Web Component Development Using Java

Session: 10

Model-View-Controller Architecture

Objectives

- Describe the use of JSP models in Web applications
- Explain JSP Model 1
- Explain JSP Model 2
- Explain the Model-View-Controller architecture
- Explain the relationship between the components of MVC
- Explain Controller and its purpose in MVC
- Explain View and its purpose in MVC
- Explain Model and its purpose in MVC
- Develop a Web application based on MVC architecture

Introduction

- Sun Microsystems has provided the JSP specification to addresses the problem of tightly-coupled presentation and business logic in Servlets.
- Based on the popularity and benefits of JSP in Web development, the commonly used approaches using JSP were identified.
- These approaches are also referred to as JSP models.

JSP Models

- There are two types of programming models for developing Web application.

JSP Model 1

- The Model 1 architecture is very simple.
- The HTML or JSP page sends request along with the data to Web container.
- The Web container invokes the mapped Servlet which handles all responsibilities for the request.
- The responsibilities include processing the request, validating data, handling the business logic, and generating a response back to browser.

JSP Model 2 (Model-View-Controller)

- It provides a clear separation of application responsibilities.
- A central servlet, known as the Controller, receives all requests for the application from JSP.
- The Controller works with the Model to prepare any data needed by the View and forwards the data back to the JSP.
- The business and presentation logic are separated from each other, which help to reuse the logic.

JSP Model 1 Architecture 1-4

- Model 1 architecture enables the Web designers to develop Web applications such that it separates business logic from presentation logic.

Business Logic

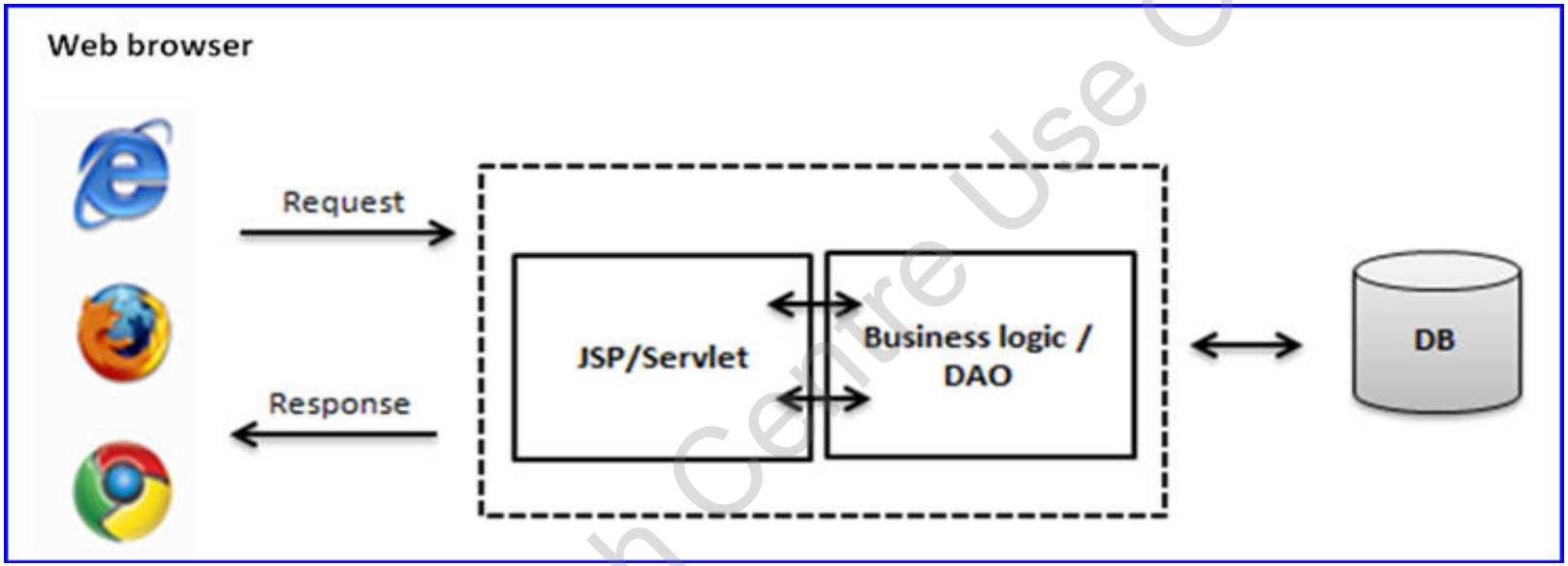
- It deals with the method of modeling real world business objects such as accounts, loans, travel, and so on in the application.
- It also deals with the storage mechanism for these objects, object interactions, access, and update rights for them.

Presentation Logic

- It deals with methods of displaying these objects.
- For example, decisions related to displaying user accounts in a list form.

JSP Model 1 Architecture 2-4

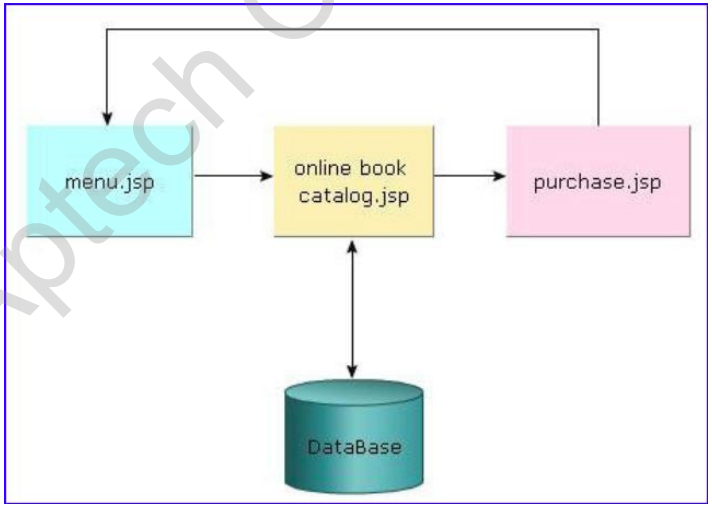
- Figure depicts the Model 1 architecture.



- In this model, there is no extra Servlet involved in the process.
- The client request is sent directly to a JSP page, which may communicate with JavaBeans or other services, but ultimately the JSP page selects the next page for the client to view.

JSP Model 1 Architecture 3-4

- JSP Model 1 architecture has a page-centric architecture.
- Page-centric architecture:
  - The application is composed of a series of interrelated JSP pages and these JSP pages handle all aspects of application.
  - The business process logic and control decisions are hard-coded inside JSP pages in the form of JavaBeans, scriptlets, and expressions.
- Figure shows an example of JSP Model 1 architecture for an online shopping Web application with all JSP pages.

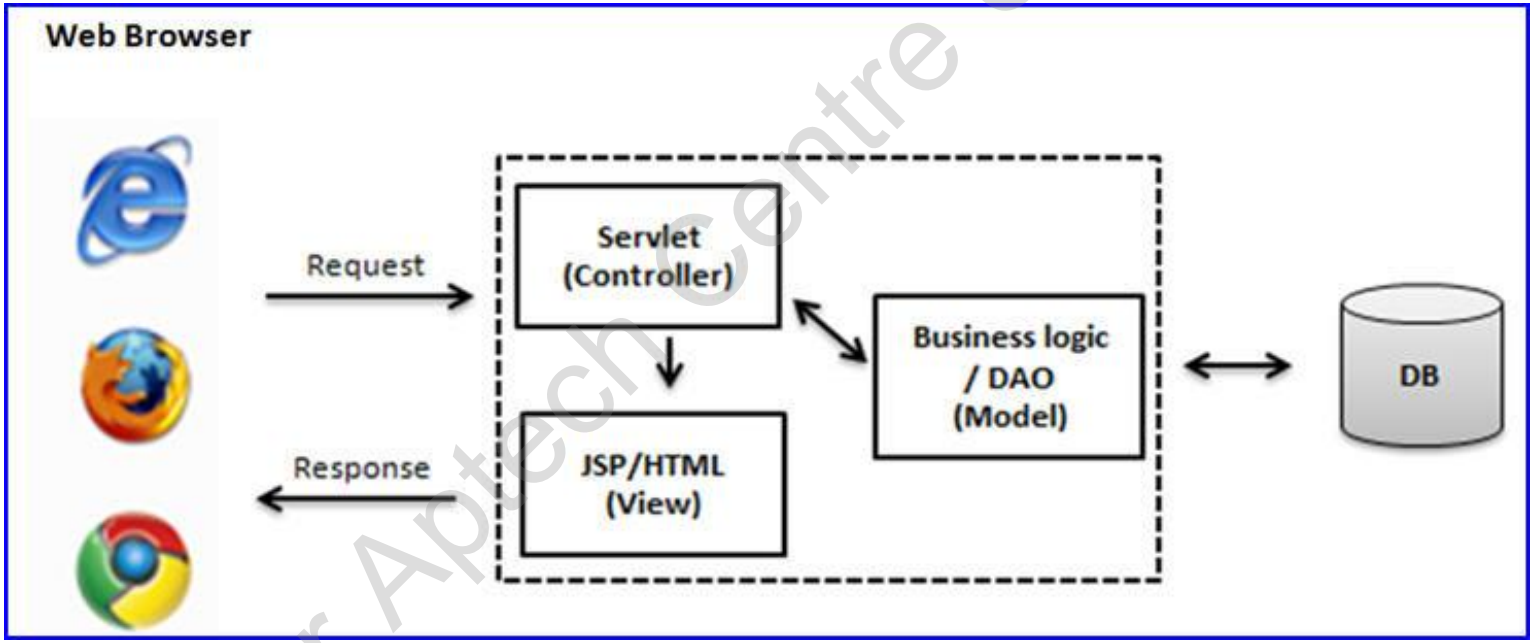


JSP Model 1 Architecture 4-4

- **Advantages of JSP Model 1:**
  - It makes development easier as there are no Servlets involved in the application.
- **Disadvantages of JSP Model 1:**
  - As business logic and presentation logic are tied together, it is difficult for building and maintaining a complex enterprise application.
  - Each of the JSP pages is individually responsible for control logic, application logic, and also to present results to the user. This makes the JSP Model 1 more dependent and less extensible.

JSP Model 2 Architecture 1-3

- Model 2 architecture is an approach used for developing a Web application.
- It separates the Business logic from the Presentation logic.
- The Model 2 has an additional component - a Controller.
- Figure shows the Model 2 architecture.



JSP Model 2 Architecture 2-3

- In Model 2 architecture, a Servlet acts as a Controller and therefore, it has a Servlet-centric architecture.
- **Servlet - Controller:**
  - Is responsible to process the incoming request and instantiate a Model - a Java object or a bean to compute the business logic.
  - Is responsible for deciding to which JSP page the request should be forwarded.
- **JSP - View:**
  - Is responsible for handling the View component.
  - Retrieves the objects created by the Servlet.
  - Extracts dynamic content for insertion within a template for display.

JSP Model 2 Architecture 3-3

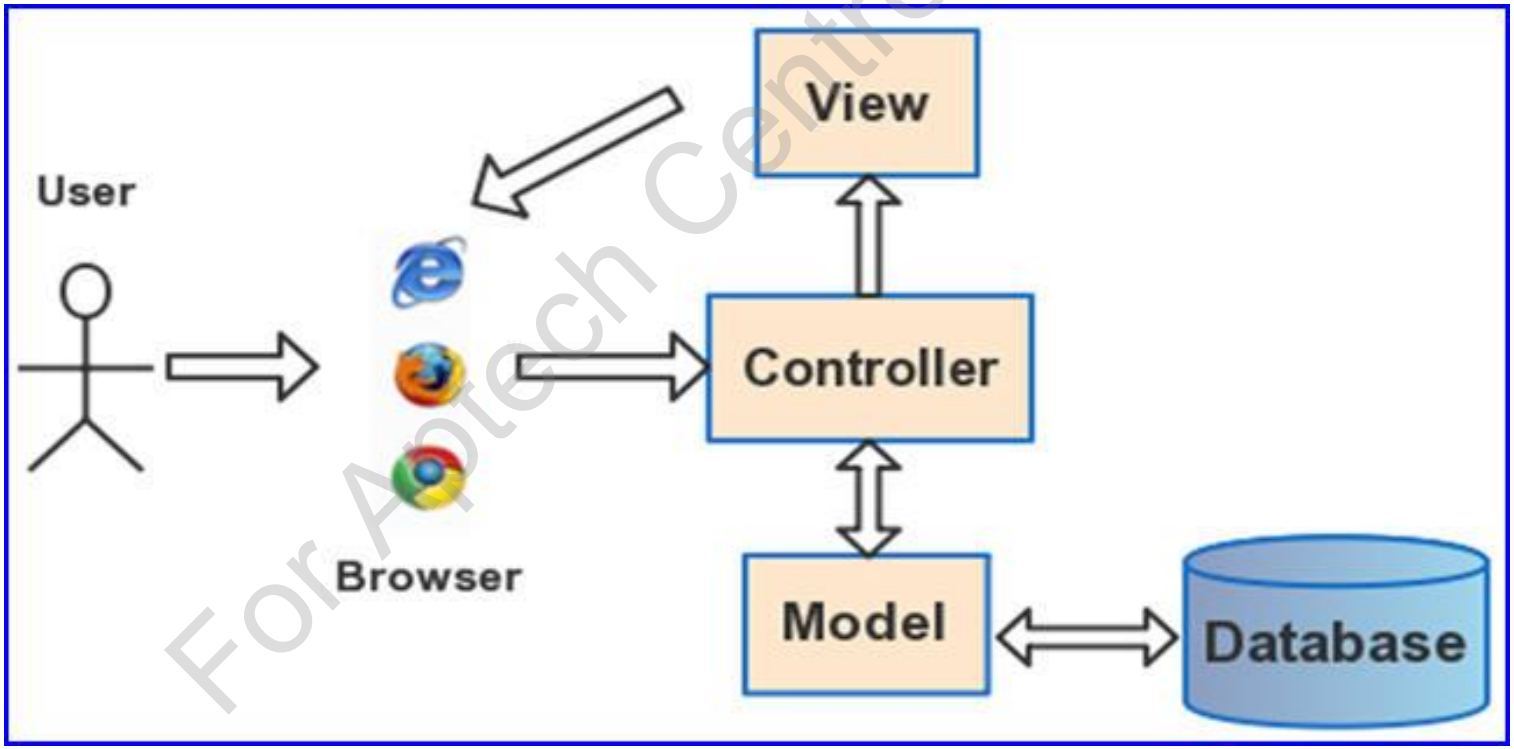
- **Advantages of Model 2:**

Web applications based on this model are easier to maintain and extendable.

Testing is easy in model 2.

Model-View-Controller (MVC) 1-2

- MVC is a software architectural pattern.
- This pattern divides the application logic from User Interface.
- The division permits independent development, testing, and maintenance of each component.
- Figure shows a brief overview of the components under the MVC architecture.



Model-View-Controller (MVC) 2-2

- MVC model divides the Web based application into three layers:

Controller

- Manages the flow of data between the Model layer and the View layer.
- Calls methods in the Model to fulfil the requested action.
- After the action has been taken on the data in Model, the Controller is responsible for redirecting the appropriate view to the user.

View

- Is used to generate the response to the browser, what the user sees.
- Are simple JSP or HTML pages.

Model

- Is a layer between the Controller and the database.
- Contains the business logics and functions that manipulate the business data.
- Can access the functionalities encapsulated in the Model.

Relationships between Components

- The different relationships between MVC components are as follows:

View and Controller Relationship

- In this relationship, the Controller is responsible for creating and selecting views.

Model and View Relationship

- In this relationship, the View depends on the Model.
- If a change is made to the Model, then there might be a requirement to make parallel changes in the View.

Model and Controller Relationship

- In this relationship, the Controller is dependent on the Model.
- If a change is made to the model interface, then there might be a requirement to make parallel changes to the Controller.

MVC in Web Applications

- While developing a Web application using MVC architecture, the different components and their roles are as follows:

Model encapsulates data and business logic using JavaBean components or Plain Old Java Object (POJO), a database API, or an XML file.

View shows the current state of the Model using an HTML or a JSP page.

Controller updates the state of the Model and generates one or more views using Servlet.

Implementation of MVC Pattern 1-8

- **Scenario:** In a Web application, you have to develop login service which will validate login details and accordingly display the appropriate JSP page.
- To design such service, we will use the MVC pattern.
- The code snippet develops the JSP pages required to handle the presentation and result pages.

```
<!-- login.jsp-->

<html>
    <head>
        <title>MVC Example</title>
    </head>

    <body>
      <form action="LoginController" method="post">
         Enter username : <input type="text"
name="username"> <BR>
         Enter password : <input type="password"
name="password"> <BR>
         <input type="submit" />
      </form>
    </body>

</html>
```

Implementation of MVC Pattern 2-8

```
<!-- success.jsp -->
<html>
    <head>
        <title>Success</title>
    </head>
    <body>
        Welcome, you have successfully login.
    </body>
</html>
```

```
<!-- error.jsp -->
<html>
    <head>
        <title>Error</title>
    </head>
    <body>
        Login failed, please try again.
    </body>
</html>
```

Implementation of MVC Pattern 3-8

- Next, we will design a Controller that takes request from the user, this is the Servlet class.
- The servlet class calls the Model which is JavaBean.
- The code snippet demonstrates the design of the Controller named `LoginController.java`.

```
package com.mvc.Controller;

import java.io.*;
import javax.servlet.*;
import javax.servlet.http.*;
import com.mvc.model.LoginModel;

public class LoginController extends HttpServlet {
    RequestDispatcher rd = null
protected void doPost(HttpServletRequest request,
HttpServletResponse response) throws ServletException,
IOException {

    // Receive the values from the request parameters
    String username = request.getParameter("username");
    String password = request.getParameter("password");

    // Instantiate the LoginModel JavaBean
    LoginModel login = new LoginModel();
```

Implementation of MVC Pattern 4-8

```
    // Verify the login credentials from model
    String result = login.authenticate(username, password);

    /**
       Dispatch the control based on the value of the
    result variable **/

     if (result.equals("success")) {
       rd = request.getRequestDispatcher("/success.jsp");
      } else {
       rd = request.getRequestDispatcher("/error.jsp");
      }
      // Forward the response to appropriate JSP
      rd.forward(request, response);
     }

}
```

Implementation of MVC Pattern 5-8

- The code snippet demonstrates the design of `LoginModel` class.

```
package com.mvc.model;
public class LoginModel {
 public String authenticate(String username, String
password) {

// Validate the login credentials with the values
    if (("username".equalsIgnoreCase(username))
        && ("password".equals(password))) {
            return "success";
    } else {
            return "failure";
    }
 }
}
```

Implementation of MVC Pattern 6-8

- The code snippet shows the deployment descriptor, `web.xml` used to configure the servlet in the Login application.

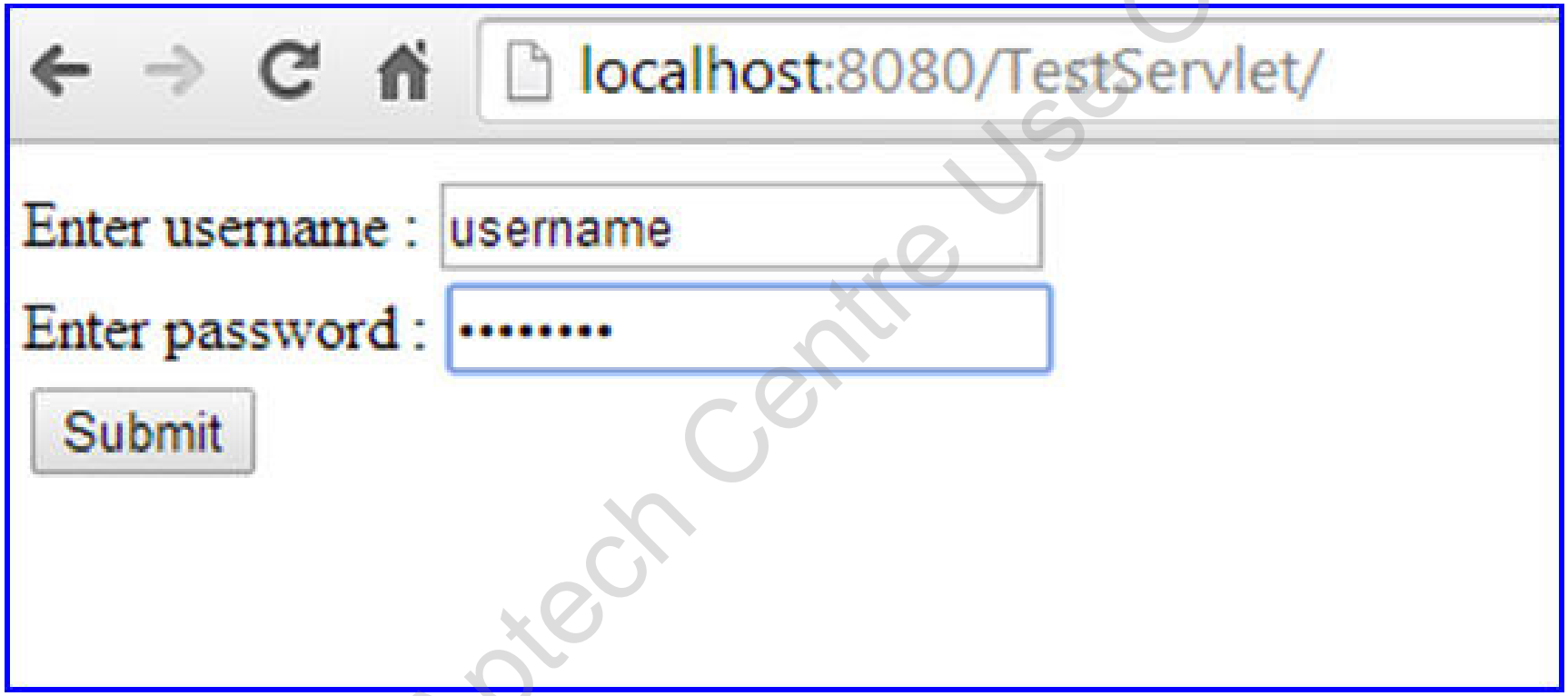
```
<!-- web.xml -->
<?xml version="1.0" encoding="UTF-8"?>
. . .
    <servlet>
        <servlet-name>LoginController</servlet-name>
        <servlet-class>com.mvc.Controller.LoginController</servlet-class>
    </servlet>

    <servlet-m apping>
        <servlet-name>LoginController</servlet-name>
        <url-pattern>/LoginController</url-pattern>
    </servlet-mapping>

    <welcome-file-list>
        <welcome-file>login.jsp</welcome-file>
        </welcome-file-list>
</web-app>
```

Implementation of MVC Pattern 7-8

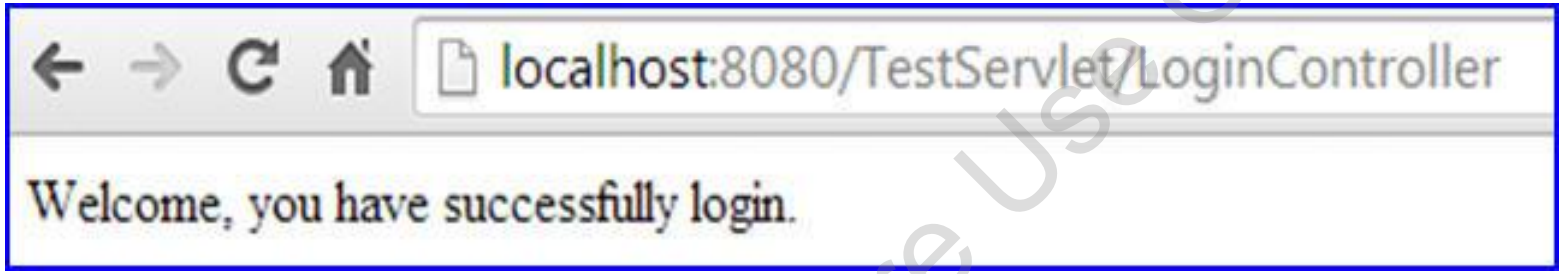
- Figure shows the request to the URL `localhost:8080/TestServlet`.



- This displays the `login.jsp` with the username and password fields.

Implementation of MVC Pattern 8-8

- Figure shows the `success.jsp`.



Summary

- The JSP specification presents two approaches for developing Web applications namely, JSP Model I and JSP Model II.
- JSP Model II is also known as MVC.
- MVC is a software design pattern, which can be used to design medium and large sized applications.
- MVC has three components as follows:
  - Model
  - View
  - Controller
- In MVC Web application, servlet acts as Controller, which receives the request from client.
- The View handles presentation of the content on the Web page and could be an HTML file or a JSP file.
- The Model component contains the business logics and functions that manipulate the business data.