

MAKE THE FUTURE JAVA

JavaOne

Java EE 7 Hands-on Lab

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1.0 Introduction

The Java EE 7 platform continues the ease of development push that characterized prior releases by bringing further simplification to enterprise development. It adds new and important APIs such as the REST client API in JAX-RS 2.0 and the long awaited Batch Processing API. Java Message Service 2.0 has undergone an extreme makeover to align with the improvements in the Java language. There are plenty of improvements to several other components. Newer web standards like HTML 5, WebSocket, and JSON processing are embraced to build modern web applications.

This hands-on lab will build a typical 3-tier end-to-end application using the following Java EE 7 technologies:

- Java Persistence API 2.1 (JSR 338)
- Java API for RESTful Web Services 2.0 (JSR 339)
- Java Message Service 2.0 (JSR 343)
- JavaServer Faces 2.2 (JSR 344)
- Contexts and Dependency Injection 1.1 (JSR 346)
- Bean Validation 1.1 (JSR 349)
- Batch Applications for the Java Platform 1.0 (JSR 352)
- Java API for JSON Processing 1.0 (JSR 353)
- Java API for WebSocket 1.0 (JSR 356)
- Java Transaction API 1.2 (JSR 907)

Together these APIs will allow you to be more productive by simplifying enterprise development.

The latest version of this document can be downloaded from glassfish.org/hol/javaee7-hol.pdf.

1.1 Software Requirement

The following software needs to be downloaded and installed:

- JDK 7 from http://www.oracle.com/technetwork/java/javase/downloads/index.html.
- NetBeans 7.4 or higher “All” or “Java EE” version from http://netbeans.org/downloads/. A preview of the downloads page is shown and highlights the exact “Download” button to be clicked.



- GlassFish 4 comes pre-bundled with NetBeans 7.4+ and does not need to be downloaded explicitly. But if you want to download GlassFish 4 then can do so from glassfish.org.

  If you have downloaded GlassFish 4 separately or using a pre-installed version of GlassFish 4, then configure it in NetBeans IDE following the instructions in Appendix A.

2.0 Problem Statement

This hands-on lab builds a typical 3-tier Java EE 7 Web application that allows customers to view the show timings for a movie in a 7-theater Cineplex and make reservations. Users can add new movies and delete existing movies. Customers can discuss the movie in a chat room. Total sales from each showing are calculated at the end of the day. Customers also accrue points for watching movies.



This figure shows the key components of the application. The User Interface initiates all the flows in the application. Show Booking, Add/Delete Movie and Ticket Sales interact with the database; Movie Points may interact with the database, however, this is out of scope for this application; and Chat Room does not interact with the database.

The different functions of the application, as detailed above, utilize various Java technologies and web standards in their implementation. The following figure shows how Java EE technologies are used in different flows.



The table below details the components and the selected technology used in its' implementation.

Flow	Description
User Interface	Written entirely in *JavaServer Faces* (JSF).
Chat Room	Utilizes client-side JavaScript and JSON to communicate with a *WebSocket* endpoint
Ticket Sales	Uses *Batch Applications for the Java Platform* to calculate the total sales and persist to the database.
Add/Delete Movie	Implemented using RESTful Web Services. JSON is used as on-the-wire data format.

Flow	Description
Movie Points	Uses *Java Message Service* (JMS) to update and obtain loyalty reward points; an optional implementation using database technology may be performed.
Show Booking	Uses lightweight *Enterprise JavaBeans* to communicate with the database using Java Persistence API.

This document is not a comprehensive tutorial of Java EE. The attendees are expected to know the basic Java EE concepts such as EJB, JPA, JAX-RS, and CDI. The Java EE 7 Tutorial is a good place to learn all these concepts. However enough explanation is provided in this guide to get you started with the application.

WARNING: This is a sample application and the code may not be following the best practices to prevent SQL injection, cross-side scripting attacks, escaping parameters, and other similar features expected of a robust enterprise application. This is intentional such as to stay focused on explaining the technology. It is highly recommended to make sure that the code copied from this sample application is updated to meet those requirements.

2.1 Lab Flow

The attendees will start with an existing maven application and by following the instructions and guidance provided by this lab they will:

- Read existing source code to gain an understanding of the structure of the application and use of the selected platform technologies.
- Add new and update existing code with provided fragments in order to demonstrate usage of different technology stacks in the Java EE 7 platform.

While you are copy/pasting the code from this document into NetBeans, here are couple of tips that will be really useful and make your experience enjoyable!

- NetBeans provides capability to neatly format the source code following conventions. This can be done for any type of source code, whether its XML or Java or something else. It is highly recommended to use this functionality after the code is copy/pasted from this document to the editor. This keeps the code legible.

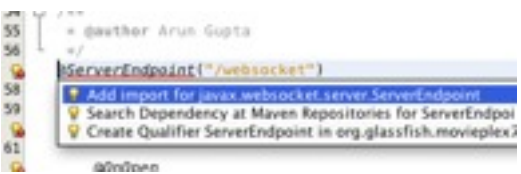
This functionality can be accessed by right-clicking in the editor pane and selecting “Format” as shown.



This functionality is also accessible using the following keyboard shortcuts:

Shortcut	Operating System
Command + Shift + F	Mac
Alt + Shift + F	Windows
Alt + Shift + F	Linux

- Copy/pasting the Java code from this document in NetBeans editor does not auto-import the classes. This is required to be done manually in order for the classes to compile. This can be fixed for each missing import statement by clicking on the yellow bulb shown in the side bar.



Alternatively all the imports can be resolved by right-clicking on the editor pane and selecting "Fix Imports" as shown.



This functionality is also accessible using the following keyboard shortcuts:

Shortcut	Operating System
Command + Shift + I	Mac
Ctrl + Shift + I	Windows
Ctrl + Shift + I	Linux

The defaults may work in most of the cases. Choices are shown in case a class is available to import from multiple packages. If multiple packages are available then specific packages to import from are clearly marked in the document.

2.2 Estimated Time

Following the complete instructions in this document can take any where from three to five hours. The wide time range accommodates for learning the new technologies, finding your way in NetBeans, copy/pasting the code, and debugging the errors.

The recommended flow is where you follow through the instructions in all sections in the listed sequence. Alternatively, you may like to cover section 4.0 through 9.0 in an order of your choice, based upon your interest and preference of the technology. However section 6.0 is a pre-requisite for section 7.0.

Here is an approximate time estimate for each section:

Section Number and Title	Estimated Time
3.0 Walk-through of Sample Application	15 - 30 mins
4.0 Chat Room (Java API for WebSocket)	30 - 45 mins
5.0 Ticket Sales (Batch Applications for the Java Platform)	30 - 45 mins
6.0 View and Delete Movie (Java API for RESTful Web Services)	30 - 45 mins
7.0 Add Movie (Java API for JSON Processing)	30 - 45 mins
8.0 Movie Points (Java Message Service)	30 - 45 mins

Section Number and Title	Estimated Time
9.0 Show Booking (JavaServer Faces)	30 - 45 mins

The listed time for each section is only an estimate and by no means restrict you within that. These sections have been completed in much shorter time, and you can do it too!

The listed time for each section also allows you to create a custom version of the lab depending upon your target audience and available time.

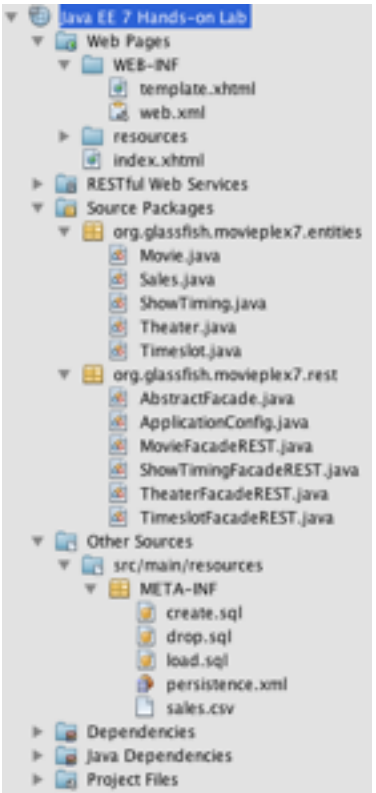
3.0 Walk-through of Sample Application

Purpose: This section will download the sample application to be used in this hands-on lab. A walk-through of the application will be performed to provide an understanding of the application architecture.

Estimated Time: 15-30 mins

3.1 Download the sample application from glassfish.org/hol/movieplex7-starting-template.zip and unzip. This will create a “movieplex7” directory and unzips all the content there.

3.2 In NetBeans IDE, select “File”, “Open Project…”, select the unzipped directory, and click on “Open Project”. The project structure is shown.


Java EE 7 Hands-on Lab
Web Pages
WEB-INF
template.xhtml
web.xml
resources
index.xhtml
RESTful Web Services
Source Packages
org.glassfish.movieplex7.entities
Movie.java
Sales.java
ShowTiming.java
Theater.java
Timeslot.java
org.glassfish.movieplex7.rest
AbstractFacade.java
ApplicationConfig.java
MovieFacadeREST.java
ShowTimingFacadeREST.java
TheaterFacadeREST.java
TimeslotFacadeREST.java
Other Sources
src/main/resources
META-INF
create.sql
drop.sql
load.sql
persistence.xml
sales.csv
Dependencies
Java Dependencies
Project Files

3.3 Maven Coordinates: Expand “Project Files” and double click on “pom.xml”. In the “pom.xml”, the Java EE 7 API is specified as a `<dependency>`**:**

```
<dependencies>
  <dependency>
    <groupId>javax</groupId>
    <artifactId>javaee-api</artifactId>
    <version>7.0</version>
    <scope>provided</scope>
  </dependency>
</dependencies>
```

This will ensure that Java EE 7 APIs are retrieved from the central Maven repository.

The Java EE 6 platform introduced the notion of “profiles”. A profile is a configuration of the Java EE platform targeted at a specific class of applications. All Java EE profiles share a set of common features, such as naming and resource injection, packaging rules, security requirements, etc. A profile may contain a proper subset or superset of the technologies contained in the platform.

The Java EE Web Profile is a profile of the Java EE Platform specifically targeted at modern web applications. The complete set of specifications defined in the Web Profile is defined in the Java EE 7 Web Profile Specification. GlassFish can be downloaded in two different flavors – Full Platform or Web Profile.

This lab requires Full Platform download. All technologies used in this lab, except Java Message Service and Batch Applications for the Java Platform, can be deployed on Web Profile.

3.4 Default Data Source: Expand “Other Sources”, “src/main/resources”, “META-INF”, and double-click on “persistence.xml”. By default, NetBeans opens the file in Design View. Click on Source tab to view the XML source.



It looks like:

```
<?xml version="1.0" encoding="UTF-8"?>
<persistence version="2.1" xmlns="http://xmlns.jcp.org/xml/ns/
persistence" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
```

```
xsi:schemaLocation="http://xmlns.jcp.org/xml/ns/persistence http://
xmlns.jcp.org/xml/ns/persistence/persistence_2_1.xsd">
  <persistence-unit name="movieplex7PU" transaction-type="JTA">
     <!--
      <jta-data-source>java:comp/DefaultDataSource</jta-data-source>
     -->
    <properties>
      <property
        name="javax.persistence.schema-generation.database.action"
        value="drop-and-create"/>
      <property
        name="javax.persistence.schema-generation.create-source"
        value="script"/>
      <property
        name="javax.persistence.schema-generation.drop-source"
        value="script"/>
      <property
        name="javax.persistence.schema-generation.drop-script-source"
        value="META-INF/drop.sql"/>
      <property
        name="javax.persistence.sql-load-script-source"
        value="META-INF/load.sql"/>
      <property
        name="eclipselink.deploy-on-startup"
        value="true"/>
      <property
        name="eclipselink.logging.exceptions"
        value="false"/>
    </properties>
  </persistence-unit>
</persistence>
```

Notice `<jta-data-source>` is commented out, i.e. no data source element is specified. This element identifies the JDBC resource to connect to in the runtime environment of the underlying application server.

The Java EE 7 platform defines a new default `DataSource` that must be provided by the runtime. This pre-configured data source is accessible under the JNDI name

```
java:comp/DefaultDataSource
```

The JPA 2.1 specification says if neither `jta-data-source` nor `non-jta-data-source` elements are specified, the deployer must specify a JTA data source or the default JTA data source must be provided by the container.

For GlassFish 4, the default data source is bound to the JDBC resource `jdbc/__default`.

Clicking back and forth between “Design” and “Source” view may prompt the error shown below:



This will get resolved when we run the application. Click on “OK” to dismiss the dialog.

3.5 Schema Generation: JPA 2.1 defines a new set of `javax.persistence.schema-generation.*` properties that can be used to generate database artifacts like tables, indexes, and constraints in a database schema. This helps in prototyping of your application where the required artifacts are generated either prior to application deployment or as part of `EntityManagerFactory` creation. This feature will allow your JPA domain object model to be directly generated in a database. The generated schema may need to be tuned for actual production environment.

The “persistence.xml” in the application has the following `javax.persistence.schema-generation.*` properties. Their meaning and possible values are explained in Table 2.

Property	Meaning	Values
`javax.persistence.schema-generation.database.action`	Specifies the action to be taken by the persistence provider with regard to the database artifacts.	“none”, “create”, “drop-and-create”, “drop”
`javax.persistence.schema-generation.create-source/drop-source`	Specifies whether the creation or deletion of database artifacts is to occur on the basis of the object/relational mapping metadata, DDL script, or a combination of the two.	“metadata”, “script”, “metadata-then-script”, “script-then-metadata”

`javax.persistence.schema-generation.create-script-source/drop-script-source`	Specifies a `java.IO.Reader` configured for reading of the SQL script or a string designating a file URL for the SQL script to create or delete database artifacts.	
`javax.persistence.sql-load-script-source`	Specifies a `java.IO.Reader` configured for reading of the SQL load script for database initialization or a string designating a file URL for the script.	

Refer to the JPA 2.1 Specification for a complete understanding of these properties.

In the application, the scripts are bundled in the WAR file in “META-INF” directory. As the location of these scripts is specified as a URL, the scripts may be loaded from outside the WAR file as well.

Feel free to open “create.sql”, “drop.sql” and “load.sql” and read through the SQL scripts. The database schema is shown.



This folder also contains “sales.csv” which carries some comma-separated data, and is used later in the application.

3.6 JPA entities, Stateless EJBs, and REST endpoints: Expand "Source Packages". The package "org.glassfish.movieplex7.entities" contains the JPA entities corresponding to the database table definitions. Each JPA entity has several convenient `@NamedQuery` defined and uses Bean Validation constraints to enforce validation.

The package "org.glassfish.movieplex7.rest" contains stateless EJBs corresponding to different JPA entities.

Each EJB has methods to perform CRUD operations on the JPA entity and convenience query methods. Each EJB is also EL-injectable (`@Named`) and published as a REST endpoint (`@Path`). The `AplicationConfig` class defines the base path of REST endpoint. The path for the REST endpoint is the same as the JPA entity class name.

The mapping between JPA entity classes, EJB classes, and the URI of the corresponding REST endpoint is shown.

JPA Entity Class	EJB Class	RESTful Path
Movie	MovieFacadeREST	/webresources/movie
Sales	SalesFacadeREST	/webresources/sales
ShowTiming	ShowTimingFacadeREST	/webresources/showtiming
Theater	TheaterFacadeREST	/webresources/theater
Timeslot	TimeslotFacadeREST	/webresources/timeslot

Feel free to browse through the code.

3.7 JSF pages: "WEB-INF/template.xhtml" defines the template of the web page and has a header, left navigation bar, and a main content section. "index.xhtml" uses this template and the EJBs to display the number of movies and theaters.

Java EE 7 enables CDI discovery of beans by default. No "beans.xml" is required in "WEB-INF". This allows all beans with bean defining annotation, i.e. either a bean with an explicit CDI scope or EJBs to be available for injection.

Note, "template.xhtml" is in "WEB-INF" folder as it allows the template to be accessible from the pages bundled with the application only. If it were bundled

with rest of the pages then it would be accessible outside the application and thus allowing other external pages to use it as well.

3.8 Run the sample: Right-click on the project and select “Run”. This will download all the maven dependencies on your machine, build a WAR file, deploy on GlassFish 4, and show the URL localhost:8080/movieplex7 in the browser. Note that this could take a while if you have never built a Maven application on your machine. Also, the project will show red squiggly lines in the source code indicating that the classes cannot be resolved. This is expected before the dependencies are downloaded. However these references will be resolved correctly after the dependencies are downloaded during project building.



During the first run, the IDE will ask you to select a deployment server. Choose the configured GlassFish server and click on “OK”.

The output looks like as shown.



4.0 Chat Room (Java API for WebSocket)

Purpose: Build a chat room for viewers. In doing so several new features of Java API for WebSocket 1.0 will be introduced and demonstrated by using them in the application.

Estimated Time: 30-45 mins

WebSocket provide a full-duplex and bi-directional communication protocol over a single TCP connection. WebSocket is a combination of IETF RFC 6455 Protocol and W3C JavaScript WebSocket API (a Candidate Recommendation as of this writing). The protocol defines an opening handshake and data transfer. The API enables Web pages to use the WebSocket protocol for two-way communication with the remote host.

JSR 356 defines a standard API for creating WebSocket applications in the Java EE 7 Platform. The JSR provides support for:

- Create WebSocket endpoint using annotations and interface
- Initiating and intercepting WebSocket events
- Creation and consumption of WebSocket text and binary messages
- Configuration and management of WebSocket sessions
- Integration with Java EE security model

This section will build a chat room for movie viewers.

4.1 Right-click on “Source Packages”, select “New”, “Java Class…”. Give the class name as “ChatServer”, package as “org.glassfish.movieplex7.chat”, and click on “Finish”.

4.2 Change the class such that it looks like:

```
@ServerEndpoint("/websocket")
public class ChatServer {

    private static final Set<Session> peers =
Collections.synchronizedSet(new HashSet<Session>());

    @OnOpen
    public void onOpen(Session peer) {
        peers.add(peer);
    }

    @OnClose
    public void onClose(Session peer) {
        peers.remove(peer);
    }

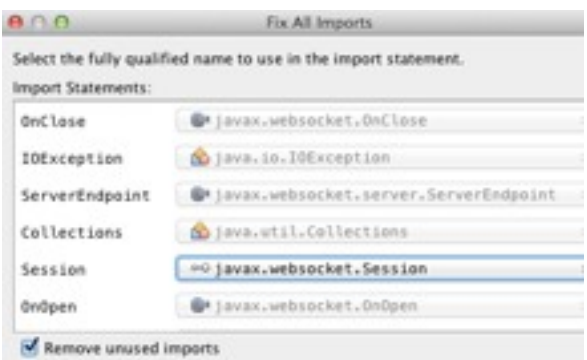
    @OnMessage
    public void message(String message, Session client) throws
IOException, EncodeException {
        for (Session peer : peers) {
           peer.getBasicRemote().sendObject(message);
        }
    }
}
```

In this code:

- `@ServerEndpoint` decorates the class to be a WebSocket endpoint. The value defines the URI where this endpoint is published.
- `@OnOpen` and `@OnClose` decorate the methods that must be called when WebSocket session is opened or closed. The `peer` parameter defines the client requesting connection initiation and termination.
- `@OnMessage` decorates the message that receives the incoming WebSocket message. The first parameter, `message`, is the payload of the message. The second parameter, `client`, defines the other end of the WebSocket connection. The method implementation transmits the received message to all clients connected to this endpoint.

Resolve the imports by right-clicking in the editor and selecting “Fix Imports” or (Command + Shift + I shortcut on Mac or Ctrl + Shift + I on Windows).

Make sure to pick `java.websocket.Session` for resolving imports.



Right-click again in the editor pane and select “Format” to format your code.

4.3 In “Web Pages”, select “New”, “Folder…”, give the folder name as “chat” and click on “Finish”.

4.4 Right-click on the newly created folder, select “New”, “Facelets Template Client”, give the File Name as “chatroom”. Click on “Browse…” next to “Template:”, expand “Web Pages”, “WEB-INF”, select “template.xhtml”, and click on “Select File”. Click on “Finish”.



In this file, remove `<ui:define>` sections where name attribute value is “top” and “left”. These sections are inherited from the template.

Replace `<ui:define>` section with “content” name such that it looks like:

```
<ui:define name="content">
  <form action="">
    <table>
      <tr>
        <td>
          Chat Log<br/>
          <textarea readonly="true" rows="6" cols="50" id="chatlog"></
textarea>
        </td>
        <td>
          Users<br/>
          <textarea readonly="true" rows="6" cols="20" id="users"></
textarea>
        </td>
      </tr>
      <tr>
        <td colspan="2">
          <input id="textField" name="name" value="Duke" type="text"/>
          <input onclick="join();" value="Join" type="button"/>
          <input onclick="send_message();" value="Send" type="button"/
><p/>
          <input onclick="disconnect();" value="Disconnect"
type="button"/>
        </td>
      </tr>
    </table>
  </form>
  <div id="output"></div>
  <script language="javascript" type="text/javascript" src="$
{facesContext.externalContext.requestContextPath}/chat/websocket.js"></
script>
</ui:define>
```

The code builds an HTML form that has two `textareas` – one to display the chat log and the other to display the list of users currently logged. A single text box is used to take the user name or the chat message. Clicking on “Join” button takes the value as user name and clicking on “Send” takes the value as chat message. JavaScript methods are invoked when these buttons are clicked and these are explained in the next section. The chat messages are sent and received as WebSocket payloads. There is an explicit button to disconnect the WebSocket connection. “output” div is the placeholder for status messages. The WebSocket initialization occurs in “websocket.js” included at the bottom of the fragment.

4.5 Right-click on “chat” in “Web Pages”, select “New”, “Web”, “JavaScript File”.

Give the name as “websocket” and click on “Finish”.

4.6 Edit the contents of “websocket.js” such that it looks like:

```
var wsUri = 'ws://' + document.location.host
               + document.location.pathname.substr(0,
                 document.location.pathname.indexOf("/faces"))
               + '/websocket';
console.log(wsUri);
var websocket = new WebSocket(wsUri);
var textField = document.getElementById("textField");
var users = document.getElementById("users");
var chatlog = document.getElementById("chatlog");

var username;
websocket.onopen = function(evt) { onOpen(evt); };
websocket.onmessage = function(evt) { onMessage(evt); };
websocket.onerror = function(evt) { onError(evt); };
websocket.onclose = function(evt) { onClose(evt); };
var output = document.getElementById("output");

function join() {
    username = textField.value;
    websocket.send(username + " joined");
}

function send_message() {
    websocket.send(username + ": " + textField.value);
}

function onOpen() {
    writeToScreen("CONNECTED");
}
```

```
function onClose() {
    writeToScreen("DISCONNECTED");
}

function onMessage(evt) {
    writeToScreen("RECEIVED: " + evt.data);
    if (evt.data.indexOf("joined") !== -1) {
        users.innerHTML += evt.data.substring(0, evt.data.indexOf("
joined")) + "\n";
    } else {
        chatlog.innerHTML += evt.data + "\n";
    }
}

function onError(evt) {
    writeToScreen('<span style="color: red;">ERROR:</span> ' +
evt.data);
}

function disconnect() {
    websocket.close();
}

function writeToScreen(message) {
    var pre = document.createElement("p");
    pre.style.wordWrap = "break-word";
    pre.innerHTML = message;
    output.appendChild(pre);
}
```

The WebSocket endpoint URI is calculated by using standard JavaScript variables and appending the URI specified in the `ChatServer` class. WebSocket is initialized by calling `new WebSocket(…)`. Event handlers are registered for lifecycle events using `onXXX` messages. The listeners registered in this script are explained in the table.

Listeners	Called When
onOpen(evt)	WebSocket connection is initiated
onMessage(evt)	WebSocket message is received
onError(evt)	Error occurs during the communication
onClose(evt)	WebSocket connection is terminated

Any relevant data is passed along as parameter to the function. Each method prints the status on the browser using `writeToScreen` utility method. The `join` method sends a message to the endpoint that a particular user has joined. The endpoint then broadcasts the message to all the listening clients. The `send_message` method appends the logged in user name and the value of the text field and broadcasts to all the clients similarly. The `onMessage` method updates the list of logged in users as well.

4.7 Edit "WEB-INF/template.xhtml" and change:

```
<h:outputLink value="item2.xhtml">Item 2</h:outputLink>
```

to

```
<h:outputLink value="$
{facesContext.externalContext.requestContextPath}/faces/chat/
chatroom.xhtml">Chat Room</h:outputLink>
```

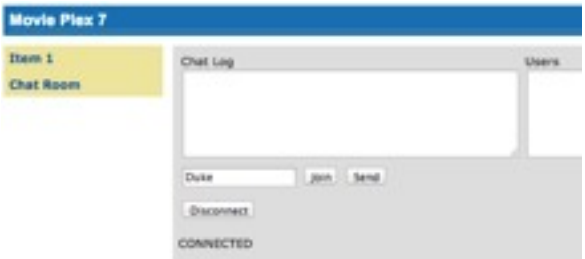
The `outputLink` tag renders an HTML anchor tag with an `href` attribute. `${facesContext.externalContext.requestContextPath}` provides the request URI that identifies the web application context for this request. This allows the links in the left navigation bar to be fully-qualified URLs.

4.8 Run the project by right clicking on the project and selecting "Run". The browser shows localhost:8080/movieplex7.



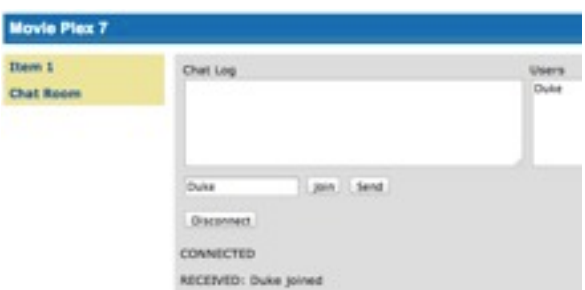
Click on "Chat Room" to see the output.

The "CONNECTED" status message is shown and indicates that the WebSocket connection with the endpoint is established.



Please make sure your browser supports WebSocket in order for this page to show up successfully. Chrome 14.0+, Firefox 11.0+, Safari 6.0+, and IE 10.0+ are the browsers that support WebSocket. A complete list of supported browsers is available at caniuse.com/websockets.

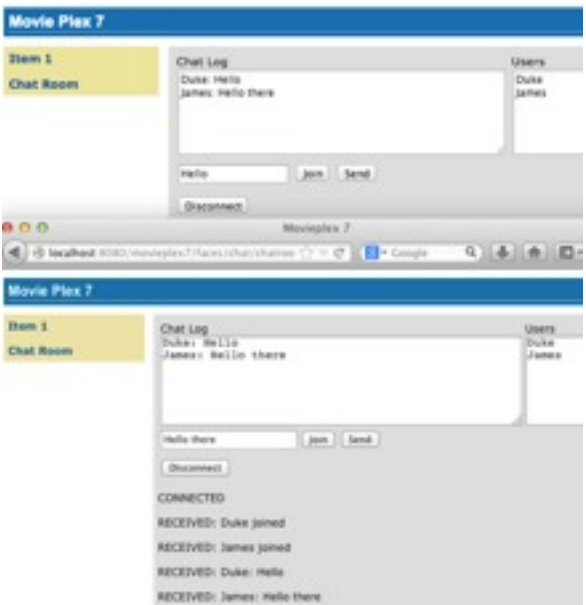
Open the URI localhost:8080/movieplex7 in another browser window. Enter “Duke” in the text box in the first browser and click “Join”.



Notice that the user list and the status message in both the browsers gets updated. Enter “James” in the text box of the second browser and click on “Join”. Once again the user list and the status message in both the browsers is updated.

Now you can type any messages in any of the browser and click on “Send” to send the message.

The output from two different browsers after the initial greeting looks like as shown.



Here it shows output from Chrome on the top and Firefox on the bottom.

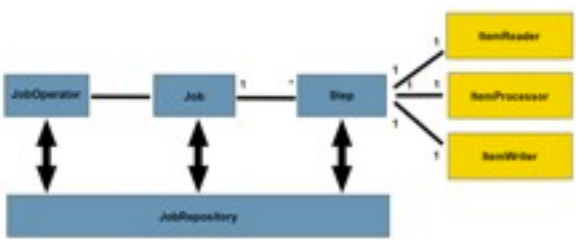
Chrome Developer Tools or Firebug in Firefox can be used to monitor WebSocket traffic.

5.0 Ticket Sales (Batch Applications for the Java Platform)

Purpose: Read the total sales for each show and populate the database. In doing so several new features of Java API for Batch Processing 1.0 will be introduced and demonstrated by using them in the application.

Estimated Time: 30-45 mins

Batch Processing is execution of series of "jobs" that is suitable for non-interactive, bulk-oriented and long-running tasks. Batch Applications for the Java Platform (JSR 352) will define a programming model for batch applications and a runtime for scheduling and executing jobs.



The core concepts of Batch Processing are:

- A **Job** is an instance that encapsulates an entire batch process. A job is typically put together using a Job Specification Language and consists of multiple steps. The Job Specification Language for JSR 352 is implemented with XML and is referred as "Job XML".
- A **Step** is a domain object that encapsulates an independent, sequential phase of a job. A step contains all of the information necessary to define and control the actual batch processing.
- **JobOperator** provides an interface to manage all aspects of job processing, including operational commands, such as start, restart, and stop, as well as job repository commands, such as retrieval of job and step executions.

- **JobRepository** holds information about jobs current running and jobs that run in the past. JobOperator provides access to this repository.
- Reader-Processor-Writer pattern is the primary pattern and is called as **Chunk-oriented Processing**. In this, **ItemReader** reads one item at a time, **ItemProcessor** processes the item based upon the business logic, such as calculate account balance and hands it to **ItemWriter** for aggregation. Once the 'chunk' numbers of items are aggregated, they are written out, and the transaction is committed.

This section will read the cumulative sales for each show from a CSV file and populate them in a database.

5.1 Right-click on Source Packages, select “New”, “Java Package…”, specify the value as “org.glassfish.movieplex7.batch”, and click on “Finish”.

5.2 Right-click on newly created package, select “New”, “Java Class…”, specify the name as “SalesReader”. Make this class extend from `AbstractItemReader`, change the class definition and add:

```
extends AbstractItemReader
```

`AbstractItemReader` is an abstract class that implements `ItemReader` interface. The `ItemReader` interface defines methods that read a stream of items for chunk processing. This reader implementation returns a `String` item type as indicated in the class definition.

Add `@Named` as a class-level annotations and it allows the bean to be injected in Job XML. Add `@Dependent` as another class-level annotation to mark this bean as a bean defining annotation so that this bean is available for injection.

Resolve the imports.

5.3 Add the following field:

```
private BufferedReader reader;
```

Override `open()` method to initialize the reader:

```
public void open(Serializable checkpoint) throws Exception {
  reader = new BufferedReader(
              new InputStreamReader(
                Thread.currentThread()
                  .getContextClassLoader()
                  .getResourceAsStream("META-INF/sales.csv")));
```

```
}
```

This method initializes a `BufferedReader` from “META-INF/sales.csv” that is bundled with the application.

Sampling of the first few lines from “sales.csv” is shown below:

```
1,500.00
2,660.00
3,80.00
4,470.00
5,1100.x0
```

Each line has a show identifier comma separated by the total sales for that show. Note that the last line (5th record in the sample) has an intentional typo. In addition, 17th record also has an additional typo. The lab will use these lines to demonstrate how to handle parsing errors.

5.4 Override the following method from the abstract class:

```
@Override
public String readItem() {
    String string = null;
    try {
        string = reader.readLine();
    } catch (IOException ex) {
        ex.printStackTrace();
    }
    return string;
}
```

The `readItem` method returns the next item from the stream. It returns `null` to indicate end of stream. Note end of stream indicates end of chunk, so the current chunk will be committed and the step will end.

Resolve the imports.

5.5 Right-click on “org.glassfish.movieplex7.batch” package, select “New”, “Java Class…”, specify the name as “SalesProcessor”. Change the class definition and add:

```
implements ItemProcessor
```

`ItemProcessor` is an interface that defines a method that is used to operate on an input item and produce an output item. This processor accepts a `String`

input item from the reader, `SalesReader` in our case, and returns a `Sales` instance to the writer (coming shortly). `Sales` is the pre-packaged JPA entity with the application starter source code.

Add `@Named` and `@Dependent` as class-level annotations so that it allows the bean to be injected in Job XML.

Resolve the imports.

5.6 Add implementation of the abstract method from the interface as:

```
@Override
public Sales processItem(Object s) {
    Sales sales = new Sales();

    StringTokenizer tokens = new StringTokenizer((String)s, ",");
    sales.setId(Integer.parseInt(tokens.nextToken()));
    sales.setAmount(Float.parseFloat(tokens.nextToken()));

    return sales;
}
```

This method takes a `String` parameter coming from the `SalesReader`, parses the value, populates them in the `Sales` instance, and returns it. This is then aggregated with the writer.

The method can return `null` indicating that the item should not be aggregated. For example, the parsing errors can be handled within the method and return `null` if the values are not correct. However this method is implemented where any parsing errors are thrown as exception. Job XML can be instructed to skip these exceptions and thus that particular record is skipped from aggregation as well (shown later).

Resolve the imports.

5.7 Right-click on “org.glassfish.movieplex7.batch” package, select “New”, “Java Class…”, specify the name as “SalesWriter”. Change the class definition and add:

```
extends AbstractItemWriter
```

`AbstractItemWriter` is an abstract class that implements `ItemWriter` interface. The `ItemWriter` interface defines methods that write to a stream of items for chunk processing. This writer writes a list of `Sales` items.

Add `@Named` and `@Dependent` as class-level annotations so that it allows the bean to be injected in Job XML.

Resolve the imports.

5.8 Inject `EntityManager` as:

```
@PersistenceContext EntityManager em;
```

Override the following method from the abstract class:

```
@Override
@Transactional
public void writeItems(List list) {
    for (Sales s : (List<Sales>)list) {
      em.persist(s);
    }
}
```

Batch runtime aggregates the list of `Sales` instances returned from the `SalesProessor` and makes it available as `List` in this method. This method iterates over the list and persist each item in the database.

The method also specifies `@Transactional` as a method level annotation. This is a new annotation introduced by JTA 1.2 that provides the ability to control transaction boundaries on CDI managed beans. This provides the semantics of EJB transaction attributes in CDI beans without dependencies such as RMI. This support is implemented via an implementation of a CDI interceptor that conducts the necessary suspending, resuming, etc.

In this case, a transaction is automatically started before the method is called, committed if no checked exceptions are thrown, and rolled back if runtime exceptions are thrown. This behavior can be overridden using `rollbackOn` and `dontRollbackOn` attributes of the annotation.

Resolve the imports.

5.9 Create Job XML that defines the job, step, and chunk.

In “Files” tab, expand the project -> “src” -> “main” -> “resources”, right-click on “resources”, “META-INF”, select “New”, “Folder…”, specify the name as “batch-jobs”, and click on “Finish”.

Right-click on the newly created folder, select “New”, “Other…”, select “XML”, “XML Document”, click on “Next >”, give the name as “eod-sales”, click on “Next”, take the default, and click on “Finish”.

Replace contents of the file with the following:

```
<job id="endOfDaySales" xmlns="http://xmlns.jcp.org/xml/ns/javaee"
version="1.0">
    <step id="populateSales">
        <chunk item-count="3" skip-limit="5">
            <reader ref="salesReader"/>
            <processor ref="salesProcessor"/>
            <writer ref="salesWriter"/>
            <skippable-exception-classes>
                <include class="java.lang.NumberFormatException"/>
            </skippable-exception-classes>
        </chunk>
    </step>
</job>
```

This code shows that the `job` has one `step` of `chunk` type. The `<reader>`, `<processor>`, and `<writer>` elements define the CDI bean name of the implementations of `ItemReader`, `ItemProcessor`, and `ItemWriter` interfaces. The `item-count` attribute defines that 3 items are read/processed/aggregated and then given to the writer. The entire reader/processor/writer cycle is executed within a transaction. The `<skippable-exception-classes>` element specifies a set of exceptions to be skipped by chunk processing.

CSV file used for this lab has intentionally introduced couple of typos that would generate `NumberFormatException`. Specifying this element allows skipping the exception, ignore that particular element, and continue processing. If this element is not specified then the batch processing will halt. The `skip-limit` attribute specifies the number of exceptions a step will skip.

5.10 Lets invoke the batch job.

Right-click on “org.glassfish.movieplex7.batch” package, select “New”, “Java Class…”. Enter the name as “SalesBean” and click on “Finish” button.

Add the following code to the bean:

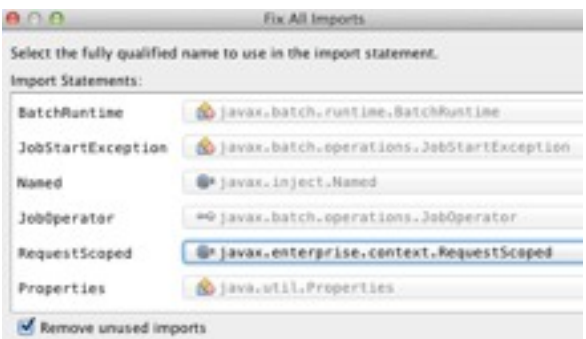
```
public void runJob() {
    try {
        JobOperator jo = BatchRuntime.getJobOperator();
        long jobId = jo.start("eod-sales", new Properties());
        System.out.println("Started job: with id: " + jobId);
    } catch (JobStartException ex) {
```

```
            ex.printStackTrace();
        }
}
```

This method uses `BatchRuntime` to get an instance of `JobOperator`, which is then used to start the job. `JobOperator` is the interface for operating on batch jobs. It can be used to start, stop, and restart jobs. It can additionally inspect job history, to discover what jobs are currently running and what jobs have previously run.

Add `@Named` and `@RequestScoped` as class-level annotations. This allows the bean to be injectable in an EL expression.

Resolve the imports.



5.11 Inject `EntityManagerFactory` in the class as:

```
@PersistenceUnit EntityManagerFactory emf;
```

and add the following method:

```
public List<Sales> getSalesData() {
    return emf.createEntityManager().createNamedQuery("Sales.findAll",
Sales.class).getResultList();
}
```

This method uses a pre-defined `@NamedQuery` to query the database and return all the rows from the table.

Resolve the imports.

5.12 Right-click on “Web Pages”, select “New”, “Folder…”, specify the name as “batch”, and click on “Finish”.

Right-click on the newly created folder, select “New”, “Other…”, “JavaServer Faces”, “Facelets Template Client”, and click on “Next >”.

Give the File Name as “sales”. Click on “Browse…” next to “Template:”, expand “Web Pages”, “WEB-INF”, select “template.xhtml”, and click on “Select File”. Click on “Finish”.

In this file, remove `<ui:define>` sections where name attribute value is “top” and “left”. These sections are inherited from the template.

Replace `<ui:define>` section with “content” name such that it looks like:

```
<ui:define name=”content”>
<h1>Movie Sales</h1>
<h:form>
    <h:dataTable value="#{salesBean.salesData}" var="s" border="1">
        <h:column>
            <f:facet name="header">
                <h:outputText value="Show ID" />
            </f:facet>
            #{s.id}
        </h:column>
        <h:column>
            <f:facet name="header">
                <h:outputText value="Sales" />
            </f:facet>
            #{s.amount}
        </h:column>
    </h:dataTable>

    <h:commandButton value="Run Job" action="sales"
actionListener="#{salesBean.runJob()}"/>
    <h:commandButton value="Refresh" action="sales" />
</h:form>
</ui:define>
```

This code displays the show identifier and sales from that show in a table by invoking `SalesBean.getSalesData()`. First command button allows invoking the job that processes the CSV file and populates the database. The second command button refreshes the page.

Right-click on the yellow bulb to fix namespace prefix/URI mapping. This needs to be repeated for `h:` and `f:` prefix.

5.13 Add the following code in "template.xhtml" along with other `<outputLink>`s:

```
<p/><h:outputLink value="$
{facesContext.externalContext.requestContextPath}/faces/batch/
sales.xhtml">Sales</h:outputLink>
```

5.14 Run the project to see the output as shown.



Notice, a new "Sales" entry is displayed in the left navigation bar.

5.15 Click on "Sales" to see the output as shown.



The empty table indicates that there is no sales data in the database.

5.16 Click on "Run Job" button to initiate data processing of CSV file. Look for "Waiting for localhost..." in the browser status bar, wait for a couple of seconds

for the processing to finish, and then click on “Refresh” button to see the updated output as shown.



Now the table is populated with the sales data.

Note that record 5 is missing from the table, as this records did not have correct numeric entries for the sales total. The Job XML for the application explicitly mentioned to skip such errors.

6.0 View and Delete Movie (Java API for RESTful Web Services)

Purpose: View, and delete a movie. In doing so several new features of JAX-RS 2 will be introduced and demonstrated by using them in the application.

Estimated Time: 30-45 mins

JAX-RS 2 defines a standard API to create, publish, and invoke a REST endpoint. JAX-RS 2 adds several new features to the API:

- Client API that can be used to access Web resources and provides integration with JAX-RS Providers. Without this API, the users need to use a low-level `HttpUrlConnection` to access the REST endpoint.
- Asynchronous processing capabilities in Client and Server that enables more scalable applications.
- Message Filters and Entity Interceptors as well-defined extension points to extend the capabilities of an implementation.
- Validation constraints can be specified to validate the parameters and return type.

This section will provide the ability to view all the movies, details of a selected movie, and delete an existing movie using the JAX-RS Client API.

6.1 Right-click on “Source Packages”, select “New”, “Java Class…”. Give the class name as “MovieClientBean”, package as “org.glassfish.movieplex7.client”, and click on “Finish”.

This bean will be used to invoke the REST endpoint.

6.2 Add `@Named` and `@RequestScoped` class-level annotations. This allows the class to be injected in an EL expression and also defines the bean to be automatically activated and passivated with the request.

Resolve the imports. Make sure to pick `javax.enterprise.context.RequestScoped` class.



6.3 Add the following code to the class:

```
Client client;
WebTarget target;

@PostConstruct
public void init() {
    client = ClientBuilder.newClient();
    target = client.target("http://localhost:8080/movieplex7/
webresources/movie/");
}

@PreDestroy
public void destroy() {
    client.close();
}
```

`ClientBuilder` is the main entry point to the Client API. It uses a fluent builder API to invoke REST endpoints. A new `Client` instance is created using the default client builder implementation provided by the JAX-RS implementation provider. `Client` are heavy-weight objects that manage the client-side communication infrastructure. It is highly recommended to create only required number of instances of `Client` and close it appropriately.

In this case, `Client` instance is created and destroyed in the lifecycle callback methods. The endpoint URI is set on this instance by calling the `target` method.

6.4 Add the following method to the class:

```
public Movie[] getMovies() {
    return target
            .request()
            .get(Movie[].class);
```

```
}
```

A request is prepared by calling the `request` method. HTTP GET method is invoked by calling `get` method. The response type is specified in the last method call and so return value is of the type `Movie[]`.

6.5 Right-click on “Web Pages”, select “New”, “Folder…”, specify the name as “client”, and click on “Finish”.

Right-click on the newly created folder, select “New”, “Other…”, “JavaServer Faces”, “Facelets Template Client”, and click on “Next >”.

Give the File Name as “movies”. Click on “Browse…” next to “Template:”, expand “Web Pages”, “WEB-INF”, select “template.xhtml”, and click on “Select File”. Click on “Finish”.

In this file, remove `<ui:define>` sections where name attribute value is “top” and “left”. These sections are inherited from the template.

6.6 Replace the content inside `<ui:define>` with “content” with the code fragment shown below:

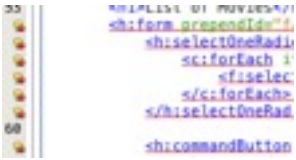
```
<h:form prependId="false">
  <h:selectOneRadio value="#{movieBackingBean.movieId}"
layout="pageDirection">
    <c:forEach items="#{movieClientBean.movies}" var="m">
      <f:selectItem itemValue="#{m.id}" itemLabel="#{m.name}"/>
    </c:forEach>
  </h:selectOneRadio>

  <h:commandButton value="Details" action="movie" />
</h:form>
```

This code fragment invokes `getMovies` method from `MovieClientBean`, iterates over the response in a `for` loop, and display the name of each movie with a radio button. The selected radio button value is bound to the EL expression `#{movieBackingBean.movieId}`.

The code also has a button with “Details” label and looks for “movie.xhtml” in the same directory. We will create this file later.

Click on the yellow bulb in the left bar to resolve the namespace prefix-to-URI resolution. This needs to be completed for – for `h:`, `c:`, and `f:` prefixes.



6.7 Right-click on “org.glassfish.movieplex7.client” package, select “New”, “Java Class…”, specify the value as “MovieBackingBean” and click on “Finish”.

Add the following field:

```
int movieId;
```

Add getters/setters by right-clicking on the editor pane and selecting “Insert Code…” (Ctrl + I shortcut on Mac). Select the field and click on “Generate”.

Add `@Named` and `@SessionScoped` class-level annotations and `implements Serializable`.

Resolve the imports. Make sure to import `javax.enterprise.context.SessionScoped`.

6.8 In “template.xhtml”, add the following code in `<ui:insert>` with `name=”left”`.

```
<p/><h:outputLink value="$
{facesContext.externalContext.requestContextPath}/faces/client/
movies.xhtml">Movies</h:outputLink>
```

Running the project (Fn + F6 shortcut on Mac) and clicking on “Movies” in the left navigation bar shows the output as shown.



The list of all the movies with a radio button next to them is displayed.

6.9 In “MovieClientBean”, inject “MovieBackingBean” to read the value of selected movie from the page. Add the following code:

```
@Inject
MovieBackingBean bean;
```

6.10 In “MovieClientBean”, add the following method:

```
public Movie getMovie() {
    Movie m = target
                .path("{movie}")
                .resolveTemplate("movie", bean.getMovieId())
                .request()
                .get(Movie.class);
    return m;
}
```

This code reuses the `Client` and `WebTarget` instances created in `@PostConstruct`. It also adds a variable part to the URI of the REST endpoint, defined using `{movie}`, and binds it to a concrete value using `resolveTemplate` method. The return type is specified as a parameter to the `get` method.

6.11 Right-click on “client” folder, select “New”, “Facelets Template Client”, give the File Name as “movie”. Click on “Browse…” next to “Template:”, expand “Web Pages”, “WEB-INF”, select “template.xhtml”, and click on “Select File”. Click on “Finish”.

In this file, remove `<ui:define>` sections where name attribute value is “top” and “left”. These sections are inherited from the template.

Replace the content inside `<ui:define>` with “content” with the code fragment shown below:

```
<h1>Movie Details</h1>
<h:form>
    <table cellpadding="5" cellspacing="5">
        <tr>
            <th align="left">Movie Id:</th>
            <td>#{movieClientBean.movie.id}</td>
        </tr>
        <tr>
            <th align="left">Movie Name:</th>
            <td>#{movieClientBean.movie.name}</td>
        </tr>
        <tr>
            <th align="left">Movie Actors:</th>
            <td>#{movieClientBean.movie.actors}</td>
         </tr>

     </table>
     <h:commandButton value="Back" action="movies" />
</h:form>
```

Click on the yellow-bulb to resolve the namespace prefix-URI mapping for `h:`. The output values are displayed by calling the `getMovie` method and using the `id`, `name`, and `actors` property values.

6.12 Run the project, select “Movies” in the left navigation bar, select a radio button next to any movie, and click on details to see the output as shown.



Click on the “Back” button to select another movie.

6.13 Add the ability to delete a movie. In “movies.xhtml”, add the following code with the other `commandButton`.

```
<h:commandButton value="Delete" action="movies"
actionListener="#{movieClientBean.deleteMovie()}"/>
```

This button displays a label “Delete”, invokes the method `deleteMovie` from “MovieClientBean”, and then renders “movies.xhtml”.

6.14 Add the following code to “MovieClientBean”:

```
public void deleteMovie() {
    target
        .path("{movieId}")
        .resolveTemplate("movieId", bean.getMovieId())
        .request()
        .delete();
}
```

This code again reuses the `Client` and `WebTarget` instances created in `@PostConstruct`. It also adds a variable part to the URI of the REST endpoint, defined using `{movieId}`, and binds it to a concrete value using `resolveTemplate` method. The URI of the resource to be deleted is prepared and then `delete` method is called to delete the resource.

Make sure to resolve the imports.

Running the project shows the output shown.



Select a movie and click on Delete button. This deletes the movie from the database and refreshes list on the page. Note that a redeploy of the project will delete all the movies anyway and add them all back.

7.0 Add Movie (Java API for JSON Processing)

Purpose: Add a new movie. In doing so several new features of the Java API for JSON Processing 1.0 will be introduced and demonstrated by using them in the application.

Estimated Time: 30-45 mins

Java API for JSON Processing provides a standard API to parse and generate JSON so that the applications can rely upon a portable API. This API will provide:

- Produce/Consume JSON in a streaming fashion (similar to StAX API for XML)
- Build a Java Object Model for JSON (similar to DOM API for XML)

This section will define a JAX-RS Entity Providers that will allow reading and writing JSON for a `Movie` POJO. The JAX-RS Client API will request this JSON representation.

JAX-RS Entity Providers supply mapping services between on-the-wire representations and their associated Java types. Several standard Java types such as `String`, `byte[]`, `javax.xml.bind.JAXBElement`, `java.io.InputStream`, `java.io.File`, and others have a pre-defined mapping and is required by the specification. Applications may provide their own mapping to custom types using `MessageBodyReader` and `MessageBodyWriter` interfaces.

This section will provide the ability to add a new movie to the application. Typically, this functionality will be available after proper authentication and authorization.

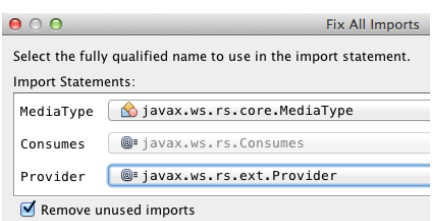
7.1 Right-click on Source Packages, select "New", "Java Package…", specify the value as "org.glassfish.movieplex7.json", and click on "Finish".

7.2 Right-click on newly created package, select "New", "Java Class…", specify the name as "MovieReader", and click on "Finish". Add the following class-level annotations:

```
@Provider
@Consumes(MediaType.APPLICATION_JSON)
```

`@Provider` allows this implementation to be discovered by the JAX-RS runtime during the provider scanning phase. `@Consumes` indicates that this implementation will consume a JSON representation of the resource.

Make sure to resolve imports from the appropriate package as shown.



7.3 Make the class `implements MessageBodyReader<Movie>`.



Click on the hint (shown as yellow bulb) on the class definition and select "Implement all abstract methods".

7.4 Change implementation of the `isReadable` method as:

```
return Movie.class.isAssignableFrom(type);
```

This method ascertains if the `MessageBodyReader` can produce an instance of a particular type.

7.5 Replace the `readFrom` method to:

```
@Override
public Movie readFrom(Class<Movie> type, Type type1, Annotation[]
antns, MediaType mt, MultivaluedMap<String, String> mm, InputStream in)
throws IOException, WebApplicationException {
  Movie movie = new Movie();
  JsonParser parser = Json.createParser(in);
  while (parser.hasNext()) {
    switch (parser.next()) {
      case KEY_NAME:
        String key = parser.getString();
        parser.next();
        switch (key) {
          case "id":
             movie.setId(parser.getInt());
             break;
          case "name":
             movie.setName(parser.getString());
             break;
          case "actors":
             movie.setActors(parser.getString());
             break;
          default:
             break;
```

```
        }
        break;
      default:
        break;
    }
  }
  return movie;
}
```

This code reads a type from the input stream `in`. `JsonParser`, a streaming parser, is created from the input stream. Key values are read from the parser and a `Movie` instance is populated and returned.

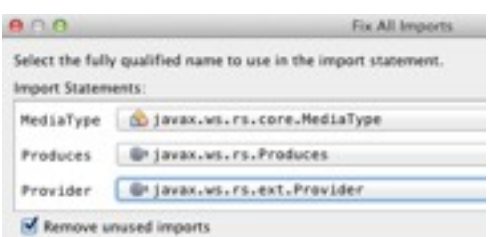
Resolve the imports.

7.6 Right-click on newly created package, select “New”, “Java Class…”, specify the name as “MovieWriter”, and click on “Finish”. Add the following class-level annotations:

```
@Provider
@Produces(MediaType.APPLICATION_JSON)
```

`@Provider` allows this implementation to be discovered by the JAX-RS runtime during the provider scanning phase. `@Produces` indicates that this implementation will produce a JSON representation of the resource.

Resolve the imports as shown.



7.7 Make this class `implements MessageBodyWriter<Movie>`.



Click on the hint (show as yellow bulb) on the class definition and select "Implement all abstract methods".

7.8 Change implementation of the `isWritable` method to:

```
return Movie.class.isAssignableFrom(type);
```

This method ascertains if the `MessageBodyWriter` supports a particular type.

7.9 Add implementation of the `getSize` method as:

```
return -1;
```

Originally, this method was called to ascertain the length in bytes of the serialized form of `t`. In JAX-RS 2.0, this method is deprecated and the value returned by the method is ignored by a JAX-RS runtime. All `MessageBodyWriter` implementations are advised to return `-1`.

7.10 Change implementation of the `writeTo` method as:

```
public void writeTo(Movie t, Class<?> type, Type type1, Annotation[]
antns, MediaType mt, MultivaluedMap<String, Object> mm, OutputStream
out) throws IOException, WebApplicationException {
    JsonGenerator gen = Json.createGenerator(out);
    gen.writeStartObject()
            .write("id", t.getId())
            .write("name", t.getName())
            .write("actors", t.getActors())
            .writeEnd();
    gen.flush();
}
```

This method writes a type to an HTTP message. `JsonGenerator` writes JSON data to an output stream in a streaming way. Overloaded `write` methods are used to write different data types to the stream.

Resolve the imports.

7.11 In “Web Pages”, right-click on “client” folder, select “New”, “Facelets Template Client”.

Give the File Name as “addmovie”. Click on “Browse…” next to “Template:”, expand “Web Pages”, “WEB-INF”, select “template.xhtml”, and click on “Select File”. Click on “Finish”.

In this file, remove `<ui:define>` sections where name attribute value is “top” and “left”. These sections are inherited from the template.

Replace the content inside `<ui:define>` with “content” with the code fragment shown below:

```
<h1>Add a New Movie</h1>
<h:form>
    <table cellpadding="5" cellspacing="5">
        <tr>
            <th align="left">Movie Id:</th>
            <td><h:inputText value="#{movieBackingBean.movieId}"/></td>
        </tr>
        <tr>
            <th align="left">Movie Name:</th>
            <td><h:inputText value="#{movieBackingBean.movieName}"/> </
td>
        </tr>
        <tr>
            <th align="left">Movie Actors:</th>
            <td><h:inputText value="#{movieBackingBean.actors}"/></td>
        </tr>

    </table>
    <h:commandButton value="Add" action="movies"
                     actionListener="#{movieClientBean.addMovie()}"/>
</h:form>
```

This code creates a form to accept input of `id`, `name`, and `actors` of a movie. These values are bound to fields in “MovieBackingBean”. The click of command button invokes the `addMovie` method from “MovieClientBean” and then renders “movies.xhtml”.

Click on the hint (show as yellow bulb) to resolve the namespace prefix/URI mapping as shown.



7.12 Add `movieName` and `actors` field to “MovieBackingBean” as:

```
String movieName;
String actors;
```

Generate getters and setters by clicking on the menu item “Source” and then “Insert Code...”.

7.13 Add the following code to “movies.xhtml”

```
<h:commandButton value="New Movie" action="addmovie" />
```

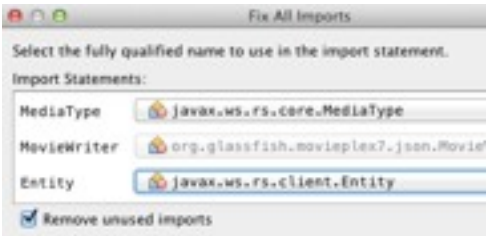
along with rest of the `<commandButton>`s.

7.14 Add the following method in “MovieClientBean”:

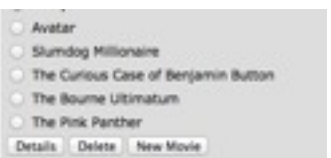
```
public void addMovie() {
    Movie m = new Movie();
    m.setId(bean.getMovieId());
    m.setName(bean.getMovieName());
    m.setActors(bean.getActors());
    target
        .register(MovieWriter.class)
        .request()
        .post(Entity.entity(m, MediaType.APPLICATION_JSON));
}
```

This method creates a new `Movie` instance, populates it with the values from the backing bean, and POSTs the bean to the REST endpoint. The `register` method registers a `MovieWriter` that provides conversion from the POJO to JSON. Media type of “application/json” is specified using `MediaType.APPLICATION_JSON`.

Resolve the imports as shown



7.15 Run the project to see the updated main page as:



A new movie can be added by clicking on “New Movie” button.

7.16 Enter the details as shown:



Click on “Add” button. The “Movie Id” value has to be greater than 20 otherwise the primary key constraint will be violated. The table definition may be updated to generate the primary key based upon a sequence; however this is not done in the application.

The updated page looks like as shown



Note that the newly added movie is now displayed.

8.0 Movie Points (Java Message Service)

Purpose: Customers accrue points for watching a movie.

Estimated Time: 30-45 mins

Java Message Service 2.0 allows sending and receiving messages between distributed systems. JMS 2 introduced several improvements over the previous version such as:

- New `JMSContext` interface
- `AutoCloseable` `JMSContext`, `Connection`, and `Session`
- Use of runtime exceptions
- Method chaining on `JMSProducer`
- Simplified message sending

This section will provide a page to simulate submission of movie points accrued by a customer. These points are submitted to a JMS queue that is then read synchronously by another bean. JMS queue for further processing, possibly storing in the database using JPA.

8.1 Right-click on Source Packages, select “New”, “Java Package…”, specify the value as “org.glassfish.movieplex7.points”, and click on “Finish”.

8.2 Right-click on newly created package, select “New”, “Java Class…”, specify the name as “SendPointsBean”.

Add the following class-level annotations:

```
@Named
@RequestScoped
```

This makes the bean to be EL-injectable and automatically activated and passivated with the request.

Resolve the imports.



8.3 A message to a JMS Queue is sent after the customer has bought the tickets. Another bean will then retrieve this message and update the points for that customer. This allows the two systems, one generating the data about tickets purchased and the other about crediting the account with the points, completely decoupled.

This lab will mimic the sending and consuming of a message by an explicit call to the bean from a JSF page.

Add the following field to the class:

```
@NotNull
@Pattern(regexp = "^\\d{2},\\d{2}",
message = "Message format must be 2 digits, comma, 2 digits, e.g.
12,12")
private String message;
```

This field contains the message sent to the queue. This field's value is bound to an `inputText` in a JSF page (created later). Constraints have been specified on this bean that enable validation of data on form submit. It requires the data to consists of 2 numerical digits, followed by a comma, and then 2 more numerical digits. If the message does not meet the validation criteria then the error message to be displayed is specified using message `attribute`.

This could be thought as conveying the customer identifier and the points accrued by that customer.

Generate getter/setters for this field. Right-click in the editor pane, select "Insert Code" (Ctrl + I shortcut on Mac), select "Getter and Setter…", select the field, and click on "Generate".

8.4 Add the following code to the class:

```
@Inject
JMSContext context;

@Resource(lookup = "java:global/jms/pointsQueue")
Queue pointsQueue;

public void sendMessage() {
    System.out.println("Sending message: " + message);

    context.createProducer().send(pointsQueue, message);
}
```

The Java EE Platform requires a pre-configured JMS connection factory under the JNDI name `java:comp/DefaultJMSConnectionFactory`. If no connection factory is specified then the pre-configured connection factory is used. In a Java EE environment, where CDI is enabled by default anyway, a container-managed `JMSContext` can be injected as:

```
@Inject
JMSContext context;
```

This code uses the default factory to inject an instance of container-managed `JMSContext`.

`JMSContext` is a new interface introduced in JMS 2. This combines in a single object the functionality of two separate objects from the JMS 1.1 API: a `Connection` and a `Session`.

When an application needs to send messages it use the `createProducer` method to create a `JMSProducer` that provides methods to configure and send messages. Messages may be sent either synchronously or asynchronously.

When an application needs to receive messages it uses one of several `createConsumer` or `createDurableConsumer` methods to create a `JMSConsumer`. A `JMSConsumer` provides methods to receive messages either synchronously or asynchronously.

All messages are then sent to a `Queue` instance (created later) identified by `java:global/jms/pointsQueue` JNDI name. The actual message is obtained from the value entered in the JSF page and bound to the `message` field.

Resolve the imports.

Make sure `Queue` class is imported from `javax.jms.Queue` instead of the default `java.util.Queue` as shown.

Click on “OK”.

8.5 Right-click on “org.glassfish.movieplex7.points” package, select “New”, “Java Class…”, specify the name as “ReceivePointsBean”.

Add the following class-level annotations:

```
@JMSDestinationDefinition(name = "java:global/jms/pointsQueue",
            interfaceName = "javax.jms.Queue")
@Named
@RequestScoped
```

This allows the bean to refered from an EL expression. It also activates and passivates the bean with the request.

`JMSDestinationDefinition` is a new annotation introduced in JMS 2. It is used by the application to provision the required resources and allow an application to be deployed into a Java EE environment with minimal administrative configuration. This code will create Queue with the JNDI name `java:global/jms/pointsQueue`.

8.6 Add the following code to the class:

```
@Inject
JMSContext context;

@Resource(lookup="java:global/jms/pointsQueue")
Queue pointsQueue;

public String receiveMessage() {
  String message =
context.createConsumer(pointsQueue).receiveBody(String.class);
  System.out.println("Received message: " + message);
  return message;
}
```

This code is very similar to `SendPointsBean`. `createConsumer` method creates `JMSConsumer` which is then used to synchronously receive a message.

8.7 Add the following method to the class:

```
public int getQueueSize() {
  int count = 0;
```

```
  try {
    QueueBrowser browser = context.createBrowser(pointsQueue);
    Enumeration elems = browser.getEnumeration();
    while (elems.hasMoreElements()) {
      elems.nextElement();
      count++;
    }
  } catch (JMSException ex) {
    ex.printStackTrace();
  }
  return count;
}
```

This code creates a `QueueBrowser` to look at the messages on a queue without removing them. It calculates and returns the total number of messages in the queue.

Make sure to resolve the import from `javax.jms.Queue`, take all other defaults.

8.8 Right-click on “Web Pages”, select “New”, “Folder…”, specify the name as “points”, and click on “Finish”.

In “Web Pages”, right-click on newly created folder, select “Facelets Template Client”, give the File Name as “points”. Click on “Browse…” next to “Template:”, expand “Web Pages”, “WEB-INF”, select “template.xhtml”, and click on “Select File”. Click on “Finish”.

In this file, remove <`ui:define`> sections where name attribute value is “top” and “left”. These sections are inherited from the template.

Replace the content inside <`ui:define`> with “content” with the code fragment shown below:

Copy the following code inside <`ui:define`> with `name="content"`:

```
<h1>Points</h1>
<h:form>
    Queue size:
    <h:outputText value="#{receivePointsBean.queueSize}"/><p/>
    <h:inputText value="#{sendPointsBean.message}"/>

    <h:commandButton value="Send Message" action="points"
actionListener="#{sendPointsBean.sendMessage()}"/>
</h:form>
<h:form>
    <h:commandButton value="Receive Message" action="points"
actionListener="#{receivePointsBean.receiveMessage()}"/>
</h:form>
```

Click on the yellow bulb to resolve namespace prefix/URI mapping for `h:` prefix.

This page displays the number of messages in the current queue. It provides a text box for entering the message that can be sent to the queue. The first command button invokes `sendMessage` method from `SendPointsBean` and refreshes the page. Updated queue count, incremented by 1 in this case, is displayed. The second command button invokes `receiveMessage` method from `ReceivePointsBean` and refreshes the page. The queue count is updated again, decremented by 1 in this case.

If the message does not meet the validation criteria then the error message is displayed on the screen.

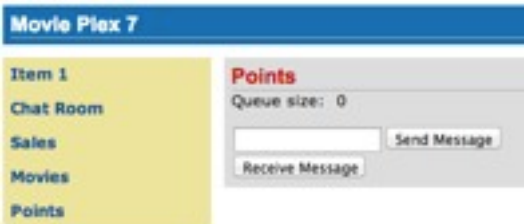
8.9 Add the following code in "template.xhtml" along with other `<outputLink>`s:

```
<p/><h:outputLink value="$
{facesContext.externalContext.requestContextPath}/faces/points/
points.xhtml">Points</h:outputLink>
```

8.10 Run the project. The update page looks like as shown:



Click on "Points" to see the output as:

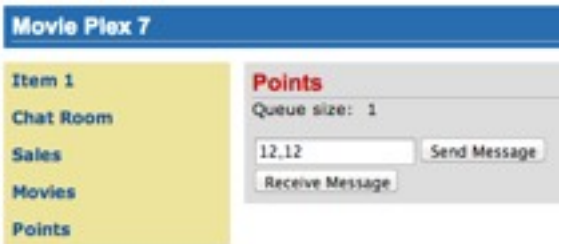


The output shows that the queue has 0 messages. Enter a message “1212” in the text box and click on “Send Message” to see the output as shown.

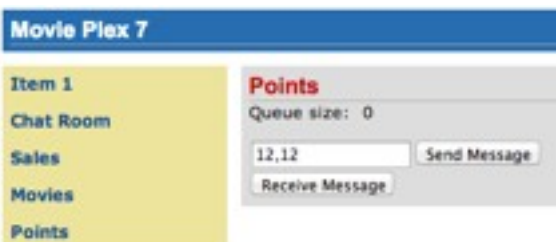


This message is not meeting the validation criteria and so the error message is displayed.

Enter a message as “12,12” in the text box and click on “Send Message” button to see the output as:

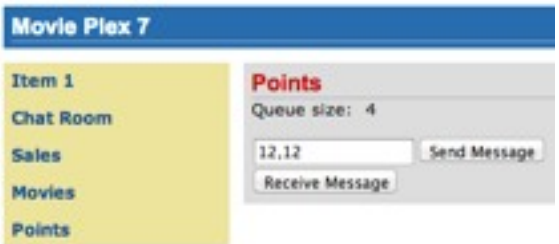


The updated count now shows that there is 1 message in the queue. Click on “Receive Message” button to see output as:

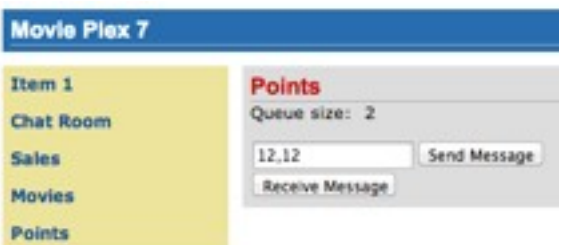


The updated count now shows that the message has been consumed and the queue has 0 messages.

Click on “Send Message” 4 times to see the output as:



The updated count now shows that the queue has 4 messages. Click on "Receive Message" 2 times to see the output as:



The count is once again updated to reflect the 2 consumed and 2 remaining messages in the queue.

9.0 Show Booking (JavaServer Faces)

Purpose: Build pages that allow a user to book a particular movie show in a theater. In doing so a new feature of JavaServer Faces 2.2 will be introduced and demonstrated by using in the application.

Estimated Time: 30-45 mins

JavaServer Faces 2.2 introduces a new feature called *Faces Flow* that provides an encapsulation of related views/pages with application defined entry and exit points. Faces Flow borrows core concepts from ADF TaskFlow, Spring Web Flow, and Apache MyFaces CODI.

It introduces `@FlowScoped` CDI annotation for flow-local storage and `@FlowDefinition` to define the flow using CDI producer methods. There are clearly defined entry and exit points with well-defined parameters. This allows the flow to be packaged together as a JAR or ZIP file and be reused. The application thus becomes a collection of flows and non-flow pages. Usually the objects in a flow are designed to allow the user to accomplish a task that requires input over a number of different views.

This application will build a flow that allows the user to make a movie reservation. The flow will contain four pages:

1. Display the list of movies
2. Display the list of available show timings
3. Confirm the choices
4. Make the reservation and show the ticket

9.1 Items in a flow are logically related to each other and so it is required to keep them together in a directory. In NetBeans, right-click on the "Web Pages", select "New", "Folder…", specify the folder name "booking", and click on "Finish".

9.2 Right-click on the newly created folder, select "New", "Facelets Template Client", give the File Name as "booking". Click on "Browse…" next to "Template:", expand "Web Pages", "WEB-INF", select "template.xhtml", and click on "Select File". Click on "Finish".

In this file, remove `<ui:define>` sections where name attribute value is "top" and "left". These sections are inherited from the template.

9.3 "booking.xhtml" is the entry point to the flow (more on this later). Replace the `<ui:define>` with `name="content"` section such that it looks like:

```
<ui:define name="content">
   <h2>Pick a movie</h2>
   <h:form prependId="false">

     <h:selectOneRadio value="#{booking.movieId}"
layout="pageDirection" required="true">
```

```
       <f:selectItems value="#{movieFacadeREST.all}" var="m"
itemValue="#{m.id}" itemLabel="#{m.name}"/>
    </h:selectOneRadio>

    <h:commandButton id="shows" value="Pick a time"
action="showtimes" />
  </h:form>
</ui:define>
```

The code builds an HTML form that displays the list of movies as radio button choices. The chosen movie is bound to `#{booking.movieId}` which will be defined as a flow-scoped bean. The value of `action` attribute on `commandButton` refers to the next view in the flow, i.e. “showtimes.xhtml” in the same directory in our case.

Click on the hint (shown as yellow bulb) and click on the suggestion to add namespace prefix. Do the same for `f:` prefix as shown.



9.4 Right-click on “Source Packages”, select “New”, “Java Class…”. Specify the class name as “Booking” and the package name as “org.glassfish.movieplex7.booking”.

Add `@Named` class-level annotation to make the class EL-injectable. Add `@FlowScoped("booking")` to define the scope of bean as the flow. The bean is automatically activated and passivated as the flow is entered or exited.

Add the following field:

```
int movieId;
```

and generate getters/setters by going to “Source”, “Insert Code…”, selecting “Getter and Setter…”, and select the field.

Inject `EntityManager` in this class by adding the following code:

```
@PersistenceContext
EntityManager em;
```

Add the following convenience method:

```
public String getMovieName() {
    try {
        return em.createNamedQuery("Movie.findById",
Movie.class).setParameter("id", movieId).getSingleResult().getName();
    } catch (NoResultException e) {
        return "";
    }
}
```

This method will return the movie name based upon the selected movie.

Alternatively, movie id and name may be passed from the selected radio button and parsed in the backing bean. This will reduce an extra trip to the database.

9.5 Create “showtimes.xhtml” in the “booking” folder following the steps in section 9.2. Replace “content” `<ui:define>` section such that it looks like:

```
<ui:define name="content">
  <h2>Show Timings for <font color="red">#{booking.movieName}</font></
h2>
  <h:form>
    <h:selectOneRadio value="#{booking.startTime}"
layout="pageDirection" required="true">
      <c:forEach items="#{timeslotFacadeREST.all}" var="s">
        <f:selectItem itemValue="#{s.id},#{s.startTime}"
itemLabel="#{s.startTime}"/>
      </c:forEach>
    </h:selectOneRadio>
    <h:commandButton value="Confirm" action="confirm" />
    <h:commandButton id="back" value="Back" action="booking"
immediate="true"/>
  </h:form>
</ui:define>
```

This code builds an HTML form that displays the chosen movie name and all the show times. `#{timeslotFacadeREST.all}` returns the list of all the movies and iterates over them using a `c:forEach` loop. The id and start time of the selected show are bound to `#{booking.startTime}`. One command button (`value="Back"`) allows going back to the previous page and the other command button (`value="Confirm"`) takes to next view in the flow, “confirm.xhtml” in our case.

Typically a user will expect the show times only for the selected movie but all the show times are shown here. This allows us to demonstrate going back and forth within a flow if an incorrect show time for a movie is chosen. A different query may be written that displays only the shows available for this movie; however this is not part of the application.

9.6 Add the following fields to the `Booking` class:

```
String startTime;
int startTimeId;
```

And the following methods:

```
public String getStartTime() {
    return startTime;
}

public void setStartTime(String startTime) {
    StringTokenizer tokens = new StringTokenizer(startTime, ",");
    startTimeId = Integer.parseInt(tokens.nextToken());
    this.startTime = tokens.nextToken();
}

public int getStartTimeId() {
    return startTimeId;
}
```

These methods will parse the values received from the form. Also add the following method:

```
public String getTheater() {
  // for a movie and show
  try {
    // Always return the first theater
    List<ShowTiming> list =
        em.createNamedQuery("ShowTiming.findByMovieAndTimingId",
        ShowTiming.class)
      .setParameter("movieId", movieId)
      .setParameter("timingId", startTimeId)
      .getResultList();
    if (list.isEmpty())
      return "none";

    return list
      .get(0)
      .getTheaterId()
     .getId().toString();
  } catch (NoResultException e) {
    return "none";
```

```
  }
}
```

This method will find the first theater available for the chosen movie and show the timing.

Additionally a list of theaters offering that movie may be shown in a separate page.

9.7 Create “confirm.xhtml” page in the “booking” folder by following the steps defined in 9.2. Replace “content” `<ui:define>` section such that it looks like:

```
<ui:define name="content">
  <c:choose>
    <c:when test="#{booking.theater == 'none'}">
      <h2>No theater found, choose a different time</h2>
      <h:form>
        Movie name: #{booking.movieName}<p/>
        Starts at: #{booking.startTime}<p/>
        <h:commandButton id="back" value="Back" action="showtimes"/>
      </h:form>
    </c:when>
    <c:otherwise>
      <h2>Confirm ?</h2>
      <h:form>
        Movie name: #{booking.movieName}<p/>
        Starts at: #{booking.startTime}<p/>
        Theater: #{booking.theater}<p/>
        <p/><h:commandButton id="next" value="Book" action="print"/>
        <h:commandButton id="back" value="Back" action="showtimes"/>
      </h:form>
    </c:otherwise>
  </c:choose>
</ui:define>
```

The code displays the selected movie, show timing, and theater if available. The reservation can proceed if all three are available. “print.xhtml”, identified by `action` of `commandButton` with “Book” `value`, is the last page that shows the confirmed reservation.

`actionListener` can be added to `commandButton` to invoke the business logic for making the reservation. Additional pages may be added to take the credit card details and email address.

9.8 Create “print.xhtml” page in the “booking” folder by following the steps defined in 9.2 and replace “content” `<ui:define>` section such that it looks like:

```
<ui:define name="content">
  <h2>Reservation Confirmed</h2>
  <h:form>
    Movie name: #{booking.movieName}<p/>
    Starts at: #{booking.startTime}<p/>
    Theater: #{booking.theater}<p/>
    <p><h:commandButton id="home" value="home" action="goHome" /></p>
  </h:form>
</ui:define>
```

This code displays the movie name, show timings, and the selected theater.

The `commandButton` initiates exit from the flow. The `action` attribute defines a navigation rule that will be defined in the next step.

9.9 "booking.xhtml", "showtimes.xhtml", "confirm.xhtml", and "print.xhtml" are all in the same directory. Now the runtime needs to be informed that the views in this directory are to be treated as view nodes in a flow. This can be done by adding "booking/booking-flow.xml" or have a class with a method that `@Produces @FlowDefinition`.

Right-click on "Web Pages/booking" folder, select "New", "Other", "XML", "XML Document", give the name as "booking-flow", click on "Next>", take the default of "Well-formed Document", and click on "Finish". Edit the file such that it looks like:

```
<faces-config version="2.2" xmlns="http://xmlns.jcp.org/xml/ns/javaee"
   xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xsi:schemaLocation="
        http://xmlns.jcp.org/xml/ns/javaee
        http://xmlns.jcp.org/xml/ns/javaee/web-facesconfig_2_2.xsd">

    <flow-definition id="booking">
      <flow-return id="goHome">
        <from-outcome>/index</from-outcome>
      </flow-return>
    </flow-definition>

</faces-config>
```

This defines the flow graph. It uses the standard parent element used in any "faces-config.xml" but defines a `<flow-definition>`.

`<flow-return>` defines a return node in a flow graph. `<from-outcome>` contains the node value, or an EL expression that defines the node, to return to. In this case, the navigation returns to the home page.

9.10 Finally, invoke the flow by editing "WEB-INF/template.xhtml" and changing:

```
<h:commandLink action="item1">Item 1</h:commandLink>
```

to

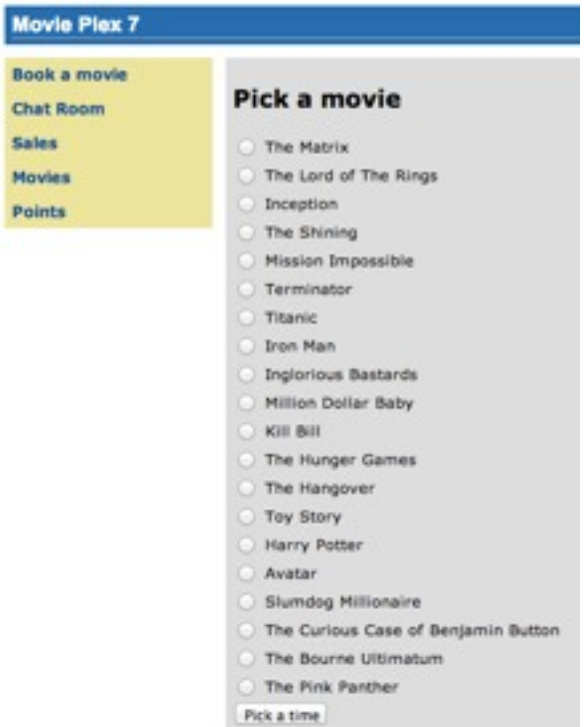
```
<h:commandLink action="booking">Book a movie</h:commandLink>
```

`commandLink` renders an HTML anchor tag that behaves like a form submit button. The `action` attribute points to the directory where all views for the flow are stored. This directory already contains “booking-flow.xml” which defines the flow of the pages.

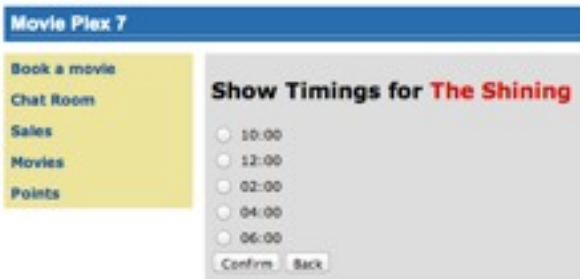
9.11 Run the project by right clicking on the project and selecting “Run”. The browser shows the updated output.



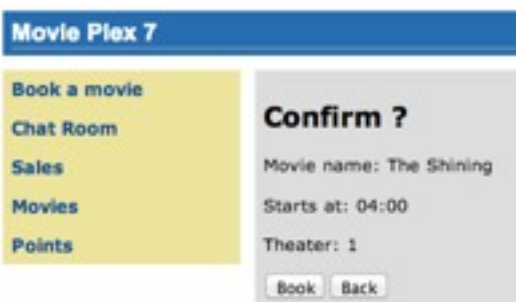
Click on “Book a movie” to see the page as shown.



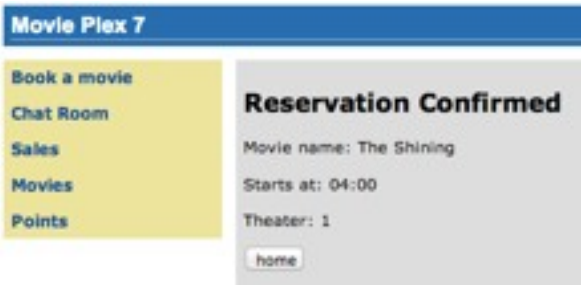
Select a movie, say “The Shining” and click on “Pick a time” to see the page output as shown.



Pick a time slot, say “04:00”, click on “Confirm” to see the output as shown.



Click on “Book” to confirm and see the output as:

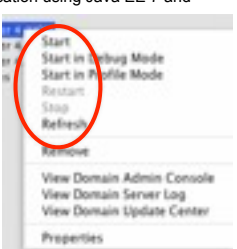


Feel free to enter other combinations, go back and forth in the flow and notice how the values in the bean are preserved.

Click on “home” takes to the main application page.

10.0 Conclusion

This hands-on lab built a trivial 3-tier web application using Java EE 7 and demonstrated the following features of the platform:



- Java EE 7 Platform (JSR 342)
  - Maven coordinates
  - Default `DataSource`
  - Default `JMSConnectionFactory`
- Java Persistence API 2.1 (JSR 338)
  - Schema generation properties
- Java API for RESTful Web Services 2.0 (JSR 339)
  - Client API
  - Custom Entity Providers
- Java Message Service 2.0 (JSR 343)
  - Default `ConnectionFactory`
  - Injecting `JMSContext`

    - Synchronous message send and receive
- JavaServer Faces 2.2 (JSR 344)
    - Faces Flow
- Contexts and Dependency Injection 1.1 (JSR 346)
    - Automatic discovery of beans
    - Injection of beans
- Bean Validation 1.1 (JSR 349)
    - Integration with JavaServer Faces
- Batch Applications for the Java Platform 1.0 (JSR 352)
    - Chunk-style processing
    - Exception handling
- Java API for JSON Processing 1.0 (JSR 353)
    - Streaming API for generating JSON
    - Streaming API for consuming JSON
- Java API for WebSocket 1.0 (JSR 356)
    - Annotated server endpoint
    - JavaScript client
- Java Transaction API 1.2 (JSR 907)
    - `@Transactional`

Hopefully this has raised your interest enough in trying out Java EE 7applications using GlassFish 4.

Send us feedback at users@glassfish.java.net.

11.0 Troubleshooting

11.1 How can I start/stop/restart GlassFish from within the IDE ?

In the “Services” tab, right-click on “GlassFish Server 4”. All the commands to start, stop, and restart are available from the pop-up menu. The server log can be viewed by clicking on “View Server Log” and web-based administration console can be seen by clicking on “View Admin Console”.

11.2 I accidentally closed the GlassFish output log window. How do I bring it back ?

In “Services” tab of NetBeans, expand “Servers”, choose the GlassFish node, and select “View Domain Server Log”.

12.0 Acknowledgements

The following GlassFish community members graciously reviewed this hands-on lab:

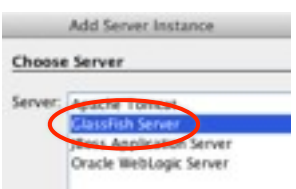
- Antonio Goncalves (@agoncal)
- Markus Eisele (@myfear)
- Craig Sharpe (@dapugs)
- Marcus Vinicius Margarites (@mvfm)
- David Delabasse (@delabasse)
- John Clingan (@jclingan)
- Reza Rahman (@reza_rahman)

Thank you very much for providing the valuable feedback!

13.0 Completed Solutions

The completed solution can be downloaded from glassfish.org/hol/movieplex7-solution.zip.

13.1 TODO



1. Add the following use cases:
    a. Concurrency Utilities for Java EE
    b. WebSocket Java Client
    c. JAX-RS Logging Filter
2. Disable errors in persistence.xml
3. How to override .m2/repository in NetBeans?
4. Add icons for Fix Imports, Format, Fix namespaces, Run the Project.
5. Change logging to use java.util.Logging.

13.2 Revision History

1. 1.1:
    a. Moving the source document from Microsoft Word to Pages.
    b. Added time estimates for each section.
    c. Updated to use NetBeans 7.4 nightly.

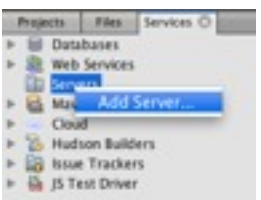
   d. Reorganized to ensure that newer Java EE 7 technologies are described first.
2. 1.0.4: Code updates from UberConf.
3. 1.0.3: Incorporating typos, missing dialog boxes, and code optimizations received during DevoxxUK.
4. 1.0.2: Updating instructions after some of the bugs have been fixed.
5. 1.0.1: Using the final GlassFish 4 build (b89).

Appendix

Appendix A: Configure GlassFish 4 in NetBeans IDE

A.1 In NetBeans, click on the “Services” tab.

A.2 Right-click on Servers, choose “Add Server...” in the pop-up menu.



A.3 Select “GlassFish Server” in the Add Server Instance wizard, set the name to “GlassFish 4.0” and click “Next >”.

A.4 Click on “Browse …” and browse to where you unzipped the GlassFish build and point to the “glassfish4” directory that got created when you unzipped the above archive. Click on “Finish”.