, it's time to scaffold web pages for these entities. We can either scaffold per entity, or use a wildcard to let Forge know it can generate a UI for each entity

```
[model]$ scaffold-generate --provider Faces --targets org.cdbookstore.model.*
```

This has the same effect of scaffolding per entity :

```
[model]$ scaffold-generate --provider Faces --targets org.cdbookstore.model.Book  
[model]$ scaffold-generate --provider Faces --targets org.cdbookstore.model.Author
```

In a single command Forge has generated configurations files (`web.xml`, `faces-config.xml`, ...), JSF pages for both `Book` and `Author`, images, CSS and added Bootstrap for the layout.

By default Forge scaffolds a web application with JSF 2.0 but you can change this configuration by executing the `faces-setup` command. In fact, most of the Forge commands can be setup (e.g. `jpa-setup`, `servlet-setup`...)

```
$ faces-setup
```

JBDS

In JBDS it's simple too. After opening the Forge wizard (Ctrl + 4 or CMD + 4 on Mac) you should choose *Scaffold: Generate*, choose *Faces* as Scaffold Type:

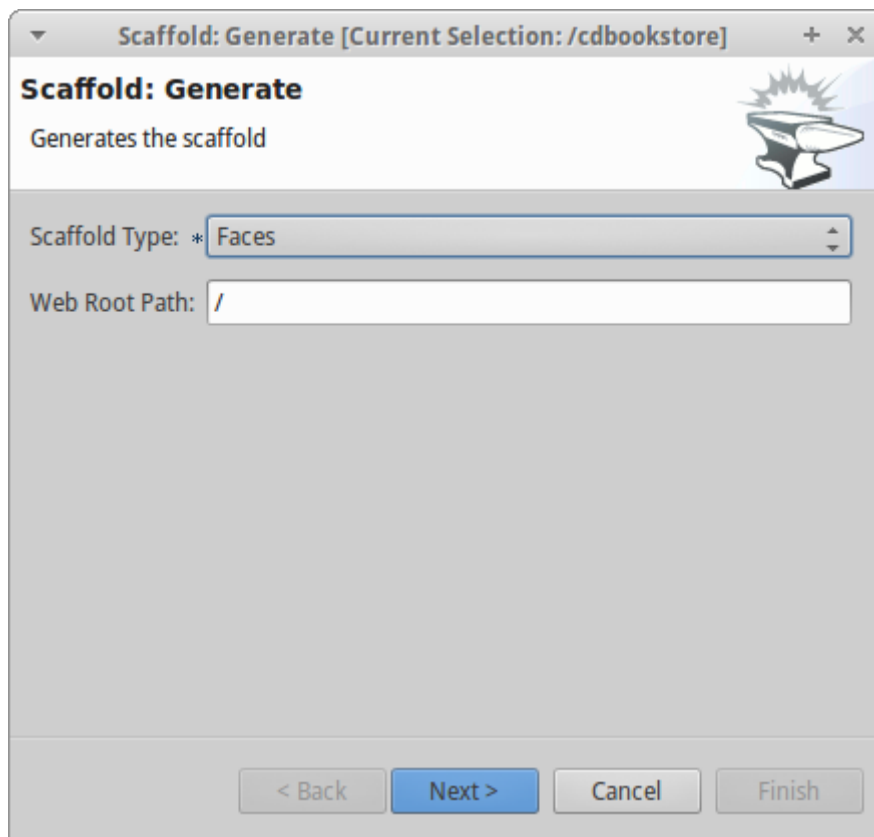


Figure 27. Configuring Faces Scaffold

If you haven't selected the Java EE 7 stack when creating the project, click Next to configure the Faces Scaffold:

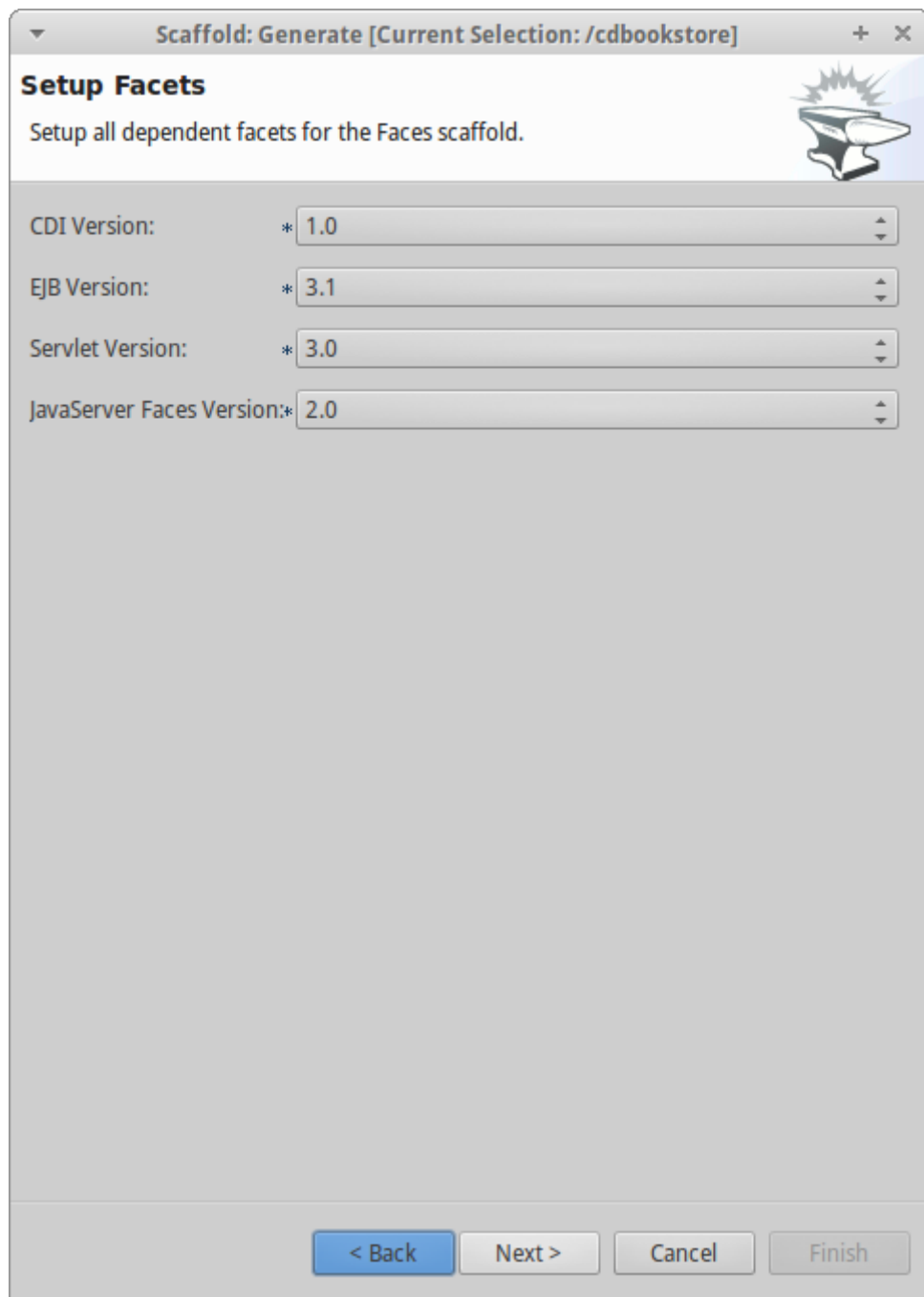


Figure 28. Setup Facets

By default Forge scaffolds set suggested values for Java EE specification versions, but you can change this configuration as well.

Click Next to continue to select entities for which you want to generate scaffolding. In this case we'll generate for all entities:

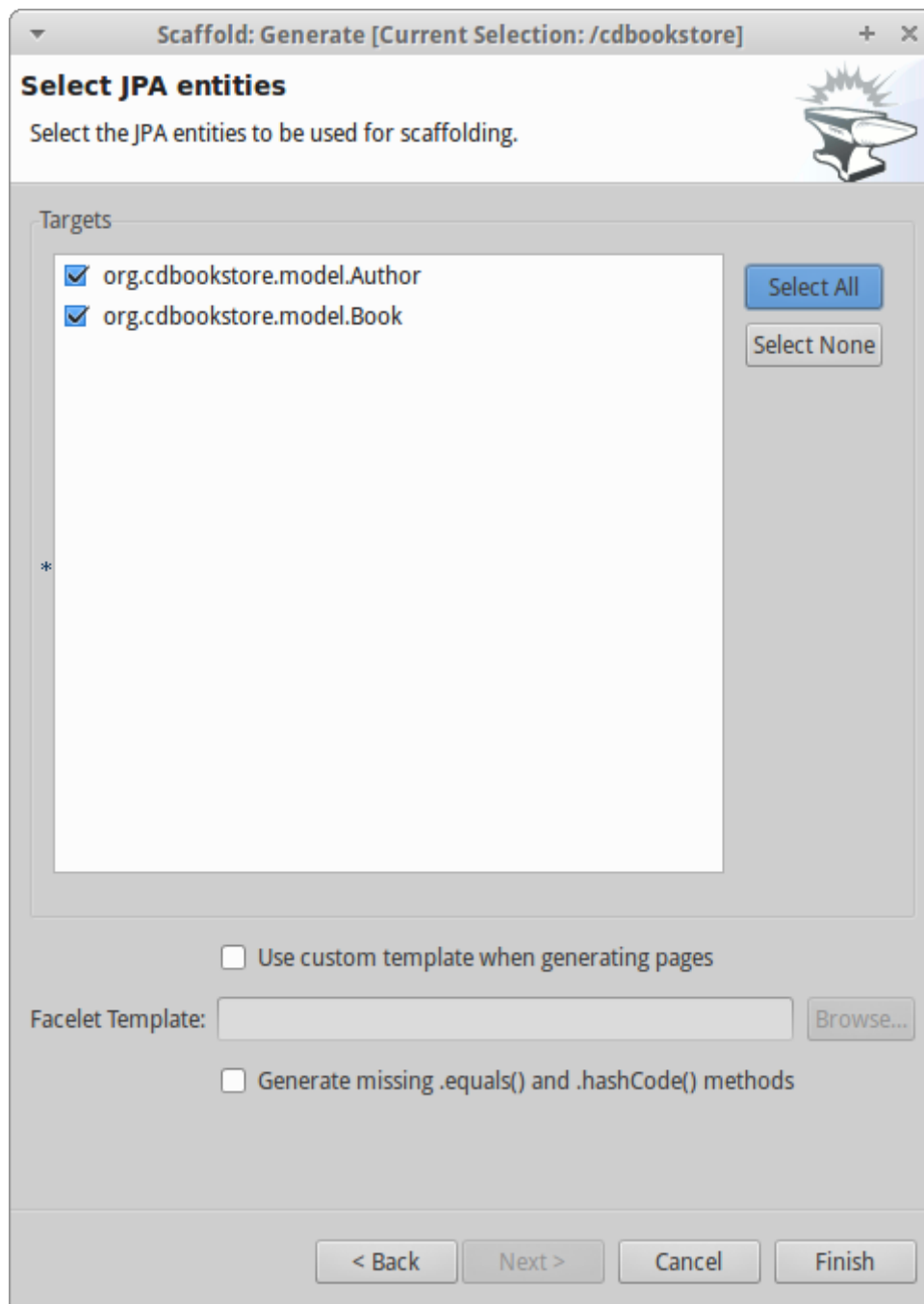


Figure 29. Selecting JPA entities

Click Finish and JBoss Forge will create your user interface.

Scaffolding REST Endpoints

REST is a very popular technology nowadays. If you want to create REST endpoints on our entities, or if you want to add a REST endpoint on your existing Java EE web application, Forge is there to help. Forge can quickly scaffold REST endpoints for each entity, giving you a set of CRUD methods. And again, generating all the code plumbing and following best practices.

CLI

Now that we have a few entities (**Book** and **Author**), it's time to generate REST endpoints. Like for JSF, it is just a matter of executing one single command:

```
[model]$ rest-generate-endpoints-from-entities --targets org.cdbookstore.model.*
```

This is the easiest command to generate the REST endpoints, but like most Forge commands, you can customize a few options if you want, such as package name and so on.

While "holding" most files as the current resource, you may inspect them using `ls`. This also works on REST endpoints. So, if you `cd BookEndpoint.java` (if you have not selected it already) and execute the command `ls`, this is what you get :

```
[model]$ cd ../rest/BookEndpoint.java
[BookEndpoint.java]$ ls

[fields]
em::javax.persistence.EntityManager

[methods]
create(org.cdbookstore.model.Book)::javax.ws.rs.core.Response
findById(java.lang.Long)::javax.ws.rs.core.Response
update(org.cdbookstore.model.Book)::javax.ws.rs.core.Response
deleteById(java.lang.Long)::javax.ws.rs.core.Response
listAll(java.lang.Integer,java.lang.Integer)::java.util.List
```

JBDS

Open the Forge wizard (Ctrl + 4 or CMD + 4 on Mac) and choose *REST: Generate Endpoints from Entities*, the first step, you need to configure the REST in your application, enter all information such as:

REST: Generate Endpoints From Entities [Current Selection: /cdbookstore]

REST: Setup

Setup REST in your project

JAX-RS Version: * 1.1

Application Path: * /rest

Configuration Strategy: * ☒ Application class ☐ Web Descriptor file (WEB.XML)

Target Package: * org.cdbookstore.rest Browse...

Class Name: * RestApplication

< Back Next > Cancel Finish

Figure 30. Configuring REST

Click next to select the entities for which endpoints should be generated, select all, and click Finish (or click Next for more options):

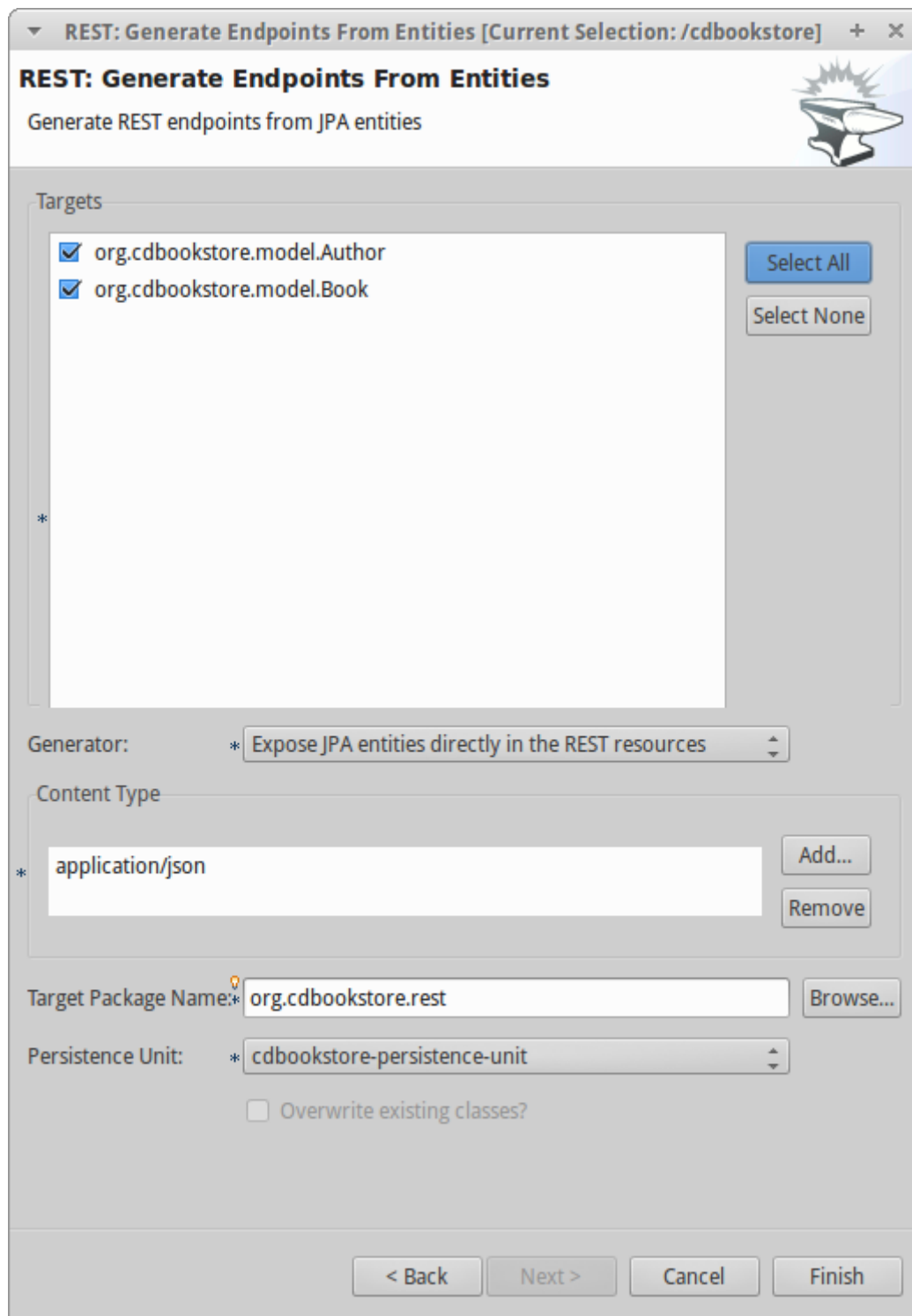


Figure 31. Generating REST endpoints from JPA entities

You can customize some options if you prefer, such as *Configuration Strategy*, *Class Name*, *Content Type* and so on.

Deploying on WildFly

Does the WildFly application server need much of an introduction? [WildFly](#)? Quickly then. WildFly is a flexible, lightweight, managed application runtime that helps you build amazing applications... and we are going to need it to deploy our web application and REST endpoints. For that, we have several options : [download](#) it, install, execute and deploy our web application, or use a JBoss Forge addon. Let's try that.

Installing the JBoss AS Forge addon

The beauty of JBoss Forge is that it's extensible. In fact, Forge is a add-on container (called Furnace) and everything is seen as an extension (as a matter of fact, the CLI itself is an add-on!). To see the list of add-ons, visit the Forge documentation(<http://forge.jboss.org/addons>). And if you want to see all the already installed add-ons, execute the following command :

```
[cdbookstore]$ addon-list
Currently installed addons:
org.jboss.forge.addon:addon-manager,2.12.2-SNAPSHOT
org.jboss.forge.addon:addon-manager-spi,2.12.2-SNAPSHOT
org.jboss.forge.addon:addons,2.12.2-SNAPSHOT
org.jboss.forge.addon:bean-validation,2.12.2-SNAPSHOT
org.jboss.forge.addon:configuration,2.12.2-SNAPSHOT
...
etc
...
```

Enough, talking, let's install the [WildFly add-on](#). For that, in the Forge console just type the following commands (and wait for Maven to download the Internet) :

```
[cdbookstore]$ addon-install-from-git --url https://github.com/forged/as-addon
--coordinate org.jboss.forge.addon:as
[cdbookstore]$ addon-install-from-git --url https://github.com/forged/jboss-as-addon
--coordinate org.jboss.forge.addon:jboss-as-wf
```

Now that you installed these new add-on, you get new **as-setup** command :

```
[cdbookstore]$ as-setup --server wildfly --version 8.1.0.Final
```

Wait a bit until WildFly is downloaded.... (in the meantime you can go to `~/.forge/addons` and have a look at what's happening... you can even check the logs under `~/.forge/log/forge.log`)... ok, now that Wildfly is downloaded into your local Maven directory... there it is.... just type **as**, press **TAB** and you will see new commands :

```
[cdbookstore]$ as-
as-deploy as-setup as-shutdown as-start as-undeploy
```

So let's build the application, start JBoss with **as-start** and deploy our application with **as-deploy** :

```
[cdbookstore]$ build
[cdbookstore]$ as-start
(...)
JBoss logs
(...)
[cdbookstore]$ as-deploy
```

WildFly is started, the application is deployed, you can now go to <http://localhost:8080/cdbookstore> and create new books and authors.

Installing the JBoss AS Forge addon on JBDS

Open the Forge wizard (Ctrl + 4 or CMD + 4 on Mac) and choose *Install an Addon from GIT*, enter <https://github.com/forged/jboss-as-addon> as GIT Repository URL and `org.jboss.forge.addon:as` as Coordinate:

```
GIT Repository|Coordinate
https://github.com/forged/as-addon | org.jboss.forge.addon:as
```

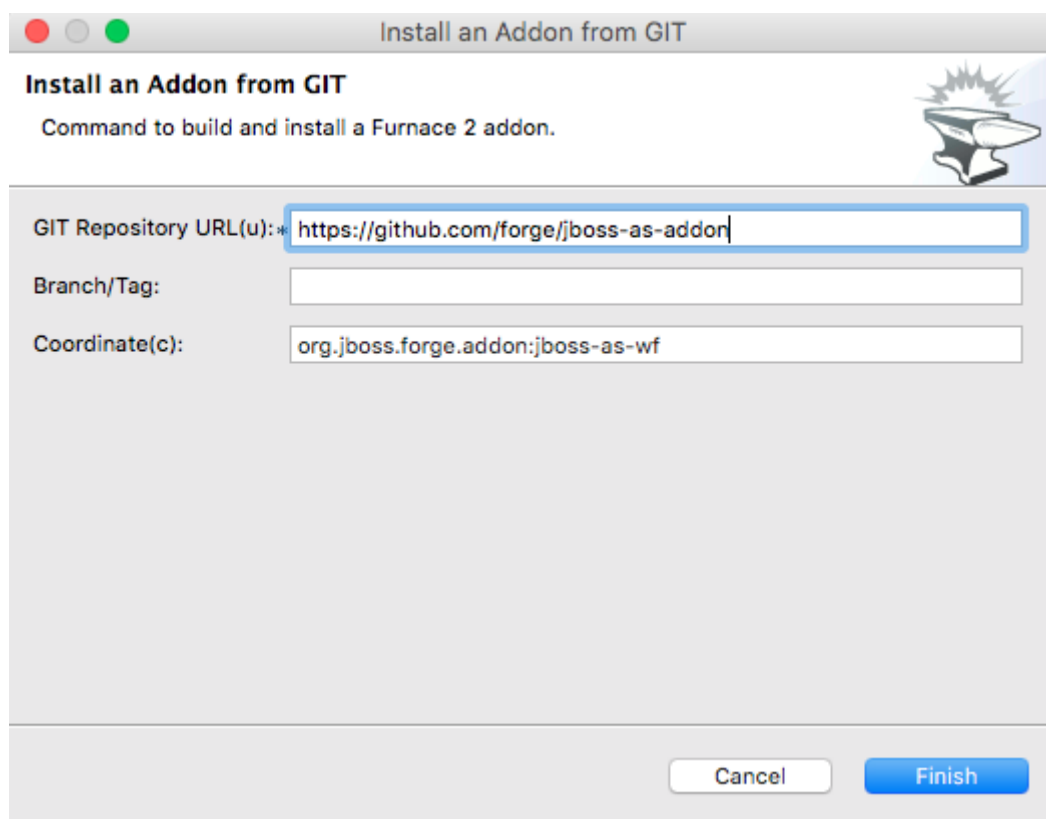


Figure 32. Installing an Addon

Open the Forge wizard again (Ctrl + 4 or CMD + 4 on Mac) and choose *Install an Addon from GIT*, enter <https://github.com/forged/jboss-as-addon> as GIT Repository URL and `org.jboss.forge.addon:jboss-as-wf` as Coordinate:

GIT Repository: <https://github.com/forged/jboss-as-addon> | Coordinate:
org.jboss.forge.addon:jboss-as-wf

It's now time to set up your server. Open the Forge wizard (Ctrl + 4 or CMD + 4 on Mac) and choose *AS: Setup*, then select *wildfly8*:

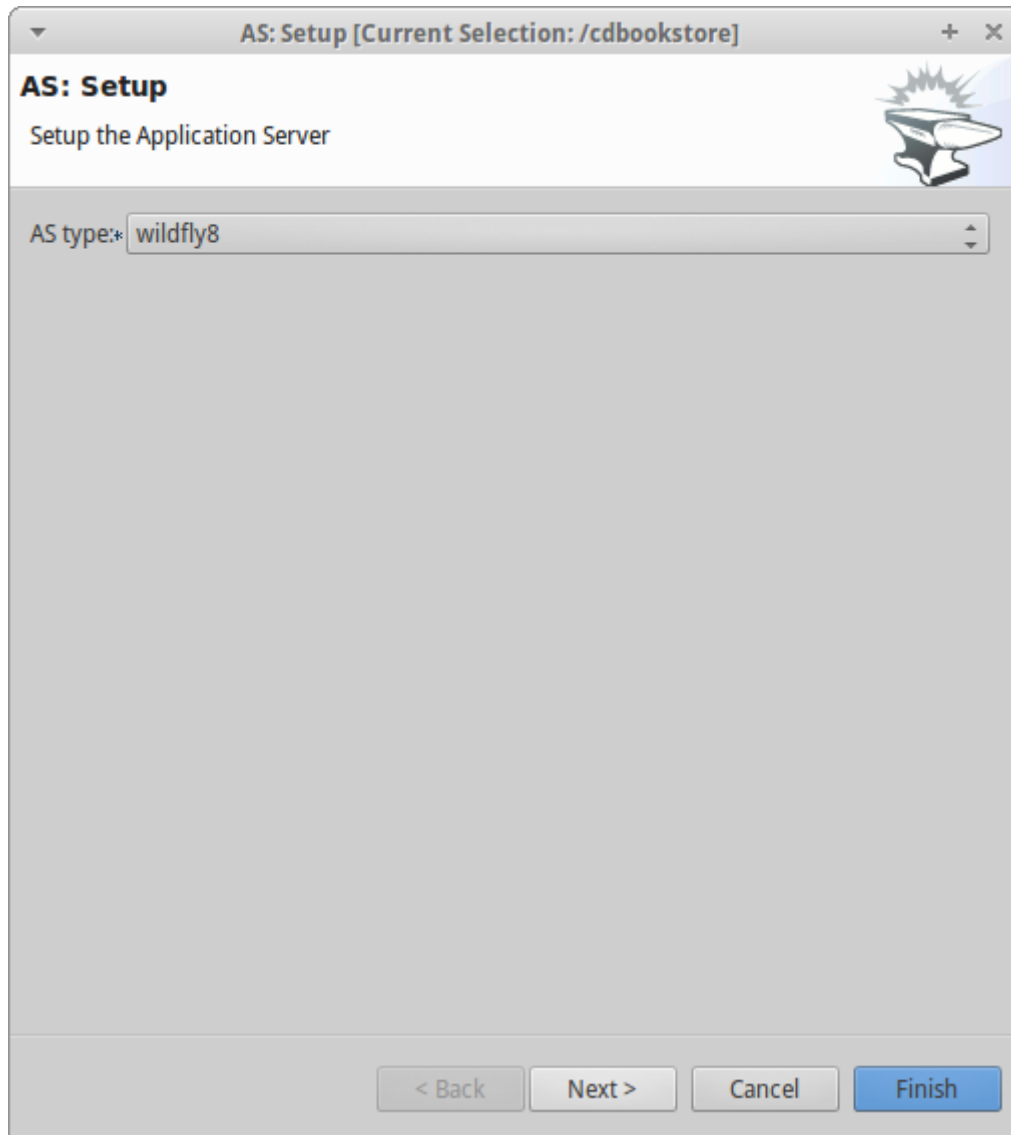


Figure 33. AS Setup

Click next to configure the *Install directory*, *Port* and so on:

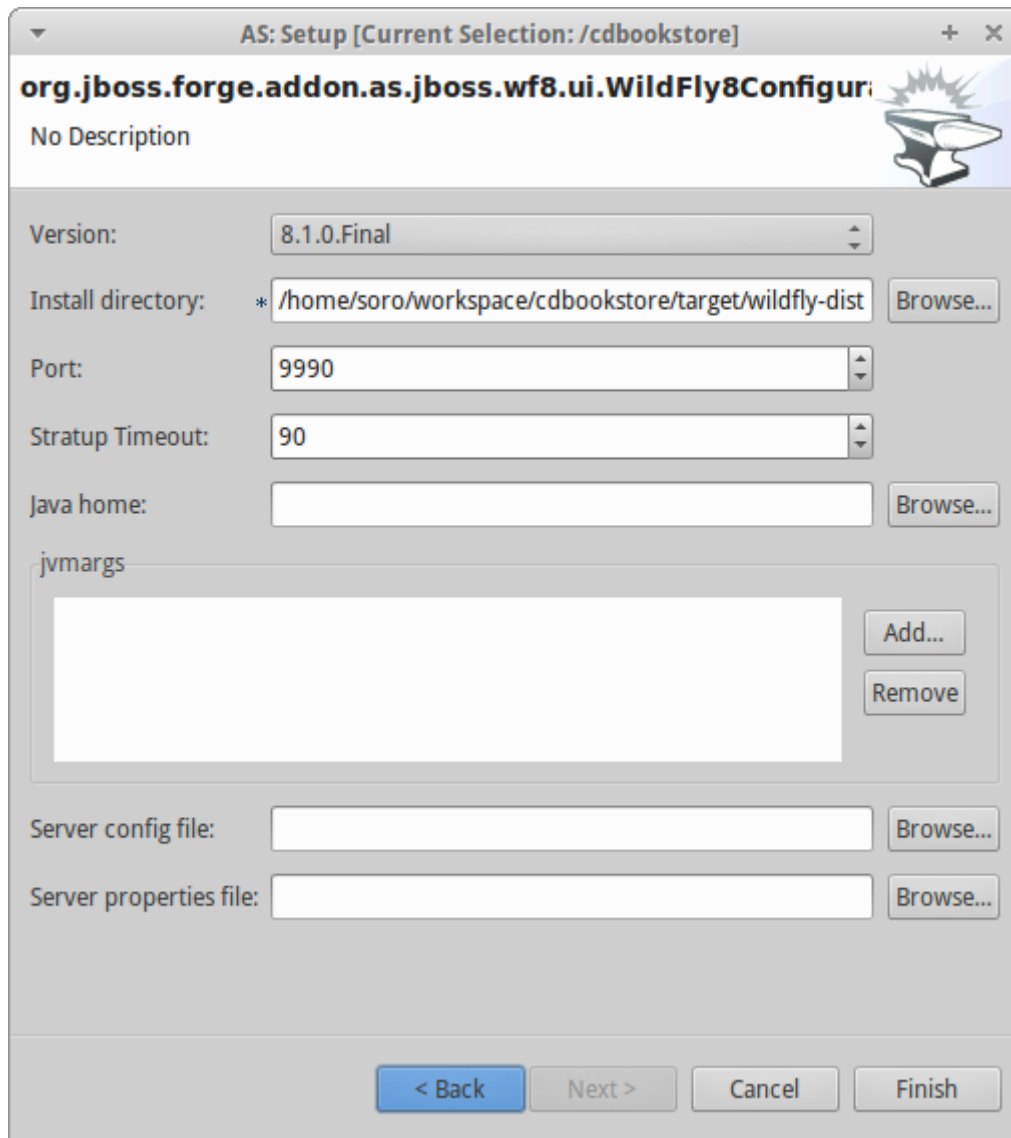


Figure 34. Configuration AS

Now let's build the application:

Open the Forge wizard (Ctrl + 4 or CMD + 4 on Mac) and choose *Build*:

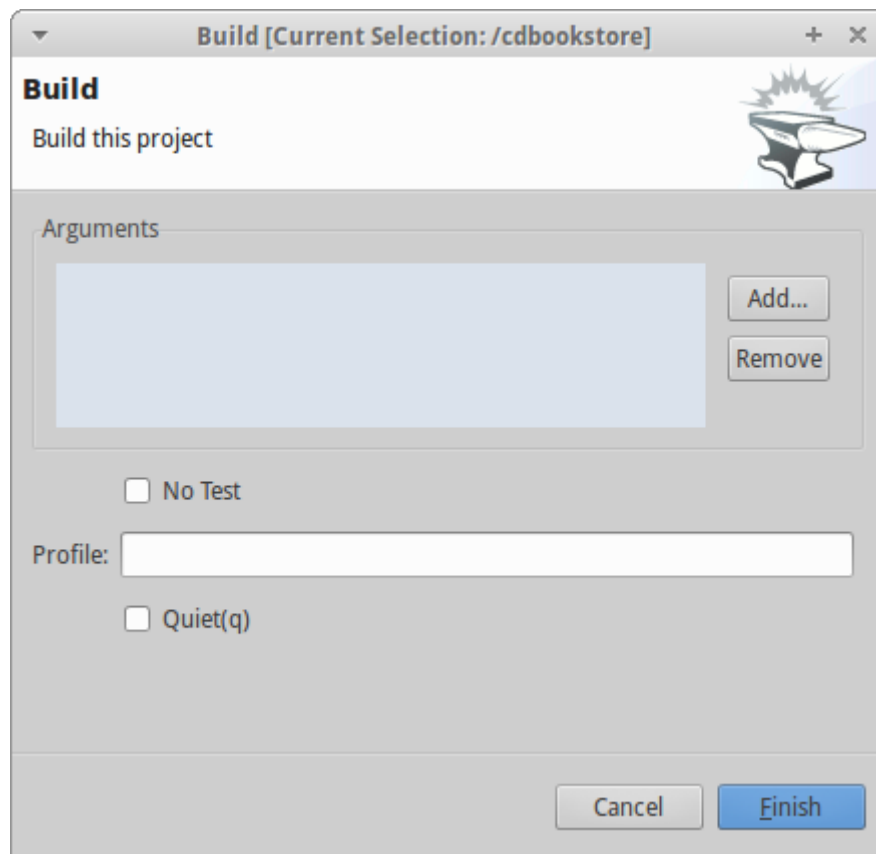


Figure 35. Building

Now start server with the `AS: Start` command and deploy application with `AS: Deploy`:

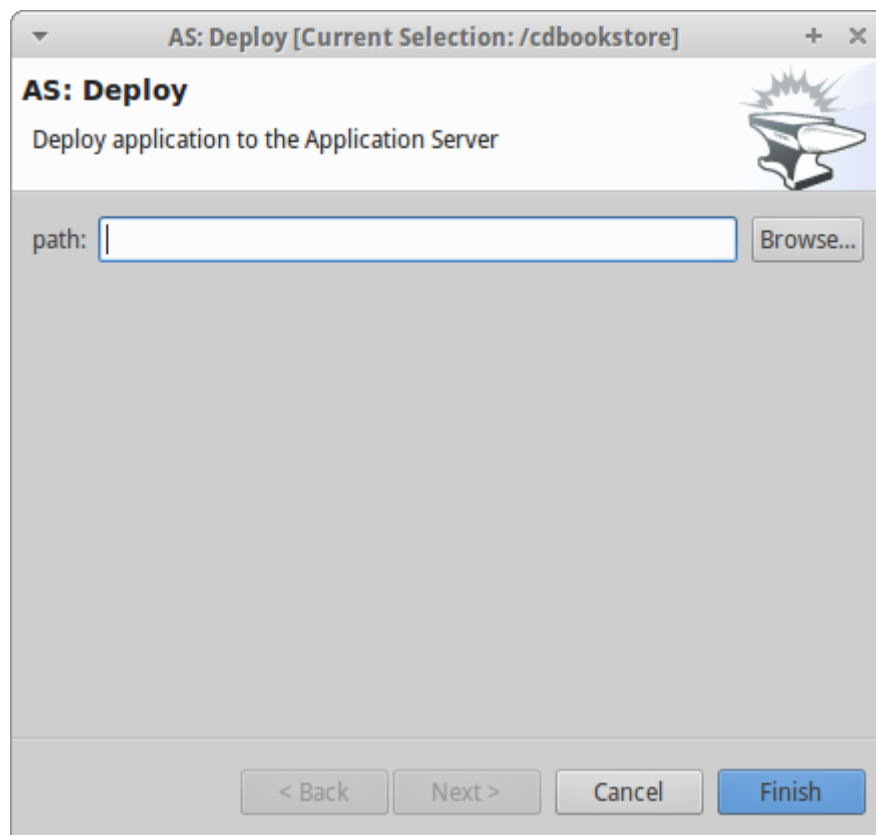


Figure 36. Deploying

Click Finish, and your application will be deployed on WildFly.

Creating Arquillian tests

Arquillian is an innovative and highly extensible testing platform for the JVM that enables developers to easily create automated integration, functional and acceptance tests for Java middleware. Picking up where unit tests leave off, Arquillian handles all the plumbing of container management, deployment and framework initialization so you can focus on the task at hand, writing your tests. Real tests. In short...

Arquillian brings the test to the runtime so you don't have to manage the runtime from the test (or the build). Arquillian eliminates this burden by covering all aspects of test execution, which entails:

- Managing the lifecycle of the container (or containers)
- Bundling the test case, dependent classes and resources into a ShrinkWrap archive (or archives)
- Deploying the archive (or archives) to the container (or containers)
- Enriching the test case by providing dependency injection and other declarative services
- Executing the tests inside (or against) the container
- Capturing the results and returning them to the test runner for reporting

To avoid introducing unnecessary complexity into the developer's build environment, Arquillian integrates seamlessly with familiar testing frameworks (e.g., JUnit 4, TestNG 5), allowing tests to be launched using existing IDE, Ant and Maven test plugins — without any add-ons.

Installing the Arquillian Forge addon

Like the WildFly add-on we just installed and used, bringing Arquillian capabilities to Forge is just a matter of installing one add-on. The easiest installation method is to install directly from a Git repository by executing the following command in the Forge console:

```
[cdbookstore]$ addon-install-from-git --url https://github.com/forge/addon-arquillian.git --coordinate org.arquillian.forge:arquillian-addon
```

To make sure the add-on is properly installed, enter **arq** and press **TAB**, you should see the command **arquillian-setup**. Now, let's use it.

NOTE | Don't forget to have a look at the available add-ons on <http://forge.jboss.org/addons>

CLI

The first thing to do is to setup Arquillian for WildFly by executing the following command:

```
[cdbookstore]$ arquillian-setup --arquillian-version 1.1.10.Final --test-framework junit --test-framework-version 4.11 --container-adapter wildfly-remote --container-adapter-version 8.2.1.Final
```

This command adds all the needed dependencies in our **pom.xml** (JUnit, Arquillian core, Arquillian

extension for WildFly) and Maven Profile (`arquillian-wildfly-remote`) to run the Arquillian tests. This command has also created an `arquillian.xml` file where all the Arquillian configuration goes. As you can see, with a single command, JBoss Forge has dealt with all the plumbing configuration.

To create an Arquillian tests, it is as easy: we use the `arquillian-create-test` command and target a specific bean. For example, in our example we can create a test for the `BookBean` as follow:

```
[cdbookstore]$ arquillian-create-test --targets org.cdbookstore.view.BookBean
```

This creates the `BookBeanTest` under `src/test/java`. The way to run this test is first, make sure WildFly is up and running, second, open a command prompt (outside Forge) and run Maven using the right profile:

```
mvn install -Parquillian-wildfly-remote
```

NOTE

the `build` command has a `known bug` that prevents running the test specifying a profile name.

The test might not work and you should look at the stack trace on the server side. If you get any `java.lang.ClassNotFoundException` (example `org.cdbookstore.model.Book`) that's because you need to fix the `Shrinkwrap` packaging by adding the missing class. And if the persistent unit is unknown, you need to package it explicitly under the `META-INF` directory. For example, in the code below, Shrinkwrap wraps the `BookBean` and its dependent classes into a single deployment:

```
@Deployment
public static JavaArchive createDeployment()
{
    return ShrinkWrap.create(JavaArchive.class)
        .addClasses(Book.class, Language.class, Author.class)
        .addClass(BookBean.class)
        .addAsManifestResource("META-INF/persistence.xml", "persistence.xml")
        .addAsManifestResource(EmptyAsset.INSTANCE, "beans.xml");
}
```

The test should be green. Isn't it?

Again, with a few Forge commands you manage to setup Arquillian, generate a test and execute it. You have no more excuse for not testing.

Keep on playing

Here we just show you a subset of the JBoss Forge features, but don't hesitate to keep on playing with other commands (full list in appendix). Now that you feel comfortable with Forge, let's jump to the next section.

Developing Forge

Now that you've installed JBoss Forge, played with it a bit (either with CLI or JBDS), it's time to quickly develop a real web application and extend it by adding Hibernate Envers. In this section you will execute a JBoss Forge script and learn how to develop add-ons.

Developing a Java EE 7 web application in few seconds

As you've seen in the previous section, with Forge you can enter a few commands, and you'll get code generated. With scaffolding you can even quickly generate a set of JSF pages and REST endpoints to have CRUD capabilities. So, even if you type on your keyboard very quickly, how would you be able to develop an entire Java EE 7 web application in a few seconds? The answer is simple: by running a Forge script!

A forge script is just a file that contains a set of commands. The commands below create a new **Country** entity with a set of fields. As you can see we can even have comments that start with the **#** symbol. You can end your lines with a **;** but you don't have to :

```
# Country entity
# #####
jpa-new-entity --named Country ;
jpa-new-field --named isoCode --length 2 --column-name iso_code --not-nullable ;
jpa-new-field --named name --length 80 --not-nullable ;
jpa-new-field --named printableName --length 80 --column-name printable_name --not-nullable ;
jpa-new-field --named iso3 --length 3 ;
jpa-new-field --named numcode --length 3 ;
```

If you save these commands into a file called **country.fsh** then, you just have to execute with :

```
[cdbookstore]$ run country.fsh
```

You will see Forge executing line by line each command in a few seconds. So what about running a bigger script?

The famous Java Petstore is back

The good thing about the [Java Petstore](#) is that we don't have to explain it much: most of us have heard about it. Haven't You?



Figure 37. Petstore splash

The Java Petstore was a sample application created by Sun for its [Java BluePrints](#) program. The Java Petstore was designed to illustrate how J2EE (and then Java EE) could be used to develop an eCommerce web application. Yes, the point of the Petstore is to sell pets online. The Petstore had a huge momentum and we started to see plenty of Petstore-like applications flourish. The idea was to build an application with a certain technology. Let's face it, the J2EE version was far too complex using plenty of (today outdated) [design patterns](#).

With a single Forge script, you will generate a CRUD application that will let you manage the Pet's back-end catalog.

Executing the script

First of all, download the script from <https://github.com/forgesamples/forgesamples/blob/master/tutorials/forgesamples/scripts/generate.fsh>. You can have a look into it. As you can see, the script:

- creates and sets up the project (a Java EE 7 one)
- creates the domain model with entities, embeddables, constraints and enums. Most of the entities have relationships (One-to-One, Many-to-One...) with others
- creates utility classes, exceptions, CDI qualifiers, interceptors
- adds a service layer with EJBs
- scaffolds JSF pages and creates new JSF beans
- generates REST endpoints
- cleans the `pom.xml` to get rid of some dependencies and add new ones

Now execute the script with :

```
[temps]$ run generate.fsh
```

Depending on the location of the script file, you can also run :

```
[temps]$ run ../../code/script/generate.fsh
```

You will see hundreds of lines of code scrolling. Once the project is successfully created, have a look at the thousands of lines of code (Java, XML, HTML, CSS...) that Forge generated. The only missing feature today in Forge is the ability to generate methods. That's why some classes are just empty (e.g. the service tier). But adding method is in the roadmap.

And the best of all, is that it works! To build the application, just do it in Forge :

```
[petstore]$ build
```

Running the application

Before deploying the application on [WildFly](https://wildfly.org/) you can grab the SQL script <https://github.com/forge/docs/blob/master/tutorials/forge-hol/scripts/import.sql> and copy it to [petstore/src/main/resources](#). This will add data to the database.

Then, just deploy the war file into WildFly, go to the URL <http://localhost:8080/petstore> and you should see the following homepage :

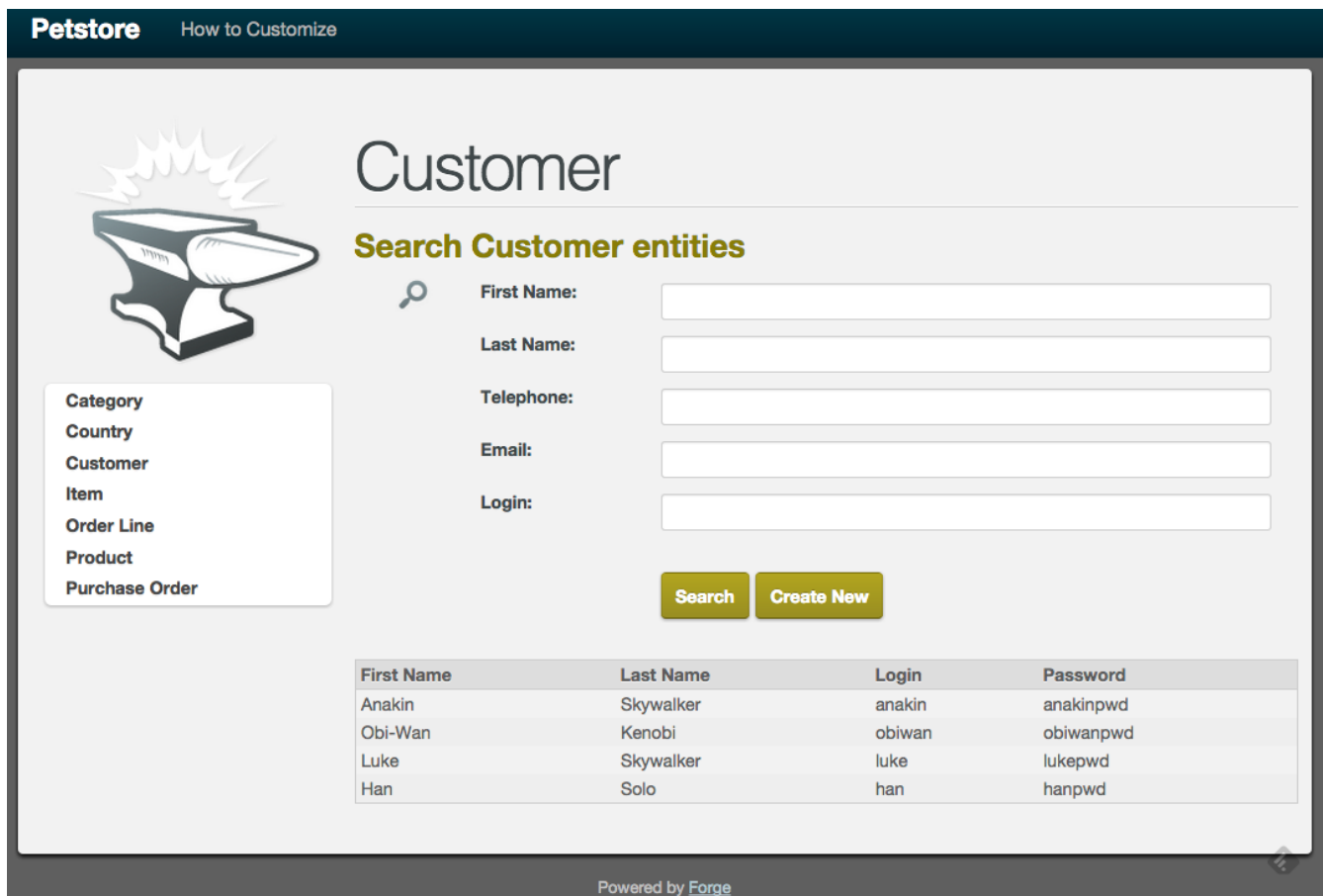


Figure 38. Petstore home page

Do not hesitate to browse the database content, create new items, remove customers, filter addresses, update categories... JBoss Forge has just created an entire CRUD web application for our domain model dealing with all the many-to-one, one-to-one... relationships.

Also check the REST interfaces. You can use any REST client (such as Postman for example) to GET/POST/PUT/DELETE data to the database. Go to the following URLs to get a peek at the REST data:

- <http://localhost:8080/petstore/rest/customers>
- <http://localhost:8080/petstore/rest/customers/1000>
- <http://localhost:8080/petstore/rest/countries>
- <http://localhost:8080/petstore/rest/countries/1000>
- <http://localhost:8080/petstore/rest/countries?max=5>

Looking at the generated code

Now that you've seen it running, it's time to take a break, fill up a cup of coffee and have a look at the code. This is what you will find in the following packages :

- **constraints** : Bean validation constraints.
- **exceptions** : Application exceptions.
- **model** : The entities, embeddables, enums.

- **rest** : The REST endpoint doing GET/POST/PUT/DELETE operations. Also check the `RestApplication` class.
- **security** : Classes for security matter
- **service** : EJB layer
- **util** : Some CDI qualifiers, interceptors, producers
- **view** : JSF backing beans using CDI conversation, extended persistence context
- **webapp** : JSF pages, Bootstrap 2, templates, css files, images

NOTE

Some of the classes that you've seen are empty or not totally implemented. When you go back home and have time to dig this topic, you can check the final application at <https://github.com/agoncal/agoncal-application-petstore-ee7>

Now that you have a real application up and running, let's use JBoss Forge to extend it by developing a few add-ons and applying them to the Petstore application.

Developing Hibernate Envers addon

Hibernate Envers is a Hibernate core module that enables auditing of persistence classes. If you want to audit the history of all the changes made to a certain entity or one of its fields during the web application runtime, you just need to audit that with `@Audited`. Envers will create a separate table for each such entity, which will hold the changes made to it.

In this section we will develop a Forge addon with the following features:

- Setup Hibernate Envers for a project by adding required dependencies to the POM
- Enable auditing an entity by adding the `@Audited` annotation on class level

Creating a new Forge addon

Creating a new Forge addon is similar to creating any new project. You can do it manually, copying and modifying an existing project of the same type, or you can use a Forge wizard to do it for you. We would certainly recommend using Forge to help you bootstrap everything for several reasons. It knows exactly which dependencies and artifacts you need as a starting point, so you will not miss anything. Forge will also not create any garbage in your new project.

Before creating the Envers addon, you need to start Forge. Before you continue, please make sure that you have followed the instructions in the Section: [\[installing-forge\]](#). You can create a new addon if you run the following command in the Forge CLI:

```
$ project-new --named envers --type addon --top-level-package org.jboss.forge.addon
```

If you run Forge from JBDS, open the Forge wizard (Ctrl + 4 or CMD + 4 on Mac) then select *Project: New* and specify *envers* as project name, *org.jboss.forge.addon* as top level package, enter project location per your preference and as a Project type select *Forge Addon*:

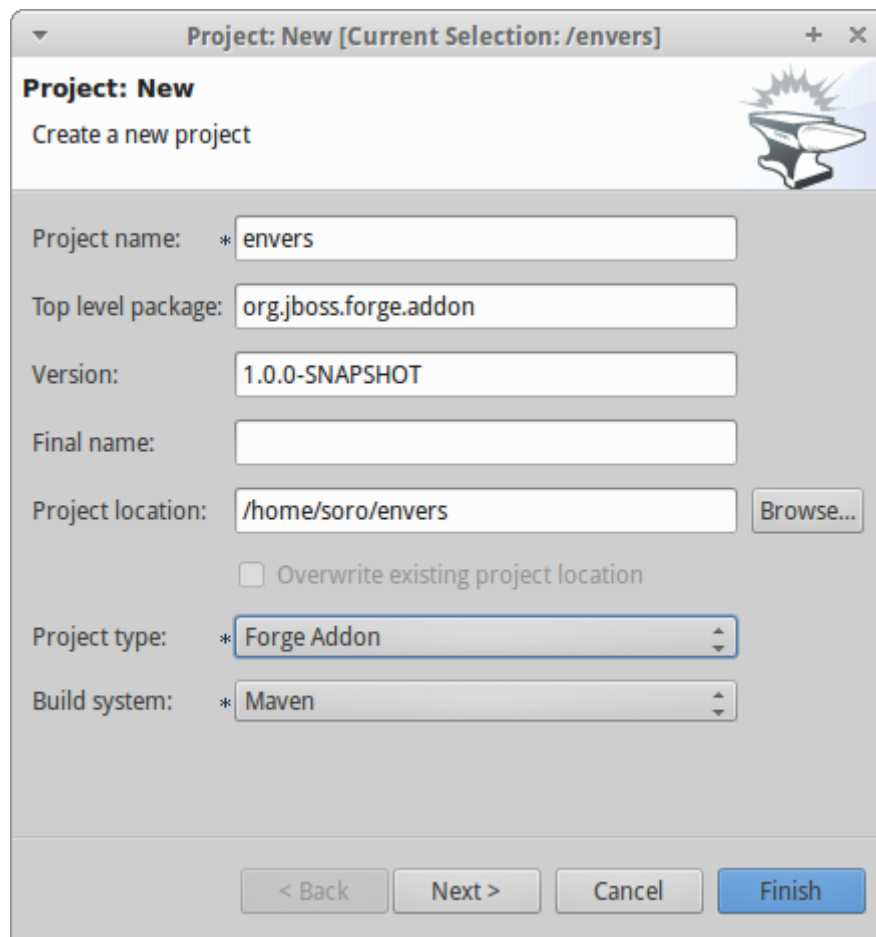


Figure 39. Creating new addon project

This will create a skeleton Maven project that has the following artifacts:

- `pom.xml` where the top level package is the group ID and the project name is the artifact ID. Besides the minimum Forge dependencies, the command will add also dependencies on any addons that you chose by using the `--addons` option. Addons specified in this way must use the following format: `<group-id>:<artifact-id>,<version>`
- Standard maven directory structure plus the top level package
- Empty `beans.xml` in the `src/main/resources/META-INF` directory. This is because Forge and its addons strongly rely on the CDI development model
- `README.asciidoc` file with a standard skeleton for documenting Forge addons (You should take a few moments to read over this file and fill in the blanks with information about your new addon.)

Developing the "Envers: Setup" command

The first command that we are going to create will set up Envers for a project. This basically means that the command will add the Envers library dependency to the current project POM (but will not actually directly edit the file, because Forge supports multiple build systems!). As with the new Forge addon, we can manually write the command class, copy and modify an existing command or let Forge itself generated it for us. Here we will go for the third option.

If you are running from the command line interface, type in:

```
[envers]$ addon-new-ui-command --named EnversSetupCommand --command-name "Envers: Setup" --categories "Auditing"
```

In JBDS, open the Forge wizard (Ctrl + 4 or CMD + 4 on Mac), then choose *Addon: New UI Command* and enter *EnversSetupCommand* in the Type Name field, *Envers: Setup* in the Command Name field and add *Auditing* to the Categories list box:

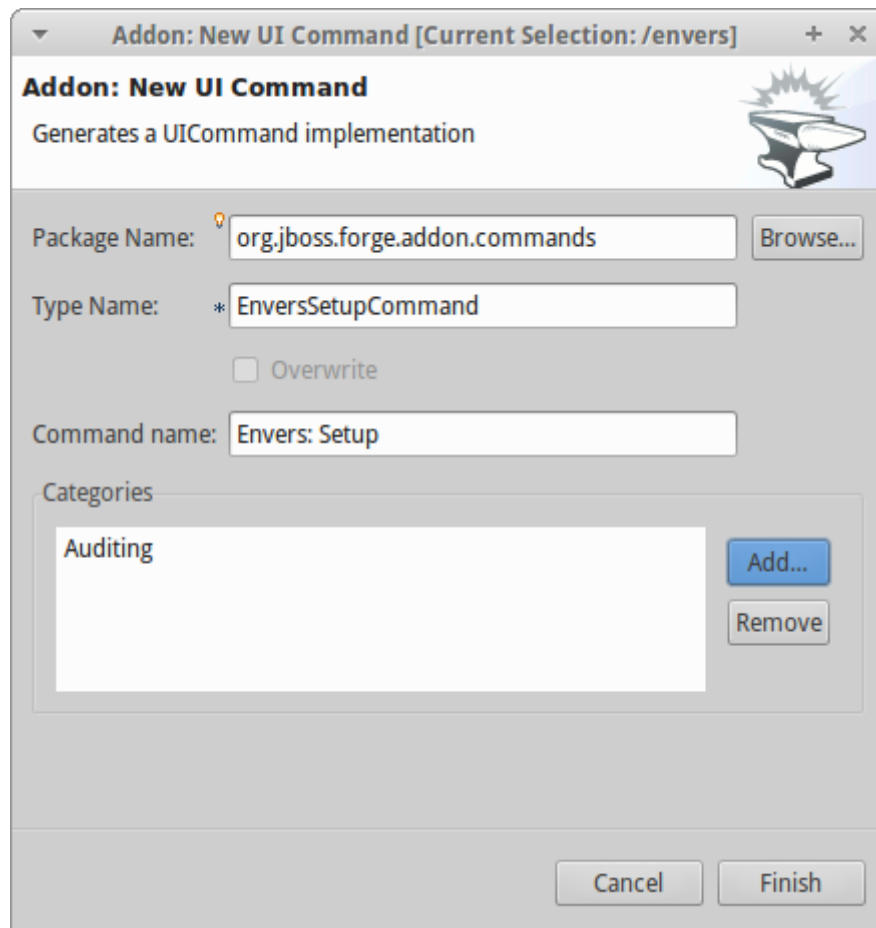


Figure 40. Creating *Envers: Setup* command

This will generate the `EnversSetupCommand` class in the `org.jboss.forge.addon.commands` package (unless you specify a different package). Forge makes this new command class extend `AbstractUICommand`, which provides some basic functionality like configuring the command name, the command dialog and the command execution. We will go through these in this and the next few sections.

The `getMetadata()` method is where basic information about your command is defined, and should be already implemented by Forge (using the values you specified in the New UI Command wizard):

```
@Override
public UICommandMetadata getMetadata(UIContext context)
{
    return Metadata.forCommand(EnversSetupCommand.class).name(
        "Envers: Setup").category(Categories.create("Auditing"));
}
```

This will basically create a command that can be called *envers-setup* from the CLI (note the substitution of colons and spaces by hyphens) and as *Envers: Setup* in the *Auditing* category in the Forge wizard

As the newly created command will not require any input from the user, we will leave the `initializeUI` method empty. However, in order to implement the command execution behavior, we will need to change a little bit our class. More precisely we will have to extend from another abstract command class. The rationale behind this is that we want to update the **current** project POM, so extending `org.jboss.forge.addon.projects.ui.AbstractProjectCommand` instead of `AbstractUICommand` will give us some handy methods to access and manipulate the Project itself:

```
public class EnversSetupCommand extends AbstractProjectCommand
{
```

We now have to implement two more abstract methods coming from this parent class. Take a moment to review the JavaDoc for these new methods, and understand their behavior. If you are confused, ask for help!:

```
@Override
protected boolean isProjectRequired()
{
    return true;
}

@Inject
private ProjectFactory projectFactory;

@Override
protected ProjectFactory getProjectFactory()
{
    return projectFactory;
}
```

The `org.jboss.forge.addon.projects.ProjectFactory` interface is used to create new or obtain references to existing project.

+ After having specified *Envers: Setup* as a "project command", we can now proceed to implementing the `execute` method. Usually this is called when the user clicks *Finish* on the command dialog or in our case, when the command has no inputs, and will be executed as soon as it is selected from the Forge quick start menu.

+ As we mentioned earlier, the command needs to add the Hibernate Envers dependency to the project. So first, let's create a representation of this dependency using the `org.jboss.forge.addon.dependencies.builder.DependencyBuilder` utility class:

```

@Override
public Result execute(UIExecutionContext context) throws Exception
{
    Dependency dependency =
        DependencyBuilder.create("org.hibernate")
            .setArtifactId("hibernate-envers")
            .setVersion("4.3.6.Final")
            .setScopeType("provided");
}

```

Speaking in Maven terms, this is a dependency on an artifact with ID `hibernate-envers`, coming from the `org.hibernate` group, having version `4.3.6.Final` and going into the project's *provided* scope.

After we have specified our dependency, we will have to add it to the project model. For that purpose we will use the `org.jboss.forge.addon.projects.dependencies.DependencyInstaller` utility, responsible for installing a given dependency into the project :

```

@Inject
private DependencyInstaller dependencyInstaller;

```

Forge 2.0 is based on modular runtime called *Furnace*. The core of Furnace itself is not bound to any development model, so addons can decide which of the Furnace container implementations it wants to use. We created our addon with the default configuration which enables the CDI container and development model. That is why we were able to use `@Inject` in the code snippet above. Forge will provide us with the dependency installer service, which we can use to add dependencies to selected Project when our command is executed.+

Now it is time to install our dependency:

```

@Override
public Result execute(UIExecutionContext context) throws Exception
{
    Dependency dependency =
        DependencyBuilder.create("org.hibernate")
            .setArtifactId("hibernate-envers")
            .setVersion("4.3.6.Final")
            .setScopeType("provided");
    dependencyInstaller.install(getSelectedProject(context), dependency);
}

```

We are using here one of the helper methods provided by the `AbstractProjectCommand`: `getSelectedProject()`.

Now our job is done, so it is time to report what we did. We do it by returning the result:

```

@Override
public Result execute(UIExecutionContext context) throws Exception
{
    Dependency dependency =
        DependencyBuilder.create("org.hibernate")
            .setArtifactId("hibernate-envers")
            .setVersion("4.3.6.Final")
            .setScopeType("provided");
    dependencyInstaller.install(getSelectedProject(context), dependency);
    return Results.success("Envers was successfully setup for the current
project!");
}

```

This will result in a *SUCCESS*: message in the command line interface and a green popup in the JBDS after our command is executed.

Now that we have a command that enables Hibernate Envers, it is time to add another command that will turn on auditing for a given JPA entity.

Adding some UI with the "Envers: Audit entity" command

We will create the class for the new command in the same way that we created the one for "Envers: Setup": with the help of Forge. If you are running the CLI, then simply type:

```

[envers]$ addon-new-ui-command --named EnversAuditEntityCommand --command-name
"Envers: Audit entity" --categories "Auditing"

```

Or alternatively in the JBDS choose *Addon: New UI Command*, enter *EnversAuditEntityCommand* in the Type Name field, *Envers: Audit entity* in the Command name field and add *Auditing* to the Categories list box:

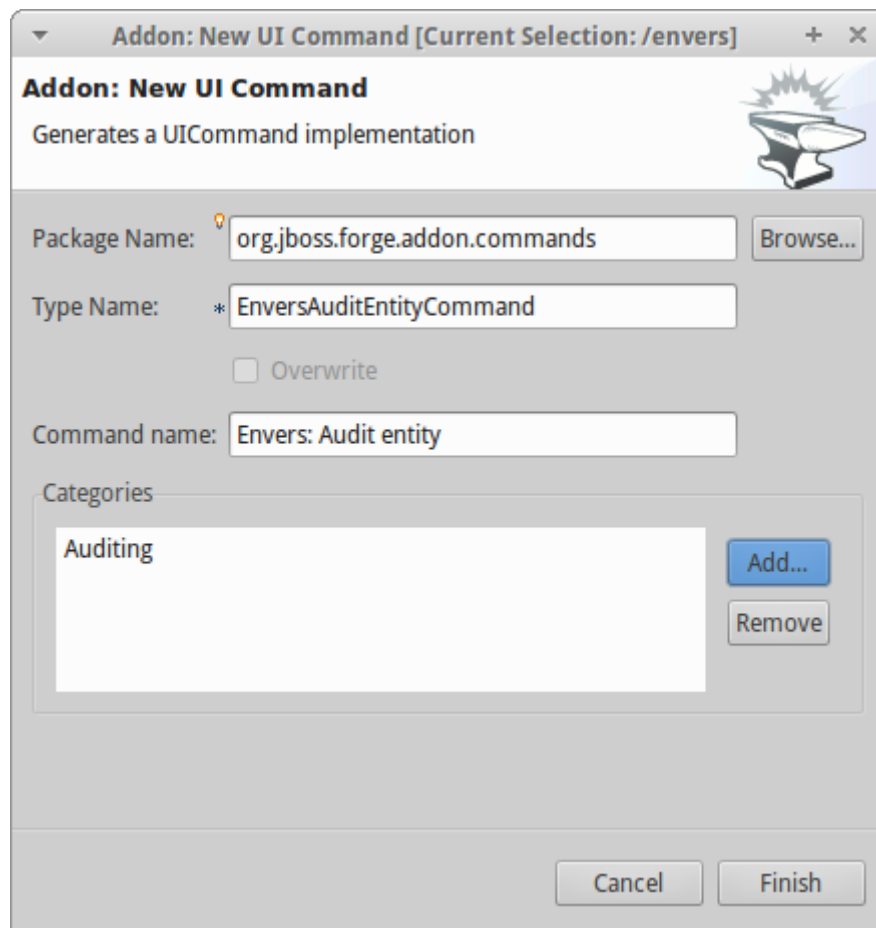


Figure 41. Creating Envers: Audit entity command

Then open the newly created class and make it extend `AbstractProjectCommand` instead of `AbstractUICommand` and also add the unimplemented methods the way you did it in the setup command.

This command will have to receive as input the entity class that has to be audited. To achieve this, we need to do two things:

1. Obtain and configure a `org.jboss.forge.addon.ui.input.UIInput` object from Furnace
2. Add our input to the `org.jboss.forge.addon.ui.context.UIBuilder` in the `initializeUI` method

Starting from number one, we should add the following member field to our command class:

```
@Inject
@WithAttributes(label = "Entity to audit", required = true)
private UIInput<JavaResource> auditEntity;
```

Here we call our field `auditEntity`. This automatically will add a `--auditEntity` option to our command in the CLI. The type of the field is `UIInput<JavaResource>`, which means a few things:

- The JBDS integration will create a text box control for the audit entity, while the command line interface will expect a single unbounded value
- The type of the value for this option should be a file that represents a `JavaResource` (class, interface or enumeration)

We have also specified some additional attributes with the `@WithAttributes` annotation:

- The `label` attribute tells Forge's JBDS integration to override the field name (`auditEntity` in this case) with *Entity to audit*. This will be the actual label of the text box in the IDE. This will not however change the option name on the command line
- The `required` attribute will not let the user complete the dialog without entering a value for the entity. The well known asterisk character will be displayed along the label in JBDS

After we define the input field, it is time to add it to the command dialog. In order to do that, we need to edit the `initializeUI` method:

```
@Override
public void initializeUI(UIBuilder builder) throws Exception
{
    builder.add(auditEntity);
}
```

We can tell now Forge to show a *Browse* button to the right of the input field, which will open the well known type picker of Eclipse. This is done by setting an *InputType* hint in our input. There are several input types to choose from, but we will need `JAVA_CLASS_PICKER`:

```
@Override
public void initializeUI(UIBuilder builder) throws Exception
{

    auditEntity.getFacet(HintsFacet.class).setInputType(InputType.JAVA_CLASS_PICKER);
    builder.add(auditEntity);
}
```

In Forge you can also set default values for inputs. This way you can omit specifying its value on the command line and in the IDE it will be pre-filled in the command dialog. You can do that with the `setDefaultValue` method of the `UIInput`. In our case the `UIInput` is generified over the `org.jboss.forge.addon.parser.java.resources.JavaResource` class, so we'll have to check whether the current selection in the UI (being the CLI or JBDS) is a file that represents a Java type. If yes, we will set it as the default value of the text field:

```
@Override
public void initializeUI(UIBuilder builder) throws Exception
{

    auditEntity.getFacet(HintsFacet.class).setInputType(InputType.JAVA_CLASS_PICKER);
    Object selection = builder.getUIContext().getInitialSelection().get();
    if (selection instanceof JavaResource)
        auditEntity.setDefaultValue((JavaResource) selection);
    builder.add(auditEntity);
}
```


Now that the command interface is ready, we can go on and implement the `execute` method. First, we should get the value entered in the text field and convert it to a `JavaResource`, then we will extract the `JavaClassSource` out of it so that we can manipulate things like annotations:

```
@Override
public Result execute(UIExecutionContext context) throws Exception
{
    JavaResource javaResource = auditEntity.getValue().reify(JavaResource.class);
    JavaClassSource javaClass = javaResource.getJavaType();

}
```

Next we will check whether the chosen class has already the `Audited` annotation and if not, will add it to that. At the end we'll save the new content and will return successful result:

```
@Override
public Result execute(UIExecutionContext context) throws Exception
{
    JavaResource javaResource = auditEntity.getValue().reify(JavaResource.class);
    JavaClassSource javaClass = javaResource.getJavaType();
    if (!javaClass.hasAnnotation("org.hibernate.envers.Audited")) {
        javaClass.addAnnotation("org.hibernate.envers.Audited");
    }
    javaResource.setContents(javaClass);
    return Results.success(
        "Entity " + javaClass.getQualifiedName() + " was successfully audited");
}
```

But what if the user enters invalid input? This could be a file that does not exist, or is not a class or is not a JPA entity. We'll implement the `validate(UIValidationContext validator)` method to handle such situations. Whenever it finds illegal input, it will add a validation error to the `validator` parameter. This will raise an error message if the command executes in the CLI; JBDS will show an error message and disable the Finish button of the dialog until the illegal value is corrected. This is how we implement the method:

```

@Override
public void validate(UIValidationContext validator)
{
    super.validate(validator);
    try
    {
        if (!auditEntity.getValue().reify(JavaResource.class).getJavaType()
            .hasAnnotation(Entity.class))
        {
            validator.addValidationError(auditEntity,
                "The selected class must be JPA entity");
        }
    }
    catch (FileNotFoundException e)
    {
        validator.addValidationError(auditEntity,
            "You must select existing JPA entity to audit");
    }
}

```

Finally, we want to avoid some compilation errors in the project where we will run this command. So it should be only available for execution if the user has called the setup command first, i.e. if the current project has dependency to Hibernate Envers. You can implement this enabling and disabling in several ways. We will show one of these: by implementing the `isEnabled` method. There we will again obtain the `DependencyFacet` and will ask it whether the desired dependency is installed. If this method returns false, the Forge commands wizard will not list the Audit entity command and it will not be available in the command completion in CLI. This is the implementation:

```

@Override
public boolean isEnabled(UIContext context)
{
    Dependency dependency = DependencyBuilder
        .create("org.hibernate")
        .setArtifactId("hibernate-envers");
    return getSelectedProject(context).getFacet(DependencyFacet.class)
        .hasEffectiveDependency(dependency);
}

```

Our first addon is ready. We can now build it, deploy it and run it on the Java EE project that we created in the beginning of this chapter.

NOTE

All the code manipulation that you've just seen come from an API called [Roaster](#). Roaster is a library that allows easy parsing of java source files, introducing a fluent interface to manipulate Java source files, like adding fields, methods, annotations and so on. You can use it outside Forge if you want. It's just an external API, smart enough to parse and manage Java source files. Give it a try.

Installing and trying the Envers addon

Once we have our basic functionality, we can build and install our new addon. For that we should use Forge's addons addon. It has a very handy command: *Addon: Build and install*. You can run it from the command line, or the IDE:

```
$ addon-build-and-install
```

If you don't specify the **project-root** parameter, Forge will look for the sources of your addon in the current folder. If this is not the intended behavior, in the CLI run the command like that:

```
$ addon-build-and-install --project-root <path-to-the-addon-sources>
```

In JBDS, either select the addon project before running the command, or specify the correct path in the command dialog:

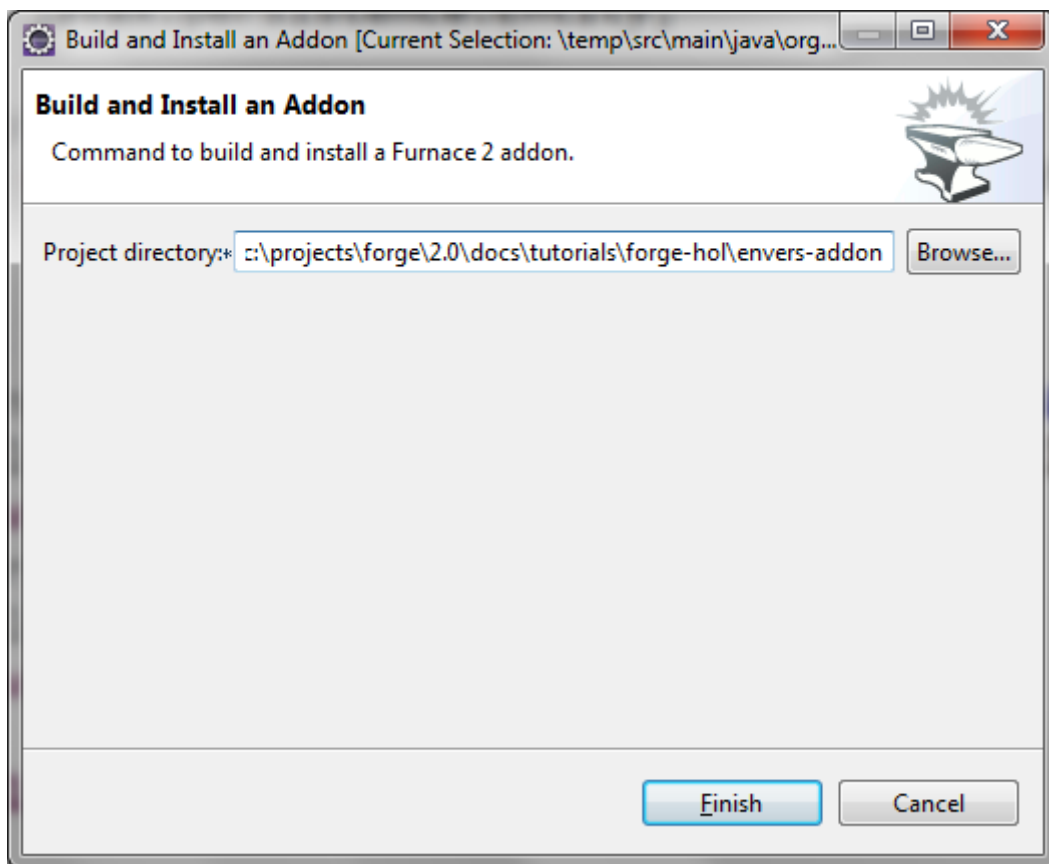


Figure 42. Specifying the addon project location

This will trigger a build of the addon, and if it is successful, Forge will install it in its addon repository. You don't have to restart the tool; Forge it will automatically load the new software once it is deployed. After you see the success message, you can re-run the Forge quick access menu and will see the new command in the command list:

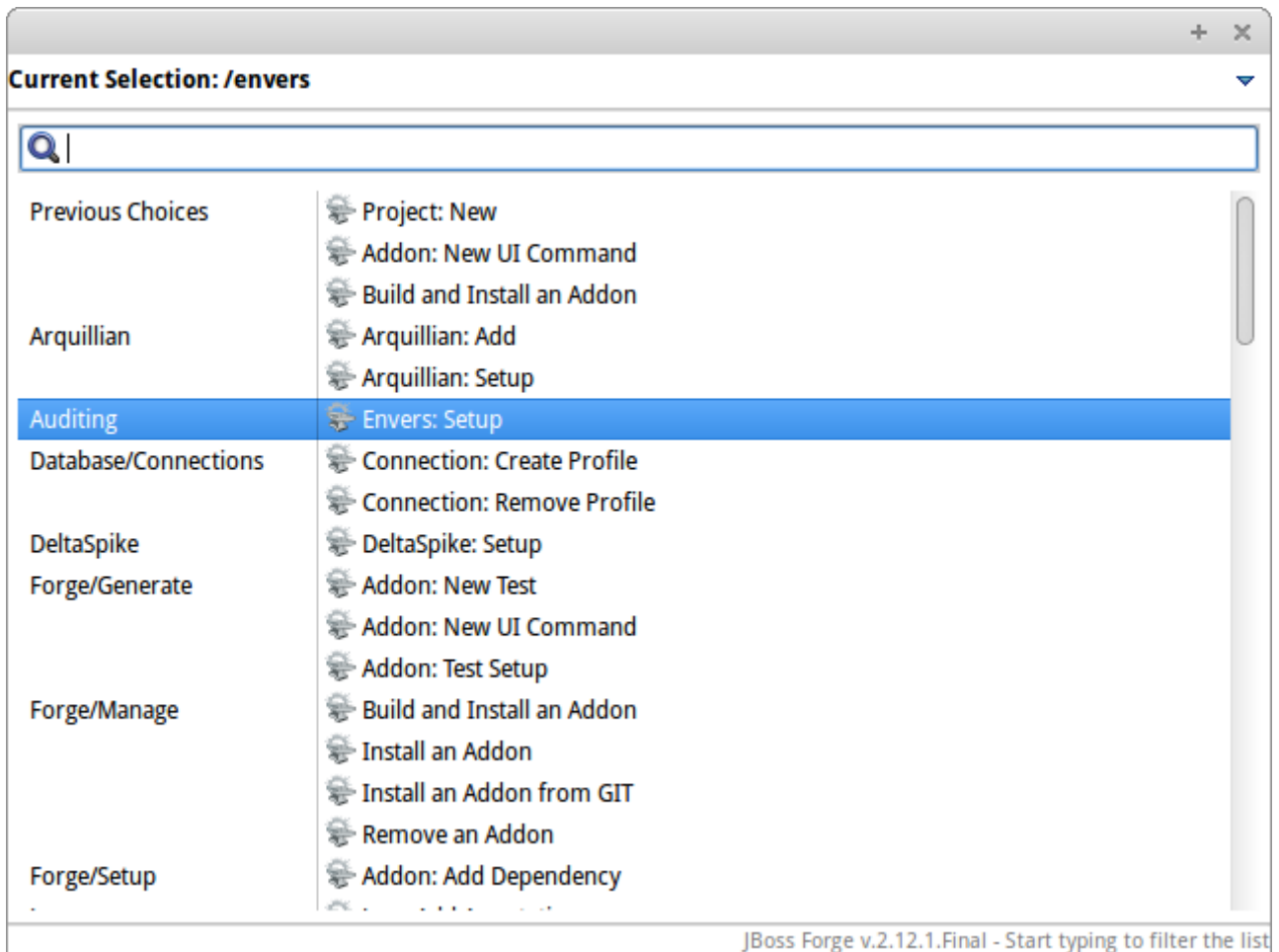


Figure 43. Envers: Setup command in the Auditing category

Now you can set up Hibernate Envers and open one of the JPA entities that you generated before starting to develop this addon, e.g. `Country`. You should be able to call now the other command. In the CLI:

```
[Country.java]$ envers-audit-entity
```

Or in JBDS press `Ctrl + 4` (or `CMD + 4` on Mac) and then pick the *Envers: Audit entity* from the command menu. Notice that the class that you opened in the editor (`org.jboss.forge.hol.petstore.model.Country`) was selected automatically for you:

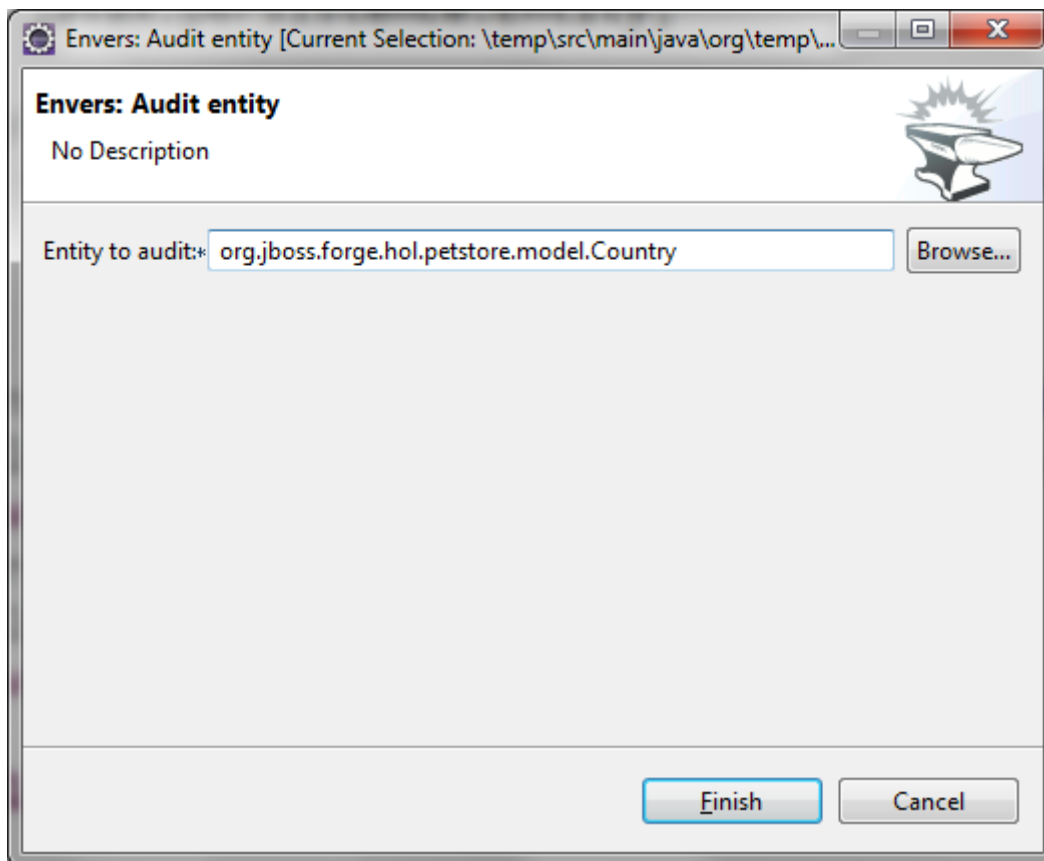


Figure 44. Envers: Audit entity command dialog

Just hit Enter and the entity will get the `@Audited` annotation.

Voila! :)

Forge configuration and Forge command execution listeners

In this final section of this chapter we will show you some more features that you could use when developing Forge addons. In order to showcase those, we will add a new requirement to the envers addon. Suppose that we want when we set it up to state that we want every new JPA entity that we create to be automatically audited. This means that the Envers: Setup command should be executable more than once, but it should add the Hibernate Envers dependency in the POM only the first time it was executed.

So, our first job is to enhance our setup command with UI in the form of a checkbox that asks the user whether they want their JPA entities to be automatically auditable. We'll use again the familiar `UIInput` class, but this time we'll generify it with `Boolean`. This will tell the IDE integration of Forge to automatically create a checkbox:

```
@Inject
@WithAttributes(label = "Audit automatically new entities",
    description = "Automatically make an entity auditable after it is created")
private UIInput<Boolean> enableAutoAudit;
```

Let's now add the checkbox to the command dialog using the `UIBuilder`:

```

@Override
public void initializeUI(UIBuilder builder) throws Exception
{
    builder.add(enableAutoAudit);
}

```

Next, we are going to make it possible running the setup command numerous times without polluting our POM file with as many dependencies to Hibernate Envers. For that we are going to use something as familiar - the `DependencyFacet`:

```

@Override
public Result execute(UIExecutionContext context) throws Exception
{
    Dependency dependency = DependencyBuilder
        .create("org.hibernate")
        .setArtifactId("hibernate-envers")
        .setVersion("4.3.6.Final")
        .setScopeType("provided");
    if (!getSelectedProject(context).getFacet(DependencyFacet.class)
        .hasDirectDependency(dependency))
    {
        dependencyInstaller.install(getSelectedProject(context), dependency);
    }

    return Results.success("Envers was successfully setup for the current
project!");
}

```

Finally we want to tell potentially other addons and commands whether the user wants or not to automatically add auditing to newly created JPA entities. For that we can use Forge's configuration. It is file based key-value-pair API, which can be used for storing project or Forge settings. The pairs are stored in `.forge_settings` file in the project root directory (this is the only non-project artifact that Forge creates) or in `~/.forge/forge.xml` directory if it is the global Forge configuration.

In order to get hold of the project configuration, you need to ask the `ConfigurationFacet` for it:

```

Configuration config = getSelectedProject(context)
    .getFacet(ConfigurationFacet.class)
    .getConfiguration();

```

TIP

the global Forge configuration is available through CDI injection. Just inject the `org.jboss.forge.addon.configuration.Configuration` API:

```

@Inject
private Configuration config;

```

Using the configuration API is straightforward. We can add this line in the `execute` method just before the return statement and it will add the boolean value of the checkbox to the project configuration file:

```
config.setProperty("autoAudit", enableAutoAudit.getValue());
```

Now, whenever and wherever we want to find whether the user has decided to automatically audit new JPA entities, we'll just need to lookup the *autoAudit* entry in the project configuration.

We can furthermore enhance the UI of our command by reading the configuration upon building it and finding out what is the current value of *autoAudit*. Based on that we can change the default value of our checkbox. For example, if the user has already run the setup command and has checked the checkbox, the next time when they run it, we want it checked rather than unchecked. As usually we want to take care of the situation when the entry is not available at all, i.e. the property is null, by providing a default value to the `getBoolean` method:

```
Configuration config = getSelectedProject(builder)
    .getFacet(ConfigurationFacet.class)
    .getConfiguration();
enableAutoAudit.setDefaultValue(config.getBoolean("autoAudit", false));
```

Now it is time for the final step in our journey: implementing automatic auditing of JPA entities. What we want now is every time the user creates a new entity class using Forge's *JPA: New Entity* command, to instrument that class with the `@Audited` annotation.

If you want to react on the execution of a Forge command, you should implement the `CommandExecutionListener` interface. Its methods give you hooks to the point before a certain command is executed as well as after the execution completes. There are a couple of methods for the latter: once for successful and another one for erroneous outcome:

```

public class JpaEntityCreationListener implements CommandExecutionListener
{
    @Override public void preCommandExecuted(UICommand uiCommand,
        UIExecutionContext uiExecutionContext)
    {
    }

    @Override public void postCommandExecuted(UICommand uiCommand,
        UIExecutionContext uiExecutionContext, Result result)
    {
    }

    @Override public void postCommandFailure(UICommand uiCommand,
        UIExecutionContext uiExecutionContext, Throwable throwable)
    {
    }
}

```

In our case we'll just want to implement the `postCommandExecuted` method. We want it to do its work only if the current command is *JPA: New Entity*

```

String commandName = uiCommand
    .getMetadata(uiExecutionContext.getUIContext())
    .getName();
if (commandName.equals("JPA: New Entity"))
{
}

```

Next we want to get hold of the project configuration to check whether automatic auditing was selected by the user. It was easy in the `AbstractProjectCommand` descendants to get the selected project with the respective utility method and then to obtain the configuration facet from there. Now we have to go through the `Projects.getSelectedProject` static factory method for that. It needs to get a project factory, which luckily we can inject. It would be also safe to check whether it is null and only then proceed to the entity instrumentation:


```

@Inject
private ProjectFactory projectFactory;

@Override public void postCommandExecuted(UICommand uiCommand,
    UIExecutionContext uiExecutionContext, Result result)
{
    String commandName = uiCommand
        .getMetadata(uiExecutionContext.getUIContext())
        .getName();
    if (commandName.equals("JPA: New Entity") && projectFactory != null)
    {
        Configuration configuration = Projects
            .getSelectedProject(projectFactory,
uiExecutionContext.getUIContext())
            .getFacet(ConfigurationFacet.class)
            .getConfiguration();
    }
}

```

Now with the `Configuration` instance at hand we can go on and check what the user preference is:

```

if (configuration.getBoolean("autoAudit", false))
{
}

```

We'll finally take advantage of the fact that Forge automatically selects a newly created class as the current resource. So, we'll get the current selection, we'll cast it to `JavaResource` and we'll basically do the same thing we did in the *Envers: Audit entity* command:

```

if (configuration.getBoolean("autoAudit", false))
{
    try {
        JavaResource resource = (JavaResource) uiExecutionContext
            .getUIContext().getSelection().get();
        JavaClassSource javaClass = resource.getJavaType();
        if (!javaClass.hasAnnotation("org.hibernate.envers.Audited")) {
            javaClass.addAnnotation("org.hibernate.envers.Audited");
        }
        resource.setContents(javaClass);
    } catch (FileNotFoundException fnfe) {
        fnfe.printStackTrace();
    }
}

```

That's it. You can now try what you have done.

For your reference, the full source code of the Forge Envers addon can be download from [here](#).

The end

This is the end of our hands on lab, but it's the beginning of a new journey: a world of productivity... even with Java EE. We hope you enjoyed it and that it helped you in discovering and learning more about JBoss Forge.

Appendix

Acknowledgements

The following JBoss Forge community members have contributed, one way or another, to this hands-on lab:

- Antonio Goncalves (@agoncal)
- Daniel Cunha (@dvlc_)
- George Gastaldi (@gegastaldi)
- Ivan St. Ivanov (@ivan_stefanov)
- Koen Aers (@koentsje)
- Lincoln Baxter III (@lincolnthree)

References

- JBoss Forge home page (<https://forge.jboss.org>)
- JBoss Forge Github repository (<https://github.com/forgexhibits/forgexhibits>)
- JBoss Forge forum (<https://developer.jboss.org/en/forgexhibits>)
- JBoss Forge add-ons (<http://forge.jboss.org/addons>)
- Roaster (<https://github.com/forgexhibits/roaster>)
- Hands-on-lab Github repository (<https://github.com/forgexhibits/docs/tree/master/tutorials/forgexhibits-hol>)
- Hands-on-lab PDF (<https://github.com/forgexhibits/docs/blob/master/tutorials/forgexhibits-hol/docs/forgexhibits-hol.pdf>)
- Hands-on-lab Envers add-on (<https://github.com/forgexhibits/docs/tree/master/tutorials/forgexhibits-hol/envers-addon>)
- Hands-on-lab Petstore script (<https://github.com/forgexhibits/docs/tree/master/tutorials/forgexhibits-hol/script>)
- Petstore Java EE 7 (<https://github.com/agoncal/agoncal-application-petstore-ee7>)

Revision History

Version 0.1

- Creation of this material
- Using JBoss Forge 2.12.x
- Used during the conference Devovx Belgium 2014
- JIRA <https://issues.jboss.org/browse/FORGE-2102>

Version 0.2

- Upgrade to Forge 3.0.0.Beta2

Version 0.3

- Added stacks information
- Updated CLI Commands Quick Reference

Version 0.4

- Images are now Center-aligned

CLI Commands Quick Reference

Cat ego ry	Co mm and	Co mm ent
Con figu rati on	con fig- clea r	
Con figu rati on	con fig- list	
Con figu rati on	con fig- set	
Dat aba se/C onn ecti ons	con nec tion -cre ate- pro file	Co mm and to cre ate a dat aba se con nec tion pro file.

Dat aba se/C onn ecti ons	con nec tion -re mo ve- pro file	Co mm and to re mo ve a dat aba se con nec tion pro file.
For ge/ Gen era te	add on- ne w- ann otat ed- ui- co mm and	Gen era tes an ann otat ed UIC om ma nd imp lem ent atio n
For ge/ Gen era te	add on- ne w- test	Gen era tes a Fur nac e test cas e for an add on

For ge/ Gen era te	add on- ne w- ui- co mm and	Gen era tes a UIC om ma nd imp lem ent atio n
For ge/ Gen era te	add on- test -set up	Ad d add on test set up to this pro ject
For ge/ Ma nag e	add on- buil d- and -ins tall	Co mm and to buil d and inst all a Fur nac e 2 add on.

For ge/ Ma nag e	add on- inst all	Co mm and to inst all a Fur nac e 2 add on.
For ge/ Ma nag e	add on- inst all- fro m- git	Co mm and to buil d and inst all a Fur nac e 2 add on.
For ge/ Ma nag e	add on- list	Co mm and to list all cur ren tly inst alle d Ad don s.

Forge/ Manage	addon- move	Command to remove a Furnace 2 add-on.
Forge/ Manage	addon- update	Command to update a Furnace 2 add-on. It may end up updating multiple add-ons.
Forge/ Manage	forge- update	Update this forge installation

For ge/ Ma nag e	for ge- upd ate- abo rt	Abo rts a pre vio us for ge upd ate
For ge/ Set up	add on- add -de pen den cy	Ad ds the pro vid ed add on as a dep end enc y to the sele cte d pro ject
Jav a	jav a- add -an not atio n	Ad d ann otat ion to clas s, pro per ty or met hod .

Jav a	jav a- add -en um- con st	Ad ds an En um con sta nt to an En um clas s
Jav a	jav a- for mat -so urc es	co mm and to for mat a file (or fold er rec ursi vel y) of Jav a sou rce file s
Jav a	jav a- gen era te- equ als- and -ha shc ode	Gen era tes equ als and has hco de for the giv en clas s

Jav a	jav a- gen era te- gett ers- and -set ters	Gen era tes mu tato rs and acc ess ors for the giv en clas s
Jav a	jav a- ne w- ann otat ion	Cre ate s a ne w Jav a An not atio n
Jav a	jav a- ne w- clas s	Cre ate s a ne w Jav a Cla ss
Jav a	jav a- ne w- enu m	Cre ate s a ne w Jav a En um

Jav a	jav a- ne w- enu m- con st	Cre ate s a ne w Jav a En um con sta nt
Jav a	jav a- ne w- exc epti on	Cre ate s a ne w Jav a Exc epti on
Jav a	jav a- ne w- fiel d	Cre ate s a ne w fiel d
Jav a	jav a- ne w- inte rfac e	Cre ate s a ne w Jav a Inte rfac e

Jav a	jav a- ne w- met hod	Gen era tes met hod s for the giv en Jav a clas s
Jav a	jav a- ne w- pac kag e	Cre ate s a ne w pac kag e
Jav a	jav a- set- def ault -for mat ter	Sets the def ault for mat ter for the Jav a res our ces
Jav a EE	jav aee -set up	Set up Jav a EE in you r pro ject

Jav a EE/ Bea n Vali dati on	con stra int- add	Ad d a Bea n Vali dati on con stra int
Jav a EE/ Bea n Vali dati on	con stra int- ne w- ann otati on	Cre ate a Bea n Vali dati on con stra int ann otati on
Jav a EE/ Bea n Vali dati on	con stra int- ne w- gro up	Cre ate a Bea n Vali dati on gro up
Jav a EE/ Bea n Vali dati on	con stra int- ne w- pay loa d	Cre ate a Bea n Vali dati on pay loa d

Java EE/Bean Validation	constraint-set-up	Setup Bean Validation in your project
Java EE/CDI	cdi-add-injection-point	Adds a new injection point field to a bean
Java EE/CDI	cdi-add-observer-method	Adds a new observer method to a bean
Java EE/CDI	cdi-list-alternatives	
Java EE/CDI	cdi-list-decorators	

Jav a EE/ CDI	cdi- list- inte rce pto rs	
Jav a EE/ CDI	cdi- ne w- ann otat ion- lite ral	Cre ate s an An not atio n Lite ral Typ e
Jav a EE/ CDI	cdi- ne w- bea n	Cre ate s a ne w CDI Ma nag ed bea n
Jav a EE/ CDI	cdi- ne w- con ver sati on	Cre ate s a con ver sati on blo ck in the spe cifi ed met hod

Jav a EE/ CDI	cdi- ne w- dec ora tor	Cre ate s a ne w CDI Dec ora tor
Jav a EE/ CDI	cdi- ne w- ext ens ion	Cre ate s a ne w CDI Ext ens ion
Jav a EE/ CDI	cdi- ne w- inte rce pto r	Cre ate s a ne w CDI Inte rce pto r
Jav a EE/ CDI	cdi- ne w- inte rce pto r- bin din g	Cre ate s a ne w CDI Inte rce pto r Bin din g ann otat ion

Java EE/ CDI	cdi- ne w- qua lifie r	Create a new CDI Quali fier ann otat ion
Java EE/ CDI	cdi- ne w- sco pe	Create a new CDI Sco pe ann otat ion
Java EE/ CDI	cdi- ne w- ster eot ype	Create a new CDI Ste reo typ e ann otat ion
Java EE/ CDI	cdi- set up	Set up CDI in you r pro ject

Java EE/EJB	ejb-newbean	Create a new EJB
Java EE/EJB	ejb-set-transaction-name-attribute	Set the transaction type of a given EJB
Java EE/EJB	ejb-set-transaction-name-attribute	Set the transaction type of a given EJB method
Java EE/EJB	ejb-setup	Set up EJB in your project

Jav a EE/J AX- RS	rest -ge ner ate- end poi nts- fro m- enti ties	Gen era te RES T end poi nts fro m JPA enti ties
Jav a EE/J AX- RS	rest -ne w- cro ss- ori gin- res our ce- sha rin g- filte r	Gen era te a Cro ss Ori gin Res our ce Sha rin g Filt er
Jav a EE/J AX- RS	rest -ne w- end poi nt	Cre ate s a ne w RES T End poi nt
Jav a EE/J AX- RS	rest -set up	Set up RES T in you r pro ject

Jav a EE/J AX- WS	soa p- ne w- ser vic e	Cre ate a ne w JAX -WS We b Ser vic e
Jav a EE/J AX- WS	soa p- set up	Set up JAX -WS (SO AP) in you r pro ject
Jav a EE/J MS	jms -set up	Set up JMS in you r pro ject
Jav a EE/J PA	jpa- gen era te- dao s- fro m- enti ties	Gen era te DA Os fro m JPA enti ties

Jav a EE/J PA	jpa- gen era te- enti ties -fro m- tabl es	Co mm and to gen era te Jav a EE enti ties fro m dat aba se tabl es.
Jav a EE/J PA	jpa- ne w- em bed dab le	Cre ate a ne w JPA Em bed dab le
Jav a EE/J PA	jpa- ne w- enti ty	Cre ate a ne w JPA Ent ity
Jav a EE/J PA	jpa- ne w- enti ty- list ene r	Cre ate a ne w JPA Ent ity List ene r

Jav a EE/J PA	jpa- ne w- fiel d	Cre ate a ne w fiel d
Jav a EE/J PA	jpa- ne w- ma ppe d- sup ercl ass	Cre ate a ne w JPA Ma ppe d Sup ercl ass
Jav a EE/J PA	jpa- ne w- na me d- que ry	Cre ate s a @N am edQ uer y in a JPA Ent ity
Jav a EE/J PA	jpa- set up	Set up JPA in you r pro ject

Jav a EE/J SF	fac es- ne w- bea n	Cre ate a ne w JSF Bac kin g Bea n
Jav a EE/J SF	fac es- ne w- con ver ter	Cre ate a ne w JSF Con ver ter
Jav a EE/J SF	fac es- ne w- vali dat or	Cre ate a ne w JSF Vali dat or
Jav a EE/J SF	fac es- ne w- vali dat or- met hod	Cre ate a ne w JSF vali dat or met hod

Jav a EE/J SF	fac es- set- pro ject -sta ge	Set the pro ject sta ge of this JSF pro ject
Jav a EE/J SF	fac es- set up	Set up Jav aSe rve r Fac es in you r pro ject
Jav a EE/J STL	jstl- set up	Set up JST L in you r pro ject
Jav a EE/J TA	jta- set up	Set up JTA in you r pro ject
Jav a EE/ Sec urit y	sec urit y- add -co nst rai nt	Ad d sec urit y con stra int

Jav a EE/ Sec urit y	sec urit y- add -log in- con fig	Ad ds a logi n con fig ele me nt to the cur ren t pro ject
Jav a EE/ Sec urit y	sec urit y- add -rol e	Ad d sec urit y role
Jav a EE/ Sec urit y	sec urit y- re mo ve- role	Re mo ve sec urit y role
Jav a EE/ Ser vlet	ser vlet -ne w- filte r	Cre ate s a ne w Ser vlet Filt er
Jav a EE/ Ser vlet	ser vlet -ne w- ser vlet	Cre ate s a ne w Ser vlet

Jav a EE/ Ser vlet	ser vlet -set up	Set up Ser vlet API in you r pro ject
Jav a EE/ We bSo cke t	we bso cke t- ne w- ser ver- end poi nt	Cre ate a ne w We bSo cke t Ser ver End poi nt
Jav a EE/ We bSo cke t	we bso cke t- set up	Set up We bSo cke t API in you r pro ject

Java/Service Loader	service-registration-as-service-provider	Register a Java type as a service implementation.
Maven	archetype-add	Adds an archetype category to the Forge configuration file

Ma ven	arc het ype -list	List s the regi ster ed arc het ype cat alo gs fro m the For ge con figu rati on file
Ma ven	arc het ype -re mo ve	Re mo ves an arc het ype cat alo g fro m the For ge con figu rati on file

Project	project-list-facets	List the facets associated with the current project
Project/Build	build	Build this project
Project/Generation	project-new	Create a new project
Project/Manage	project-add-dependencies	Add one or more arguments to the current project.

Project/Manage	project-adminaged-dependencies	Added or more managed dependencies to the current project.
Project/Manage	project-adminrepository	Added a repository to the current project descriptor.

Project /Manager	project -has dependencies	Check one or more arguments in the current project .
Project /Manager	project -has managed dependencies	Check one or more managed dependencies in the current project .

Pro ject /Ma nag e	pro ject -re mo ve- dep end enc ies	Re mo ve one or mo re arg um ent s fro m the cur ren t pro ject .
Pro ject /Ma nag e	pro ject -re mo ve- ma nag ed- dep end enc ies	Re mo ve one or mo re ma nag ed arg um ent s fro m the cur ren t pro ject .

Pro ject /Ma nag e	pro ject -re mo ve- rep osit ory	Re mo ve a rep osit ory con figu red in the cur ren t pro ject des crip tor.
Pro ject /Ma nag e	pro ject -set -co mpi ler- ver sio n	Set the jav a sou rce s and the tar get co mpi lati on ver sio n

Project / Stack	project-list-stacks	List the stacks associated with the current project
SCM / GIT	git-checkout	Checkout a branch from GIT repository or create a new one
SCM / GIT	git-clone	Clone a GIT repository

SC M / GIT	git- re mo ve- patt ern	Re mo ve patt ern fro m .giti gno re
SC M / GIT	git- set up	Pre par es the pro ject for fun ctio nin g in GIT con text
SC M / GIT	giti gno re- add -pat tern	Ad d patt ern to .giti gno re
SC M / GIT	giti gno re- cre ate	Cre ate .giti gno re fro m tem plat es

SC M / GIT	giti gno re- edit	Ope n .giti gno re and edit it
SC M / GIT	giti gno re- list- patt ern s	List ava ilab le .giti gno re patt ern s
SC M / GIT	giti gno re- list- tem plat es	List all ava ilab le .giti gno re tem plat es

SC M / GIT	giti gno re- set up	Cre ate .giti gno re file s bas ed on tem plat e file s fro m https://git hub .co m/g ith ub/ giti gno re.g it.
SC M / GIT	giti gno re- upd ate- tem plat es	Up dat e the loc al .giti gno re tem plat e rep osit ory
Sca ffol d/G ene rat e	scaf fold -ge ner ate	Gen era tes the scaf fold

Scaffolding/Setup	scaffold -set up	Set up the scaffold
Shell	cat	The cat utility reads files sequentially, writing them to the standard output. The file operands are processed in command-line order.

Shell	cd	Change the current directory
Shell	clear	Clear the console
Shell	cp	Copy a file or directory
Shell	echo	display a line of text
Shell	edit	Edit files with the default system editor
Shell	exit	Exit the shell
Shell	ls	List files

Shell	mkdir	Create a new directory.
Shell	mv	Move a file or directory
Shell	open	Open files with the default system application
Shell	pwd	Print the full file name of the current working directory.

Shell	rm	Remove (unlink) the FILE(s).
Shell	run	Execute/run a forgescript file.
Shell	touch	Create a new file or modify file timestamp.

Shell	track-changes	Initiate a transaction for each executed command.
Shell	transaction-commit	Commit a transaction
Shell	transaction-rollback	Rollback a transaction
Shell	transaction-start	Start a transaction
Shell	wait	Wait for ENTER.

Unc ate gor ize d	abo ut	Dis pla y inf or mat ion abo ut this for ge.
Unc ate gor ize d	co mm and -list	List all ava ilab le co mm and s.
Unc ate gor ize d	dat e	pri nt cur ren t dat e
Unc ate gor ize d	syst em- pro per ty- get	Get one or all syst em pro per ties
Unc ate gor ize d	syst em- pro per ty- set	Set a syst em pro per ty

Unc ate gor ize d	ver sio n	Dis pla ys the cur ren t For ge ver sio n.
Unc ate gor ize d	wai t	Wa it for EN TER .