Table of Contents

List of Examples

Preface

Juzu is a web framework based on MVC concepts for developing Portlet applications. Juzu is an open source project developed on GitHub project licensed under the LGPL 2.1 license.

1

Build and deploy

We will see in this chapter how to build and deploy a Juzu application.

1.1. Build

Building a Juzu application is usually done in two steps

- Compile the application to its binary representation
- Package the application as a war file

Compiling an application requires a few jars to be present on the compilation classpath:

- The Juzu core jar for the Juzu API
- The JSR-330 jar for the @Inject API
- Any Juzu extension jar such as plugins or additinal template engines

After compilation, classes need to be packaged as a web application archive (*war*) and then deployed in a server. We will show several ways to package a Juzu application.

> At the moment Juzu focuses on Maven because it is built with Maven, however that does not mean that Juzu is coupled to Maven, in the future we will provide additional examples or quickstart for alternative build systems.

1.1.1. With Maven

Juzu libraries are deployed in the Maven Central repository, compiling an application with require a few dependencies to find the correct jars.

1.1.1.1. Using the Juzu Maven *builder*

The *builder* is a Juzu artifact that serves the purpose of building and packaging an application:

1. provide a set of dependencies that will be sufficient for compiling the application using its Maven transitive dependencies

2. provide a predefined assembly descriptor that creates a war file containing the application classes, resources and libraries

To achieve the first step, we simply declare the following dependency in a Maven artifact:

```
<dependency>
  <groupId>org.juzu</groupId>
  <artifactId>juzu-packager</artifactId>
  <version>0.6.0-beta13</version>
</dependency>
```

Assembling the application requires more XML but is very straightforward:

```
<build>
  <plugins>
    <plugin>
      <artifactId>maven-assembly-plugin</artifactId>
      <version>2.3</version>
      <dependencies>
        <dependency>
          <groupId>org.juzu</groupId>
          <artifactId>juzu-packager</artifactId>
          <version>0.6.0-beta13</version>
        </dependency>
      </dependencies>
      <executions>
        <execution>
          <id>gatein</id>
          <goals>
            <goal>single</goal>
          </goals>
          <phase>package</phase>
          <configuration>
            <classifier>gatein</classifier>
            <descriptorRefs>
              <descriptorRef>gatein</descriptorRef>
            </descriptorRefs>
          </configuration>
        </execution>
      </executions>
    </plugin>
  </plugins>
</build>
```

The *assembly* plugin takes care of packaging the application:

1. The plugin dependency declares on the *juzu-packager* artifact because it contains the predefined descriptors such as the `gatein` descriptor

2. The goal *single* of the assembly plugin is executed on the *package* phase

3. The predefined descriptor *gatein* packages the application

    1. Any dependency on the application is packaged in *WEB-INF/lib*

2. The application classes are copied in *WEB-INF/classes*
3. The web application *src/main/webapp* files are copied to the root of the archive
4. Specific deployment descriptors may be copied in the war file depending on the predefined descriptor

In this example we used the *gatein* predefined descriptor, the same descriptor for the Liferay Portal server can also be used with the name *liferay*.

The builder relies p, the Maven Assembly plugin: Juzu provides the predefined assembly descriptors *gatein* and *liferay* that makes easy to package a Juzu application.

> The predefined assembly descriptor does a similar job to the Maven *war* packaging but with more flexibility. To achieve the same result, the usage of a war packaging with the overlay feature.

1.1.1.2. Juzu archetype

The following produces a base Juzu application:

```
mvn archetype:generate \
   -DarchetypeGroupId=org.juzu \
   -DarchetypeArtifactId=juzu-archetype \
   -DarchetypeVersion=0.6.0-beta13 \
   -DgroupId=org.example \
   -DartifactId=myapp \
   -DpackageName=org.example.myapp \
   -Dversion=1.0.0-SNAPSHOT
```

The generated application is a quickstart ready to can be customzed for developing more complex applications. The archetype uses the packager described in the previous section.

1.1.2. Using a prepackaged application

The Juzu distribution contains the Booking and Tutorial applications for GateIn and Liferay servers. They can be used as basis to create applications.

1.1.3. Using an IDE

Juzu uses Annotation Processing Tool to perform many tasks at compilation time. APT is a standard extension of a Java compiler. All Java IDE (Eclipse, Intellij and Netbeans) provide good support for APT, we will show in the section how to configure and uses APT within those IDEs.

IDEs provide also Maven support, we will focus in this section on using APT without the Maven support. Indeed the APT support may work differently when using Maven in your project, the Maven and APT support within IDEs has a dedicated section.

1.1.3.1. Intellij support

todo

1.1.3.2. Eclipse support

todo

1.1.3.3. Netbeans support

todo

1.2. Deploy

At the moment the supported (i.e tested) portal servers are

- GateIn 3.2 / GateIn 3.3
- Liferay 6.1

Other server may work but we are not aware of that as it was not tested in other environments.

1.2.1. GateIn

1.2.1.1. GateIn on Tomcat 6/7

No specific deployment instruction.

1.2.1.2. GateIn on JBoss AS 7

GateIn on JBoss AS7 requires a little modification to do:

Open the file *modules/javax/api/main/module.xml* and add ***<path name="javax/annotation/processing"/>*** among the *paths* declaration:

```
<module xmlns="urn:jboss:module:1.1" name="javax.api">
  <dependencies>
    <system export="true">
      <paths>
        <path name="javax/annotation/processing"/>
        ...
      </paths>
    </system>
  </dependencies>
</module>
```

This configuration exposes the `javax.annotation.processing` package to the classes seen by Juzu.

1.2.2. Liferay

Liferay has been tested extensively with the Tomcat version, no specific deployment instruction is required.

2

Request

Applications are build to process request, this concept deserves an entire chapter that explains how Juzu process http request. Request life cycle is the most important concept to get right when developping a web application, whether it is a Juzu application or not.

2.1. Phases

Juzu request life cycle is composed of four phases, we will explain three of them in this chapter, the last one will be explained in another chapter of this guide.

- The view phase : invoke the application to produce markup output aggregated within a page
- The action phase : invoke the application to process an action
- The resource phase : invoke the application to produce any kind of output as a full response (i.e not in a page)

During the execution of a phase, parameters are provided by Juzu to execute the phase. Those parameters are set by the application itself, for instance when it creates a link. The scope of the parameters (i.e when the validity of the parameters) depends on the phase.

2.1.1. View phase

The view phase invokes the application for the purpose of creating markup. This phase is indempotent, it means that repeated invocation of the same phase with the same parameters should produce the same markup (supposing than the application does not depend on some other state, like a database that could change over time).

View parameters are associated with the current URL, it means that they are somehow persistent. For instance you interact with an application to change its view parameters on each request and then you interact with another application on the same page: the view parameters will remain the same accross the invocation of the view phase of the application when the second application is used.

2.1.2. Action phase

The action phase invokes the application for processing an action. During the invocation, action parameters are provided and their validity is limited to the current action phase being executed, after they will not be anymore available.

The action phase is not idempotent, invoking several times an action phase could have side effects such as inserting several times the same data in a database.

Juzu does not expect markup returned during this phase, however it provides the opportunity to configure the view parameters of the next view phase.

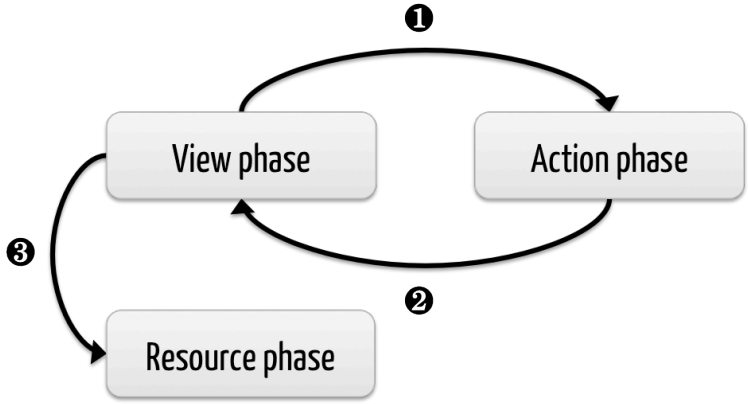
2.1.3. Resource phase

The resource phase allows the application to produce a web resource such as an image or a full page. When this phase is invoked, a set of resources parameters are provided in the URL producing the resource.

2.2. Interactions

Now that we have an overview of the phase, it is time to connect them and explain the interactions between the phases.

Figure 2.1. Interaction between phases



1. An action phase is invoked by an URL produced during a view phase, this URL contains the action parameters
2. After an action phase a view phase is executed and the view parameters are updated
3. A resource phase is invoked by anURL produced during a view phase, this URL contains the resource parameters

2.3. Mapping onto HTTP

As said before, phases and interactions have a natural mapping with the HTTP protocol. It is worthy to explain it because it will help you to understand fully the interations managed by Juzu.

2.3.1. View phase

View phases are mapped on *GET* requests:

- The view phase is idempotent like GET
- View parameters are identified to query parameters
- The response returned by a GET request should remain identical for the same parameters

During a view phase, the application produces URL which can invoke any application phase.

Figure 2.2. View phase

In this example the view phase produce markup parameterized by the `color` parameter having the *red* value.

2.3.2. Action phase

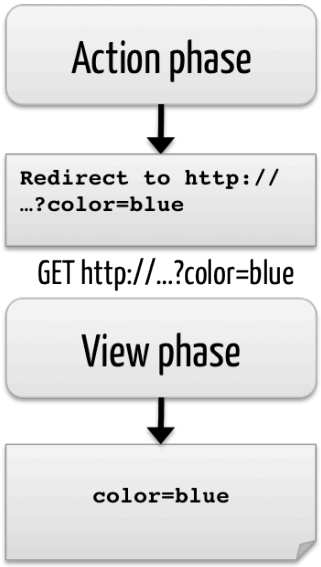
Action phase are created from view phase by processing a link that was found in the markup response. The action phase is mapped on *POST* requests:

- Both action phases and POST request are not idempotent
- Action parameters are identified to form parameters
- Action phase and POST requests should not be invoked more than one time

Figure 2.3. Action phase

Now let's update our example and suppose that the application returns markup with a form that invokes an action phase. When the user submits the form it triggers the action phase, which in returns updates the `color` view parameter of the next view phase to the value *blue*.

Figure 2.4. View phase after action phase



The HTTP redirection will update the browser to show the next view phase with the expected view parameters.

During the action phase, the application configures the parameters of the next view phase. When the invocation of the phase is over, the server redirects the browser (with an HTTP temporary redirection) to the next view phase URL. This URL contains the view parameters. This mechanism is well known as *Redirect After Post* pattern and is often used to ensure that a POST request is not triggered several times when the refresh button of the browser is used.

2.3.3. Resource phase

Resource phases are trivially mapped on *GET* request pretty much like a view phase. The main difference is that the resource phase is responsible for managing the entire response instead of just a fragment of the response.

3

Responses

Each request produces a response object: a subclass of the `juzu.Response` class.

Response objects are returned by method processing phases, the class of the object determines the kind of response sent to the client. A response object may carry additional objects such as assets (css or script).

Response object are created thanks to the static factory methods of the `juzu.Response` class. The `Response` class is abstract and it has several subclasses that form a possible hierarchy of response adapted to the phase being processed.

3.1. Content responses

A *content* response is a markup or binary data, it can be created with the `ok` static method:

```
  public static Response.Content<Stream.Char> ok(CharSequence content) { ... }
```

It can be used during a *view* or *resource* phase to return markup:

```
@View
public Response.Content index() {
  return Response.ok("Hello World");
}
```

3.2. Render response

A *render* response extends a *content* response, it specializes it for aggregated markup, i.e a response where the application manages only one portion of the full page such as a portal:

```
@View
public Response.Render index() {
  return Response.render("Hello World").withTitle("The Hello");
}
```

3.3. View response

View response is returned after the *action* phase to configure the next *view* phase. Usually view responses are not created directly using static factory methods, instead they are created using controller companion static methods, this will be explained in the controller chapter.

3.4. Redirect response

Redirect responses are returned during an *action* phase to redirect the user agent to an URL, its usage is simple:

```
@Action
public Response.Redirect process() {
  return Response.redirect("http://www.host.com/");
}
```

4

Controllers

Controllers play an essential role in a Juzu application: they contain the code executed when Juzu processes a request, this chapter provides an in depth study of Juzu controllers.

4.1. Overview

Juzu controllers are simply annotated methods of the application, here is the most basic controller declaration:

```
public class Controller {
  @View public Response.Content index() {
     return Response.render("hello world");
  }
}}
```

The annotation `@juzu.View` declares a *view* controller, the name `index` has a special meaning as it will be used when no other controller is specifed in a Juzu request.

Controller methods can declare parameters for receiving request parameters:

```
public class Controller {
  @View public Response.Content index(String person) {
     return Response.render("Hello " + person == null ? "world" : person);
  }
}
```

Like previously, the `index` controller returns the *hello world* value when it is called the first time. When the controller is called with the `person` parameter it returns the hello string personalized with the corresponding parameter value: Juzu use the declared method parameter name to match against the request parameters, in our case the `person` request parameter.

Any controller class (any class containing at least one controller method) generates a *companion* class during the compilation of the project. Such companion class extends the original controller class to provider companion methods for the controller method. The companion class has the same name than the original class appended with the _ character:

```
public class Controller_ {
  public static Dispatch index() { /* Generated code */ }
  public static Dispatch index(String person) { /* Generated code */ }
}
```

Each `index` methods generated a corresponding `index` method companion. When any `index` method is invoked it returns an `juzu.Dispatch` object that generates the URL dispatching to the corresponding phase when the `toString()` method is invoked. When parameters are provided they will be encoded in the generated URL.

```
@View public Response.Content index() {
  return Response.render("Hello word. <a href='" + Controller_.index("Juzu") +
}
```

URL companion methods have the name of the originating method appended with the *URL* suffix. The method parameter types are the same.

4.2. Controller phases

There are several kinds of controllers bound to a request phase studied in the ???:

- View controllers annoted with the `@juzu.View` annotation
- Action controllers annotated with the `@juzu.Action` annotation
- Resource controllers annotated with the `@juzu.Resource` annotation
- Event controllers annotated with the `@juzu.Event` annotation (*not yet implemented*)

4.2.1. View controllers

A view controller method produces aggregated markup for the application, the invocation of the method should produce markup that will be aggregated in larger page, therefore it should not care about the overall HTML structure.

View parameters describe the current parameters of the view, they are often used for navigation purpose in the application. Juzu supports simple data types such as string and structured data types modelled by Java objects.

- Simple data types can be the following types `String`, `List<String>` and `String[]`. Later this will be expanded to more simple types such as number, etc..
- Structured data types : todo

View controller method should return a `juzu.Response` object that is the content produced by the method. To be more precise it should return a `Response.Content` or `Response.Render` object (the latter being a subclass of the former) that contains everything Juzu needs to display the application.

`Response.Content` is a base class for content, it defines the `send` method. Juzu invokes this

method when it needs to render the response produced by the view method. The invocation of the `send` method will be performed after the view method is invoked.

```
    public void send(S stream) throws IOException {
      streamable.send(stream);
    }
```

During the view phase a controller can generate URLs to other phases (except the event phase) by using controller companion methods. Companion methods returns a `juzu.Dispatch` object to represent the URL. The final URL is returned by the `toString()` method of the dispatch object.

4.2.2. Action controllers

Action controller are executed during the action phase of a Juzu application. Usually action methods perform two tasks

- implement the logic of the application processing, for instance inserting an entity in the database
- configure the next view phase: setting the next view controller to display and configuring its view parameters of the method when they exist

In the following example, the controller method `createUser` creates a user and returns a `Response.View` object that will tell Juzu to use the `showUser` view controller during the next view phase:

```
@Action
public Response.View addUser(String userName, String password) {
  orgService.createUser(userName, password);
  return Controller_.showUser(userName);
}
```

`showUser` is a companion *view* method that creates a `Response.View` object configured with the controller and arguments to use. Like url companion methods, view companion methods are generated during the compilation of the project by Juzu.

4.2.3. Resource controllers

Resource controllers are similar to view controllers, however the resource has full control over the target page. It means that a resource controller must produce the entire resource and it can also chose the mime type returned. Resource controllers have several use cases:

- Implement ajax resource serving
- Produce an application resource, such as an image, a script, etc...

4.2.4. Event controllers

not yet implemented

4.3. Controller classes

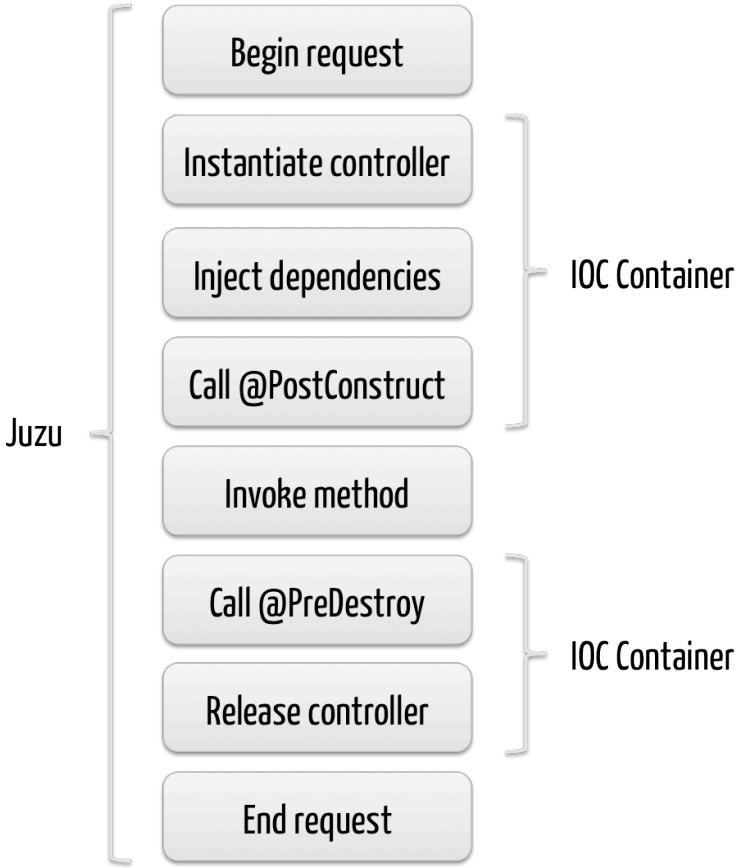
Controller methods belongs to Java classes known as controller classes. Controller classes are ordinary java classes, any class can be turned into a controller by declaring a controller method. Controller classes are registered in the IOC container of the Juzu application, we will study later the benefits.

4.3.1. Controller life cycle

We will study in this section the complete life cycle of a controller object. Juzu relies on the IOC container for managing the life cycle of controller objects, based on the `@javax.inject.Inject` annotation. If the controller desires, it can receive life cycle callbacks thanks to the `@javax.annotation.PostConstruct` and `@javax.annotation.PreDestroy` annotations.

Let's have a look at the complete life cycle of a controller object during a Juzu request:

Figure 4.1. Life cycle of a controller object



1. Juzu begins the request, it will need an controller instance for the request and asks the IOC container an instance
2. The IOC container creates a fully operational controller instance in several stesp
    1. It gets a controller object instance either by creating a new instance by using the default constructor or the constructor annotated with `@Inject`

    2. It injects the controller declared dependencies by the `@Inject` annotation
    3. It invokes any method annotated with `@PostConstruct`
3. Juzu obtains a valid controller instance and simply invokes the controller method
4. After the invocation, Juzu releases the controller instance and delegates it to the IOC container again
    1. It invokes any method annotated with `@PreDestroy`
    2. It makes the instance available to the garbage collector
5. Juzu ends the request and use the `Response` objet returned by the controller method

5

Inversion of Control

Juzu provides native support for Injection of Control (known as *IOC*) and relies on the specification JSR-330 (known as @*Inject*) for providing implementation free IOC.

Although the JSR-330 is quite small it provides the necessary ground for building Juzu applications. Juzu itself relies on the injection container for wiring the entire Juzu runtime (controllers, templates, plugins, etc...).

We will explain how Juzu uses IOC for its runtime, we will suppose that the reader is famillia with IOC and with the @Inject specification, in particular the notion of injection, scope and qualifier should be famillia.

5.1. Juzu IOC

5.1.1. IOC containers

The JSR-330 is implemented by several projects, we refer to them as IOC containers, they are *implementations* of the JSR-330 specification:

- Spring Core 3
- Context and Dependency Injection also know as *CDI* implemented by the Weld project
- Google Guice 3

Juzu is able to run with any of those implementation and leaves you the choice of the IOC implementation you want to use.

> CDI is a specification that extends the @*Inject* specification: CDI provides more features than @Inject, however this specification is only implemented by Weld. Nevertheless if your choice is to use CDI you will be leverage its specific features in your Juzu application

5.1.2. Beans

Beans are simply object managed by the IOC container, any bean can be injected other beans:

```
@java.inject.Inject
Service service;
```

5.1.3. Scopes

Scopes define how a instances of a bean are managed by the IOC container: for a given bean, shall it be instantiated only one time and shared or shall it instantiated everty time it is required ? that's the kind of question that scope answers.

Juzu provides 4 scopes to use within your application:

- `@javax.inject.Singleton` scope: a single bean instance is the same for the whole application
- `@juzu.RequestScoped` scope: the bean is instantiated once per request
- `@juzu.SessionScoped` scope: the bean is instantiated once per session
- `@juzu.FlashScoped` scope: the bean is instantiated once per request but is reused if it was instantiated during an action request in the next render request and only in the first one

5.1.4. Qualifiers

Qualifier are designed to distinguish several instances of a same bean. How does a bean differ from another bean ? it's not really possible to tell, qualifiers simply answer this question, allowing to:

- distinguish beans based upon the qualifier members
- configure the bean instance for a particular usage

The JSR-330 specification provides the `@Named` qualifier whose purpose is to give a name to a bean, for instance

```
@Named("john")
@Inject Person john;

@Named("peter")
@Inject Person peter;
```

5.2. Beans in action

Beans are simply the objects managed by the IOC engine. In a Juzu applications we have several kind of beans:

- Controllers
- Template
- Application beans

- Plugin beans

5.2.1. Template beans

Every template has a corresponding `juzu.template.Template` class at runtime. The template class allows applications to interact with templates, most of the time for rendering purpose:

```
template.render();
```

A template bean is always qualified by the `@Path` qualifier. The path qualifier is simply the value of the path relative to the *templates* package, for instance *index.gtmpl* is a valid qualifier value. The qualifier allows to have several `Template` instances and distinguish them.

Templates have the `@Singleton` scope: a single instance of the template object is created and shared in the IOC container.

5.2.2. Controller beans

Each controller class is turned into a bean, that's how controllers can be injected with other beans. As soon as Juzu finds a class annotated by `@View`, `@Action` or `@Resource`, it is automatically turned into a bean.

Controller have the `Request` scope by default: every time a controller instance is required it will be created for the duration of the request. It is possible to change the scope of a controller by annotating it with another scope annotation managed by Juzu:

```
@SessionScoped
public class Controller {
   @View
   public void index() { }
}
```

5.2.2.1. Injection a template into a controller

Injecting a template bean into a controller bean is probably the most common Juzu pattern:

```
@Inject
@Path("index.gtmpl")
Template index;
```

The template can then be used for rendering purposes:

```
@View
public void index() {
   index.render();
}
```

5.2.3. Application beans

Application beans model the custom logic of an application, they are normally injected in controller beans that use them when they process requests. The *binding* plugin allows an application to declare custom beans that can be used in the application.

5.2.3.1. POJO bean binding

Binding a Plain Old Java Object (POJO) is a very simple task to accomplish:

```
@Bindings(@Binding(Mailer.class))
package myapplication;
```

The bean will be entirely managed by the IOC container, the binding plugin will just declare it in the IOC container. The POJO will be created when needed, for instance when it is inserted in a controller.

```
public class MyController {
   @Inject Mailer mailer;
   @Action
   public void sendMail(String recipient, String subject, String message) {
      mail.send(recipient, subject, message);
   }
}
```

5.2.3.2. Abstract bean binding

Binding an abstract class or an interface type is also possible with the `implementation` member of the `@Binding` annotation:

```
@Bindings(@Binding(value=Mailer.class,implementation=MailerImpl.class))
package myapplication;
```

5.2.3.3. Binding with a provider

Sometimes the implementation cannot be created by the IOC container, for instance it may not have a correct constructor, it can only be retrieved using a factory or it should be configured before being used. For such scenarios the implementation can specify a class implementing the `javax.inject.Provider` interface.

```
public class ConfiguredMailerProvider implements javax.inject.Provider<Mailer>

   private String email
   private String password;

   public ConfiguredMailerProvider() {
      this.email = System.getProperty("mailer.email");
      this.password = System.getProperty("mailer.password");
   }

   public Mailer get() {
      return new MailerImpl(email, password);
   }
}
```

Thanks to the provider, we have a `Mailer` provider that returns a `MailerImpl` configured before usage.

5.2.3.4. Scoped binding

The `@Binding` annotation provides room for declaring a bean scope:

```
@Bindings(@Binding(value=Mailer.class,scope=Scope.SINGLETON))
```

When the scope is not specified, the scope is determined from the bean or implementation that should be annotated with a scope annotation. When it is specified, it overrides the annotation scope the bean could declare.

5.2.3.5. Qualifying provider

A provider implementation can declare qualifiers on the `get` method they implement in order to set the qualifiers of the returned bean:

```
public class MailerProvider implements Provider<Mailer> {
   @Named("mailer")
   public Mailer get() {
      return new MailerImpl();
   }
}
```

This is useful for declaring qualifiers on a class that is not annotated by qualifiers, because it is not possible to declare qualifiers in an `@Binding` annotation due to limitations of the Java language.

5.3. Provider factories

Provider factories provides plugability for integrating beans that are not managed by the IOC container. The provider factory is a factory for `javax.inject.Provider` whose purpose is to return a provider for a specific class. Usually provider factories will lookup the service in a registry (like another IOC container) and returns a provider that return them lazily or not.

The provider factory defines the `getProvider` method:

```
  /**
   * Returns a provider for a specific type or null if it cannot be produced.
   *
   * @param implementationType the implementation class object
   * @param <T>                the implementation generic type
   * @return a provider for this class or null
   * @throws Exception any exception that would prevent to obtain the provider
   */
  <T> Provider<? extends T> getProvider(Class<T> implementationType)
    throws Exception;
```

The factory implementation must provide a public zero argument constructor and it will be instantiated during the application boostrap by Juzu to obtain the provider. The returned providers will then be bound into the IOC container.

The IOC container uses the `java.util.ServiceLoader` discovery mechanism for finding provider factories when injection occurs.

Let's study a simple example with a provider for the current time:

Example 5.1. Time provider factory

```
package my;

public class TimeProvider implements java.inject.ProviderFactory {
   public <T> Provider<? extends T> getProvider(Class<T> implementationType) {
      if (implementationType == java.util.Date.class) {
         return implementationType.cast(new java.util.Date());
      } else {
         return null;
      }
   }
}
```

This provider should be declared in the *META-INF/services/juzu.inject.ProviderFactory* file:

Example 5.2. Time provider configuration

```
my.TimeProvider
```

6

Templating

Templating is the *View* part of a Model View Controlle architecture. We will study in this chapter how the templating system interacts with the Juzu, at compilation time and at runtime, both aspects are very important.

6.1. The templating engines

Juzu can use several templating engines, it provides a native template engine as well as the Mustache templating engine. Those engines are not competing, instead they should be seen as alternatives: the native Groovy engine provides the goodness of the Groovy languages, however sometimes some people prefer logic-less templates and Mustache is a template engine they should use. Let's introduce them briefly.

6.1.1. The native template engine

The native template engine extends the Groovy templating system: it can include snippet of Groovy code or resolve Groovy expressions:

6.1.1.1. Expressions

Expressions are simply Groovy expressions wrapped with the `${...}` syntax:

```
The sky is ${color}
```

6.1.1.2. Scriplets

Groovy code can also literaly be used with the *scriplet* syntax: `<% ... %>`. Within a scriptlet the `out` implicit object can be used for outputting markup:

```
<ul>
<% ["red","green","blue"].each({ color -> out.print("<li>The sky is " + color +
</ul>
```

The scriplet syntax `<%= ... %>` can also be used:

```
The sky is <%= color %>
```

6.1.1.3. Controller urls

Controller urls is natively supported by the engine, it allows to create controller URL with a short and compact syntax `@{...}`:

Example 6.1. Controller URL syntax

```
<a href="@{index()}">Home</a>
```

URL expressions can contain parameters and they must be named:

Example 6.2. Controller URL with parameters

```
<a href="@{purchase(product=1)}">Purchase</a>
```

The *purchase* method refers to a controller method, when the application has several controllers, the controller name can be used to prefix the url expression and remove the ambiguity:

Example 6.3. Explicit controller URL

```
<a href="@{Controller.purchase(product=1)}">Purchase</a>
```

Under the hood the controller URL syntax uses the controller compagnion for creating the URL: the `Controller.purchase(product=1)` will uses the controller compagnion `Controller_#purchase(String product)`.

6.1.1.4. Taglib

The native engine provides taglib support using the `#{tag}...#{/tag}}` or `#{tag/}` syntax:

```
#{title value=Hello/}
```

Available tags are explained in the taglib chapter.

6.1.2. The Mustache template engine

The Mustache template engine uses *logic-less* templates based on Mustache.java the Java port of Mustache. Mustache is very easy to use, you can read the documentation, however we will have a quick overview of how it can be used in Juzu:

6.1.2.1. Variables

Variables uses the `{{...}}` syntax, they are resolved against template parameters or beans.

```
The sky is {{color}}
```

6.1.2.2. Sections

Mustache sections allows to iterate expressions that are multivalued.

```
todo
```

6.2. Using templates

A template as seen by an application is a bean managed by the IOC container.

6.2.1. Template declaration

Applications use a template by injecting a `juzu.template.Template` object in its controllers qualified by the `juzu.Path` annotation:

Example 6.4. Using a template

```
public class Controller {

  @Inject
  @Path("index.gtmpl") ❶
  Template index;

  @View
  public void index() {
    index.render(); ❷
  }
}
```

❶ Declares the template path

❷ Renders the template and send the markup to the response

The `juzu.Path` annotation is a qualifier annotation managed by the IOC container. It is very similar to the `@javax.inject.Named` qualifier, but it has a special meaning for Juzu for declaring the template.

The `render` method of a template returns a `juzu.Response.Render` response which can also be returned by the controller method. This is equivalent to the previous example.

Example 6.5. Returning the generated juzu.Response.Render

```
  @View
  public Response.Render index() {
    return index.render();
  }
```

6.2.2. Type safe parameters

Template type safe parameters brings more type safety in your applications. Templates can declare parameters and they are made available on a subclass of the `juzu.template.Template` class.

Parameters are declared using the taglib support of the native template engine

Example 6.6. Native template parameter declaration

```
#{param name=color/}
The sky is ${color}.
```

or the pragma support of the Mustache engine

Example 6.7. Mustache template parameter declaration

```
{{%param color}}
The sky is {{color}}.
```

When the template is declared in a controller, a subclass of `juzu.template.Template` can be used:

```
package weather;

public class Controller {

  @Inject
  @Path("sky.gtmpl")
  weather.templates.sky sky; ❶

  @View
  public void index() {
    sky.with().color("blue").render(); ❷
  }
}
```

❶ The `weather.templates.sky` typed template class

❷ Use the `sky` template `color` parameter

The `weather.templates.sky` class does not exist in the original source but it is available when the application is compiled because it will be generated by Juzu compiler integration. The `sky` templates provides a *fluent* syntax to bind parameters: `sky.with().color("blue").render()`.

6.2.3. Expression resolution

When we studied the templating engine syntax but we did not mentioned exactly how expression are resolved.

6.2.3.1. Single name expressions

Both templating system provides a syntax for resolving single name expressions:

- `${...}` for Groovy
- `{{...}}` for Mustache

Resolution is performed against template parameters or bean named with the `javax.inject.Named` qualifier.

Example 6.8. Named bean

```
@javax.inject.Named("color")
public class Color {
  public String toString() {
    return "red";
  }
}
```

Example 6.9. Template parameters

```
index.with().set("color", "red").render(); ❶
index.with().color("red").render(); ❷
```

❶ Detyped version

❷ Type safe version

6.2.3.2. Compound expressions

Compound expressions are resolved the same way for the first name and the expression resolve will attempt to navigate the rest of the expressions from this object:

- `${weather.color}` for Groovy
- `{{#weather}}{{color}}{{/weather}}` for Mustache

Example 6.10. Named bean

```
@javax.inject.Named("weather")
public class Weather {

  private String color;

  public Weather(String color) {
    this.color = color;
  }

  public Weather() {
    this.color = "red";
  }

  public String getColor() {
    return color;
  }
}
```

Example 6.11. Template parameters

```
index.with().set("weather", new Weather("blue")).render(); ❶
index.with().color(new Weather("blue")).render(); ❷
```

❶ Detyped version

❷ Type safe version

}}}

7

Templating SPI

This chapter dives into the template life cycle from compilation time to run time. We will describe the template Service Provider Interface (SPI), the SPI is designed to make Juzu templating extensible and integrating new template engines in Juzu. This chapter is optional is you are writing application with Juzu, however it is a must read if you want to know more Juzu internals or if you want to understand how to integrate a template engine in Juzu.

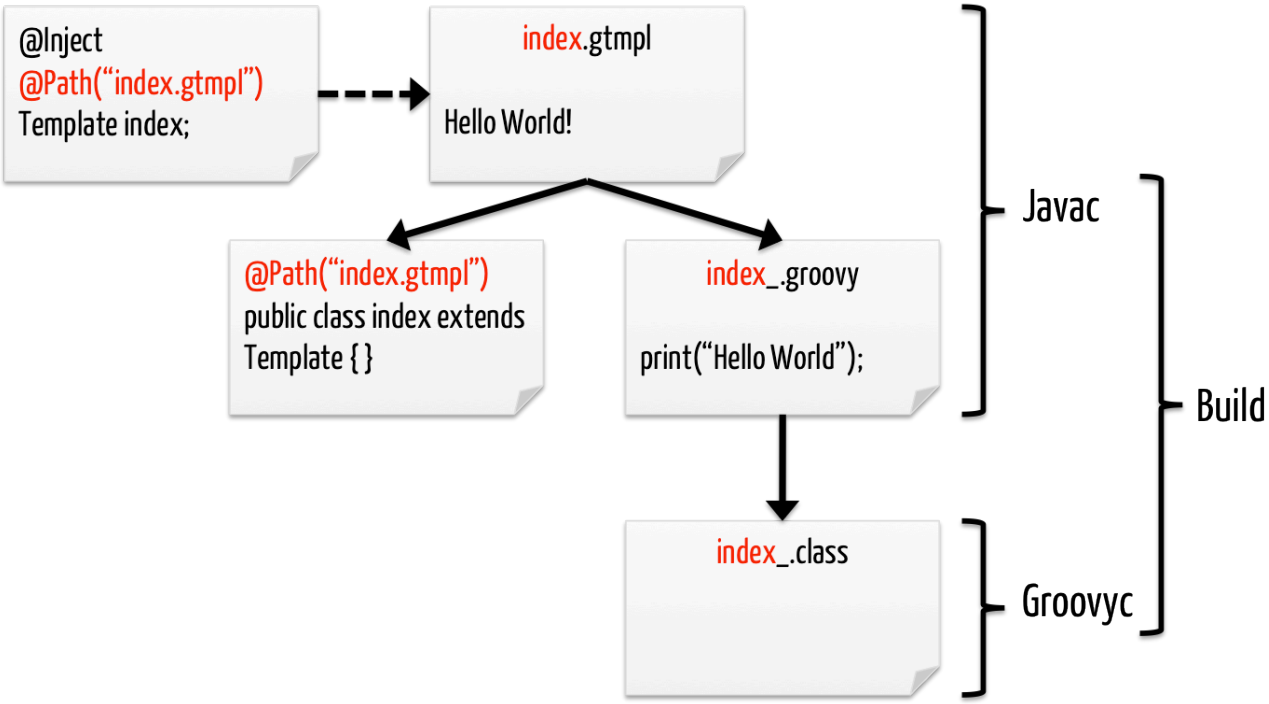
When a Juzu application is compiled, the Juzu annotation processor detects the `@Path` annotations and triggers the compilation of the related templates. The template compilation can be split in two parts:

- Generating the template companion class that inherits the `juzu.template.Template` class. This part is generic and works with any templating system, it is entirely managed by Juzu.
- Compiling the template file, this task is delegated to the `TemplateProvider` and is extensible. The provider allows to have several templating system in Juzu and decouples the template compilation process from the details of the templating engine.

7.1. Compiling a Groovy template

Let's study an example with the Groovy template at compilation time.

Figure 7.1. Compiling a Groovy template



When the Java compiler is invoked, the following steps are executed

1. The Java compiler triggers the Juzu annotation processor when it finds the `@Path` annotation
2. Juzu resolves the relative path to the `templates` package of the application
    1. When the template cannot be resolved a compilation error is triggered
    2. Otherwise the template is loaded
3. The template provider is looked up according to the file name extension, it will generate the *index.groovy* source file
4. Juzu creates the `index` class that extends the `juzu.template.Template` class annotated by the `@Path("index.gtmpl")` annotation

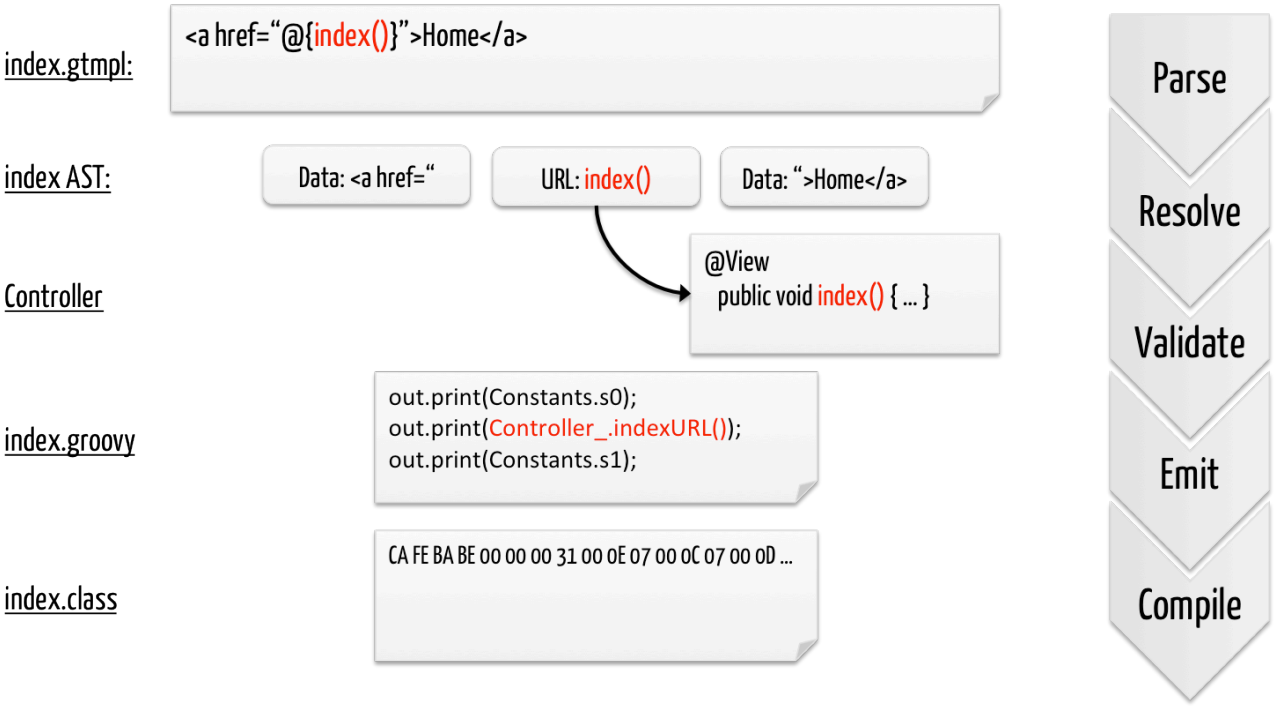
After that the only remaining part is to compile the *index.groovy* source to a class. It can be achieved either at build time using the *groovyc* compiler or at load time when the `index` template is loaded using a `GroovyClassLoader`. The former approach makes the build a bit more complex (but not much as Groovy compilation is fairly well supported in build systems or IDEs) as it requires to run a Groovy compilation but it will perform additional validation of the template as well as reduce the load time of the template. The later approach will detect any compilation error (such as Groovy syntax error) at runtime and the *index.groovy* compilation will take a few milliseconds.

This flexibility allows to use the lazy approach during development and when the application is released then the Groovy compiler can be used to compile the *index.groovy* once and for all.

7.2. Type safe URL resolution

Groovy templates provides the `@{...}` syntax for generating URL from the application controllers. This section gives an overview of the underlying resolution mechanism.

Figure 7.2. Template URL resolution during compilation



- Parse: the template is parsed into its model representation
- Resolve: the `index` link is resolved againt the controller meta model
- Validate: the `index` link is validated
- Emit: the corresponding *index.groovy* file is emitted and save on the class output
- Compile: the Groovy source is compiled into a class by the *groovyc* compiler (this part is done after *javac*)

7.3. Template Service Provider Interface

Juzu provides a Service Provider Interface (SPI) for integrating thirdparty template engine. Actually all template system are integrated with the SPI. We will study briefly the integration points so you can integrate a template engine of your choice in Juzu.

7.3.1. Template providers

The `juzu.impl.template.spi.TemplateProvider` is the main entry point when a templating system is integrated. The provider is triggered during the compilation phase by the APT system built into the Java compiler.

```
/**
 * A provider for templating system.
 *
 * @author <a href="mailto:julien.viet@exoplatform.com">Julien Viet</a>
 * @param <M> the template model
 */
public abstract class TemplateProvider<M extends Serializable> {
  ...
}
```

The provider must declare the template model `<M>` generic type. It must be a serializable type because Juzu will sometimes write template models on the disk during the compilation this usually happens only in Eclipse due its incremental compiler architecture. The type specified by the provider is privately managed (i.e it is opaque for Juzu) and it symbolizes an internal representation of the parsed source (usually an Abstract Syntax Tree), it will be used in various methods of the provider.

Let's have a review of the methods of this class to have a better understanding.

```
  public abstract String getSourceExtension();

Could not locate the JavaCodeLink[juzu.impl.template.spi.TemplateProvider#getTa
```

The `getSourceExtension()` method is used to determine what file extension the provider can compile. The implementation should return a constant value, for instance the Groovy provide simply returns the `gtmpl` value.

The `getTargetExtension()` method returns a file extension of the file that is generated by the provider. This extension is optional and it can return null if the provider will not generate a target file. For instance the Groovy provider returns the `groovy` value because it will emit a a Groovy file, however the Mustache provider will return null because it won't emit any file.

```
  public abstract M parse(
      ParseContext context,
      CharSequence source) throws TemplateException;

  public abstract void process(
      ProcessContext context,
      Template<M> template) throws TemplateException;

Could not locate the JavaCodeLink[juzu.impl.template.spi.TemplateProvider#emit(
```

The `parse`, `process` and `emit` methods care about transforming the template source to its final representation : the template stub.

- The `parse` method is invoked with the content of the template and returns a template model. The representation returned by the parse method is a parsed representation of the template source. If a parsing error occurs the method can throw a `TemplateException`.
- The `process` method is invoked after the template is parsed with the necessary context for

performing further processing of the template, for instance the Groovy templating engine performs the resolution of type safe URLs or type safe parameters declaration at this moment. During the process:

- The provider can resolve other templates using the `ProcessContext`, if the template to resolve is not yet loaded it will trigger the `parse`/`process`/`emit` lifecycle, it if was already processed the template is simply returned
- The implementation can resolve controller methods and translate them into method invocation, this is used for checking type safe URL and translating them into controller companion invocation
- The `juzu.impl.template.spi.Template` argument represents the template, it has several fields such as the template model or the template path
- The implementation can declare type safe parameters using the `Template#addParameter(String)` method. The declared parameters will be generated on the `juzu.template.Template` subclass

- The `emit` method is invoked when the template processing is over. The implementation can return null or a `CharSequence` that will be saved in a file named after the origin template file but with the extension returned by the `getTargetExtension()` method.

```
public abstract Class<? extends TemplateStub> getTemplateStubType();
```

Finally the `getTemplateStubType()` returns the type of a java class that will be used for creating a template stub. For each template, a stub is created, the stub is responsible for loading the template at runtime.

7.3.2. Template stub

Template stubs are java class created by the template compiler for managing the template at runtime on behalf of the provider. Each provider provides its own stub implementation as a `juzu.impl.template.spi.TemplateStub` subclass, when Juzu finalizes the compilation of a template it will create a subclass of the stub for the compiled template. A stub must implement two abstract methods:

```
protected abstract void doInit(ClassLoader loader);

protected abstract void doRender(TemplateRenderContext renderContext)
    throws TemplateExecutionException, IOException;
```

The `doInit` method loads the template using the provided `ClassLoader`, it will be call only once before the template is rendered.

The `doRender` method renders the template using the provided `TemplateRenderContext`. The render context provides the necessary hooks such as:

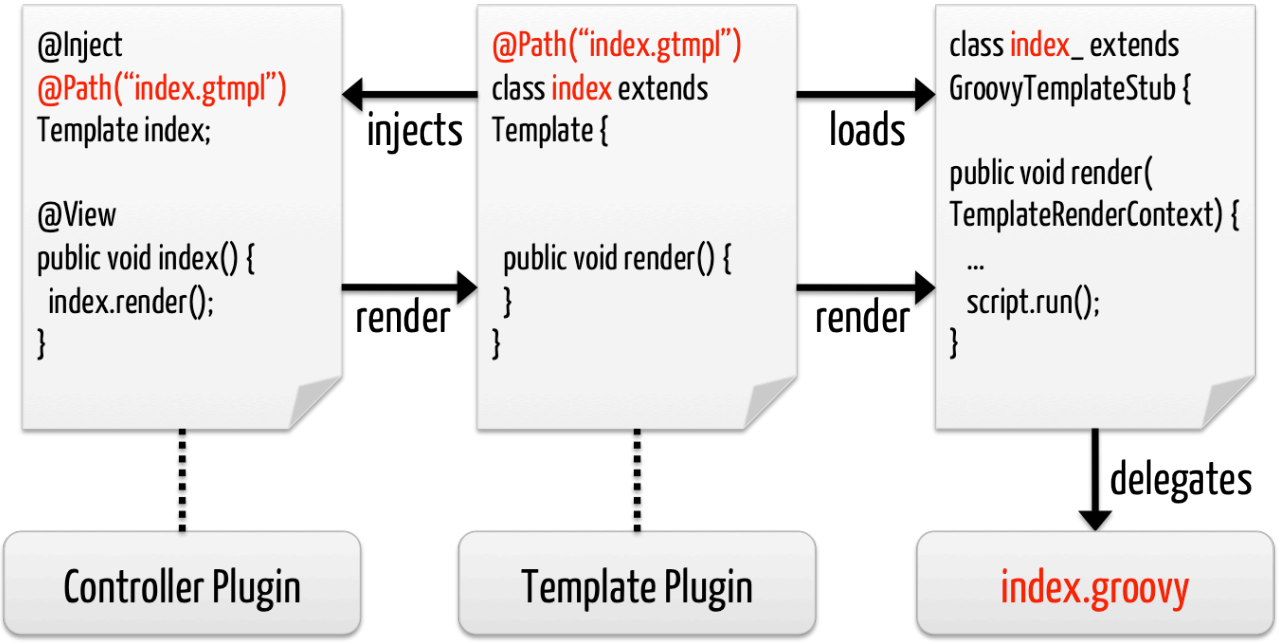
- Producing markup

- Setting the title
- Obtaining the locale
- Accessing parameters or application beans for resolving expressions

7.4. Template at work

After having described the various pieces of the templating SPI, let's look at how the template generated stubs are used by Juzu templating system at runtime.

Figure 7.3. index groovy at work



When the controller declares the *index.gtmpl* template the compiler produces three artifacts

- the `index` class template inherits `juzu.template.Template`: it is the only class visible from the controller and the whole application
- the *index.groovy* Groovy template is the effective template code: it produces the markup, resolve expressions, etc...
- the `index_` template stub inherits `GroovyTemplateStub`: it is the bridge between the `index` class and the *index.groovy* file, it loads the Groovy template and runs it when the `Template` need to render the template

When a controller is instantiated, the `index` template instance is injected into the controller, the `@Path` annotation plays an essential role because it's a qualifier and that qualifier is used to distinguish the correct subclass to inject in the controller.

Instead of using the qualified template injection, the controller could declare directly the template *index* subclass it will still work. Actually this approach should be used when type safe parameters are used as only the `index` type declares the fluent API.

For instance if the *index.gtmpl* declares the *color* parameter the `index` class will look like:

```
@Path("index.gtmpl")
public class index extends Template {

  ...

  public index with() {
    return new index.Builder();
  }

  public class Builder extends Template.Builder {

    public Builder color(String color) {
      // Generated code
    }
  }
}
```

The controller can then use the fluent API:

```
public class Controller {

  @Inject
  @Path("index.gtmpl")
  Template index;

  @View
  public void index() {
    index.with().color("red").render();
  }
}
```

8

Taglib

A tag library is an essential component of a templating system, allowing to enrich a templating with encapsulated programmable logic.

> Juzu does not yet allow application to define their own tags, it will be added a a new feature in a future version.

8.1. Taglib syntax

Like most taglib syntaxes, Juzu provides two syntaxes for invoking a tag:

Example 8.1. Start and end tag syntax

```
#{foo}bar#{/foo}
```

The start/end syntax opens the tag with `#{foo}` and ends it with `#{/foo}`.

A tag can also be empty:

Example 8.2. Empty tag syntax

```
#{foo/}
```

A tag can also be invoked empty with the `#{foo/}` syntax.

8.2. Include tag

The *include* tag simply includes a template inside the current template. The inclusion is dynamic and not static, meaning that the content of the included template is not *inserted* in the calling template, instead when inclusion is performed the control is passed to the included template.

Example 8.3. The include tag

```
#{include path=dispatched.gtmpl/}
```

The *path* attribute determines the template to include, the path value is relative to the templates package.

8.3. Decorate / Insert tag

The *decorate* tag allows the content of the decorating template to wrap the content of the template invoking the tag. The *insert* tag should be used in the decorating template to specify the place where to insert the markup produced by the template to decorate.

Example 8.4. The wrapped template

```
#{decorate path=box.gtmpl/}
```

Example 8.5. The decoraring template

```
<div style="border: 1px solid black">
#{insert/}
</div>
```

8.4. Title tag

The *title* tag specifies a title to insert in the `juzu.Response.Render` object the template will produce.

Example 8.6. Setting the title

```
#{title value=Home/}
```

8.5. Param tag

The *param* tag enhances the type safety of templates, allowing to declare parameters for executing a template. When such a parameter is declared, the generated template class companion will have a fluent parameter for setting the value of the parameter:

Example 8.7. Declaring a template parameter

```
#{param name=color/}
```

Example 8.8. Using the template parameter

```
@Inject my.templates.index index;

@View
public void index() {
  index.with().color("red").render();
}
```

9

Assets

Web assets are resources used over the web such as stylesheet and script files. Juzu provides a few facilities for managing applications assets.

9.1. Asset serving

The class `juzu.asset.Asset` represents an asset in Juzu, assets can be of two types:

- `Asset.Value` is the coordinate of an asset, i.e how Juzu can resolve and create a valid URL to an asset. An asset value is determined by a *location* and an *uri*. The location determines where the asset can be resolved for instance the *server* location means that the asset is served by the web server. The uri is simply the absolute or relative asset path that resolves in the location.

- `Asset.Ref` is a reference to an asset value. Asset reference are useful because they decouple the application of the value and allow external configuration to determine the asset. For example, an application will add to a response an asset reference to *jquery* instead of adding the *https://ajax.googleapis.com/ajax/libs/jquery/1.7.2/jquery.min.js* jquery asset address to a response.

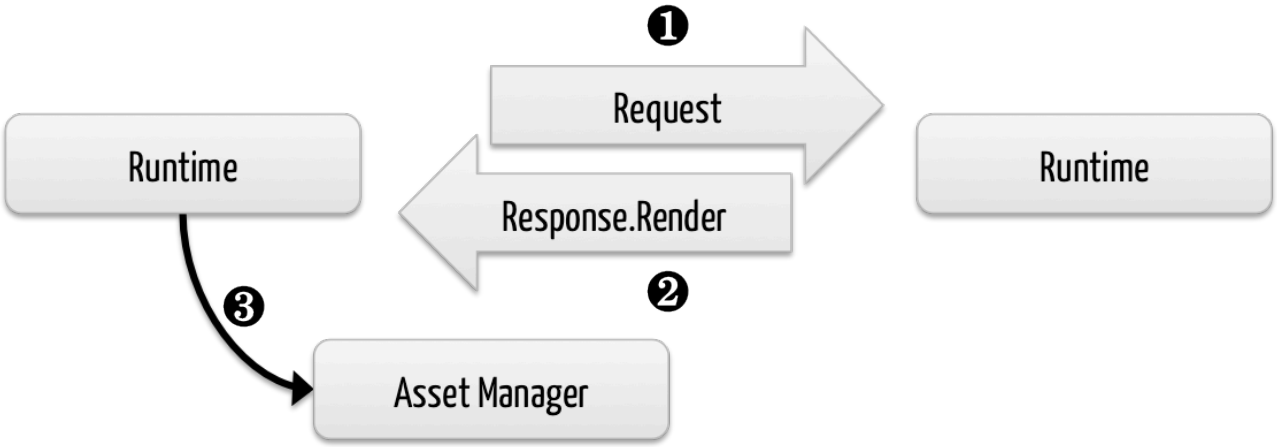
When an application is deployed, the plugin can configure assets in the *asset manager*. The asset manager has several responsibilities:

- manage asset dependencies: the order in which assets are literaly declared when they are served. For instance the *jquery-ui* asset depends on the *jquery* asset because the jquery script must be loaded before the *jquery-ui* script.

- resolve asset references: each asset reference must be resolved and produce a final web url that will produce the resource when it is resolved by the web browsers

During a request, assets of both kind can be added to the response. At the end of the request, the runtime uses the asset manager to translate the response assets into a list of uri to add to the page:

Figure 9.1. Compiling a Groovy template



An asset reference is a link to an asset value that is configured externally, thus an asset of any kind will always resolve to a location and an uri. Let's examine the different possible asset location:

- external: the value is opaque to Juzu, for instance the a CDN hosted script such as *https://ajax.googleapis.com/ajax/libs/jquery/1.7.2/jquery.min.js*.
- server: the asset is served by the same web server in which Juzu is deployed. If the asset value is relative, the final uri will resolve relatively to the web archive context address.
- classpath: the asset is served by Juzu *asset server* (a servlet configured in the web application) and the resource is located on the classpath.

9.2. Declaring assets programmatically

When an application requires an asset, it adds the asset to the `Response.Render` object:

```
@Inject
@Path("index.gtmpl")
Template index;

@View
public Response.Render index() {
  Response.Render render = index.render();
  render.addScript(Asset.uri("https://ajax.googleapis" +
    ".com/ajax/libs/jquery/1.7.2/jquery.min.js"));
  return render;
}
```

The same with a fluent syntax:

```
@Inject
@Path("index.gtmpl")
Template index;

@View
public Response.Render index() {
  return index.render().addScript(Asset.uri("https://ajax.googleapis.com" +
    "/ajax/libs/jquery/1.7.2/jquery.min.js"));
}
```

9.3. Asset plugin

The asset plugin provides declarative asset configuration. The `@Assets` annotation declares a list of assets used by the an application.

Example 9.1. JQuery UI declarative asset configuration

```
@Assets(
  scripts = {
    @Script(id = "jquery",
            src = "public/javascripts/jquery-1.7.1.min.js"), ❶
    @Script(src = "public/javascripts/jquery-ui-1.7.2.custom.min.js", ❷
            depends = "jquery") ❸
  },
  stylesheets = {
    @Stylesheet(src = "public/ui-lightness/jquery-ui-1.7.2.custom.css")
  }
)
package my.application;
```

❶ Declares the jquery asset

❷ Declares the jquery-ui asset

❸ Make jquery-ui depend on jquery

The assets will be served from the war file because the server location is configured by default. The first `@Script` annotation declares the JQuery asset reference identified by the `id` member as being *jquery*. The second `@Script` annotation declares the JQuery-UI plugin, it does not need an *id* member because nothing refers to it, however it declares a dependency with the *depends* member that declares it depending on the *jquery* asset.

JQuery-UI requires also a stylesheet to be served along with the script, it is achieved thanks to the `@Stylesheet` annotation.

9.3.1. Server assets

Server assets are served by the webserver in which the application is deployed. Relative server assets are served from the war file containing the application.

Example 9.2. Declarative relative server asset configuration

```
@Assets(scripts = @Script(src = "myscript.js"))
package my.application;
```

9.3.2. Classpath assets

Classpath assets can be located anywhere on the application classpath, they can be either absolute or relatives. Relative classpath assets declared by the asset plugin must be located in the `assets` package of the application, for instance an application packaged under `my.application` will have its relative assets located under `my.application.assets`.

Example 9.3. Declarative relative classpath asset configuration

```
@Assets(scripts = @Script(
  src = "myscript.js",
  location = AssetLocation.CLASSPATH))
package my.application;
```

9.3.3. External assets

External assets declares an opaque URL for Juzu.

Example 9.4. External classpath asset configuration

```
@Assets(scripts = @Script(
  src = "https://ajax.googleapis.com/ajax/libs/jquery/1.7.2/jquery.min.js",
  location = AssetLocation.CLASSPATH))
package my.application;
```

10

Juzu File Upload Plugin

The file upload plugin integrates Apache Commons FileUpload in Juzu. The plugin decodes multipart requests as file objects and can inject them as controller method parameters. This plugin works with the servlet bridge and the portlet bridge.

10.1. File upload in an action phase

File upload can be handled during an action of a portlet or a servlet:

```
@Action
@Route("/upload")
public void upload(org.apache.commons.fileupload.FileUpload file) {
   if (file != null) {
      // Handle the file upload
   }
}
```

The `@Route` annotation is only meaningfull for the servlet bridge. In case of a portlet, the URL is managed by the portal.

10.2. File upload in a resource phase

File upload can also be handled in a resource phase.

```
@Resource
@Route("/upload")
public Response.Content upload(org.apache.commons.fileupload.FileUpload file) {
   if (file != null) {
      // Handle the file upload
   }
   return Response.ok("Upload is done");
}
```

Handling upload in a resource phase can be used when the file is uploaded via Ajax: the application does not want a view phase to be triggered after the upload.

11

Juzu Portlet Plugin

The portlet plugin enhance Juzu portlet applications.

11.1. Portlet class generation

A Juzu portlet application is managed by a `JuzuPortlet` configured with the application name. The `@juzu.plugin.portlet.Portlet` annotation can be used to generate a subclass of the `JuzuPortlet` that configures the application name for you, easing the configuration of the *portlet.xml* corresponding section.

```
@Portlet
package my;
```

```
<portlet>
  <portlet-name>MyApplication</portlet-name>
  <display-name xml:lang="EN">My Application</display-name>
  <portlet-class>myapp.MyPortlet</portlet-class>
  <supports>
    <mime-type>text/html</mime-type>
  </supports>
  <portlet-info>
    <title>My Application</title>
  </portlet-info>
</portlet>
```

The plugin will generate the portlet using the application name with the first letter capitalized and the *Portlet* suffix. In our example the *my* application generates the `MyPortlet` class. If you don't like it you can change the name of the generated class in the application:

```
@Portlet(name "MyGreatPortlet")
package my;
```

```
<portlet>
  <portlet-name>MyApplication</portlet-name>
  <display-name xml:lang="EN">My Application</display-name>
  <portlet-class>myapp.MyGreatPortlet</portlet-class>
  <supports>
    <mime-type>text/html</mime-type>
  </supports>
  <portlet-info>
    <title>My Application</title>
  </portlet-info>
</portlet>
```

11.2. Portlet preferences injection

During the various phase of an application, the current portlet preferences can be injected::

Example 11.1. Injecting portlet preferences

```
@Inject javax.portlet.PortletPreferences preferences;
```

> The same restriction defined in the portlet specification applies to the provided preferences object: i.e saving preferences can only be performed during an action phase.

11.3. Resource bundle injection

During the various phase of an application, the portlet resource bundle for the current locale can be injected:

Example 11.2. Injecting the portlet resource bundle

```
@Inject java.util.ResourceBundle bundle;
```

This is equivalent of doing:

```
Locale locale = request.getLocale();
ResourceBundle bundle = portlet.getConfig().getResourceBundle(locale);
```

This resource bundle can be configured in the *portlet.xml* deployment descriptor.

11.4. Building

Add the Portlet plugin jar to your compilation classpath.

In Maven it can achieved by adding the Less plugin dependency to your POM:

```
<dependency>
  <groupId>org.juzu</groupId>
  <artifactId>juzu-plugins-portlet</artifactId>
  <version>$[juzu.version]</version>
</dependency>
```

12

Juzu Less Plugin

LESS is a dynamic stylesheet language which extends CSS with dynamic behavior such as variables, mixins, operations and functions. LESS is easy to learn thanks to the online documentation.

Juzu provides a LESS plugin that takes care of compiling a LESS stylesheet into a CSS stylesheet which are then served by the Asset plugin. This chapter explains how to use LESS and combine it with the Asset plugin.

12.1. Usage

The LESS plugin operates at compilation time only because the only task he has to do is to transform a LESS source code into a CSS stylesheet. The runtime part is usually done by the Asset plugin.

The `@Less` annotation annotates a package containing an `assets` package. This `assets` package should contain the LESS files to be compiled.

Example 12.1. Annotating an application package for processing LESS files

```
@Less("stylesheet.less")
@Application
package myapp;

import juzu.plugin.less.Less;
```

The *stylesheet.less* file will be located in the `myapp.assets` package. The `assets` child package of the annotated package should contain the stylesheet, this is done on purpose to coincide exactly with the `assets` package used by the Asset plugin. During the compilation phase the *stylesheet.less* will be compiled to the *stylesheet.css*. If we want this file to be served with the application we simply add the corresponding `@Assets` annotation:

Example 12.2. LESS and Asset plugins in action

```
@Less("stylesheet.less")
@Assets(stylesheets = @Stylesheet(
  src = "stylesheet.css",
  location = AssetLocation.CLASSPATH)
)
@Application
package myapp;

import juzu.Application;
import juzu.asset.AssetLocation;
import juzu.plugin.less.Less;
import juzu.plugin.asset.Assets;
import juzu.plugin.asset.Stylesheet;
```

By default LESS will use a default formatting for the generated CSS. To achieve smaller CSS size, a *minify* option can be used, this option will trim the whitespace when processing the file : `@Less(value = "stylesheet.less", minify = true)`.

12.2. Building

Add the Less plugin jar to your compilation classpath.

In Maven it can achieved by adding the Less plugin dependency to your POM:

```
<dependency>
  <groupId>org.juzu</groupId>
  <artifactId>juzu-plugins-less</artifactId>
  <version>$[juzu.version]</version>
</dependency>
```