The Java EE 7 Tutorial

Volume 1

Fifth Edition

Eric Jendrock, Ricardo Cervera-Navarro, Ian Evans,
Kim Haase, William Markito

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Preface

This tutorial is a guide to developing enterprise applications for the Java Platform, Enterprise Edition 7 (Java EE 7), using GlassFish Server Open Source Edition.

GlassFish Server Open Source Edition is the leading open-source and open-community platform for building and deploying next-generation applications and services. GlassFish Server Open Source Edition, developed by the GlassFish project open-source community at `https://glassfish.java.net/`, is the first compatible implementation of the Java EE 7 platform specification. This lightweight, flexible, and open-source application server enables organizations not only to leverage the new capabilities introduced within the Java EE 7 specification, but also to add to their existing capabilities through a faster and more streamlined development and deployment cycle. GlassFish Server Open Source Edition is hereafter referred to as GlassFish Server.

The following topics are addressed here:

- Audience
- Before You Read This Book
- Related Documentation
- The Oracle Accessibility Program
- Conventions
- Default Paths and File Names
- Acknowledgments

Audience

This tutorial is intended for programmers interested in developing and deploying Java EE 7 applications. It covers the technologies comprising the Java EE platform and describes how to develop Java EE components and deploy them on the Java EE Software Development Kit (SDK).

Before You Read This Book

Before proceeding with this book, you should have a good knowledge of the Java programming language. A good way to get to that point is to work through the Java Tutorials (`http://docs.oracle.com/javase/tutorial/`).

Related Documentation

The Java EE 7 Tutorial, Volume 2 covers Java EE 7 technologies and topics not included in this volume, including Enterprise JavaBeans, Java Persistence, the Java Message Service, security, and others. The volume concludes with three case studies that incorporate multiple Java EE 7 technologies.

The GlassFish Server documentation set describes deployment planning and system installation. To obtain documentation for GlassFish Server Open Source Edition, go to `https://glassfish.java.net/docs/`.

The Java EE 7 API specification can be viewed at `http://docs.oracle.com/javaee/7/api/` and is also provided in the Java EE 7 SDK.

Additionally, the Java EE Specifications at `http://www.oracle.com/technetwork/java/javaee/tech/` might be useful.

For information about creating enterprise applications in the NetBeans Integrated Development Environment (IDE), see `https://netbeans.org/kb/`.

For information about the Java DB database for use with GlassFish Server, see `http://www.oracle.com/technetwork/java/javadb/overview/`.

The GlassFish Samples project is a collection of sample applications that demonstrate a broad range of Java EE technologies. The GlassFish Samples are bundled with the Java EE Software Development Kit (SDK) and are also available from the GlassFish Samples project page at `https://glassfish-samples.java.net/`.

The Oracle Accessibility Program

For information about Oracle's commitment to accessibility, visit the Oracle Accessibility Program website at `http://www.oracle.com/pls/topic/lookup?ctx=acc&id=docacc`.

Conventions

The following table describes the typographic conventions that are used in this book.

Convention	Meaning	Example
Boldface	Boldface type indicates graphical user interface elements associated with an action or terms defined in text.	From the **File** menu, choose **Open Project**. A **cache** is a copy that is stored locally.
`Monospace`	Monospace type indicates the names of files and directories, commands within a paragraph, URLs, code in examples, text that appears on the screen, or text that you enter.	Edit your `.login` file. Use `ls -a` to list all files. `machine_name% you have mail.`
Italic	Italic type indicates book titles, emphasis, or placeholder variables for which you supply particular values.	Read Chapter 6 in the *User's Guide*. Do *not* save the file. The command to remove a file is `rm` *filename*.

Default Paths and File Names

The following table describes the default paths and file names that are used in this book.

Placeholder	Description	Default Value
as-install	Represents the base installation directory for GlassFish Server or the SDK of which GlassFish Server is a part.	Installations on the Solaris operating system, Linux operating system, and Mac operating system: *user's-home-directory*`/glassfish4/glassfish` Windows, all installations: *SystemDrive*`:\glassfish4\glassfish`

Placeholder	Description	Default Value
as-install-parent	Represents the parent of the base installation directory for GlassFish Server.	Installations on the Solaris operating system, Linux operating system, and Mac operating system: *user's-home-directory*`/glassfish4` Windows, all installations: *SystemDrive*`:\glassfish4`
tut-install	Represents the base installation directory for the *Java EE Tutorial* after you install GlassFish Server or the SDK and run the Update Tool.	*as-install-parent*`/docs/javaee-tutorial`
domain-dir	Represents the directory in which a domain's configuration is stored.	*as-install*`/domains/domain1`

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6

Getting Started with Web Applications

This chapter introduces web applications, which typically use JavaServer Faces technology and/or Java Servlet technology. A **web application** is a dynamic extension of a web or application server. Web applications are of the following types:

- **Presentation-oriented**: A **presentation-oriented web application** generates interactive web pages containing various types of markup language (HTML, XHTML, XML, and so on) and dynamic content in response to requests. Development of presentation-oriented web applications is covered in Chapter 7, "JavaServer Faces Technology," through Chapter 20, "Internationalizing and Localizing Web Applications."
- **Service-oriented**: A **service-oriented web application** implements the endpoint of a web service. Presentation-oriented applications are often clients of service-oriented web applications. Development of service-oriented web applications is covered in Chapter 28, "Building Web Services with JAX-WS," through Chapter 31, "JAX-RS: Advanced Topics and an Example," in Part VI, "Web Services."

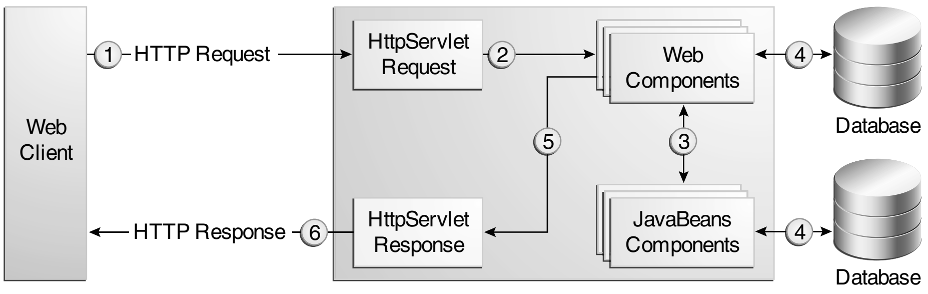
The following topics are addressed here:

- Web Applications
- Web Application Lifecycle
- A Web Module That Uses JavaServer Faces Technology: The hello1 Example
- A Web Module That Uses Java Servlet Technology: The hello2 Example
- Configuring Web Applications
- Further Information about Web Applications

6.1 Web Applications

In the Java EE platform, **web components** provide the dynamic extension capabilities for a web server. Web components can be Java servlets, web pages implemented with JavaServer Faces technology, web service endpoints, or JSP pages. Figure 6–1 illustrates the interaction between a web client and a web application that uses a servlet. The client sends an HTTP request to the web server. A web server that implements Java Servlet and JavaServer Pages technology converts the request into an `HTTPServletRequest` object. This object is delivered to a web component, which can interact with JavaBeans components or a database to generate dynamic content. The web component can then generate an `HTTPServletResponse` or can pass the request to another web component. A web component eventually generates a `HTTPServletResponse` object. The web server converts this object to an HTTP response and returns it to the client.

Figure 6–1 Java Web Application Request Handling



Servlets are Java programming language classes that dynamically process requests and construct responses. Java technologies, such as JavaServer Faces and Facelets, are used for building interactive web applications. (Frameworks can also be used for this purpose.) Although servlets and JavaServer Faces and Facelets pages can be used to accomplish similar things, each has its own strengths. Servlets are best suited for service-oriented applications (web service endpoints can be implemented as servlets) and the control functions of a presentation-oriented application, such as dispatching requests and handling nontextual data. JavaServer Faces and Facelets pages are more appropriate for generating text-based markup, such as XHTML, and are generally used for presentation-oriented applications.

Web components are supported by the services of a runtime platform called a **web container**. A web container provides such services as request dispatching, security, concurrency, and lifecycle management. A web container also gives web components access to such APIs as naming, transactions, and email.

Certain aspects of web application behavior can be configured when the application is installed, or *deployed*, to the web container. The configuration information can be specified using Java EE annotations or can be maintained in a text file in XML format called a web application deployment descriptor (DD). A web application DD must conform to the schema described in the Java Servlet specification.

This chapter gives a brief overview of the activities involved in developing web applications. First, it summarizes the web application lifecycle and explains how to package and deploy very simple web applications on GlassFish Server. The chapter then moves on to configuring web applications and discusses how to specify the most commonly used configuration parameters.

6.2 Web Application Lifecycle

A web application consists of web components; static resource files, such as images and cascading style sheets (CSS); and helper classes and libraries. The web container provides many supporting services that enhance the capabilities of web components and make them easier to develop. However, because a web application must take these services into account, the process for creating and running a web application is different from that of traditional stand-alone Java classes.

The process for creating, deploying, and executing a web application can be summarized as follows:

1. Develop the web component code.
2. Develop the web application deployment descriptor, if necessary.
3. Compile the web application components and helper classes referenced by the components.
4. Optionally, package the application into a deployable unit.
5. Deploy the application into a web container.
6. Access a URL that references the web application.

Developing web component code is covered in the later chapters. Steps 2 through 4 are expanded on in the following sections and illustrated with a Hello, World–style, presentation-oriented application. This application allows a user to enter a name into an HTML form and then displays a greeting after the name is submitted.

The Hello application contains two web components that generate the greeting and the response. This chapter discusses the following simple applications:

- `hello1`, a JavaServer Faces technology–based application that uses two XHTML pages and a managed bean
- `hello2`, a servlet-based web application in which the components are implemented by two servlet classes

The applications are used to illustrate tasks involved in packaging, deploying, configuring, and running an application that contains web components.

6.3 A Web Module That Uses JavaServer Faces Technology: The hello1 Example

The `hello1` application is a web module that uses JavaServer Faces technology to display a greeting and response. You can use a text editor to view the application files, or you can use NetBeans IDE.

The source code for this application is in the *tut-install*`/examples/web/jsf/hello1/` directory.

6.3.1 To View the hello1 Web Module Using NetBeans IDE

1. From the **File** menu, choose **Open Project**.
2. In the Open Project dialog box, navigate to:

   tut-install`/examples/web/jsf`

3. Select the `hello1` folder and click **Open Project**.
4. Expand the **Web Pages** node and double-click the `index.xhtml` file to view it in the editor.

   The `index.xhtml` file is the default landing page for a Facelets application. In a typical Facelets application, web pages are created in XHTML. For this application, the page uses simple tag markup to display a form with a graphic image, a header, a field, and two command buttons:

```
<!DOCTYPE html PUBLIC "-//W3C//DTD XHTML 1.0 Transitional//EN"
    "http://www.w3.org/TR/xhtml1/DTD/xhtml1-transitional.dtd">
<html lang="en"
      xmlns="http://www.w3.org/1999/xhtml"
      xmlns:h="http://xmlns.jcp.org/jsf/html">
    <h:head>
        <title>Facelets Hello Greeting</title>
    </h:head>
    <h:body>
        <h:form>
            <h:graphicImage url="#{resource['images:duke.waving.gif']}"
                            alt="Duke waving his hand"/>
            <h2>Hello, my name is Duke. What's yours?</h2>
            <h:inputText id="username"
                         title="My name is: "
                         value="#{hello.name}"
                         required="true"
                         requiredMessage="Error: A name is required."
                         maxlength="25" />
            <p></p>
            <h:commandButton id="submit" value="Submit"
                             action="response" />
            <h:commandButton id="reset" value="Reset" type="reset" />
        </h:form>
        ...
    </h:body>
</html>
```

The most complex element on the page is the `inputText` field. The `maxlength` attribute specifies the maximum length of the field. The `required` attribute specifies that the field must be filled out; the `requiredMessage` attribute provides the error message to be displayed if the field is left empty. The `title` attribute provides the text to be used by screen readers for the visually disabled. Finally, the `value` attribute contains an expression that will be provided by the `Hello` managed bean.

The web page connects to the `Hello` managed bean through the Expression Language (EL) value expression `#{hello.name}`, which retrieves the value of the `name` property from the managed bean. Note the use of `hello` to reference the managed bean `Hello`. If no name is specified in the `@Named` annotation of the managed bean, the managed bean is always accessed with the first letter of the class name in lowercase.

The Submit `commandButton` element specifies the action as `response`, meaning that when the button is clicked, the `response.xhtml` page is displayed.

5. Double-click the `response.xhtml` file to view it.

The response page appears. Even simpler than the greeting page, the response page contains a graphic image, a header that displays the expression provided by the managed bean, and a single button whose `action` element transfers you back to the `index.xhtml` page:

```
<!DOCTYPE html PUBLIC "-//W3C//DTD XHTML 1.0 Transitional//EN"
    "http://www.w3.org/TR/xhtml1/DTD/xhtml1-transitional.dtd">
<html lang="en"
      xmlns="http://www.w3.org/1999/xhtml"
      xmlns:h="http://xmlns.jcp.org/jsf/html">
    <h:head>
        <title>Facelets Hello Response</title>
    </h:head>
    <h:body>
        <h:form>
            <h:graphicImage url="#{resource['images:duke.waving.gif']}"
                            alt="Duke waving his hand"/>
            <h2>Hello, #{hello.name}!</h2>
            <p></p>
            <h:commandButton id="back" value="Back" action="index" />
        </h:form>
    </h:body>
</html>
```

6. Expand the **Source Packages** node, then the `javaeetutorial.hello1` node.
7. Double-click the `Hello.java` file to view it.

   The `Hello` class, called a managed bean class, provides getter and setter methods for the `name` property used in the Facelets page expressions. By default, the expression language refers to the class name, with the first letter in lowercase (`hello.name`).

```
package javaeetutorial.hello1;

import javax.enterprise.context.RequestScoped;
import javax.inject.Named;

@Named
@RequestScoped
public class Hello {
    private String name;

    public Hello() {
    }

    public String getName() {
        return name;
    }
    public void setName(String user_name) {
        this.name = user_name;
    }
}
```

If you use the default name for the bean class, you can specify `@Model` as the annotation instead of having to specify both `@Named` and `@RequestScoped`. The `@Model` annotation is called a **stereotype**, a term for an annotation that encapsulates other annotations. It is described later in Section 25.8, "Using Stereotypes in CDI Applications." Some examples will use `@Model` where it is appropriate.

8. Under the **Web Pages** node, expand the **WEB-INF** node and double-click the `web.xml` file to view it.

   The `web.xml` file contains several elements that are required for a Facelets application. All of the following are created automatically when you use NetBeans IDE to create an application.

   - A context parameter specifying the project stage:

     ```
     <context-param>
         <param-name>javax.faces.PROJECT_STAGE</param-name>
         <param-value>Development</param-value>
     </context-param>
     ```

     A context parameter provides configuration information needed by a web application. An application can define its own context parameters. In addition, JavaServer Faces technology and Java Servlet technology define context parameters that an application can use.

   - A `servlet` element and its `servlet-mapping` element specifying the `FacesServlet`. All files with the `.xhtml` suffix will be matched:

     ```
     <servlet>
         <servlet-name>Faces Servlet</servlet-name>
         <servlet-class>
             javax.faces.webapp.FacesServlet
         </servlet-class>
         <load-on-startup>1</load-on-startup>
     </servlet>
     <servlet-mapping>
         <servlet-name>Faces Servlet</servlet-name>
         <url-pattern>*.xhtml</url-pattern>
     </servlet-mapping>
     ```

- A `welcome-file-list` element specifying the location of the landing page:

  ```
  <welcome-file-list>
      <welcome-file>index.xhtml</welcome-file>
  </welcome-file-list>
  ```

6.3.1.1 Introduction to Scopes

In the `Hello.java` class, the annotations `javax.inject.Named` and `javax.enterprise.context.RequestScoped` identify the class as a managed bean using request scope. Scope defines how application data persists and is shared.

The most commonly used scopes in JavaServer Faces applications are the following:

- **Request (**`@RequestScoped`**)**: Request scope persists during a single HTTP request in a web application. In an application like `hello1`, in which the application consists of a single request and response, the bean uses request scope.
- **Session (**`@SessionScoped`**)**: Session scope persists across multiple HTTP requests in a web application. When an application consists of multiple requests and responses where data needs to be maintained, beans use session scope.
- **Application (**`@ApplicationScoped`**)**: Application scope persists across all users' interactions with a web application.

For more information on scopes in JavaServer Faces technology, see Section 16.1.1, "Using Managed Bean Scopes."

6.3.2 Packaging and Deploying the hello1 Web Module

A web module must be packaged into a WAR in certain deployment scenarios and whenever you want to distribute the web module. You can package a web module into a WAR file by using Maven or by using the IDE tool of your choice. This tutorial shows you how to use NetBeans IDE or Maven to build, package, and deploy the `hello1` sample application.

You can deploy a WAR file to GlassFish Server by:

- Using NetBeans IDE
- Using the `asadmin` command
- Using the Administration Console
- Copying the WAR file into the *domain-dir*`/autodeploy/` directory

Throughout the tutorial, you will use NetBeans IDE or Maven for packaging and deploying.

6.3.2.1 To Build and Package the hello1 Web Module Using NetBeans IDE

1. Start GlassFish Server as described in Section 2.2.1, "To Start GlassFish Server Using NetBeans IDE," if you have not already done so.
2. From the **File** menu, choose **Open Project**.
3. In the Open Project dialog box, navigate to:

   ```
   tut-install/examples/web/jsf
   ```

4. Select the `hello1` folder.
5. Click **Open Project**.
6. In the **Projects** tab, right-click the `hello1` project and select **Build**. This command deploys the project to the server.

6.3.2.2 To Build and Package the hello1 Web Module Using Maven

1. Start GlassFish Server as described in Section 2.2.3, "To Start GlassFish Server Using the Command Line," if you have not already done so.
2. In a terminal window, go to:

   ```
   tut-install/examples/web/jsf/hello1/
   ```

3. Enter the following command:

   ```
   mvn install
   ```

   This command spawns any necessary compilations and creates the WAR file in *tut-install*`/examples/web/jsf/hello1/target/`. It then deploys the project to the server.

6.3.3 Viewing Deployed Web Modules

GlassFish Server provides two ways to view the deployed web modules: the Administration Console and the `asadmin` command. You can also use NetBeans IDE to view deployed modules.

6.3.3.1 To View Deployed Web Modules Using the Administration Console

1. Open the URL `http://localhost:4848/` in a browser.
2. Select the **Applications** node.

The deployed web modules appear in the **Deployed Applications** table.

6.3.3.2 To View Deployed Web Modules Using the asadmin Command

Enter the following command:

```
asadmin list-applications
```

6.3.3.3 To View Deployed Web Modules Using NetBeans IDE

1. In the **Services** tab, expand the **Servers** node, then expand the GlassFish Server node.
2. Expand the **Applications** node to view the deployed modules.

6.3.4 Running the Deployed hello1 Web Module

Now that the web module is deployed, you can view it by opening the application in a web browser. By default, the application is deployed to host `localhost` on port 8080. The context root of the web application is `hello1`.

1. Open a web browser.
2. Enter the following URL:

   ```
   http://localhost:8080/hello1/
   ```

3. In the field, enter your name and click **Submit**.

   The response page displays the name you submitted. Click **Back** to try again.

6.3.4.1 Dynamic Reloading of Deployed Modules

If dynamic reloading is enabled, you do not have to redeploy an application or module when you change its code or deployment descriptors. All you have to do is copy the changed pages or class files into the deployment directory for the application or module. The deployment directory for a web module named *context-root* is *domain-dir*`/applications/`*context-root*. The server checks for changes periodically and redeploys the application, automatically and dynamically, with the changes.

This capability is useful in a development environment because it allows code changes to be tested quickly. Dynamic reloading is not recommended for a production environment, however, because it may degrade performance. In addition, whenever a reload takes place, the sessions at that time become invalid, and the client must restart the session.

In GlassFish Server, dynamic reloading is enabled by default.

6.3.5 Undeploying the hello1 Web Module

You can undeploy web modules and other types of enterprise applications by using either NetBeans IDE or the `asadmin` command.

6.3.5.1 To Undeploy the hello1 Web Module Using NetBeans IDE

1. In the **Services** tab, expand the **Servers** node, then expand the GlassFish Server node.
2. Expand the **Applications** node.
3. Right-click the `hello1` module and select **Undeploy**.
4. To delete the class files and other build artifacts, go back to the **Projects** tab, right-click the project, and select **Clean**.

6.3.5.2 To Undeploy the hello1 Web Module Using the asadmin Command

1. In a terminal window, go to:

   `tut-install``/examples/web/jsf/hello1/`

2. Enter the following command:

   ```
   mvn cargo:undeploy
   ```

3. To delete the class files and other build artifacts, enter the following command:

   ```
   mvn clean
   ```

6.4 A Web Module That Uses Java Servlet Technology: The hello2 Example

The `hello2` application is a web module that uses Java Servlet technology to display a greeting and response. You can use a text editor to view the application files, or you can use NetBeans IDE.

The source code for this application is in the *tut-install*`/examples/web/servlet/hello2/` directory.

6.4.1 Mapping URLs to Web Components

When it receives a request, the web container must determine which web component should handle the request. The web container does so by mapping the

URL path contained in the request to a web application and a web component. A URL path contains the context root and, optionally, a URL pattern:

```
http://host:port/context-root[/url-pattern]
```

You set the URL pattern for a servlet by using the `@WebServlet` annotation in the servlet source file. For example, the `GreetingServlet.java` file in the `hello2` application contains the following annotation, specifying the URL pattern as `/greeting`:

```
@WebServlet("/greeting")
public class GreetingServlet extends HttpServlet {
    ...
```

This annotation indicates that the URL pattern `/greeting` follows the context root. Therefore, when the servlet is deployed locally, it is accessed with the following URL:

```
http://localhost:8080/hello2/greeting
```

To access the servlet by using only the context root, specify `"/"` as the URL pattern.

6.4.2 Examining the hello2 Web Module

The `hello2` application behaves almost identically to the `hello1` application, but it is implemented using Java Servlet technology instead of JavaServer Faces technology. You can use a text editor to view the application files, or you can use NetBeans IDE.

6.4.2.1 To View the hello2 Web Module Using NetBeans IDE

1. From the **File** menu, choose **Open Project**.
2. In the Open Project dialog box, navigate to:

   ```
   tut-install/examples/web/servlet
   ```

3. Select the `hello2` folder and click **Open Project**.
4. Expand the **Source Packages** node, then expand the `javaeetutorial.hello2` node.
5. Double-click the `GreetingServlet.java` file to view it.

   This servlet overrides the `doGet` method, implementing the `GET` method of HTTP. The servlet displays a simple HTML greeting form whose **Submit** button, like that of `hello1`, specifies a response page for its action. The following excerpt begins with the `@WebServlet` annotation, which specifies the URL pattern relative to the context root:

```
@WebServlet("/greeting")
public class GreetingServlet extends HttpServlet {

    @Override
    public void doGet(HttpServletRequest request,
            HttpServletResponse response)
            throws ServletException, IOException {

        response.setContentType("text/html");
        response.setBufferSize(8192);
        try (PrintWriter out = response.getWriter()) {
            out.println("<html lang=\"en\">"
                    + "<head><title>Servlet Hello</title></head>");

            // then write the data of the response
            out.println("<body  bgcolor=\"#ffffff\">"
                + "<img src=\"duke.waving.gif\" "
                + "alt=\"Duke waving his hand\">"
                + "<form method=\"get\">"
                + "<h2>Hello, my name is Duke. What's yours?</h2>"
                + "<input title=\"My name is: \"type=\"text\" "
                + "name=\"username\" size=\"25\">"
                + "<p></p>"
                + "<input type=\"submit\" value=\"Submit\">"
                + "<input type=\"reset\" value=\"Reset\">"
                + "</form>");

            String username = request.getParameter("username");
            if (username != null && username.length()> 0) {
                RequestDispatcher dispatcher =
                    getServletContext().getRequestDispatcher("/response");

                if (dispatcher != null) {
                    dispatcher.include(request, response);
                }
            }
            out.println("</body></html>");
        }
    }
    ...
```

6. Double-click the `ResponseServlet.java` file to view it.

This servlet also overrides the `doGet` method, displaying only the response. The following excerpt begins with the `@WebServlet` annotation, which specifies the URL pattern relative to the context root:

```
@WebServlet("/response")
public class ResponseServlet extends HttpServlet {

    @Override
    public void doGet(HttpServletRequest request,
            HttpServletResponse response)
            throws ServletException, IOException {
        try (PrintWriter out = response.getWriter()) {

            // then write the data of the response
            String username = request.getParameter("username");
            if (username != null && username.length()> 0) {
                out.println("<h2>Hello, " + username + "!</h2>");
            }
        }
    }
    ...
```

6.4.3 Running the hello2 Example

You can use either NetBeans IDE or Maven to build, package, deploy, and run the `hello2` example.

6.4.3.1 To Run the hello2 Example Using NetBeans IDE

1. Start GlassFish Server as described in Section 2.2.1, "To Start GlassFish Server Using NetBeans IDE," if you have not already done so.
2. From the **File** menu, choose **Open Project**.
3. In the Open Project dialog box, navigate to:

   ```
   tut-install/examples/web/servlet
   ```

4. Select the `hello2` folder.
5. Click **Open Project**.
6. In the **Projects** tab, right-click the `hello2` project and select **Build** to package and deploy the project.
7. In a web browser, open the following URL:

   ```
   http://localhost:8080/hello2/greeting
   ```

The URL specifies the context root, followed by the URL pattern.

The application looks much like the `hello1` application. The major difference is that after you click **Submit** the response appears below the greeting, not on a separate page.

6.4.3.2 To Run the hello2 Example Using Maven

1. Start GlassFish Server as described in Section 2.2.3, "To Start GlassFish Server Using the Command Line," if you have not already done so.
2. In a terminal window, go to:

   ```
   tut-install/examples/web/servlet/hello2/
   ```

3. Enter the following command:

   ```
   mvn install
   ```

   This target builds the WAR file, copies it to the *tut-install*`/examples/web/hello2/target/` directory, and deploys it.
4. In a web browser, open the following URL:

   ```
   http://localhost:8080/hello2/greeting
   ```

   The URL specifies the context root, followed by the URL pattern.

   The application looks much like the `hello1` application. The major difference is that after you click **Submit** the response appears below the greeting, not on a separate page.

6.5 Configuring Web Applications

This section describes the following tasks involved with configuring web applications:

- Setting context parameters
- Declaring welcome files
- Mapping errors to error screens
- Declaring resource references

6.5.1 Setting Context Parameters

The web components in a web module share an object that represents their application context. You can pass context parameters to the context, or you can pass initialization parameters to a servlet. Context parameters are available to the entire application. For information on initialization parameters, see Section 17.4, "Creating and Initializing a Servlet."

6.5.1.1 To Add a Context Parameter Using NetBeans IDE

These steps apply generally to web applications but do not apply specifically to the examples in this chapter.

1. Open the project.
2. Expand the project's node in the **Projects** tree.
3. Expand the **Web Pages** node and then the **WEB-INF** node.
4. Double-click `web.xml`.

   If the project does not have a `web.xml` file, create one by following the steps in Section 6.5.1.2, "To Create a web.xml File Using NetBeans IDE."
5. Click **General** at the top of the editor window.
6. Expand the **Context Parameters** node.
7. Click **Add**.
8. In the Add Context Parameter dialog box, in the **Parameter Name** field, enter the name that specifies the context object.
9. In the **Parameter Value** field, enter the parameter to pass to the context object.
10. Click **OK**.

6.5.1.2 To Create a web.xml File Using NetBeans IDE

1. From the **File** menu, choose **New File**.
2. In the New File wizard, select the **Web** category, then select **Standard Deployment Descriptor** under **File Types**.
3. Click **Next**.
4. Click **Finish**.

   A basic `web.xml` file appears in `web/WEB-INF/`.

6.5.2 Declaring Welcome Files

The **welcome files** mechanism allows you to specify a list of files that the web container can append to a request for a URL (called a valid partial request) that is not mapped to a web component. For example, suppose that you define a welcome file `welcome.html`. When a client requests a URL such as *host*:*port*/*webapp*/*directory*, where *directory* is not mapped to a servlet or XHTML page, the file *host*:*port*/*webapp*/*directory*/`welcome.html` is returned to the client.

If a web container receives a valid partial request, the web container examines the welcome file list, appends to the partial request each welcome file in the order specified, and checks whether a static resource or servlet in the WAR is mapped to that request URL. The web container then sends the request to the first resource that matches in the WAR.

If no welcome file is specified, GlassFish Server will use a file named `index.html` as the default welcome file. If there is no welcome file and no file named `index.html`, GlassFish Server returns a directory listing.

You specify welcome files in the `web.xml` file. The welcome file specification for the `hello1` example looks like this:

```
<welcome-file-list>
    <welcome-file>index.xhtml</welcome-file>
</welcome-file-list>
```

A specified welcome file must not have a leading or trailing slash (`/`).

The `hello2` example does not specify a welcome file, because the URL request is mapped to the `GreetingServlet` web component through the URL pattern `/greeting`.

6.5.3 Mapping Errors to Error Screens

When an error occurs during execution of a web application, you can have the application display a specific error screen according to the type of error. In particular, you can specify a mapping between the status code returned in an HTTP response or a Java programming language exception returned by any web component and any type of error screen.

You can have multiple `error-page` elements in your deployment descriptor. Each element identifies a different error that causes an error page to open. This error page can be the same for any number of `error-page` elements.

6.5.3.1 To Set Up Error Mapping Using NetBeans IDE

These steps apply generally to web applications but do not apply specifically to the examples in this chapter.

1. Open the project.
2. Expand the project's node in the **Projects** tab.

3. Expand the **Web Pages** node and then the **WEB-INF** node.
4. Double-click `web.xml`.

   If the project does not have a `web.xml` file, create one by following the steps in Section 6.5.1.2, "To Create a web.xml File Using NetBeans IDE."
5. Click **Pages** at the top of the editor window.
6. Expand the **Error Pages** node.
7. Click **Add**.
8. In the Add Error Page dialog box, click **Browse** to locate the page that you want to act as the error page.
9. Specify either an error code or an exception type.
   - To specify an error code, in the **Error Code** field enter the HTTP status code that will cause the error page to be opened, or leave the field blank to include all error codes.
   - To specify an exception type, in the **Exception Type** field enter the exception that will cause the error page to load. To specify all throwable errors and exceptions, enter `java.lang.Throwable`.
10. Click **OK**.

6.5.4 Declaring Resource References

If your web component uses such objects as enterprise beans, data sources, or web services, you use Java EE annotations to inject these resources into your application. Annotations eliminate a lot of the boilerplate lookup code and configuration elements that previous versions of Java EE required.

Although resource injection using annotations can be more convenient for the developer, there are some restrictions on using it in web applications. First, you can inject resources only into container-managed objects, because a container must have control over the creation of a component so that it can perform the injection into a component. As a result, you cannot inject resources into such objects as simple JavaBeans components. However, managed beans are managed by the container; therefore, they can accept resource injections.

Components that can accept resource injections are listed in Table 6–1.

This section explains how to use a couple of the annotations supported by a web container to inject resources. Chapter 9, "Running the Persistence Examples," in *The Java EE 7 Tutorial, Volume 2*, explains how web applications use annotations supported by the Java Persistence API. Chapter 19, "Getting Started Securing Web

Applications," in *The Java EE 7 Tutorial, Volume 2*, explains how to use annotations to specify information about securing web applications. See Chapter 23, "Resource Adapters and Contracts," in *The Java EE 7 Tutorial, Volume 2*, for more information on resources.

Table 6–1 Web Components That Accept Resource Injections

Component	Interface/Class
Servlets	`javax.servlet.Servlet`
Servlet filters	`javax.servlet.ServletFilter`

Event listeners	`javax.servlet.ServletContextListener`
	`javax.servlet.ServletContextAttributeListener`
	`javax.servlet.ServletRequestListener`
	`javax.servlet.ServletRequestAttributeListener`
	`javax.servlet.http.HttpSessionListener`
	`javax.servlet.http.HttpSessionAttributeListener`
	`javax.servlet.http.HttpSessionBindingListener`

Managed beans	Plain Old Java Objects

6.5.4.1 Declaring a Reference to a Resource

The `@Resource` annotation is used to declare a reference to a resource, such as a data source, an enterprise bean, or an environment entry.

The `@Resource` annotation is specified on a class, a method, or a field. The container is responsible for injecting references to resources declared by the `@Resource` annotation and mapping it to the proper JNDI resources.

In the following example, the `@Resource` annotation is used to inject a data source into a component that needs to make a connection to the data source, as is done when using JDBC technology to access a relational database:

```
@Resource javax.sql.DataSource catalogDS;
public getProductsByCategory() {
    // get a connection and execute the query
    Connection conn = catalogDS.getConnection();
    ...
}
```

The container injects this data source prior to the component's being made available to the application. The data source JNDI mapping is inferred from the field name, `catalogDS`, and the type, `javax.sql.DataSource`.

If you have multiple resources that you need to inject into one component, you need to use the `@Resources` annotation to contain them, as shown by the following example:

```
@Resources ({
    @Resource(name="myDB" type=javax.sql.DataSource.class),
    @Resource(name="myMQ" type=javax.jms.ConnectionFactory.class)
})
```

The web application examples in this tutorial use the Java Persistence API to access relational databases. This API does not require you to explicitly create a connection to a data source. Therefore, the examples do not use the `@Resource` annotation to inject a data source. However, this API supports the `@PersistenceUnit` and `@PersistenceContext` annotations for injecting `EntityManagerFactory` and `EntityManager` instances, respectively. Chapter 9, "Running the Persistence Examples," in *The Java EE 7 Tutorial, Volume 2*, describes these annotations and the use of the Java Persistence API in web applications.

6.5.4.2 Declaring a Reference to a Web Service

The `@WebServiceRef` annotation provides a reference to a web service. The following example shows uses the `@WebServiceRef` annotation to declare a reference to a web service. `WebServiceRef` uses the `wsdlLocation` element to specify the URI of the deployed service's WSDL file:

```
...
import javax.xml.ws.WebServiceRef;
...
public class ResponseServlet extends HTTPServlet {
@WebServiceRef(wsdlLocation="http://localhost:8080/helloservice/hello?wsdl")
static HelloService service;
```

6.6 Further Information about Web Applications

For more information on web applications, see

- JavaServer Faces 2.2 specification:

  `http://jcp.org/en/jsr/detail?id=344`

- Java Servlet 3.1 specification:

  `http://jcp.org/en/jsr/detail?id=340`

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