STRUTS

BY

Mr.N.RAMESH

(Real Time Expert)

DURGA
Software Solutions®

23/3RT, IInd Floor, Opp. Andhra Bank, Near Umesh Chandra Statue,
S.R. Nagar, Hyderabad - 500 038. Ph: 040-64512786
www.durgasoft.com

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MVC (MODEL-VIEW-CONTROLLER)

The main aim of the MVC architecture is to separate the business logic and application data from the presentation data to the user.

Here are the reasons why we should use the MVC design pattern.

1. They are **resuable**: When the problems reaccurs, there is no need to invent a new solution, we just have to follow the pattern and adapt it as necessary.
2. They are **expressive**: By using the MVC design pattern our application becomes more expressive.

1) **Model:** The model object knows about all the data that need to be displayed. It is model who is aware about all the operations that can be applied to transform that object. It only represents the data of an application. The model represents enterprise data and the business rules that govern access to and updates of this data. Model is not aware about the presentation data and how that data will be displayed to the browser.

2) **View:** The view represents the presentation of the application. The view object refers to the model. It uses the query methods of the model to obtain the contents and renders it. The view is not dependent on the application logic. It remains same if there is any modification in the business logic. In other words, we can say that it is the responsibility of the of the view's to maintain the consistency in its presentation when the model changes.

3) **Controller:** Whenever the user sends a request for something then it always go through the controller. The controller is responsible for intercepting the requests from view and passes it to the model for the appropriate action. After the action has been taken on the data, the controller is responsible for directing the appropriate view to the user. In GUIs, the views and the controllers often work very closely together.

Flexibility in large component based systems raise questions on how to organize a project for easy development and maintenance while protecting your data and reputation, especially from new developers and unwitting users. The answer is in using the Model, View, Control architecture. Architecture such as MVC is a design pattern that describes a recurring problem and its solution where the solution is never exactly the same for every recurrence.

To use the *Model-View-Controller* MVC paradigm effectively you must understand the division of labor within the MVC triad. You also must understand how the three parts of the triad communicate with each other and with other active views and controllers; the sharing of a single mouse, keybord and display screen among several applications demands communication and cooperation. To make the best use of the MVC paradigm you need also to learn about the available subclasses of View and Controller which provide ready made starting points for your applications.

In the MVC design pattern, application flow is mediated by a central controller. The controller delegates requests to an appropriate handler. The controller is the means by which the user interacts with the web application. The controller is responsible for the input to the model. A pure GUI controller accepts input from the user and instructs the

model and viewport to perform action based on that input. If an invalid input is sent to the controller from the view, the model informs the controller to direct the view that error occurred and to tell it to try again.

A web application controller can be thought of as specialised view since it has a visual aspect. It would be actually be one or more HTML forms in a web application and therefore the model can also dictate what the controller should display as input. The controller would produce HTML to allow the user input a query to the web application. The controller would add the necessary parameterisation of the individual form element so that the Servlet can observe the input. This is different from a GUI, actually back-to-front, where the controller is waiting and acting on event-driven input from mouse or graphics tablet.

The controller adapts the request to the model. The model represents, or encapsulates, an application's business logic or state. It captures not only the state of a process or system, but also how the system works. It notifies any observer when any of the data has changed. The model would execute the database query for example.

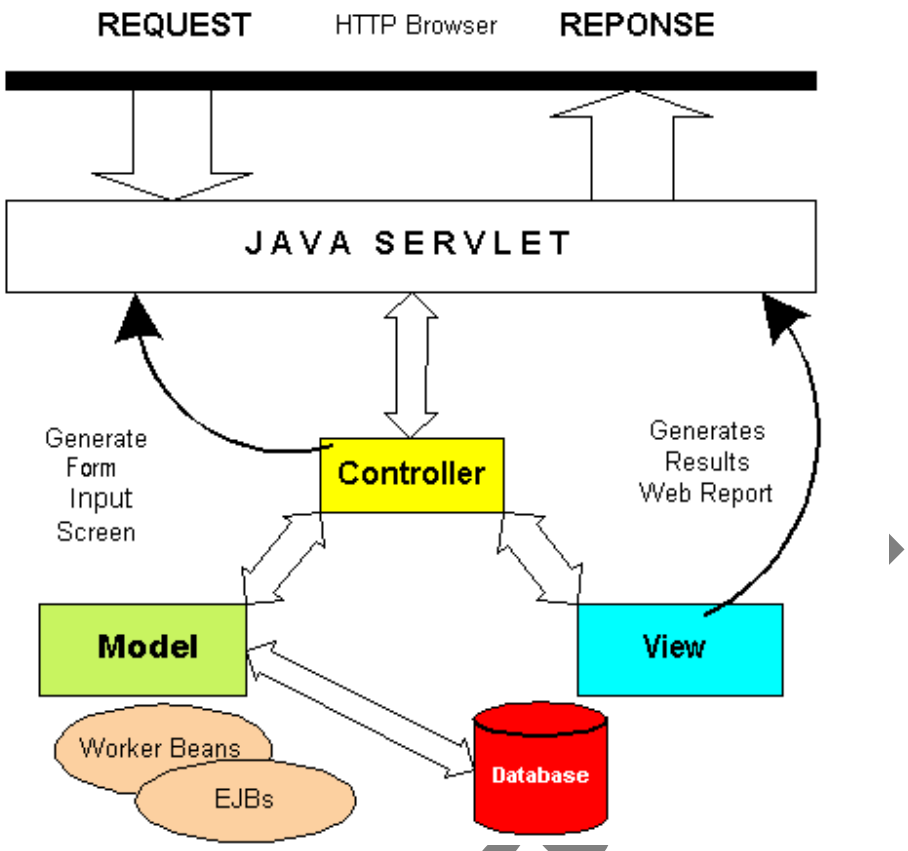
Control is then usually forwarded back through the controller to the appropriate view. The view is responsible for the output of the model. A pure GUI view attaches to a model and renders its contents to the display surface. In addition, when the model changes, the viewport automatically redraws the affected part of the image to reflect those changes. A web application view just transforms the state of the model into readable HTML. The forwarding can be implemented by a lookup in a mapping in either a database or a file. This provides a loose coupling between the model and the view, which can make an application much easier to write and maintain.

Features of MVC1:

1. Html or jsp files are used to code the presentation. To retrieve the data JavaBean can be used.
2. In mvc1 archictecture all the view, control elements are implemented using Servlets or Jsp.
3. In MVC1 there is tight coupling between page and model as data access is usually done using Custom tag or through java bean call.

Features of MVC2:

1. The MVC2 architecture removes the page centric property of MVC1 architecture by separating Presentation, control logic and the application state.
2. In MVC2 architecture there is only one controller which receives all the request for the application and is responsible for taking appropriate action in response to each request.

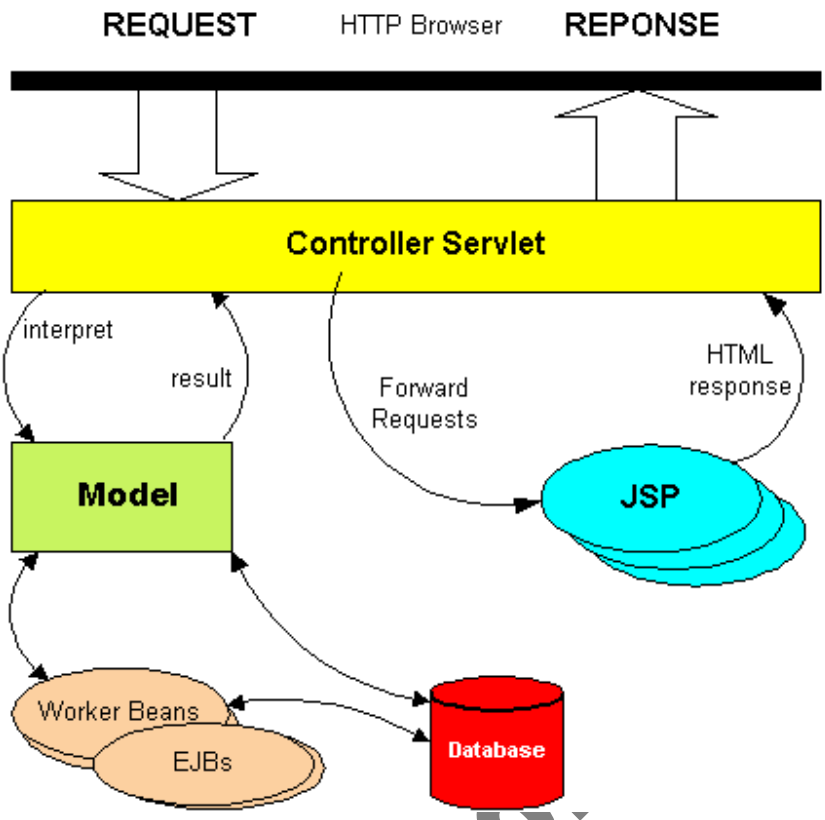


By dividing the web application into a Model, View, and Controller we can, therefore, separates the presentation from the business logic. If the MVC architecture is designed purely, then a Model can have multiple views and controllers. Also note that the model does not necessarily have to be a Java Servlet. In fact a single Java Servlet can offer multiple models. The Java Servlet is where you would place security login, user authentication and database pooling for example. After all these latter have nothing to do with the business logic of the web application or the presentation.

MVC in Java Server Pages

Now that we have a convenient architucture to separate the view, how can we leverage that? *Java Server Pages* (JSP) becomes more interesting because the HTML content can be separated from the Java business objects. JSP can also make use of Java Beans. The business logic could be placed inside Java Beans. If the design is architected correctly, a Web Designer could work with HTML on the JSP site without interfering with the Java developer.

The Model/View/Controller architecture also works with JSP. In fact it makes the initial implementation a little easier to write. The controller object is master Servlet. Every request goes through the controller who retrieves the necessary model object. The model may interact with other business entities such as databases or *Enterprise Java Beans* (EJB). The model object sends the output results back to the controller. The controller takes the results and places it inside the web browser session and forwards a redirect request to a particular Java Server Page. The JSP, in the case, is the view.



The controller has to bind a model and a view, but it could be any model and associated any view. Therein lies the flexibility and perhaps an insight to developing a very advanced dynamic controller that associates models to a view.

The prior sections have concentrated on their being one controller, one model, and one view. In practice, multiple controllers may exist - but only one controls a section of the application at a time. For example, the administrator's functions may be controlled by one controller and the main logic controlled by another. Since only one controller can be in control at a given time, they must communicate. There may also be multiple models - but the controller takes the simplified view representation and maps it to the models appropriately and also translates that response back to the view. The view never needs to know how the logic is implemented.

The case for separating presentation and logic

Decoupling data presentation and the program implementation becomes beneficial since a change to one does not affect the other. This implies that both can be developed separately from the other: a division of labor. The look and feel of the web application, the fonts, the colours and the layout can be revised without having to change any Java code. As it should be. Similarly if the business logic in the application changes, for instance to improve performance and reliability, then this should not cause change in the presentation.

A model-view-controller based web application written with only Java Servlets would give this decoupling. If the presentation changed then the Java code that generates the HTML, the presentation, in the view object only has to change.

Similarly if the business logic changed then only the model object has to change. A web application built with MVC and Java Server Pages would be slightly easier if the business logic is contained only in Java Beans. The presentation (JSP) should only access these beans through custom tag libraries. This means that the Java Beans did not have Java code that wrote HTML. Your beans would only concern themselves with the business logic and not the presentation. The JSP would get the data from the Beans and then display the presentation (the "view"). Decoupling is therefore easy. A change to the implementation only necessitates changes to the Java Beans. A change to the presentation only concern changes to the relevant Java Server Page. With Java Server Pages a web designer who knows nothing about Java can concentrate on the HTML layout, look and feel. While a Java developer can concentrate on the Java Beans and the core logic of the web application.

STRUTS

Struts is an open source framework used for developing J2EE web applications using Model View Controller (MVC) design pattern. It uses and extends the Java Servlet API to encourage developers to adopt an MVC architecture. Struts framework provides three key components:

1. A **request** handler provided by the application developer that is used to mapped to a particular URI.
2. A **response** handler which is used to transfer the control to another resource which will be responsible for completing the response.
3. A **tag library** which helps developers to create the interactive form based applications with server pages.

Struts provides you the basic infrastructure for implementing MVC allowing the developers to concentrate on the business logic.

The Struts framework is composed of approximately 300 classes and interfaces which are organized in about 12 top level packages. Along with the utility and helper classes framework also provides the classes and interfaces for working with controller and presentation by the help of the custom tag libraries. It is entirely on to us which model we want to choose. The view of the Struts architecture is given below:

The Struts Controller Components:

Whenever a user request for something, then the request is handled by the Struts Action Servlet. When the ActionServlet receives the request, it intercepts the URL and based on the Struts Configuration files, it gives the handling of the request to the Action class. Action class is a part of the controller and is responsible for communicating with the model layer.

The Struts View Components:

The view components are responsible for presenting information to the users and accepting the input from them. They are responsible for displaying the information provided by the model components. Mostly we use the Java Server Pages for the view presentation. To extend the capability of the view we can use the Custom tags, java script etc.

The Struts model component:

The model components provides a model of the business logic behind a Struts program. It provides interfaces to databases or back- ends systems. Model components are generally a java class. There is not any such defined format for a Model component, so it is possible for us to reuse Java code which are written for other projects. We should choose the model according to our client requirement.

How Struts Works

The basic purpose of the Java Servlets in struts is to handle requests made by the client or by web browsers. In struts JavaServerPages are used to design the dynamic web pages. In struts, servlets helps to route request which has been made by the web browsers to the appropriate ServerPage. The use of servlet as a router helps to make the web applications easier to design, create, and maintain. Struts is purely based on the MVC design pattern. It is one of the best and most well developed design patterns in use. By using the MVC architecture we break the processing in three sections named Model, the View, and the Controller. Below we are describing the working of struts.

1. As we all are well aware of the fact that each application we develop has a deployment descriptor i.e. **WEB-INF/web.xml**. This is the file which the container reads. This file has all the configuration information which we have defined for our web application. The configuration information includes the index file, the default welcome page, the mapping of our servlets including path and the extension name, any init parameters, information related to the context elements.In the file WEB-INF/web.xml of struts application we need to configure the Struts ActionServlet which handles all the request made by the web browsers to a given mapping. ActionServlet is the central component of the Struts controller. This servlet extends the HttpServlet. This servlet basically performs two important things. **First is:** When the container gets start, it reads the Struts Configuration files and loads it into memory in the **init()** method. You will know more about the Struts Configuration files below. **Second point is:** It intercepts the HTTP request in the **doGet()** and **doPost()** method and handles it appropriately.

2. In struts application we have another xml file which is a Struts configuration file named as **struts.config.xml**. The name of this file can be changed. The name of the struts configuration file can be configured in the web.xml file. This file is placed under the **WEB-INF** directory of the web application. It is an XML document that describes all or part of Struts application. This file has all the information about many types of Struts resources and configures their interaction. This file is used to associate paths with the controller components of your application, known as Action classes like **<action path ="/login" type = "LoginAction">**. This tag tells the Struts **ActionServlet** that whenever the incoming request is **http://myhost/myapp/login.do**, then it must invoke the controller component **LoginAction**. Above, you can see that we have written **.do** in the URL. This mapping is done to tell the web application that whenever a request is received with the **.do** extension then it should be appended to the URL.

3. For each action we also have to configure Struts with the names of the resulting pages that will be shown as a result of that action. In our application there can be more than one view which depends on the result of an action. One can be for a **success** and the other for the **failure**. If the result action is "success" then the action tells the ActionServlet that the action has been successfully accomplished or vice- versa. The struts knows how to forward the specific page to the concerned destination. The model which we want to use is entirely to you, the model is called from within the controller components.

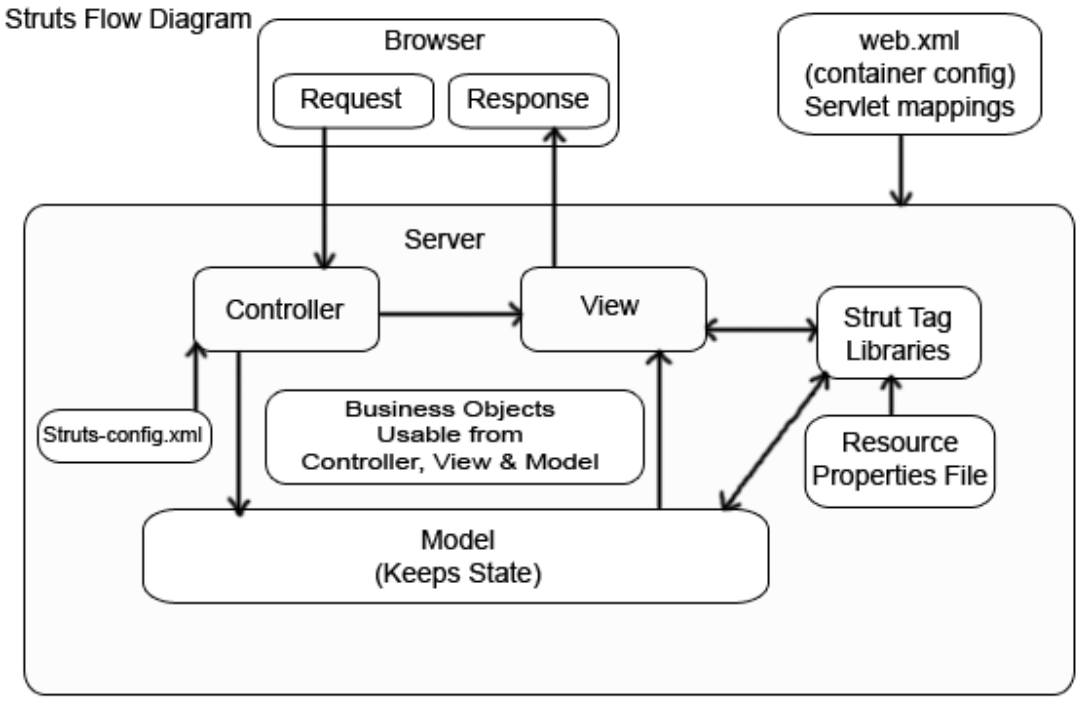
4. Action can also get associate with a JavaBean in our Struts configuration file. Java bean is nothing but a class having getter and setter methods that can be used to communicate between the view and the controller layer. These java beans are validated by invoking the **validate()** method on the **ActionForm** by the help of the Struts

system. The client sends the request by the normal form submission by using Get or Post method, and the Struts system updates that data in the Bean before calling the controller components.

5.The view we use in the struts can be either Jsp page, Velocity templates, XSLT pages etc. In struts there are set of JSP tags which has been bundled with the struts distribution, but it is not mandatory to use only Jsp tags, even plain HTML files can be used within our Struts application but the disadvantage of using the html is that it can't take the full advantage of all the dynamic features provided in the struts framework.The framework includes a set of custom tag libraries that facilitate in creating the user interfaces that can interact gracefully with ActionForm beans. The struts Jsp taglibs has a number of generic and struts specific tags tags which helps you to use dynamic data in your view. These tags helps us to interact with your controller without writing much java code inside your jsp. These tags are used create forms, internally forward to other pages by interacting with the bean and helps us to invoke other actions of the web application. There are many tags provided to you in the struts frameworks which helps you in sending error messages, internationalization etc.

Note: The points we have described above will be in effect if and only if when the ActionServlet is handling the request. When the request is submitted to the container which call the ActionServlet, make sure that the extension of the file which we want to access should have the extension .**do**.

Struts working:



Process flow:

web.xml: Whenever the container gets start up the first work it does is to check the web.xml file and determine what struts action Servlets exist. The container is response ble for mapping all the file request to the correct action Servlet.

A Request: This is the second step performed by the container after checking the web.xml file. In this the user submits a form within a browser and the request is interce pted by the controller.

The Controller: This is the heart of the container. Most Struts application will have only one controller that is ActionServlet which is responsible for directing several Actions. The controller determines what action is required and sends the information to be processed by an action Bean. The key advantage of having a controller is its ability to control the flow of logic through the highly controlled, centralized points.

struts.config.xml: Struts has a configuration file to store mappings of actions. By using this file there is no need to hard code the module which will be called within a component. The one more responsibility of the controller is to check the struts-config .xml file to determine which module to be called upon an action request. Struts only reads the struts-config.xml file upon start up.

Model: The model is basically a business logic part which takes the response from the user and stores the result for the duration of the process. This is a great place to perform the preprocessing of the data received from request. It is possible to reuse the same model for many page requests. Struts provides the ActionForm and the Action classes which can be extended to create the model objects.

View: The view in struts framework is mainly a jsp page which is responsible for produ cing the output to the user.

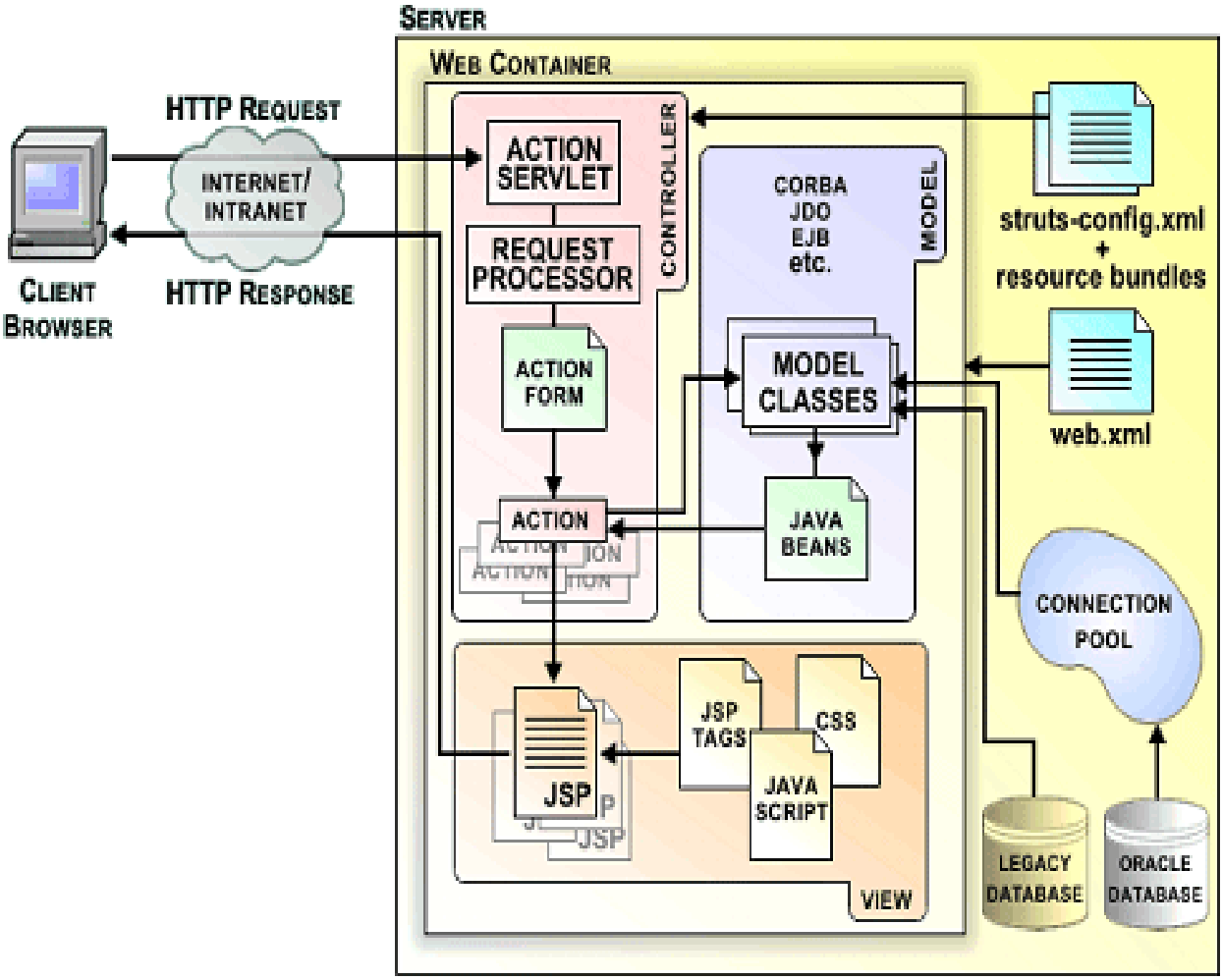
Struts tag libraries: These are struts components helps us to integrate the struts framework within the project's logic. These struts tag libraries are used within the JSP page. This means that the controller and the model part can't make use of the tag library but instead use the struts class library for strut process control.

Property file:It is used to store the messages that an object or page can use. Proper ties files can be used to store the titles and other string data. We can create many prope rty files to handle different languages.

Business objects: It is the place where the rules of the actual project exists. These are the modules which just regulate the day- to- day site activities.

The Response:This is the output of the View JSP object.

The Struts Architecture:



The Struts Controller Components

When a request is sent to a Struts application, it's handled by the Struts ActionServlet. The Struts framework includes a concrete ActionServlet that for many users is adequate and requires no customization or additional work.

When the ActionServlet receives a request, it inspects the URL and based on the Struts configuration files, it delegates the handling of the request to an Action class. The Action class is part of the controller and is responsible for communicating with the model layer. The Struts framework provides an abstract Action class that you must extend for your own needs.

Understanding Struts Controller

Here I will describe you the Controller part of the Struts Framework. I will show you how to configure the struts-config.xml file to map the request to some destination servlet or jsp file.

The class *org.apache.struts.action.ActionServlet* is the heart of the Struts Framework. It is the Controller part of the Struts Framework. *ActionServlet* is configured as Servlet in the **web.xml** file as shown in the following code snippets.

```
<servlet>
    <servlet-name>action</servlet-name>
    <servlet-class>org.apache.struts.action.ActionServlet</servlet-class>
    <init-param>
      <param-name>config</param-name>
      <param-value>/WEB-INF/struts-config.xml</param-value>
    </init-param>
   <load-on-startup>2</load-on-startup>
</servlet>
```

This servlet is responsible for handing all the request for the Struts Framework, user can map the specific pattern of request to the ActionServlet. **<servlet-mapping>** tag in the **web.xml** file specifies the url pattern to be handled by the servlet. By default it is ***.do**, but it can be changed to anything. Following code form the **web.xml** file shows the mapping.

```
<!-- Standard Action Servlet Mapping -->
<servlet-mapping>
   <servlet-name>action</servlet-name>
   <url-pattern>*.do</url-pattern>
</servlet-mapping>
```

The above mapping maps all the requests ending with **.do** to the ActionServlet. ActionServlet uses the configuration defined in struts-config.xml file to decide the destination of the request. Action Mapping Definitions (described below) is used to map any action. For this lesson we will create Welcome.jsp file and map the "Welcome.do" request to this page.

Welcome.jsp

```
<%@ taglib uri="/tags/struts-bean" prefix="bean" %>
<%@ taglib uri="/tags/struts-html" prefix="html" %>
<html:html>
  <body bgcolor="white">
  <h3><bean:message key="welcome.heading"/></h3>
  <p><bean:message key="welcome.message"/></p>
</body>
</html:html>
```

Forwarding the Welcome.do request to Welcome.jsp

The "Action Mapping Definitions" is the most important part in the **struts-config.xml**. This section takes a form defined in the "Form Bean Definitions" section and maps it to an action class. Following code under the <action-mappings> tag is used to forward the request to the Welcome.jsp.

```
<action path="/Welcome"
        forward="/pages/Welcome.jsp"/>
```

To call this Welcome.jsp file we will use the following code.

```
<html:link page="/Welcome.do">First Request to the controller</html:link>
```

Once the use clicks on on First Request to the controller link on the index page, request (for **Welcome.do**) is sent to the Controller and the controller forwards the request to **Welcome.jsp**. The content of **Welcome.jsp** is displayed to the user.

The ActionForm Class

Here we will learn about the ActionForm in detail. I will show you a good example of ActionForm. This example will help you understand Struts in detail. We will create user interface to accept the address details and then validate the details on server side. On the successful validation of data, the data will be sent to model (the action class). In the Action class we can add the business processing logic but in this case we are just forwarding it to the sucess.jsp.

What is ActionForm?

Any java class that that extends from org.apache.struts.action.ActionForm is called ActionForm. ActionForm maintains the session state for web application and the ActionForm object is automatically populated on the server side with data entered from a form on the client side. We will first create the class LoginForm which extends the ActionForm class. Here is the code of the class:

LoginForm.java

```
package com.durgasoft.login;
import org.apache.struts.action.ActionForm;
public class LoginForm extends ActionForm {
        private String username=null;
        private String password=null;
        public void setUsername(String username)
                {
                this.username = username;
                }
        public String getUsername()
                {
                return username;
                }
        public void setPassword(String password)
                {
                this.password = password;
                }
        public String getPassword()
                {
                return password;
                }
        }
public void reset(ActionMapping mapping, HttpServletRequest request)
 {
   this.name=null;
   this.address=null;
   this.emailAddress=null;
}
public ActionErrors validate(ActionMapping mapping, HttpServletRequest request )
 {
     ActionErrors errors = new ActionErrors();

     if( usename==null || username.equals("")) {
```

```
      errors.add("username",new ActionMessage("error.username"));
    }
    if( password==null || password.equals("")) {
      errors.add("password",new ActionMessage("error.password"));
    }
        return errors;
}
```

The above class populates the Login Form data and validates it. The validate() method is used to validate the inputs. If any or all of the fields on the form are blank, error messages are added to the ActionMapping object. Note that we are using ActionMessage class, ActionError is now deprecated and will be removed in next version.

DynaActionForm

Here you will learn how to create Struts DynaActionForm. We will recreate our address form with Struts DynaActionForm. DynaActionForm is specialized subclass of ActionForm that allows the creation of form beans with dynamic sets of properties, without requiring the developer to create a Java class for each type of form bean. DynaActionForm eliminates the need of FormBean class and now the form bean definition can be written into the struts-config.xml file. So, it makes the FormBean declarative and this helps the programmer to reduce the development time.In this session we will recreate the add form with the help of DynaActionForm. It also shows you how you can validate use input in the action class.

Adding DynaActionForm Entry in struts-config.xml

First we will add the necessary entry in the struts-config.xml file. Add the following entry in the struts-config.xml file. The form bean is of org.apache.struts.action. DynaActionForm type. The **<form-property/>** tag is used to define the property for the form bean. We have defined three properties for our dynamic form bean.

```
<form-bean name="DynaAddressForm"
        type="org.apache.struts.action.DynaActionForm">
        <form-property name="name" type="java.lang.String"/>
        <form-property name="address" type="java.lang.String"/>
        <form-property name="email" type="java.lang.String" />
</form-bean>
```

Adding action mapping

Add the following action mapping in the struts-config.xml file:

```
<action path="/DynaAddress" type=" com.durgasoft.struts.AddressDynaAction"
    name="DynaAddressForm"
    scope="request"
    validate="true"
    input="/pages/DynaAddress.jsp">
   <forward name="success" path="/pages/success.jsp"/>
   <forward name="invalid" path="/pages/DynaAddress.jsp" />
</action>
```

Creating Action Class

Code for action class is as follows:

```
package com.durgasoft.struts;
import javax.servlet.http.*
 import org.apache.struts.action.*;
public class AddressDynaAction extends Action
{
  public ActionForward execute(ActionMapping mapping,  ActionForm form,
    HttpServletRequest request, HttpServletResponse response) throws Exception
         {
           DynaActionForm addressForm = (DynaActionForm)form;
           //Create object of ActionMesssages
          ActionMessages errors = new ActionMessages();
           //Check and collect errors
         if(((String)addressForm.get("name")).equals("")) {
         errors.add("name",new ActionMessage("error.name.required"));
         if(((String)addressForm.get("address")).equals("")) {
        errors.add("address",new ActionMessage("error.address.required"));
         }
}
```

Creating the JSP file

We will use the Dyna Form **DynaAddressForm** created above in the jsp file. Here is the code of the jsp(**DynaAddress.jsp**) file.

```
<%@ taglib uri="/tags/struts-bean" prefix="bean" %>
<%@ taglib uri="/tags/struts-html" prefix="html" %>
<html:html>
<body bgcolor="white">
<html:form action="/DynaAddress" method="post">
<table>
<tr>
<td align="center" colspan="2">
<font size="4">Please Enter the Following Details</font>
</tr>
<tr>
<td align="left" colspan="2">
<font color="red"><html:errors/></font>
</tr>
<tr>
<td align="right">Name</td>
<td align="left">
<html:text property="name" size="30" maxlength="30"/>
</td>
</tr>
<tr>
<td align="right">Address</td>
<td align="left">
```

```
<html:text property="address" size="30" maxlength="30"/>
</td>
</tr>
<tr>
<td align="right">E-mail address</td>
<td align="left">
<html:text property="email" size="30" maxlength="30"/>
</td>
</tr>
<tr>
<td align="right"><html:submit>Save</html:submit>
</td>
<td align="left"><html:cancel>Cancel</html:cancel></td>
</tr>
</table>
</html:form>
</body>
</html:html>
```

Add the following line in the index.jsp to call the form.

```
<li>
<html:link page="/pages/DynaAddress.jsp">Dyna Action Form Example</html:link>
<br>
Example shows you how to use DynaActionForm.
</li>
```

Action Class

What is Action Class?

Any java class which extends from org.apache.struts.action.Action is called Action Class. Action class acts as wrapper around the business logic and provides an interface to the application's Model layer. It acts as glue between the View and Model layer. It also transfers the data from the view layer to the specific business process layer and finally returns the processed data from business layer to the view layer.An Action works as an adapter between the contents of an incoming HTTP request and the business logic that corresponds to it. Then the struts controller (ActionServlet) selects an appropriate Action and creates an instance if necessary, and finally calls execute method.

To use the Action, we need to Subclass and overwrite the execute() method. In the Action Class don't add the business process logic, instead move the database and business process logic to the process or dao layer. The ActionServlet (commad) passes the parameterized class to Action Form using the *execute()* method. The return type of the execute method is *ActionForward* which is used by the Struts Framework to forward the request to the file as per the value of the returned *ActionForward* object.

Developing our Action Class?

Our Action class (Loginction.java) is simple class that only forwards the TestAction.jsp. Our Action class returns the *ActionForward* called "testAction", which is defined in the struts-config.xml file (action mapping is show later in this page). Here is code of our Action Class:

LoginAction.java

```
package com.durgasoft.login;
import javax.servlet.http.*;
import org.apache.struts.action.*;
public class LoginAction extends Action
{
	public ActionForward execute(ActionMapping mapping,ActionForm
form,HttpServletRequest request,HttpServletResponse response)throws Exception
	{
		LoginForm loginform = (LoginForm)form;
		String user = loginform.getUsername();
		String pass = loginform.getPassword();
		if(user.equals("ramesh") && pass.equals("durgasoft"))
			return mapping.findForward("success");
		else
			return mapping.findForward("failure");
	}
}
```

Understanding Action Class

Here is the signature of the Action Class.

public ActionForward **execute**(ActionMapping mapping,ActionForm form,HttpServlet Request request,HttpServletResponse response) throws java.lang.Exception

Action Class process the specified HTTP request, and create the corresponding HTTP response (or forward to another web component that will create it), with provision for handling exceptions thrown by the business logic. Return an ActionForward instance describing where and how control should be forwarded, or null if the response has already been completed.

Parameters:

mapping - The ActionMapping used to select this instance
form - The optional ActionForm bean for this request (if any)
request - The HTTP request we are processing
response - The HTTP response we are creating

Throws:

Action class throws java.lang.Exception - if the application business logic throws an exception

Following code under the <action-mappings> tag is used to for mapping the **TestAction** class.

```
<action
    path="/login"
    name=”loginform”
    type="com.durgasoft.login.LoginAction">
    <forward name="testAction" path="/pages/TestAction.jsp"/>
  </action>
```

The RequestProcessor

How a Request is Processed

ActionServlet is the only servlet in Struts framework, and is responsible for handling all of the requests. Whenever it receives a request, it first tries to find a sub-application for the current request. Once a sub-application is found, it creates a RequestProcessor object for that sub-application and calls its process() method by passing it HttpServletRequest and HttpServletResponse objects.

The RequestProcessor.process() is where most of the request processing takes place. The process() method is implemented using the Template Method design pattern, in which there is a separate method for performing each step of request processing, and all of those methods are called in sequence from the process() method. For example, there are separate methods for finding the ActionForm class associated with the current request, and checking if the current user has one of the required roles to execute action mapping. This gives us tremendous flexibility. The RequestProcessor class in the Struts distribution provides a default implementation for each of the request-processing steps. That means you can override only the methods that interest you, and use default implementations for rest of the methods. For example, by default Struts calls request.isUserInRole() to find out if the user has one of the roles required to execute the current ActionMapping, but if you want to query a database for this, then then all you have to do is override the processRoles() method and return true or false, based whether the user has the required role or not.First we will see how the process() method is implemented by default, and then I will explain what each method in the default RequestProcessor class does, so that you can decide what parts of request processing you want to change.


```
public void process(HttpServletRequest request, HttpServletResponse response)
                                        throws IOException, ServletException
  {
  // Wrap multipart requests with a special wrapper
  request = processMultipart(request);
  // Identify the path component we will use to select a mapping
  String path = processPath(request, response);
  if (path == null) {
     return;
  }
  if (log.isDebugEnabled()) {
     log.debug("Processing a '" + request.getMethod() +"' for path '" + path + "'");
  }
  // Select a Locale for the current user if requested
  processLocale(request, response);
  // Set the content type and no-caching headers if requested
  processContent(request, response);
  processNoCache(request, response);
  // General purpose preprocessing hook
  if (!processPreprocess(request, response)) {
     return;
  }
  // Identify the mapping for this request
```

```
ActionMapping mapping =
    processMapping(request, response, path);
if (mapping == null) {
    return;
}
// Check for any role required to perform this action
if (!processRoles(request, response, mapping)) {
    return;
}
// Process any ActionForm bean related to this request
ActionForm form = processActionForm(request, response, mapping);
processPopulate(request, response, form, mapping);
if (!processValidate(request, response, form, mapping)) {
    return;
}
// Process a forward or include specified by this mapping
if (!processForward(request, response, mapping)) {
    return;
}
if (!processInclude(request, response, mapping)) {
    return;
}
// Create or acquire the Action instance to process this request
Action action = processActionCreate(request, response, mapping);
if (action == null) {
    return;
}
// Call the Action instance itself
ActionForward forward =
                    processActionPerform(request, response, action, form, mapping);
// Process the returned ActionForward instance
processForwardConfig(request, response, forward);
}
```

1. processMultipart(): In this method, Struts will read the request to find out if its contentType is multipart/form-data. If so, it will parse it and wrap it in a wrapper implementing HttpServletRequest. When you are creating an HTML FORM for posting data, the contentType of the request is application/x-www-form-urlencoded by default. But if your form is using FILE-type input to allow the user to upload files, then you have to change the contentType of the form to multipart/form-data. But by doing that, you can no longer read form values submitted by user via the getParameter() method of HttpServletRequest; you have to read the request as an InputStream and parse it to get the values.
2. processPath(): In this method, Struts will read request URI to determine the path element that should be used for getting the ActionMapping element.
3. processLocale(): In this method, Struts will get the Locale for the current request and, if configured, it will save it in HttpSession as the value of the org.apache.struts.action.LOCALE attribute. HttpSession would be created as a side effect of this method. If you don't want that to happen, then you can set the locale property to false in ControllerConfig by adding these lines to your *struts-config.xml* file:

```
4.    <controller>
5.              <set-property  property="locale" value="false"/>
```

```
    </controller>
```

7. processContent(): Sets the contentType for the response by calling response.setContentType(). This method first tries to get the contentType as configured in *struts-config.xml*. It will use text/html by default. To override that, use the following:

```
    <controller>
            <set-property  property="contentType" value="text/plain"/>
    </controller>
```

11. processNoCache(): Struts will set the following three headers for every response, if configured for no-cache:

```

    requested in struts config.xml
    response.setHeader("Pragma", "No-cache");
    response.setHeader("Cache-Control", "no-cache");
    response.setDateHeader("Expires", 1);
```

If you want to set the no-cache header, add these lines to *struts-config.xml*:

```
<controller>
  <set-property  property="noCache" value="true"/>
</controller>
```

17. processPreprocess(): This is a general purpose, pre-processing hook that can be overridden by subclasses. Its implementation in RequestProcessor does nothing and always returns true. Returning false from this method will abort request processing.
18. processMapping(): This will use path information to get an ActionMapping object. The ActionMapping object represents the <action> element in your *struts-config.xml* file.

```

    <action path="/newcontact" type="com.sample.NewContactAction"
          name="newContactForm" scope="request">
              <forward name="sucess" path="/sucessPage.do"/>
              <forward name="failure" path="/failurePage.do"/>
    </action>
```

The ActionMapping element contains information like the name of the Action class and ActionForm used in processing this request. It also has information about ActionForwards configured for the current ActionMapping.

25. processRoles(): Struts web application security just provides an authorization scheme. What that means is once user is logged into the container, Struts' processRoles() method can check if he has one of the required roles for executing a given ActionMapping by calling request.isUserInRole().

```

            <action path="/addUser" roles="administrator"/>
```

Say you have AddUserAction and you want only the administrator to be able to add a new user. What you can do is to add a role attribute with the value administrator in your AddUserAction action element. So before executing AddUserAction, it will always make sure that the user has the administrator role.

28. processActionForm(): Every ActionMapping has a ActionForm class associated with it. When Struts is processing an ActionMapping, it will find the name of the associated ActionForm class from the value of the name attribute in the <action> element.

```
    <form-bean name="newContactForm"
            type="org.apache.struts.action.DynaActionForm">
```

```
31.                     <form-property name="firstName"
32.                     type="java.lang.String"/>
33.                     <form-property name="lastName"
34.                     type="java.lang.String"/>
35.   </form-bean>
```

In our example, it will first check to see if an object of the org.apache.struts. action.DynaActionForm class is present in request scope. If so, it will use it; otherwise, it will create a new object and set it in the request scope.

36. processPopulate(): In this method, Struts will populate the ActionForm class instance variables with values of matching request parameters.
37. processValidate(): Struts will call the validate() method of your ActionForm class. If you return ActionErrors from the validate() method, it will redirect the user to the page indicated by the input attribute of the <action>element.
38. processForward() and processInclude(): In these functions, Struts will check the value of the forward or include attributes of the <action> element and, if found, put the forward or include request in the configured page.

```
39.
40.             <action forward="/Login.jsp" path="/loginInput"/>
41.             <action include="/Login.jsp" path="/loginInput"/>
```

You can guess difference in these functions from their names. processForward() ends up calling RequestDispatcher.forward(), and processInclude() calls Request-Dispatcher.include(). If you configure both forward and include attributes, it will always call forward, as it is processed first.

42. processActionCreate(): This function gets the name of the Action class from the type attribute of the <action> element and create and return instances of it. In our case it will create an instance of the com.sample.NewContactAction class.
43. processActionPerform(): This function calls the execute() method of your Action class, which is where you should write your business logic.
44. processForwardConfig(): The execute() method of your Action class will return an object of type ActionForward, indicating which page should be displayed to the user. So Struts will create RequestDispatcher for that page and call the RequestDispatcher.forward() method.

The above list explains what the default implementation of RequestProcessor does at every stage of request processing and the sequence in which various steps are executed. As you can see, RequestProcessor is very flexible and it allows you to configure it by setting properties in the <controller> element. For example, if your application is going to generate XML content instead of HTML, then you can inform Struts about this by setting a property of the controller element.

Creating Your own RequestProcessor

Above, we saw how the default implementation of RequestProcessor works. Now we will present a example of how to customize it by creating our own custom RequestProcessor. To demonstrate creating a custom RequestProcessor, we will change our sample application to implement these two business requirements:

- We want to create a ContactImageAction class that will generate images instead of a regular HTML page.
- Before processing every request, we want to check that user is logged in by checking for userName attribute of the session. If that attribute is not found, we will redirect the user to the login page.

We will change our sample application in two steps to implement these business require ments.

1. Create your own CustomRequestProcessor class, which will extend the RequestProcessor class, like this:

```
public class CustomRequestProcessor
    extends RequestProcessor {
        protected boolean processPreprocess (
            HttpServletRequest request,
            HttpServletResponse response) {
            HttpSession session = request.getSession(false);
        //If user is trying to access login page
        // then don't check
        if( request.getServletPath().equals("/loginInput.do")
            || request.getServletPath().equals("/login.do") )
            return true;
        //Check if userName attribute is there is session.
        //If so, it means user has allready logged in
        if( session != null &&
        session.getAttribute("userName") != null)
            return true;
        else{
            try{
                //If no redirect user to login Page
                request.getRequestDispatcher
                    ("/Login.jsp").forward(request,response);
            }catch(Exception ex){
            }
        }
        return false;
    }

    protected void processContent(HttpServletRequest request,
                HttpServletResponse response) {
            //Check if user is requesting ContactImageAction
            // if yes then set image/gif as content type
            if( request.getServletPath().equals("/contactimage.do")){
                response.setContentType("image/gif");
                return;
            }
        super.processContent(request, response);
    }
}
```

In the processPreprocess method of our CustomRequestProcessor class, we are checking for the userName attribute of the session and if it's not found, redirect the user to the login page.

For our requirement of generating images as output from the ContactImageAction class, we have to override the processContent method and first check if the request is for the /contactimage path. If so, we set the contentType to image/gif; otherwise, it's text/html.

40. Add these lines to your *struts-config.xml* file after the <action-mapping> element to inform Struts that CustomRequestProcessor should be used as the Request Processor class:

```
<controller>
            <set-property  property="processorClass"
```

```
43.             value="com.durgasoft.CustomRequestProcessor"/>
44.  </controller>
```

Please note that overriding processContent() is OK if you have very few Action classes where you want to generate output whose contentType is something other than text/html. If that is not the case, you should create a Struts sub-application for handling requests for image-generating Actions and set image/gif as the contentType for it.

The Tiles framework uses its own RequestProcessor for decorating output generated by Struts.

The org.apache.struts.action.RequestProcessor contains the logic that the Struts controller performs with each servlet request from the container. The RequestProcessor is the class that you will want to override when you want to customize the processing of the ActionServlet.

Creating a New RequestProcessor

Now that we have discussed what the RequestProcessor is, let's look at an example Plugin implementation.The RequestProcessor contains n-number of methods that you can override to change the behavior of the ActionServlet.

To create your own RequestProcessor, you must follow the steps described in the following list:

1. Create a class that extends the org.apache.struts.action.RequestProcessor class.
2. Add a default empty constructor to the RequestProcessor implementation.
3. Implement the method that you want to override. Our example overrides the processPreprocess() method.
4. In our example, we are going to override one of the more useful RequestProcessor methods, the processPreprocess() method, to log information about every request being made to our application.

The processPreprocess() method is executed prior to the execution of every Action.execute() method. It allows you to perform application-specific business logic before every Action. The method prototype for the processPreprocess() method is shown below:

protected boolean processPreprocess(HttpServletRequest request, HttpServletResponse response)

The default implementation of the processPreprocess() method simply returns true, which tells the framework to continue its normal processing. You must return true from your overridden processPreprocess() method if you want to continue processing the request.

Note If you do choose to return false from the processPreprocess() method, then the RequestProcessor will stop processing the request and return control back to the doGet() or doPost() of the ActionServlet.

To see how all of this really works, take a look at our example RequestProcessor imple mentation, which is listed in the following snippet.

```
Package com.durgasoft;
import javax.servlet.http.HttpServletRequest;
import javax.servlet.http.HttpServletResponse;
import javax.servlet.http.HttpServlet;
import javax.servlet.ServletException;
```

```
import javax.servlet.http.Cookie;
import java.io.IOException;
import java.util.Enumeration;
import org.apache.struts.action.RequestProcessor;
public class CustomRequestProcessor extends RequestProcessor {
public CustomRequestProcessor() {
}
public boolean processPreprocess(HttpServletRequest request,
HttpServletResponse response) {
log("----------processPreprocess Logging----------");
log("Request URI = " + request.getRequestURI());
log("Context Path = " + request.getContextPath());
Cookie cookies[] = request.getCookies();
if (cookies != null) {
for (int i = 0; i < cookies.length; i++) {
log("Cookie = " + cookies[i].getName() + " = " +
cookies[i].getValue());
}
}
Enumeration headerNames = request.getHeaderNames();
while (headerNames.hasMoreElements()) {
String headerName =
(String) headerNames.nextElement();
Enumeration headerValues =
request.getHeaders(headerName);
while (headerValues.hasMoreElements()) {
String headerValue =
(String) headerValues.nextElement();
log("Header = " + headerName + " = " + headerValue);
}
}
log("Locale = " + request.getLocale());
log ("Method = " + request.getMethod());
log ("Path Info = " + request.getPathInfo());
log("Protocol = " + request.getProtocol());
log("Remote Address = " + request.getRemoteAddr());
log("Remote Host = " + request.getRemoteHost());
log("Remote User = " + request.getRemoteUser());
log("Requested Session Id = "+ request.getRequestedSessionId());
log("Scheme = " + request.getScheme());
log("Server Name = " + request.getServerName());
log("Server Port = " + request.getServerPort());
log("Servlet Path = " + request.getServletPath());
log("Secure = " + request.isSecure());
log("-----------------------------------------------");
return true;
}
}
```

In our processPreprocess() method, we are retrieving the information stored in the request and logging it to the
ServletContext log. Once the logging is complete, the processPreprocess() method returns the Boolean value

true, and normal processing continues. If the processPreprocess() method had returned false, then the ActionServlet would have terminated processing, and the Action would never have been performed.

Configuring an Extended RequestProcessor

Now that you have seen a Plugin and understand how it can be used, let's take a look at how a Plugin is deployed and configured. To deploy and configure our application, you must Compile the new RequestProcessor and move it into the Web application's classpath.

1. Add a <controller> element to the application's struts-config.xml file describing the new RequestProcessor. An example <controller> entry, describing the our new RequestProcessor, is shown in the following code snippet:

```
<controller processorClass="com.durgasoft.CustomRequestProcessor" />
```

2.Note The <controller> element must follow the <action-mappings> element and precede the <message-resources /> elements in the struts-config.xml

3.When this deployment is complete, the new RequestProcessor will take effect. To see the results of these log statements, open the <*CATALINA_HOME*>/ logs/localhost_log. *todaysdate*.txt file, and you will see the logged request at the bottom of the log file.

Validator Framework

Struts Framework provides the functionality to validate the form data. It can be use to validate the data on the users browser as well as on the server side. Struts Framework emits the java scripts and it can be used to validate the form data on the client browser. Server side validation of the form can be accomplished by sub classing your From Bean with **DynaValidatorForm** class.

The Validator framework was developed by David Winterfeldt as third-party add-on to Struts. Now the Validator framework is a part of Jakarta Commons project and it can be used with or without Struts. The Validator framework comes integrated with the Struts Framework and can be used without doing any extra settings.

Using Validator Framework

Validator uses the XML file to pickup the validation rules to be applied to an form. In XML validation requirements are defined applied to a form. In case we need special validation rules not provided by the validator framework, we can plug in our own custom validations into Validator.

The Validator Framework uses two XML configuration files **validator-rules.xml** and **validation.xml**. The **validator-rules.xml** defines the standard validation routines, these are reusable and used in **validation.xml**. to define the form specific validations. The **validation.xml** defines the validations applied to a form bean.

Structure of validator-rule.xml

The **validation-rules.xml** is provided with the Validator Framework and it declares and assigns the logical names to the validation routines. It also contains the client-side javascript code for each validation routine. The validation routines are java methods plugged into the system to perform specific validations.

Following table contains the details of the elements in this file:

Element	Attributes and Description
form-validation	This is the root node. It contains nested elements for all of the other configuration settings.
global	The validator details specified within this, are global and are accessed by all forms.
validator	The validator element defines what validators objects can be used with the fields referenced by the formset elements. The attributes are: • **name**: Contains a logical name for the validation routine • **classname**: Name of the Form Bean class that extends the subclass of ActionForm class • **method**: Name of the method of the Form Bean class • **methodParams**: parameters passed to the method • **msg**: Validator uses Struts' Resource Bundle mechanism for externalizing error messages. Instead of having hard-coded error messages in the framework, Validator allows you to specify a key to a message in the ApplicationResources.properties file that should be returned if a validation fails. Each validation routine in the validator-

	rules.xml file specifies an error message key as value for this attribute. • **depends**: If validation is required, the value here is specified as 'required' for this attribute. • **jsFunctionName**: Name of the javascript function is specified here.
javascript	Contains the code of the javascript function used for client-side validation. Starting in Struts 1.2.0 the default javascript definitions have been consolidated to commons-validator. The default can be overridden by supplying a <javascript> element with a CDATA section, just as in struts 1.1.

The Validator plug-in (validator-rules.xml) is supplied with a predefined set of commonly used validation rules such as Required, Minimum Length, Maximum length, Date Validation, Email Address validation and more. This basic set of rules can also be extended with custom validators if required.

Structure of validation.xml

This **validation.xml** configuration file defines which validation routines that is used to validate Form Beans. You can define validation logic for any number of Form Beans in this configuration file. Inside that definition, you specify the validations you want to apply to the Form Bean's fields. The definitions in this file use the logical names of Form Beans from the struts-config.xml file along with the logical names of validation routines from the validator-rules.xml file to tie the two together.

Element	Attributes and Description
form-validation	This is the root node. It contains nested elements for all of the other configuration settings
global	The constant details are specified in <constant> element within this element.
constant	Constant properties are specified within this element for pattern matching.
constant-name	Name of the constant property is specified here
constant-value	Value of the constant property is specified here.
formset	This element contains multiple <form> elements
form	This element contains the form details. The attributes are: **name**:Contains the form name. Validator uses this logical name to map the validations to a Form Bean defined in the struts-config.xml file
field	This element is inside the form element, and it defines the validations to apply to specified Form Bean fields. The attributes are: • **property**: Contains the name of a field in the specified Form Bean • **depends**: Specifies the logical names of validation routines from the validator-rules.xml file that should be applied to the field.
arg	A key for the error message to be thrown incase the validation fails, is specified here
var	Contains the variable names and their values as nested elements within this element.

var-name	The name of the criteria against which a field is validated is specified here as a variable
var-value	The value of the field is specified here

Example of form in the **validation.xml** file:

```
<!-- An example form -->
<form name="loginForm">
<field property="username"
      depends="required">
      <arg key="logonForm.username"/>
     </field>
    <field property="password"
       depends="required,mask">
       <arg key="logonForm.password"/>
       <var>
         <var-name>mask</var-name>
         <var-value>^[0-9a-zA-Z]*$</var-value>
      </var>
  </field>
 </form>
```

The <html:javascript> tag to allow front-end validation based on the xml in validation.xml.

For example the code:

```
<html:javascript formName="logonForm" dynamicJavascript="true" staticJavascript=
"true" />
```

generates the client side java script for the form "logonForm" as defined in the validation.xml file. The <html:javascript> when added in the jsp file generates the client site validation script.

Client Side Validation in Struts

Here we will create JSP page for entering the address and use the functionality provided by Validator Framework to validate the user data on the browser. Validator Framework emits the JavaScript code which validates the user input on the browser. To accomplish this we have to follow the following steps:

1. **Enabling the Validator plug-in:** This makes the Validator available to the system.
2. **Create Message Resources** for the displaying the error message to the user.
3. **Developing the Validation rules** We have to define the validation rules in the validation.xml for the address form. Struts Validator Framework uses this rule for generating the JavaScript for validation.
4. **Applying the rules:** We are required to add the appropriate tag to the JSP for generation of JavaScript.
5. **Build and test:** We are required to build the application once the above steps are done before testing.

Enabling the Validator plug- in

To enable the validator plug-in open the file struts-config.xml and make sure that following line is present in the file.

```
<!--  Validator plugin -->
<plug-in className="org.apache.struts.validator.ValidatorPlugIn">
        <set-property
          property="pathnames"
         value="/WEB-INF/validator-rules.xml,/WEB-INF/validation.xml"/>
</plug-in>
```

Creating Message Resources

Message resources are used by the Validator Framework to generate the validation error messages. In our application we need to define the messages for name, Address and E-mail address. Open the \WEB-INF\MessageResources.properties file and add the followi ng lines:

```
AddressForm.name=Name
AddressForm.address=Address
AddressForm.emailAddress=E-mail address
```

Developing Validation rules

In this application we are adding only one validation that the fields on the form should not be blank. Add the following code in the validation.xml.

```
<!-- Address form Validation-->
<form name="AddressForm">
   <field  property="name"
        depends="required">
       <arg key="AddressForm.name"/>
   </field>
   <field  property="address"
       depends="required">
       <arg key="AddressForm.address"/>
    </field>
    <field  property="emailAddress"
       depends="required">
      <arg key="AddressForm.emailAddress"/>
    </field>
</form>
```

The above definition defines the validation for the form fields **name**, **address** and **emailAddress**. The attribute **depends="required"** instructs the Validator Frame work to generate the JavaScript that checks that the fields are not left blank. If the fields are left blank then JavaScript shows the error message. In the error message the message are taken from the key defined in the <arg **key=".."**/> tag. The value of key is taken from the message resources (WEB-INF**MessageResources.properties**).

Applying Validation rules to JSP

Now create the **AddressJavascriptValidation.jsp** file to test the application. The code for AddressJavascriptValidation.jsp is as follows:

```
<%@ taglib uri="/tags/struts-bean" prefix="bean" %>
<%@ taglib uri="/tags/struts-html" prefix="html" %>
<html:html>
<head>
```

```
   <title><bean:message key="welcome.title"/></title>
</head>
<body bgcolor="white">
<html:form action="/AddressJavascriptValidation" method="post" onsubmit="return
validateAddressForm(this);">

<div align="left">
<p>
This application shows the use of Struts Validator.<br>
The following form contains fields that are processed by Struts Validator.<br>
Fill in the form and see how JavaScript generated by Validator Framework validates the
form.
</p>
<p>
<html:errors/>
</p>
<table>
<tr>
<td align="center" colspan="2">
<font size="4"><b>Please Enter the Following Details</b></font>
</tr>
<tr>
<td align="right"><b>Name</b></td>
<td align="left"><html:text property="name" size="30" maxlength="30"/></td>
</tr>
<tr>
<td align="right"><b>Address</b></td>
<td align="left"><html:text property="address" size="30" maxlength="30"/></td>
</tr>
<tr>
<td align="right"><b>E-mail address</b></td>
<td align="left"><html:text property="emailAddress" size="30" maxlength="30"/>
</td>
</tr>
<tr>
<td align="right"><html:submit>Save</html:submit></td>
<td align="left"><html:cancel>Cancel</html:cancel></td>
</tr>
</table>
</div>

<!-- Begin Validator Javascript Function-->
<html:javascript formName="AddressForm"/>
<!-- End of Validator Javascript Function-->
</html:form>
</body>
</html:html>
```

The code **<html:javascript formName="AddressForm"/>** is used to plug-in the Validator JavaScript.

Create the following entry in the struts-config.xml for the mapping the **/AddressJavascriptValidation** url for handling the form submission through **AddressJavascriptValidation.jsp**.

```
<action
    path="/AddressJavascriptValidation"
    type="com.durgasoft.AddressAction"
    name="AddressForm"
    scope="request"
    validate="true"
    input="/pages/AddressJavascriptValidation.jsp">
    <forward name="success" path="/pages/success.jsp"/>
</action>
```

Add the following line in the index.jsp to call the form.

```
<li>
<html:link page="/pages/AddressJavascriptValidation.jsp">Client Side Validation for Address Form</html:link>
<br>
The Address Form that validates the data on the client side using Stuts Validator generated JavaScript.
</li>
```

Struts Framework provides the functionality to validate the form data. It can be use to validate the data on the users browser as well as on the server side. Struts Framework emits the java scripts and it can be used validate the form data on the client browser. Server side validation of form can be accomplished by sub classing your From Bean with DynaValidatorForm class

Creating Custom Validators in STRUTS

Struts Validator framework provides many validation rules that can be used in the web applications. If you application needs special kind of validation, then you can extend the validator framework to develop your own validation rule. The client-side validation in Struts is well known. Here are some of the available features:

- required
- requiredif
- validwhen
- minlength
- maxlength
- mask
- byte
- short
- integer
- long
- float
- double
- byteLocale
- shortLocale
- integerLocale
- longLocale
- floatLocale
- doubleLocale
- date
- intRange
- longRange
- floatRange
- doubleRange

- creditCard
- email
- url

These are found in the validator-rules.xml inside the <validator> tags. The validator-rules.xml file is found in the commons-validator jar.

Let us know create a new validator for entering the name field of a form. The form should accept only "administrator" for the name field. To accomplish this edit the validator-rules.xml and add the following code under the <global> tag:

```
<validator name="matchname"
          classname="org.apache.struts.validator.FieldChecks"
          method="validateName"
          methodParams="java.lang.Object,
             org.apache.commons.validator.ValidatorAction,
             org.apache.commons.validator.Field,
             org.apache.struts.action.ActionMessages,
             org.apache.commons.validator.Validator,
             javax.servlet.http.HttpServletRequest"
          msg="errors.name">
<javascript><![CDATA[
      function validateName(form) {
var isValid = true;
var focusField = null;
var i = 0;
var fields = new Array();

var omatchName= eval('new ' + jcv_retrieveFormName(form) +  '_matchname()
');

for (var x in omatchName) {
   if (!jcv_verifyArrayElement(x, omatchName[x])) {
      continue;
   }
   var field = form[omatchName[x][0]];

   if (!jcv_isFieldPresent(field)) {
      fields[i++] = omatchName[x][1];
      isValid=false;
      } else if (field.value != "administrator") {
            fields[i++]=omatchName[x][1];
            isValid=false;
      }
}

if (fields.length > 0) {
  jcv_handleErrors(fields, focusField);
}
return isValid;
}
]]>
</javascript>
</validator>
```

To understand the above code:

- matchname is the new validator we are creating; use can use anything you want (e.g. matchAdmin) remembering that this will be used in another file which will be described later
- the error message issued in the browser has the key errors.name; you can have any name here like errors.admin; once again this will be explained later
- the JavaScript function to call is declared in the method attribute of the validator tag; in the above it is called validateName; you can have any valid Java Script function name (e.g. validateAdmin)
- the JavaScript to process this tag is declared inside CDATA; note that the function name should match EXACTLY with the name declared in the method attribute of the validator tag
- the field.value != "administrator" is where we actually test the value entered in the browser; you can substitute any string in the place of "administrator"; also you can do more sophisticated checking (e.g. replace all blanks; check for upper/lower case, etc.) if you are an experienced Java Script programmer

To use our matchname validator create a file validation.xml and add the following lines:

```
<!-- Name form Validation-->
<form-validation>
<formset>
<form name="AdminForm">
   <field property="name"
        depends="matchname">
       <arg0 key="AddressForm.name"/>
   </field>
</form>
</formset>
</form-validation>
```

Copy the files validation.xml and validator-rules.xml to the directory where your struts-config.xml resides. Let us say it is WEB-INF. Next we have to create the error message for errors.name. Create a directory WEB-INF/resources and a file in this directory with the name application.properties.

Add the following lines to application.properties

```
AdminForm.name=Name
errors.name={0} should be administrator.
errors.required={0} is required.
errors.minlength={0} can not be less than {1} characters.
errors.maxlength={0} can not be greater than {1} characters.
errors.invalid={0} is invalid.
errors.byte={0} must be a byte.
errors.short={0} must be a short.
errors.integer={0} must be an integer.
errors.long={0} must be a long.
errors.float={0} must be a float.
errors.double={0} must be a double.
errors.date={0} is not a date.
errors.range={0} is not in the range {1} through {2}.
errors.creditcard={0} is an invalid credit card number.
errors.email={0} is an invalid e-mail address.
```

Edit struts-configuration.xml and add the following lines

```
<form-bean name="AdminForm" type="test.AdminForm"/>

<action
    path="/AdminFormValidation"
    type="test.AdminForm"
    name="AdminForm"
    scope="request"
    validate="true"
    input="admin.jsp">
    <forward name="success" path="success.jsp"/>
</action>
<message-resources parameter="resources/application"/>

<plug-in className="org.apache.struts.validator.ValidatorPlugIn">
    <set-property property="pathnames"
                  value="/WEB-INF/validator-rules.xml,/WEB-INF/validation.xml"/>
</plug-in>
```

Create a JSP file as follows:

```
<%@ taglib uri="struts-bean.tld" prefix="bean" %>
<%@ taglib uri="struts-html.tld" prefix="html" %>
<html:html>
<body bgcolor="white">
<html:form action="/AdminFormValidation" method="post" onsubmit="return
validateAdminForm(this);">
<div align="left">
<p>
This application shows the use of Struts Validator.<br>
The following form contains fields that are processed by Struts Validator.<br>
Fill in the form and see how JavaScript generated by Validator Framework validates the
form.
</p>
<p>
<html:errors/>
</p>
<table>
<tr>
<td align="right"><b>Name</b></td>
<td align="left"> <html:text property="name" size="30" maxlength="30"/></td>
</tr>
<tr>
<td align="right"> <html:submit>Save</html:submit></td>
<td align="left"> <html:cancel>Cancel</html:cancel> </td>
</tr>
</table>
</div>
<!-- Begin Validator Javascript Function-->
<html:javascript formName="AddressForm"/>
<!-- End of Validator Javascript Function-->
</html:form>
```

```
</body>
</html:html>
```

Then we create the success.jsp

```
<% out.println("SUCCESS") %>
```

Then we create the AdminForm

```
package com.durgasoft;
import javax.servlet.http.HttpServletRequest;
import org.apache.struts.action.*;
public class AdminForm extends ActionForm
{
   private String name=null;
   public void setName(String name)
     {
      this.name=name;
     }
   public String getName()
     {
      return this.name;
     }
  public void reset(ActionMapping mapping, HttpServletRequest request)
     {
      this.name=null;
     }
 public ActionErrors validate(ActionMapping mapping, HttpServletRequest request )
       {
       ActionErrors errors = new ActionErrors();
       if( getName() == null || getName().length() < 1 )
          {
           errors.add("name",new ActionMessage("error.name.required"));
          }
        return errors;
       }
  }
```

Create the AdminAction.java

```
package com.durgasoft;
import javax.servlet.http.HttpServletRequest;
import javax.servlet.http.HttpServletResponse;
import org.apache.struts.action.Action;
import org.apache.struts.action.ActionForm;
import org.apache.struts.action.ActionForward;
import org.apache.struts.action.ActionMapping;
public class AdminAction extends Action
{
   public ActionForward execute(ActionMapping mapping,ActionForm form,
   HttpServletRequest request, HttpServletResponse response) throws Exception
 {
    return mapping.findForward("success");
 }
}
```

Finally compile the classes and restart the web server and view the AdminForm.jsp

Struts Built-In Actions

These built-in utility actions provide different functionalities useful to diverse applications.

These Action classes are defined in org.apche.struts.actoins package.

Actions	Description
org.apache.struts.actions.DispatchAction	It provides mechanism to collect related functions into a single action and eliminates the need of creating multiple independent actions for each function.
org.apache.struts.actions.ForwardAction	It enables to forward request to the specified URL.
org.apache.struts.actions.IncludeAction	It provides mechanism to include the contents of a specified URL.
org.apache.struts.actions.LocaleAction	It provides mechanism to set a user's locale and further forwarding that to a specified page.
org.apache.struts.actions.LookupDispatchAction	It provides mechanism to combine many similar actions into a single action class, in order to simplify the application design .Java map class is used to dispatch methods.
org.apache.struts.actions.MappingDispatchAction	It lets you combine many related actions into a single action class and manage through creating multiple action-mappings.
org.apache.struts.actions.switchAction	It provides a mechanism to switch between modules and then forwards control to a URI (specified in a number of possible ways) within the new module.

ForwardAction

The ForwardAction (org.apache.struts.actions.ForwardAction) is one of the Built-in Actions that is shipped with struts framework.

The **org.apache.struts.actions.ForwardAction** class enables a user to forward request to the specified URL. ForwardAction is an utility classs that is used in cases where a user simply needs to forward the control to an another JSP page. Linking directly a JSP to an another, violates the MVC principles. So we achieve this through action-mapping. Note that we do not create any action class. With ForwardAction , simply create an action mapping in the Strut Configuration and specify the location where the action will forward the request.

Here in this example you will learn more about Struts Forward Action that will help you in grasping the concept better.

No need to develop an Action Class

Developing the Action Mapping in the struts-config.xml

Create seperate action-mapping , for each page you want to link.. Note that the **"type"** attribute always take **"org.apache.struts.actions.ForwardAction"** value.

Here "**parameter"** attribute specifies the URL to which the request is forwarded .

```
<action
    path="/success"
    type="org.apache.struts.actions.ForwardAction"
    parameter="/pages/Success.jsp"
    input="/pages/ForwardAction.jsp"
    scope="request"
    validate="false">
</action>
```


Developing a jsp page

Code of the jsp (ForwardAction.jsp) to forward request to a different jsp page :

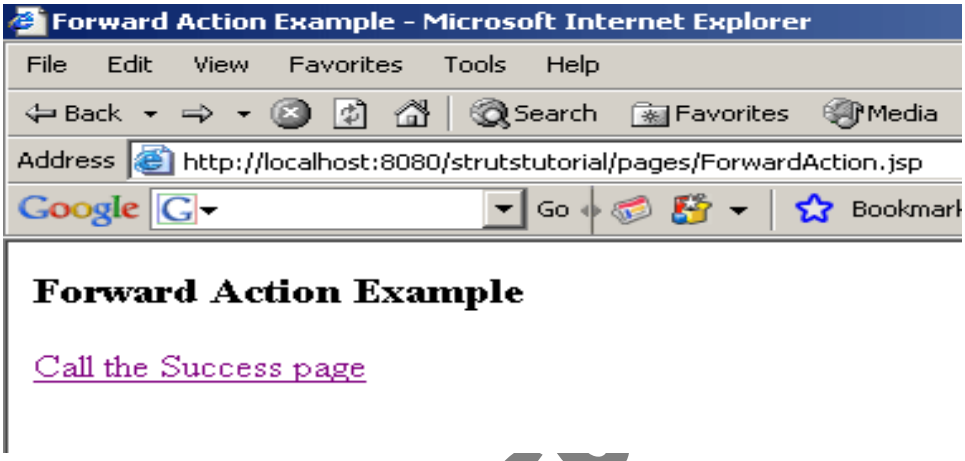
```
<%@ taglib uri="/WEB-INF/struts-bean.tld" prefix="bean"%>
<%@ taglib uri="/WEB-INF/struts-html.tld" prefix="html"%>
<html:html>
<HEAD>
<TITLE>Forward Action Example</TITLE>
<BODY>
<H3>Forward Action Example</H3>
<p><html:link page="/success.do">Call the Success page</html:link></p>
</html:html>
```

Add the following line in the index.jsp to call the form.

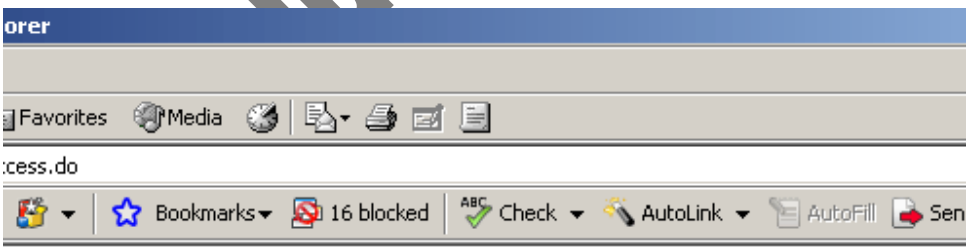
```
<li>
<html:link page="/pages/ForwardAction.jsp">Struts Forward Action</html:link>
<br>
Example shows you how to use forward class to forward request to another JSP page.
</li>
```

Building and Testing the Example

To build and deploy the application go to Struts\Strutstutorial directory and type ant on the command prompt. This will deploy the application. Open the browser and navigate to the ForwardAction.jsp page. Your browser will display the following ForwardAction page.



Selecting **Call the Success page** displays the following **Success.jsp** page



DispatchAction

Struts Dispatch Action (org.apache.struts.actions.DispatchAction) is one of the Built-in Actions provided along with the struts framework.

The **org.apache.struts.actions.DispatchAction** class enables a user to collect related functions into a single Action. It eliminates the need of creating multiple independent actions for each function. Here in this example you will learn more about Struts Dispatch Action that will help you grasping the concept better.

Let's develop **Dispatch_Action** class which is a sub class of **org.apache.struts.actions.DispatchAction** class. This class does not provide an implementation for the **execute()** method because **DispatchAction** class itself implements this method. This class manages to delegate the request to one of the methods of the derived Action class.

An Action Mapping is done to select the particular method (via Struts-onfiguration file).

Here the Dispatch_Action class contains multiple methods ie.. add() , edit() , search() , save(). Here all the methods are taking the same input parameters but each method returns a different ***ActionForward*** like **"add"** in case of **add()** method , **"edit"** in case of **edit()** etc.Each ActionForward is defined in the **struts-config.xml** file (action mapping is shown later in this page).

Here is the code for Action Class.

Developing an Action Class (Dispatch_Action.java)

```
package com.durgasoft.dispatch;
import java.io.*;
import javax.servlet.http.HttpServletRequest;
import javax.servlet.http.HttpServletResponse;
import javax.servlet.ServletException;
import org.apache.struts.actions.DispatchAction;
import org.apache.struts.action.ActionForm;
import org.apache.struts.action.ActionForward;
import org.apache.struts.action.ActionMapping;
public class Dispatch_Action extends DispatchAction
{
public ActionForward add(ActionMapping mapping, ActionForm form,
   HttpServletRequest request,HttpServletResponse response) throws Exception{
   System.out.println("You are in add function.");
     return mapping.findForward("add");
  }
public ActionForward edit(ActionMapping mapping, ActionForm form,
   HttpServletRequest request,HttpServletResponse response) throws Exception {
   System.out.println("You are in edit function.");
   return mapping.findForward("edit");
  }
public ActionForward search(ActionMapping mapping, ActionForm form,
   HttpServletRequest request, HttpServletResponse response) throws Exception{
   System.out.println("You are in search function");
   return mapping.findForward("search");
  }
public ActionForward save(ActionMapping mapping, ActionForm form,
   HttpServletRequest request, HttpServletResponse response) throws Exception{
   System.out.println("You are in save function");
```

```
    return mapping.findForward("save");
 }
}
```

Developing an ActionForm Class

Our form bean class contains only one property **"parameter**" which is playing prime role in this example. Based on the parameter value appropriate function of Action class is executed. Here is the code for **FormBean (DispatchActionForm.java):**

```
package com.durgasoft.dispatch;
import org.apache.struts.action.ActionForm;
public class DispatchActionForm extends ActionForm
{
  private String parameter =" ";
 public String getParameter()
 {
  return parameter;
 }
 public void setParameter(String parameter)
 {
 this.parameter=parameter;
 }
}
```

Defining form Bean in struts-config.xml file

Add the following entry in the struts-config.xml file for defining the form bean

```
<form-bean name="DispatchActionForm"
        type="com.durgasoft.dispatch.DispatchActionForm"/>
```

Developing the Action Mapping in the struts-config.xml

Here, Action mapping helps to select the method from the Action class for specific requests. Note that the value specified with the **parameter attribute** is used to delegate request to the required method of the Dispath_Action Class.

```
<action
    path="/DispatchAction"
    type=" com.durgasoft.dispatch.Dispatch_Action"
    parameter="parameter"
    input="/pages/DispatchAction.jsp"
    name="DispatchActionForm"
    scope="request"
    validate="false">
        <forward name="add" path="/pages/DispatchActionAdd.jsp" />
        <forward name="edit" path="/pages/DispatchActionEdit.jsp" />
        <forward name="search" path="/pages/DispatchActionSearch.jsp"/>
        <forward name="save" path="/pages/DispatchActionSave.jsp" />
</action>
```

Developing jsp page

Code of the jsp (DispatchAction.jsp) to delegate requests to different jsp pages :

```
<%@ taglib uri="/WEB-INF/struts-bean.tld" prefix="bean"%>
<%@ taglib uri="/WEB-INF/struts-html.tld" prefix="html"%>
<html:html>
<HEAD>
<TITLE>Dispatch Action Example</TITLE>
<BODY>
```

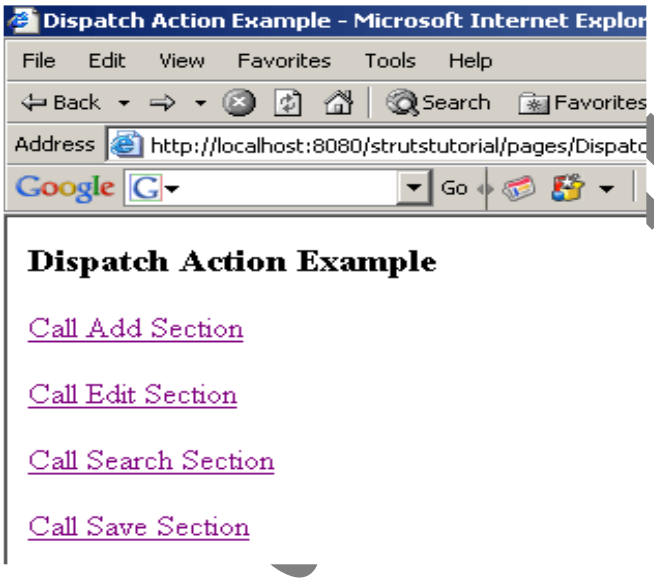
```
<H3>Dispatch Action Example</H3>
<p><html:link page="/DispatchAction.do?parameter=add">Call Add Section
</html:link> </p>
<p><html:link page="/DispatchAction.do?parameter=edit">Call Edit Section
</html:link> </p>
<p><html:link page="/DispatchAction.do?parameter=search">Call Search Section
</html:link> </p>
<p><html:link page="/DispatchAction.do?parameter=save">Call Save Section
</html:link> </p>
</html:html>
```

Add the following line in the index.jsp to call the form.

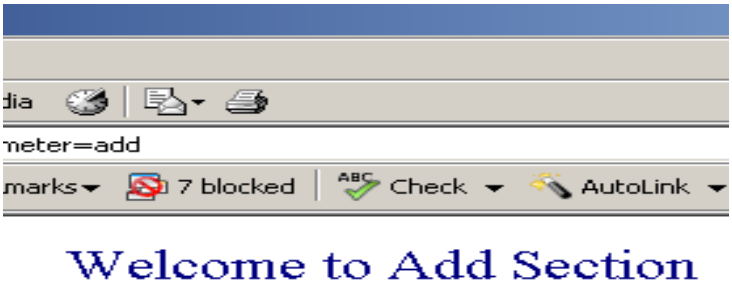
```
<li><html:link page="/pages/DispatchAction.jsp">Struts File Upload</html:link>
<br> Example demonstrates  how DispatchAction Class works. </li>
```

Building and Testing the Example

To build and deploy the application go to Struts\Strutstutorial directory and type ant on the command prompt. This will deploy the application. Open the browser and navigate to the DispatchAction.jsp page. Your browser displays the following DispatchAction page.



Selecting **Call Add Section** displays the following **DispatchActionAdd.jsp** page



LookupDispatchAction

Struts LookupDispatch Action (org.apache.struts.actions.LookupDispatchAction) is one of the Built-in Actions provided along with the struts framework.The **org.apache. struts.actions.LookupDispatchAction** class is a subclass of **org.apache. struts. actions.DispatchAction** class. This class enables a user to collect related functions into a single action class. It eliminates the need of creating multiple independent actions for each function. Here in this example you will learn more about Struts LookupDispatch Action that will help you to grasp the concept better.

Let's develop a class **LookupDispatch_Action** which is a sub class of **org.apache. struts.actions.LookupDispatchAction** class. This class does not provide an implementation for the **execute()** method because **DispatchAction** class itself implements this method. ***LookupDispatchAction class is much like the Dispatch Action class except that it uses a Java Map and ApplicationResource. properties file to dispatch methods.*** At run time, this class manages to delegate the request to one of the methods of the derived Action class. Selection of a method depends on the value of the parameter passed from the incoming request. LookupDispatchAction uses this parameter value to reverse-map to a property in the Struts Resource bundle file (ie..ApplicationResource.properties). This eliminates the need of creating an instance of ActionForm class.

LookupDispatch_Action class contains multiple methods ie.. add() , edit() , search() , save() . Here all the methods are taking the same input parameters but each method returns a different ***ActionForward*** like **"add"** in case of **add()** method , **"edit"** in case of **edit()** etc. Each ActionForward is defined in the **struts-config.xml** file (action mapping is shown later in this page).

Notice the implementation of the **getKeyMethodMap()**method.This method is required to map the names of the keys in the Struts Resource bundle file (ie..ApplicationResource.properties) to the methods in the class. The key values in the bundle file are matched against the value of the incoming request parameter (which is specified in the action tag through struts-config.xml file). Then this matching key is mapped to the appropriate method to execute ,the mecahanism is implemented through the getKeyMethodMap()and can be defined as key-to-method mapping.

Here is the code for Action Class

```
package com.durgasoft.lookupdispatch;
import java.io.*;
import java.util.*;
import javax.servlet.http.*;
import javax.servlet.ServletException;
import org.apache.struts.actions.LookupDispatchAction;
import org.apache.struts.action.ActionForm;
import org.apache.struts.action.ActionForward;
import org.apache.struts.action.ActionMapping;
public class LookupDispatch_Action extends LookupDispatchAction
{
  protected Map getKeyMethodMap()
```

```
        {
        Map map =  new HashMap();
        map.put("form.add","add");
        map.put("form.edit","edit");
        map.put("form.search","search");
        map.put("form.save","save");
        return map;
        }

  public ActionForward add(ActionMapping mapping, ActionForm form,
    HttpServletRequest request, HttpServletResponse response) throws Exception{
    System.out.println("You are in add function.");
      return mapping.findForward("add");
  }

  public ActionForward edit(ActionMapping mapping, ActionForm form,
    HttpServletRequest request, HttpServletResponse response) throws Exception{
    System.out.println("You are in edit function.");
    return mapping.findForward("edit");
  }

    public ActionForward search(ActionMapping mapping, ActionForm form,
    HttpServletRequest request, HttpServletResponse response) throws Exception{
    System.out.println("You are in search function");
    return mapping.findForward("search");
  }

  public ActionForward save(ActionMapping mapping, ActionForm form,
    HttpServletRequest request, HttpServletResponse response) throws Exception{
    System.out.println("You are in save function");
    return mapping.findForward("save");
  }
}
```

No need to Develop an ActionForm Class

Instead create an Application Resource Property File:

Application.properties

we can save this properties fiel in the classes folder.

```
form.add=add
form.edit=edit
form.search=search
form.save=save
```

Add the following, Message Resources Definitions in struts-config.xml

```
<message-resources parameter="ApplicationResources" />
```

Develop the following Action Mapping in the struts-config.xml

Here, Action mapping helps to select the method from the Action class for specific requests. Note that the value specified with the **parameter Pattribute** is used to delegate request to the required method of the LookupDispatch_Action Class.

```
<action
  path="/LookupDispatchAction"
  type=" com.durgasoft.lookupdispatch .LookupDispatch_Action"
  parameter="parameter"
  input="/pages/LookupDispatchAction.jsp"
  name="LookupDispatchActionForm"
  scope="request"
  validate="false">
    <forward name="add" path="/pages/LookupDispatchActionAdd.jsp" />
    <forward name="edit" path="/pages/LookupDispatchActionEdit.jsp" />
    <forward name="search" path="/pages/LookupDispatchActionSearch.jsp"/>
    <forward name="save" path="/pages/LookupDispatchActionSave.jsp" />
</action>
```

Developing jsp page

Code of the jsp (LookupDispatchAction.jsp) to delegate requests to different jsp pages :

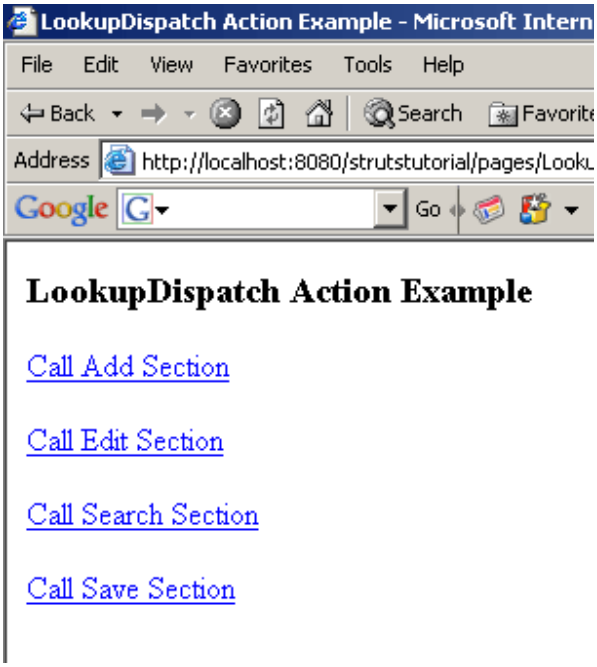
```
<%@ taglib uri="/WEB-INF/struts-bean.tld" prefix="bean"%>
<%@ taglib uri="/WEB-INF/struts-html.tld" prefix="html"%>
<html:html>
<p><html:link page="/LookupDispatchAction.do?parameter=add">Call Add Section
</html:link></p>
<p><html:link page="/LookupDispatchAction.do?parameter=edit">Call Edit Section
</html:link></p>
<p><html:link page="/LookupDispatchAction.do?parameter=search">Call Search
Section </html:link></p>
<p><html:link page="/LookupDispatchAction.do?parameter=save">Call Save Section
</html:link></p>
</html:html>
```

Add the following line in the index.jsp to call the form.

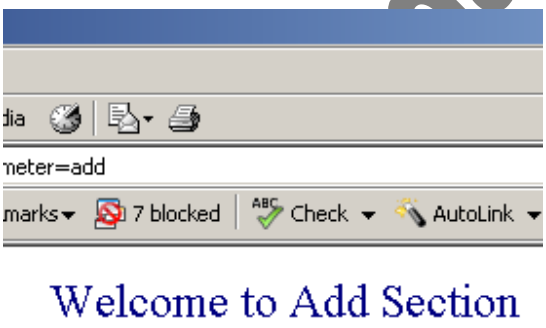
```
<li>
<html:link page="/pages/LookupDispatchAction.jsp">Struts File Upload</html:link>
<br>
Example demonstrates how LookupDispatchAction class works.
</li>
```

Building and Testing the Example

To build and deploy the application go to Struts\Strutstutorial directory and type ant on the command prompt. This will deploy the application. Open the browser and navigate to the **LookupDispatchAction.jsp** page. Your browser displays the following LookupDispatchAction page.



Selecting **Call Add Section** displays the following **LookupDispatchActionAdd.jsp** Page



MappingDispatchAction

Struts MappingDispatch Action (org.apache.struts.actions.MappingDispatchAction) is one of the Built-in Actions provided along with the struts framework.

The **org.apache.struts.actions.MappingDispatchAction** class is a subclass of **org.apache.struts.actions.DispatchAction** class. This class enables a user to collect related functions into a single action class. It needs to create multiple independent actions for each function. Here in this example you will learn more about Struts MappingDispatchAction that will help you to grasp the concept better. Let's develop a class **MappingDispatch_Action** which is a sub class of **org.apache.struts.actions. MappingDispatchAction** class. This class does not provide an implementation for the **execute()** method because **DispatchAction** class itself implements this method. ***MappingDispatchAction class is much like the DispatchAction class except that it uses a unique action corresponding to a new request,to dispatch the methods*** At run time, this class manages to delegate the request to one of the methods of the derived Action class. Selection of a method depends on the value of the parameter passed from the incoming request. MappingDispatchAction uses this request parameter value and selects a corresponding action from the different action-mappings defined. This eliminates the need of creating an instance of ActionForm class. MappingDispatch_Action class contains multiple methods ie.. add() , edit() , search() , save() . Here all the methods are taking the same input parameters but each method returns a different ***ActionForward*** like **"add"** in case of **add()** method , **"edit"** in case of **edit()** etc.

Each ActionForward is defined in the **struts-config.xml** file (action mapping is shown laterin this page).

Developing an Action Class (MappingDispatch_Action.java)

```
package com.durgasoft.mappingdispatch;
import java.io.*;
import java.util.*;
import javax.servlet.http.HttpServletRequest;
import javax.servlet.http.HttpServletResponse;
import javax.servlet.ServletException;
import org.apache.struts.actions.MappingDispatchAction;
import org.apache.struts.action.ActionForm;
import org.apache.struts.action.ActionForward;
import org.apache.struts.action.ActionMapping;
public class MappingDispatch_Action extends MappingDispatchAction
{
  public ActionForward add(ActionMapping mapping, ActionForm form,
    HttpServletRequest request, HttpServletResponse response) throws Exception{
    System.out.println("You are in add function.");
      return mapping.findForward("add");  }
  public ActionForward edit(ActionMapping mapping, ActionForm form,
    HttpServletRequest request, HttpServletResponse response) throws Exception{
    System.out.println("You are in edit function.");
    return mapping.findForward("edit");  }
public ActionForward search(ActionMapping mapping, ActionForm form,
    HttpServletRequest request, HttpServletResponse response) throws Exception{
    System.out.println("You are in search function");
    return mapping.findForward("search");  }
```

```
public ActionForward save(ActionMapping mapping, ActionForm form,
   HttpServletRequest request, HttpServletResponse response) throws Exception{
   System.out.println("You are in save function");
   return mapping.findForward("save");
  }
}
```

No need to Develop an ActionForm Class

Developing the Action Mapping in the struts-config.xml

Here, we need to create multiple independent actions for each method defined in the action class. Note that the value specified with the **parameter attribute** is used to delegate request to the required method of the MappingDispatch_Action Class.

```
<action path="/MappingDispatchAction"
   type=" com.durgasoft.mappingdispatch.MappingDispatch_Action"
   parameter="add"
   input="/pages/MappingDispatchAction.jsp"
   scope="request"
   validate="false">
    <forward name="add" path="/pages/MappingDispatchActionAdd.jsp" />
 </action>
<action path="/MappingDispatchAction"
  type=" com.durgasoft.mappingdispatch.MappingDispatch_Action"
  parameter="edit"
  input="/pages/MappingDispatchAction.jsp"
  scope="request"
  validate="false">
   <forward name="edit" path="/pages/MappingDispatchActionEdit.jsp" />
</action>
<action path="/MappingDispatchAction"
  type=" com.durgasoft.mappingdispatch.MappingDispatch_Action"
  parameter="search"
  input="/pages/MappingDispatchAction.jsp"
  scope="request"
  validate="false">
  <forward name="search" path="/pages/MappingDispatchActionSearch.jsp"/>
</action>
<action path="/MappingDispatchAction"
  type=" com.durgasoft.mappingdispatch.MappingDispatch_Action"
  parameter="save"
  input="/pages/MappingDispatchAction.jsp"
  scope="request"
  validate="false">
  <forward name="save" path="/pages/MappingDispatchActionSave.jsp" />
</action>
```

eveloping jsp page

Code of the jsp (MappingDispatchAction.jsp) to delegate requests to different jsp pages

```
<%@ taglib uri="/WEB-INF/struts-bean.tld" prefix="bean"%>
<%@ taglib uri="/WEB-INF/struts-html.tld" prefix="html"%>
<html:html>
<H3>Dispatch Action Example</H3>
<p><html:link page="/MappingDispatchAction.do?parameter=add">Call Add Section
</html:link></p>
```

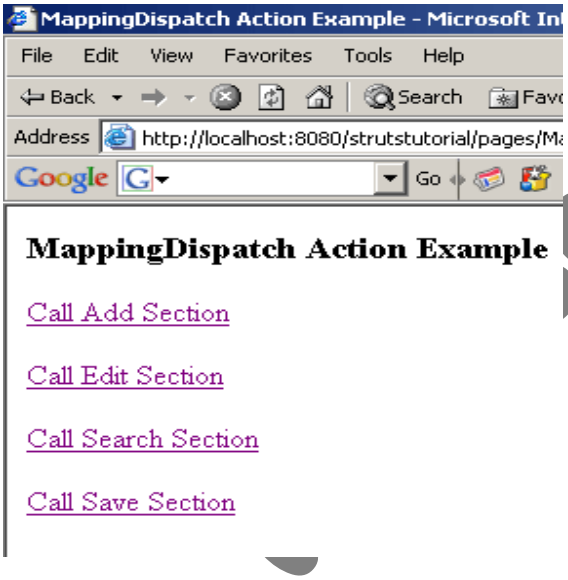
```
<p><html:link page="/MappingDispatchAction.do?parameter=edit">Call Edit Section
</html:link></p>
<p><html:link page="/MappingDispatchAction.do?parameter=search">Call Search
Section </html:link></p>
<p><html:link page="/MappingDispatchAction.do?parameter=save">Call Save Section
</html:link></p>
</html:html>
```

Add the following line in the index.jsp to call the form.

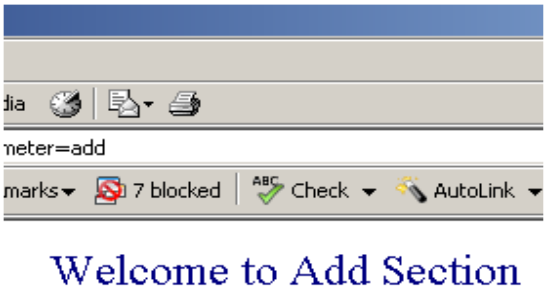
```
<li>
<html:link page="/pages/MappingDispatchAction.jsp">Struts File Upload</html:link>
<br>
Example demonstrates  how MappingDispatchAction class works.
</li>
```

Building and Testing the Example

To build and deploy the application go to Struts\Strutstutorial directory and type ant on the command prompt. This will deploy the application. Open the browser and navigate to the MappingDispatchAction.jsp page. Your browser displays the following MappingDispatchAction page.



Selecting **Call Add Section** displays the following **MappingDispatchActionAdd.jsp** page



FileUpload

The interface **org.apache.struts.upload.FormFile** is the heart of the struts file upload application_This interface represents a file that has been uploaded by a client. It is the only interface or class in upload package which is typically referenced directly by a Struts application.

Creating Form Bean

Our form bean class contains only one property **theFile**, which is of type **org.apache.struts.upload.FormFile**.
Here is the code of FormBean **(UploadForm.java)**

```
package com.durgasoft.upload
import org.apache.struts.upload.FormFile;
import org.apache.struts.action.ActionForm;
public class UploadForm extends ActionForm
    {
        private FormFile file1;
        private FormFile file2;
        public FormFile getFile1()
          {
           return file1;
            }
        public void setFile1(FormFile file1)
           {
           this.file1 = file1;
             }
         public FormFile getFile2()
          {
          return file2;
            }
         public void setFile2(FormFile file2)
           {
           this.file2 = file2;
          }
}
```


Creating Action Class

Our action class simply calls the **getTheFile()** function on the **FormBean** object to retrieve the reference of the uploaded file. Then the reference of the FormFile is used to get the uploaded file and its information. Here is the code of UploadAction class.

```
package com.durgasoft.upload;
import java.io.*;
import javax.servlet.http.*;
import org.apache.struts.action.*;
import org.apache.struts.upload.FormFile;
public class UploadAction extends Action {
public ActionForward execute(ActionMapping mapping, ActionForm form,
HttpServletRequest request, HttpServletResponse response) throws Exception
```

```
    {
      UploadForm uform = (UploadForm) form;
       FormFile f1 =uform.getFile1();
       FormFile f2 =uform.getFile2();
       InputStream s1=f1.getInputStream();
       InputStream s2=f2.getInputStream();
       String fname1=f1.getFileName();
       String fname2=f2.getFileName();
       request.setAttribute("fName1", fname1);
       request.setAttribute("fName2", fname2);
     return mapping.findForward("result");
    }
}
```

Defining form Bean in struts-config.xml file

Add the following entry in the struts-config.xml file for defining the form bean:

```
<form-bean
   name="FileUpload"
   type=" com.durgasoft.upload.UploadForm"/>
```

Defining Action Mapping

Add the following action mapping entry in the struts-config.xml file:

```
<action-mappings>
   <action  path="/upload"
            type="com.durgasoft.upload.UploadAction"
            name=" FileUpload ">
      <forward name="result" path="/result.jsp" />
   </action>
</action-mappings>
```

Developing jsp page

Code of the jsp (FileUpload.jsp) file to upload is as follows:

```
<%@ taglib uri="XYZ" prefix="html" %>
<html:form action="upload.do" enctype="multipart/form-data">
 <center><h1>Please Select The File</h1></center>
 Enter File1   <html:file property="file1" /><br /><br />
 Enter File2 <html:file property="file2" /><br /><br />
 <html:submit />
</html:form>
```

Note that we are setting the encrypt property of the form to **enctype="multipart/form-data".**

code for the result page (**Result.jsp)** is:

```
<b>The File Name1</b>: <%= request.getAttribute("fName1") %> <br />
<b>The File Name2</b>: <%= request.getAttribute("fName2") %> <br />
```

Struts PlugIn

Struts PlugIn allows the programmer to enhance their web applications. There are many PlugIns available for struts e.g. Struts Tiles PlugIn, Struts Hibernate PlugIn, Struts Spring PlugIn etc. Beside these available PlugIn you can create your own PlugIn.

Understanding PlugIn.

Struts PlugIns are configured using the <plug-in> element within the Struts configuration file. This element has only one valid attribute, 'className', which is the fully qualified name of the Java class which implements the org.apache.struts.action. PlugIn interface. For PlugIns that require configuration themselves, the nested <set-property> element is available.

The plug-in tag in the struts-config.xml file is used to declare the PlugIn to be loaded at the time of server start-up. Following example shows how to declare the Tiles PlugIn:

```
<plug-in className="org.apache.struts.tiles.TilesPlugin">
   <set-property property="definitions-config"
                  value="/WEB-INF/tiles-defs.xml"/>
</plug-in>
```

The above declaration instructs the struts to load and initialize the Tiles plugin for your application on startup.

Writing Struts PlugIn Java Code

In this example we write HelloWorld Struts PlugIn example that will give you idea about creating, configuring and checking Struts PlugIn. Our HelloWorld Stuts PlugIn contains a method called Say Hello, which simply returns HelloWorld message.

Here is code of HelloWorld Struts Plugin:

```
package com.durgasoft.plugin;
import javax.servlet.ServletContext;
import javax.servlet.ServletException;
import org.apache.struts.action.PlugIn;
import org.apache.struts.action.ActionServlet;
import org.apache.struts.config.ModuleConfig;
public class HelloWorldStrutsPlugin implements PlugIn {
    public static final String PLUGIN_NAME_KEY
          = HelloWorldStrutsPlugin.class.getName();

   public void destroy() {
     System.out.println("Destroying Hello World PlugIn");
   }
   public void init(ActionServlet servlet, ModuleConfig config)
throws ServletException {
     System.out.println("Initializing Hello World PlugIn");
   ServletContext context = null;
   context = servlet.getServletContext();
   HelloWorldStrutsPlugin objPlugin = new HelloWorldStrutsPlugin();
   context.setAttribute(PLUGIN_NAME_KEY, objPlugin);

   }
```

```
public String sayHello(){
  System.out.println("Hello Plugin");
  return "Hello Plugin";
}
```

Configuring PlugIn

To configure the plugin add the following line your struts-config.xml file.

```
<plug-in className="com.durgasoft.plugin.HelloWorldStrutsPlugin">
</plug-in>
```

Calling PlugIn From JSP Page

Here is the code for calling our PlugIn from jsp page.

```
<%@page contentType="text/html" import="java.util.*,com.durgasoft.plugin.*" %>
<%
ServletContext servletContext = this.getServletContext();
HelloWorldStrutsPlugin plugin= (HelloWorldStrutsPlugin)
servletContext.getAttribute
(HelloWorldStrutsPlugin.PLUGIN_NAME_KEY);
String strMessage = plugin.sayHello();
%>

Message From Plugin: <%=strMessage%>
```

Building and Testing

Use ant tool to build the application and then deploy on the server. Enter the url http://localhost:8080/strutstutorial/pages/plugin.jsp in your browser. It display "**Hello Plugin**" message. Your server console also should display "Hello Plugin" message.

STRUTS INTERNATIONALIZATION

The Multinational Corporations have their branches in various parts of the world. so, they must provide products and services to their clients and customers in their traditional way. The customers will expect the product to work in their native languages especially the date, time, currency etc.,. So, the we should not make any assumptions about their clients region or language. If such assumptions become invalid, we have to re-engineer the applications.

Internationalization or I18N is the process of designing the software to support multiple languages and regions, so that we don't need to re-engineer the applications every language or country needs to be supported.

Struts provides various locale sensitive JSP tags which can be used to make the applications simpler. With this short introduction we shall see how to implement i18n in a Simple JSP file of Struts.

```
<%@ page language="java" %>
<%@ taglib uri="/WEB-INF/struts-html.tld" prefix="html" %>
<%@ taglib uri="/WEB-INF/struts-bean.tld" prefix="bean" %>
<%@ taglib uri="/WEB-INF/struts-logic.tld" prefix="logic" %>
<html:html locale="true">
<body bgcolor=pink>
<bean:message key="index.info" />
</body>
</html:html>
```

Next copy struts-blank.war to f:\tomcat\webapps and start the tomcat with JAVA_HOME as jdk1.4. A folder named struts-blank will be created. Rename the folder as localedemo. Copy the above JSP file to f:\tomcat\webapps\localedemo. Now we have to edit the property files for various locales. The struts framework (struts1.1) provides a property file named application.properties. It is present in the folder **f:\tomcat\webapps\localedemo\web-inf\classes\resources**. We have to add our own property file in this folder only. Our property file much be named along with the language code

For example the language code of

1. German - de
2. Spanish - es
3. English - en
4. Korean - ko
5. French - fr
6. Italy – it

So, when we write i18n message in German language it must be placed in property file named application_de.properties and all the properties files must be present in the resources folder only. Also when we write the property file of a particular language it need not be of the same language. For example we can create application_de.properties and write the message in french or english. In fact, the message does not depend on any language. It is a simple key value pair. The message we give for the key is just substituted. The property file to locate the value of key depends on the language settings of the browser.

For this example, we will write four properties file as follows.
f:\tomcat\webapps\localedemo\web-inf\classes\resources\ application_de.properties

index.info=GERMANY
---
f:\tomcat\webapps\localedemo\web-inf\classes\resources\ application_es.properties

index.info=SPAIN
---
f:\tomcat\webapps\localedemo\web-inf\classes\resources\ application_en.properties

index.info=ENGLISH
---
f:\tomcat\webapps\localedemo\web-inf\classes\resources\ application_fr.properties

index.info=FRANCE

Also append this text in the **application.properties** file
index.info=STRUTS TUTORIAL.
Now we have to add entry in the
struts-config.xml file for all the properties files. The entry and its corresponding portion is shown below.

```
<!-- Message Resources Definitions -->

    <message-resources parameter="resources.application_fr"/>
    <message-resources parameter="resources.application_es"/>
    <message-resources parameter="resources.application_en"/>
    <message-resources parameter="resources.application_de"/>
    <message-resources parameter="resources.application"/>
```

Now restart the Tomcat server. Open the Internet Explorer and type the URL as **http://localhost:8080/localedemo/localedemo.jsp**. We will get the message 'ENGLAND'. This is because our default browser language is 'United States English'.

Now we have to change the language settings of the browser to change the locale. For that, Open a new Internet Explorer, goto 'Tools' menu and select the 'Internet Options'. In the 'Internet Option' dialog box, select 'General' tab and click the 'Languages...' button. We will get 'Language Preference' dialog box. There click 'Add...' button and add the languages. For this example add **English, Spanish, German and French**. Here we have languages specific to particular region. For example we have, French Belgium, French Canada, French France etc., we can select any one of these in all cases. Next select 'German' and by using the 'Move up' button, place it on the top. Now type the URL as http://localhost:8080/localedemo/localedemo.jsp. We will get the message 'GERMAN' similarly place 'Spanish' and 'French' at the top, we will get the message 'SPAIN' and 'FRANCE' respectively.

Struts Tag Libraries

The Struts framework provides a set of six built-in Tag libraries that allow you to build the view part of the MVC without embedding Java code directly within your application JSPs.
The six Struts libraries are:

- Bean Tags
- HTML Tags
- Logic Tags
- Nested Tags
- Template Tags
- Tiles Tags

The Bean Tags

The Tags within the Bean Library are used for creating and accessing JavaBeans and a few other general purpose uses. Although these tags work with any standard JavaBean, they are often used with Objects that extend the Struts ActionForm class. Table 1 lists the tags within the Bean Library.

Tags within the Struts Bean Tag Library

Tag Name	Description
cookie	Define a scripting variable based on the value(s) of the specified request cookie.
define	Define a scripting variable based on the value(s) of the specified bean property.
header	Define a scripting variable based on the value(s) of the specified request header.
include	Load the response from a dynamic application request and make it available as a bean.
message	Render an internationalized message string to the response.
page	Expose a specified item from the page context as a bean.
parameter	Define a scripting variable based on the value(s) of the specified request parameter.
resource	Load a web application resource and make it available as a bean.
size	Define a bean containing the number of elements in a Collection or Map.
struts	Expose a named Struts internal configuration object as a bean.
write	Render the value of the specified bean property to the current JspWriter.

Two of the most often used Tags from above Table are the message and write Tags.

The HTML Tags

Struts provides HTML tag library for easy creation of user interfaces. There are also a few other useful Tags used in the creation and rendering of HTML-based user interfaces. The Tags included within the HTML Library are shown in following table.
To use the Struts HTML Tags we have to include the following line in our JSP file:
<%@ taglib uri="/tags/struts-html" prefix="html" %>
above code makes available the tag to the jsp.

Tags within the Struts HTML Tag Library

Tag Name	Description
base	**Render an HTML <base> Element** Tag generates the base tag. <BASE ...> tells the browser to pretend that the current page is located at some URL other than where the browser found it. Any relative reference will be calculated from the URL given by <BASE HREF="..."> instead of the actual URL. <BASE ...> goes in the <HEAD> section.
button	Render a Button Input Field Renders an HTML <input> element of type button, populated from the specified value or the content of this tag body. This tag is only valid when nested inside a form tag body
cancel	Render a Cancel Button
checkbox	Render a Checkbox Input Field Renders an HTML <input> element of type checkbox, populated from the specified value or the specified property of the bean associated with our current form. This tag is only valid when nested inside a form tag body.
errors	Tag prints all the available error on the page.
file	Tag creates the file upload element on the form. The property must be of the type org.apache.struts.upload.FormFile.
form	Define an Input Form Renders an HTML <form> element whose contents are described by the body content of this tag. The form implicitly interacts with the specified request scope or session scope bean to populate the input fields with the current property values from the bean.
frame	Render an HTML frame element
hidden	Tag creates the hidden html element on the form.

html	Render an HTML <html> Element
image	Render an input tag of type "image"
img	Render an HTML img tag
javascript	Render JavaScript validation based on the validation rules loaded by the ValidatorPlugIn. The set of validation rules that should be generated is based on the formName attribute passed in, which should match the name attribute of the form element in the xml file.
link	Render an HTML anchor or hyperlink
messages	Looks up the message corresponding to the given key in the message resources and displays it.
multibox	Render a Checkbox Input Field
option	Render a Select Option
options	Render a Collection of Select Options
optionsCollection	Render a Collection of Select Options
password	Tag creates the password field. The string is stored in the property named prop in the form bean.
radio	Render a Radio Button Input Field
reset	Tag creates a reset button with the provided content as the button text.
rewrite	Render an URI
select	Tag creates list box on the form. The property selectBox must be an array of supported data-types, and the user may select several entries. Use <html:options> to specify the entries.
submit	Tag creates a submit button with the provided content as the button text.
text	Tag creates the text field. The string is retrieved from and later stored in the property named text1 in the form bean.
textarea	Render a Textarea Field
xhtml	Render HTML tags as XHTML

Most all of the Tags within the HTML Tag library must be nested within the Struts Form Tag.

The Logic Tags

The Logic Tag Library contains tags that are helpful with iterating through collections, conditional generation of output, and application flow. Table 3 lists the Tags within the Logic Library.

Tags within the Struts Logic Tag Library

Tag Name	Description
empty	Evaluate the nested body content of this tag if the requested variable is either null or an empty string.
equal	Evaluate the nested body content of this tag if the requested variable is equal to the specified value.
forward	Forward control to the page specified by the specified ActionForward entry.
greaterEqual	Evaluate the nested body content of this tag if the requested variable is greater than or equal to the specified value.
greaterThan	Evaluate the nested body content of this tag if the requested variable is greater than the specified value.
iterate	Repeat the nested body content of this tag over a specified collection.
lessEqual	Evaluate the nested body content of this tag if the requested variable is greater than or equal to the specified value.
lessThan	Evaluate the nested body content of this tag if the requested variable is less than the specified value.
match	Evaluate the nested body content of this tag if the specified value is an appropriate substring of the requested variable.
messagesNotPresent	Generate the nested body content of this tag if the specified message is not present in this request.
messagesPresent	Generate the nested body content of this tag if the specified message is present in this request.
notEmpty	Evaluate the nested body content of this tag if the requested variable is neither null, nor an empty string, nor an empty java.util.Collection (tested by the .isEmpty() method on the java.util.Collection interface).
notEqual	Evaluate the nested body content of this tag if the requested variable is not equal to the specified value.
notMatch	Evaluate the nested body content of this tag if the specified value is not an appropriate substring of the requested variable.

notPresent	Generate the nested body content of this tag if the specified value is not present in this request.
present	Generate the nested body content of this tag if the specified value is present in this request.
redirect	Render an HTTP Redirect.

The Nested Tags

The Nested Tags were added to Struts during development of the 1.1 release. They extend the existing Tags functionality by allowing the Tags to relate to each other is a nested fashion. This is most useful when dealing with Object graphs.

The Nested Tags don't add any additional functionality over the Struts standard Tags other than to support the nested approach. For each Tag in the Bean, HTML, and Logic libraries, there is an equivalent nested Tag.

The Template Tags

The Template Tag Library was created to reduce the redundancy found in most web applications. In most web sites, there are sections within multiple pages that are exactly the same. The header, menus, or footers are three obvious examples. Instead of duplicating the content in each page and having to modify all pages when something like the look and feel changes, Templates allow you to have the common content in one place and insert it where necessary.

However, since the Tiles framework was introduced, the Template Tags have been deprecated and developers are encouraged to use Tiles.

Tiles Library Tags

As mentioned earlier, the Tiles framework is now integrated into the core Struts framework. Tiles is similar to the Template Tags except that it adds much more functionality and flexibility. For instance, Tiles supports inheritance between Tiles and allows you to define layouts and reuse those layouts within your site. They also support different Tiles and layouts based on I18N and channel. The Tags with the Tiles Library are shown in Table 4.

Tags within the Struts Tiles Tag Library

Tag Name	**Description**
add	Add an element to the surrounding list. Equivalent to 'put', but for list element.
definition	Create a tile/component/template definition bean.

get	Gets the content from request scope that was put there by a put tag.
getAsString	Render the value of the specified tile/component/template attribute to the current JspWriter.
importAttribute	Import Tile's attribute in specified context.
initComponentDefinitions	Initialize Tile/Component definitions factory.
insert	Insert a tiles/component/template.
put	Put an attribute into tile/component/template context.
putList	Declare a list that will be pass as attribute to tile.
useAttribute	Use attribute value inside page.

Tiles FrameWork

What is Struts Tiles?

Tiles is a framework for the development user interface. Tiles is enables the developers to develop the web applications by assembling the reusable tiles (jsp, html, etc..). Tiles uses the concept of reuse and enables the developers to define a template for the web site and then use this layout to populate the content of the web site. For example, if you have to develop a web site having more that 500 page of static content and many dynamically generated pages. The layout of the web site often changes according to the business requirement. In this case you can use the Tiles framework to design the template for the web site and use this template to populate the contents. In future if there is any requirement of site layout change then you have to change the layout in one page. This will change the layout of you whole web site.

Steps To Create Tiles Application

Tiles is very useful framework for the development of web applications. Here are the steps necessary for adding Tiles to your Struts application:

1. Add the Tiles Tag Library Descriptor (TLD) file to the web.xml.
2. Create layout JSPs.
3. Develop the web pages using layouts.
4. Repackage, run and test application.
5.

Add the Tiles TLD to web.xml file

Tiles can can be used with or without Struts. Following entry is required in the web.xml file before you can use the tiles tags in your application.

```
<taglib>
    <taglib-uri>/tags/struts-tiles</taglib-uri>
     <taglib-location>/WEB-INF/struts-tiles.tld</taglib-location>
</taglib>
```

Create layout JSPs.

Our web application layout is divided into four parts: To Banner, Left Navigation Bar, Content Area and Bottom of the page for copy right information. Here is the code for out template (**template.jsp**):

```
<%@ taglib uri="/WEB-INF/struts-tiles.tld" prefix="tiles" %>
<html>
<head>
   <title><tiles:getAsString name="title" ignore="true"/></title>
</head>
<body>
<table border="1" cellpadding="0" cellspacing="0" width="100%"
bordercolor="#000000" bgcolor="#E7FDFE">
<tr>
<td width="100%" colspan="2" valign="top"><tiles:insert
attribute="header"/></td>
</tr>
<tr>
<td width="23%"><tiles:insert attribute="menu"/></td>
```

```
<td width="77%" valign="top" valign="top"><tiles:insert attribute="body"/></td>
</tr>
<tr>
<td width="100%" colspan="2" valign="top"><tiles:insert
attribute="bottom"/></td>
</tr>
</table>
</body>
</html>
```

We have defined the structure for web application using the appropriate html and did the following things:

- Referenced the /WEB-INF/struts-tiles.tld TLD.
- Used the string parameters to display title using the tiles:getAsString tag. If the attribute **ignore="true"** then Tiles ignore the missing parameter. If this is true then the Tiles framework will through the exception in case the parameter is missing.
- To insert the content JSP, the **tiles:insert** tag is used, which inserts any page or web resources that framework refers to as a title. For Example **<tiles:insert attribute="header"/>** inserts the header web page.

Develop the web pages using layouts

Now we will use tile layout create a page to display the content page in the in our application. For every content page there is additional jsp file for inserting the content in the Layout, so we have to create two jsp files one for content and another for displaying the content. In our example these file are example.jsp and content.jsp. Here is the code for both the files:

content.jsp

```
<p align="left"><font color="#000080" size="5">Welcome to the Title
Tutorial</font></p>
<p align="left"><font color="#000080" size="5">This is the content page</font></p>
```

The content.jsp simply define the content of the page. The content may be dynamic or static depending on the requirements.

example.jsp

```
<%@ page language="java" %>
<%@ taglib uri="/WEB-INF/struts-tiles.tld" prefix="tiles" %>
<tiles:insert page="/tiles/template.jsp" flush="true">
   <tiles:put name="title" type="string" value="Welcome" />
   <tiles:put name="header" value="/tiles/top.jsp" />
   <tiles:put name="menu" value="/tiles/left.jsp" />
   <tiles:put name="body" value="/tiles/content.jsp" />
   <tiles:put name="bottom" value="/tiles/bottom.jsp" />
</tiles:insert>
```

The code **<tiles:insert page="/tiles/template.jsp" flush="true">** specifies the tiles layout page to be used. We have set the flush attribute to true, this makes the tile file to be written to browser before the rest of the page. To specify the title of the page **<tiles:put name="title" type="string" value="Welcome" />** is used. The following code is used to insert the actual pages in the template.:

```
<tiles:put name="header" value="/tiles/top.jsp" />
<tiles:put name="menu" value="/tiles/left.jsp" />
<tiles:put name="body" value="/tiles/content.jsp" />
<tiles:put name="bottom" value="/tiles/bottom.jsp" />
```

The top.jsp will be inserted in the layout's header region. The left.jsp will be inserted in the layout's menu region. The content.jsp wil be inserted in the layout's body region and the bottom.jsp will be inserted in the bottom region.
Repackage, run and test application

Add the following code in the index.jsp to test the this tile example:

```
<li>
<html:link page="/tiles/example.jsp">Tiles Example</html:link>
<br>
Example of creating first tile application.
</li>
```

Use the ant tool to build the application and deploy on the server. To test the application go to the index.jps and click on the Tiles Example link.

Using tiles-defs.xml in Tiles Application

In Tiles we can define the definition in the tiles-defs.xml which specifies the different components to "plugin" to generate the output. This eliminates the need to define extra jsp file for each content file. For example in the last section we defined example.jsp to display the content of content.jsp file. In this section I will show you how to eliminate the need of extra jsp file using tiles-defs.xml file.

Steps to Use the tiles-defs.xml

Setup the Tiles plugin in struts-config.xml file.

Add the following code in the struts-config.xml (If not present). This enables the TilesPlugin to use the /WEB-INF/tiles-defs.xml file.

```
<plug-in className="org.apache.struts.tiles.TilesPlugin" >
      <!-- Path to XML definition file -->
      <set-property property="definitions-config" value="/WEB-INF/tiles-defs.xml" />
      <!-- Set Module-awareness to true -->
      <set-property property="moduleAware" value="true" />
</plug-in>
```

Defining the tiles-defs.xml

In this file we are defining the different components to "plugin". Here is the code:

```
<definition name="Tiles.Example" page="/tiles/template.jsp">
      <put name="title" type="string" value="Welcome" />
      <put name="header" value="/tiles/top.jsp" />
      <put name="menu" value="/tiles/left.jsp" />
      <put name="body" value="/tiles/content.jsp" />
      <put name="bottom" value="/tiles/bottom.jsp" />
</definition>
```

The name of the definition is Tiles.Example, we will use this in struts-config.xml (While creating forwards in struts-config.xml file) file. The page attribute defines the template

file to be used and the put tag specifies the different components to "plugin". Your tiles-defs.xml should look like:

```
<?xml version="1.0" encoding="ISO-8859-1" ?>

<!DOCTYPE tiles-definitions PUBLIC
"-//Apache Software Foundation//DTD Tiles Configuration 1.1//EN"
"http://jakarta.apache.org/struts/dtds/tiles-config_1_1.dtd">

<tiles-definitions>
    <definition name="Tiles.Example" page="/tiles/template.jsp">
        <put name="title" type="string" value="Welcome" />
        <put name="header" value="/tiles/top.jsp" />
        <put name="menu" value="/tiles/left.jsp" />
        <put name="body" value="/tiles/content.jsp" />
        <put name="bottom" value="/tiles/bottom.jsp" />
    </definition>
<definition name="${YOUR_DEFINITION_HERE}">
</definition>
</tiles-definitions>
```

Configure the Struts Action to use Tiles Definition

Open the struts-config.xml file and add the following code:

```
<action path="/Tiles/Example"
      forward="Tiles.Example"/>
```

With Tiles, the action points to the Tiles definition, as shown in the above code. In this code we are using the **Tiles.Example** definition which we have defined in the tiles-defs.xml file. Without Tiles, forward and action definitions point directly to JSPs. With Tiles, they point to the page's definition in the Tiles configuration file.

Testing the Application

Create a link in index.jsp to call the Example. Code added are:

```
<li>
<html:link page="/Tiles/Example.do">Using tiles-defs.xml</html:link>
<br>
Example shows you how to use tiles-defs.xml file.
</li>
```

To test the application build it using ant and deploy on the Tomcat server.
Type http://localhost:8080/strutstutorial/index.jsp in the bowser and select the Using tiles-defs.xml link. Your browser should show the page..

Design Patterns

What is the design pattern?

If a problem occurs over and over again, a solution to that problem has been used effectively. That solution is described as a pattern. The design patterns are language-independent strategies for solving common object-oriented design problems. When you make a design, you should know the namesj of some common solutions. Learning design patterns is good for people to communicate each other effectively. In fact, you may have been familiar with some design patterns, you may not use well-known names to describe them. SUN suggests GOF (Gang of Four--four pioneer guys who wrote a book named "Design Patterns"- Elements of Reusable Object-Oriented Software), so we use that book as our guide to describe solutions. Please make you be familiar with these terms and learn how other people solve the code problems.

Do I have to use the design pattern?

If you want to be a professional Java developer, you should know at least some popular solutions to coding problems. Such solutions have been proved efficient and effective by the experienced developers. These solutions are described as so-called design patterns. Learning design patterns speeds up your experience accumulation in OOA/OOD. Once you grasped them, you would be benefit from them for all your life and jump up yourselves to be a master of designing and developing. Furthermore, you will be able to use these terms to communicate with your fellows or assessors more effectively.

Many programmers with many years experience don't know design patterns, but as an Object-Oriented programmer, you have to know them well, especially for new Java programmers. Actually, when you solved a coding problem, you have used a design pattern. You may not use a popular name to describe it or may not choose an effective way to better intellectually control over what you built. Learning how the experienced developers to solve the coding problems and trying to use them in your project are a best way to earn your experience and certification.

Remember that learning the design patterns will really change how you design your code; not only will you be smarter but will you sound a lot smarter, too.

How many design patterns?

Many. A site says at least 250 existing patterns are used in OO world, including Spaghetti which refers to poor coding habits. The 23 design patterns by GOF are well known, and more are to be discovered on the way.
Note that the design patterns are not idioms or algorithms or components.

What is the relationship among these patterns?

Using a single component to process application requests. Generally, to build a system, you may need many patterns to fit together. Different designer may use different patterns to solve the same problem. Usually:

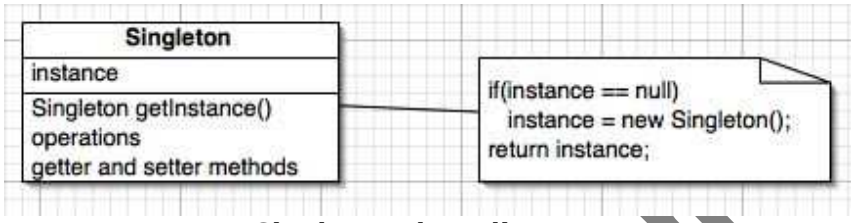
- Some patterns naturally fit together
- One pattern may lead to another
- Some patterns are similar and alternative
- Patterns are discoverable and documentable

- Patterns are not methods or framework
- Patterns give you hint to solve a problem effectively

Singleton Design Pattern

This is one of the most commonly used patterns. There are some instances in the application where we have to use just one instance of a particular class. Let's take up an example to understand this.

The figure below illustrates the Singleton design pattern class diagram.



Singleton class diagram

As you can see from the figure above, there's not a whole lot to the Singleton design pattern. Singletons maintain a static reference to the sole singleton instance and return a reference to that instance from a static instance() method.
The following example shows a classic Singleton design pattern implementation:

```
public class ClassicSingleton {
  private static ClassicSingleton instance = null;
  protected ClassicSingleton() {
    // Exists only to defeat instantiation.
  }
  public static ClassicSingleton getInstance() {
    if(instance == null) {
      instance = new ClassicSingleton();
    }
    return instance;
  }
}
```

The singleton implemented in above example is easy to understand. The ClassicSingleton class maintains a static reference to the lone singleton instance and returns that reference from the static getInstance() method.

There are several interesting points concerning the ClassicSingleton class. First, ClassicSingleton employs a technique known as *lazy instantiation* to create the singleton; as a result, the singleton instance is not created until the getInstance() method is called for the first time. This technique ensures that singleton instances are created only when needed.

Second, notice that ClassicSingleton implements a protected constructor so clients cannot instantiate ClassicSingleton instances; however, you may be surprised to discover that the following code is perfectly legal:

```
public class SingletonInstantiator
{
  public SingletonInstantiator() {
```

```
   ClassicSingleton instance = ClassicSingleton.getInstance();
ClassicSingleton anotherInstance = new ClassicSingleton();
      ...
  }
}
```

How can the class in the preceding code fragment—which does not extend ClassicSingleton—create a ClassicSingleton instance if the ClassicSingleton constructor is protected? The answer is that protected constructors can be called by subclasses and *by other classes in the same package*. Because ClassicSingleton and SingletonInstantiator are in the same package (the default package), SingletonInstantiator() methods can create ClassicSingleton instances. This dilemma has two solutions: You can make the ClassicSingleton constructor private so that only ClassicSingleton() methods call it; however, that means ClassicSingleton cannot be subclassed. Sometimes, that is a desirable solution; if so, it's a good idea to declare your singleton class final, which makes that intention explicit and allows the compiler to apply performance optimizations. The other solution is to put your singleton class in an explicit package, so classes in other packages (including the default package) cannot instantiate singleton instances.

Front Controller Design pattern

Brief Description

Many interactive Web applications are composed of brittle collections of interdependent Web pages. Such applications can be hard to maintain and extend. The ***Front Controller*** pattern defines a single component that is responsible for processing application requests. A front controller centralizes functions such as view selection, security, and templating, and applies them consistently across all pages or views. Consequently, when the behavior of these functions need to change, only a small part of the application needs to be changed: the controller and its helper classes.

Detailed Example

- ***Centralizing request processing and view selection.***
  A Servlet is utilized as the main point of entry for web requests. The class MainServlet is the front controller for the Java Pet Store sample application website. All requests that end with **.do* are mapped to go through the MainServlet for processing. The following code excerpts form the core of the controller. A sequence diagram outlining the actions taken by the MainServlet in response to the user request appears in Figure 1 below.

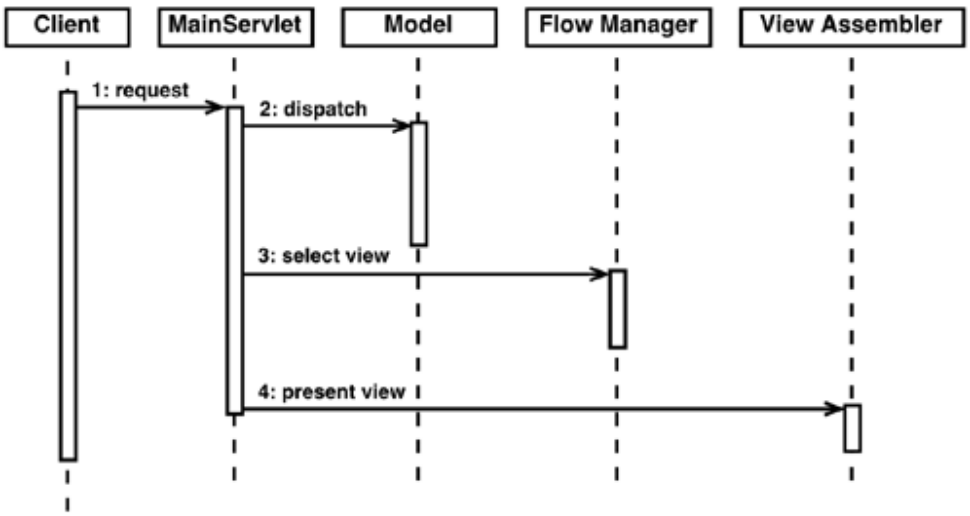


Figure 1. Sequence diagram of MainServlet in action

The MainServlet source code is straightforward:

The methods that process HTTP POST and GET (transition number 1 in Figure 1) both use method doProcess, shown in this example. The method receives the request and response, and passes the request to the RequestProcessor, which dispatches the request to the business logic (represented by the "Model" in Figure 1 above) that handles it. The request processor executes an application function that corresponds to the request URL ("2: dispatch" in Figure 1). The map from request URLs to application functions is defined in an XML file, mappings.xml.

```
private void doProcess(HttpServletRequest request,
                       HttpServletResponse response)
  throws IOException, ServletException {
   ...
  try {
    getRequestProcessor().processRequest(request);
```

After dispatching the request to the business logic, the controller then passes the request to the ScreenFlowManager, which chooses the next screen to display, again based on the contents of mappings.xml ("3: select view" in Figure 1). Exceptions can also be mapped to screens in mappings.xml: if business logic throws an exception, the exception is stored in the request, and the next screen is chosen based on the exception type. If no next screen is defined, a default screen is used.

```
      getScreenFlowManager().forwardToNextScreen(request, response);
  } catch (Throwable ex) {
    String className = ex.getClass().getName();
    nextScreen = getScreenFlowManager().getExceptionScreen(ex);
    // put the exception in the request
```

```
            request.setAttribute("javax.servlet.jsp.jspException", ex);
            if (nextScreen == null) {
              // send to general error screen
              ex.printStackTrace();
              throw new ServletException("MainServlet: unknown exception: " +
                className);
            }
          }
```

- Finally, the front controller forwards the request to the next screen ("4: present view" in Figure 1). The component (usually the templating service) at the URL for the next screen receives the screen name and any server-side state defined by the previous operations. This functionality is delegated to the ScreenFlowManager, which forwards to the next screen.

DATA TRANSFOR OBJECT

The client tier in an EJB system needs a way to transfer bulk data with the server, as the J2EE aplications implement server side business component.Some methods exposed by the business components return data to the client. Often, the client invokes a business object's get methods multiple times until it obtains all the attribute values.

If the client needs to display or update a set of attributes that live on the server, these attributes could live in an entity bean or be accessible through a session bean. The client could get or update the data is by loading many parameters into a method call, when updating data on the server, or by making multiple fine-grained calls to the server to retrieve data. Every call between the client and server is a remote method call with substantial network overhead. If the client application calls the individual getter and setter methods that require or update single attribute values, it will require as many remote calls as there are attributes. The individual calls generate a lot of network traffic and affects severely the system performance.

The solution to this problem is to use a plain java classes called Value Objects or Transfer Objects which encapsulate the bulk business data. A single method call is used to send and retrieve the Transfer Object / Value Obects. When the client requests the enterprise bean for the business data, the enterprise bean can construct the Transfer Object, populate it with its attribute values, and pass it by value to the client.

When an enterprise bean uses a Transfer Object / Value Obects, the client makes a single remote method invocation to the enterprise bean to request the Transfer Object / Value Obects instead of numerous remote method calls to get individual attribute values. The enterprise bean then constructs a new Transfer Object instance, copies values into the object and returns it to the client. The client receives the Transfer Object / Value Obects and can then invoke accessor or getter methods on the Transfer Object to get the individual attribute values from the Transfer Object. The implementation of the Transfer Object / Value Obectsmay be such that it makes all attributes public. Because the Transfer Object / Value Obects is passed by value to the client, all calls to the Transfer Object / Value Obects instance are local calls instead of remote method invocations.

A Transfer object / value object is a plain serializable Java class that represents a snapshot of some server side data, as in the following code example:

```
import java.io.Serializable;
public class OneValueObject implements Serializable {
private int attribute1;
private String attribute2;
private String attribute3;
private long attribute4;
…
public int getAttribute1();
public String getAttribute2();
public String getAttribute3();
public long getAttribute4();
…
}
```

The responsibilities of the three components participating in this patterns are :

Client

This represents the client of the enterprise bean. The client can be an end-user application, like jsp, servlets or a java applet, as in the case of a rich client application that has been designed to directly access the enterprise beans. The client can be Business Delegates or a different BusinessObject.

Business Object

The Business Object represents a role in this pattern that can be fulfilled by a session bean, an entity bean, or a Data Access Object (DAO). The BusinessObject is responsible for creating the Transfer Object and returning it to the client upon request. The Business Object may also receive data from the client in the form of a Transfer Object / Value Obects and use that data to perform an update.

Transfer Object / Value Objects

The Transfer Object / Value Obects is an arbitrary serializable Java object referred to as a Transfer Object / Value Obects. Transfer Object / Value Obects has all the business values required by the client. A Transfer Object / Value Obects class may provide a constructor that accepts all the required attributes to create the Transfer Object / Value Obects. The constructor may accept all entity bean attribute values that the Transfer Object / Value Obects is designed to hold. Typically, the members in the Transfer Object / Value Obects are defined as public, thus eliminating the need for get and set methods. If some protection is necessary, then the members could be defined as protected or private, and methods are provided to get the values. Transfer Objects / Value Obects can be mutable or immutabel depending on whether the application wants to allow updates to the Transfer Objects / Value Obects

STRUTS2

Struts and webwork has joined together to develop the Struts 2 Framework. Struts 2 Framework is very extensible and elegant for the development of enterprise web application of any size. In this section we are going to explain you the architecture of Struts 2 Framework.

The strut-2 framework is designed for the compilation of the entire development cycle including of building, developing and maintaining the whole application. It is very extensible as each class of the framework is based on an Interface and all the base classes are given an extra application and even you can add your own. The basic platform requirements are Servlet API 2.4, JSP API 2.0 and Java 5.We are assuming here that you have some knowledge about the technologies used.

Features:
Some of the general features of the current Apache Strut 2 framework are given below.

Architecture – First the web browser request a resource for which the Filter Dispatcher decides the suitable action. Then the Interceptors use the required functions and after that the Action method executes all the functions like storing and retrieving data from a database. Then the result can be seen on the output of the browser in HTML, PDF, images or any other.

Tags - Tags in Strut 2 allow creating dynamic web applications with less number of coding. Not only these tags contain output data but also provide style sheet driven markup that in turn helps in creating pages with less code. Here the tags also support validation and localization of coding that in turn offer more utilization. The less number of codes also makes it easy to read and maintain.

MVC – The **Model View Controller** in Strut 2 framework acts as a coordinator between application's model and web view. Its Controller and View components can come together with other technology
to develop the model. The framework has its library and markup tags to present the data dynamically.

Configuration – Provides a deployment descriptor to initialize resources in XML format. The initialization takes place simply by scanning all the classes using Java packages or you can use an application configuration file to control the entire configuration. Its general-purpose defaults allow using struts directly Out of the box. Configuration files are re-loadable that allows changes without restarting a web container.

Other Features:

- All framework classes are based on interfaces and core interfaces are independent from HTTP.
- Check boxes do not require any kind of special application for false values.
- Any class can be used as an action class and one can input properties by using any JavaBean directly to the action class.
- Strut 2 actions are Spring friendly and so easy to Spring integration.
- AJAX theme enables to make the application more dynamic.

- Portal and servlet deployment are easy due to automatic portlet support without altering code.
- The request handling in every action makes it easy to customize, when required.

Differences between Struts1 and Struts 2

Struts2 is more powerful framework as compared to struts1. The table given below describes some differences between struts1 and struts2

Feature	Struts 1	Struts 2
Action classes	Struts1 extends the abstract base class by its action class. The problem with struts1 is that it uses the abstract classes rather than interfaces.	While in Struts 2, an Action class implements an Action interface, along with other interfaces use optional and custom services. Struts 2 provides a base ActionSupport class that implements commonly used interfaces. Although an Action interface is **not** necessary, any POJO object along with an execute signature can be used as an Struts 2 Action object.
Threading Model	Struts 1 Actions are singletons therefore they must be thread-safe because only one instance of a class handles all the requests for that Action. The singleton strategy restricts to Struts 1 Actions and requires extra care to make the action resources thread safe or synchronized while developing an application.	Struts 2 doesn't have thread-safety issues as Action objects are instantiated for each request. A servlet container generates many throw-away objects per request, and one more object does not impose a performance penalty or impact garbage collection.
Servlet Dependency	Actions are dependent on the servlet API because HttpServletRequest and HttpServletResponse is passed to the execute method when an Action is invoked therefore Struts1.	Container does not treat the Struts 2 Actions as a couple. Servlet contexts are typically represented as simple Maps that allow Actions to be tested in isolation. Struts 2 Actions can still access the original request and response, if required. While other architectural elements directly reduce or eliminate the need to access the HttpServetRequest or HttpServletResponse.
Testability	Struts1 application has a major problem while testing the application because the execute method exposes the Servlet API. Struts TestCase provides a set of	To test the Struts 2 Actions instantiate the Action, set the properties, and invoking methods. Dependency Injection also makes testing easier.

	mock object for Struts 1.	
Harvesting Input	Struts 1 recieves an input by creating an ActionForm object. Like the action classes, all ActionForms class must extend a ActionForm base class. Other JavaBeans classes cannot be used as ActionForms, while developers create redundant classes to receive the input. DynaBeans is the best alternative to create the conventional ActionForm classes.	Struts 2 requires Action properties as input properties that eliminates the need of a second input object. These Input properties may be rich object types, since they may have their own properties. Developer can access the Action properties from the web page using the taglibs. Struts 2 also supports the ActionForm pattern, POJO form objects and POJO Actions as well.
Expression Language	Struts1 integrates with JSTL, so it uses the JSTL EL. The EL has basic object graph traversal, but relatively weak collection and indexed property support.	Struts 2 can use JSTL, but the framework also supports a more powerful and flexible expression language called "Object Graph Notation Language" (OGNL).
Binding values into views	Struts 1 binds objects into the page context by using the standard JSP mechanism.	Struts 2 uses a ValueStack technology to make the values accessible to the taglibs without coupling the view to the object to which it is rendering. The ValueStack strategy enables us to reuse views across a range of types, having same property name but different property types.
Type Conversion	Struts 1 ActionForm properties are almost in the form of Strings. Commons-Beanutils are used by used by Struts 1 for type conversion. Converters are per-class, which are not configurable per instance.	Struts 2 uses OGNL for type conversion and converters to convert Basic and common object types and primitives as well.
Validation	Struts 1 uses manual validation that is done via a validate method on the ActionForm, or by using an extension to the Commons Validator. Classes can have different validation contexts for the same class, while chaining to validations on sub-objects is not allowed.	Struts 2 allows manual validation that is done by using the validate method and the XWork Validation framework. The Xwork Validation Framework allows chaining of validations into sub-properties using the validations defined for the properties class type and the validation context.
Control Of Action Execution	Each module in Struts 1 has a separate Request Processors (lifecycles), while all the Actions in the module must share the same lifecycle.	In Struts 2 different lifecycles are created on a per Action basis via Interceptor Stacks. Custom stacks are created and used with different Actions, as required.s

History

Apache Struts is an open-source framework that is used for developing Java web application. Originally developed by the programmer and author Craig R. McClanahan, this was later taken over by the Apache Software Foundation in 2002. Struts have provided an excellent framework for developing application easily by organizing JSP and Servlet based on HTML formats and Java code. Strut1 with all standard Java technologies and packages of Jakarta assists to create an extensible development environment. However, with the growing demand of web application, **Strut 1** does not stand firm and needs to be changed with demand. This leads to the creation of Strut2, which is more developer friendly with features like Ajax, rapid development and extensibility.

Struts is a well-organized framework based on **MVC** architecture. In **Model-View-Controller Architecture**, Model stands for the business or database code, View represents the page design code and the Controller for navigational code. All these together makes Struts an essential framework for building Java applications. But with the development of new and lightweight MVC based framworks like Spring, Stripes and Tapestry, it becomes necessary to modify the Struts framework. So, the team of Apache Struts and another J2EE framework, **WebWork** of *OpenSymphony* joined hand together to develop an advanced framework with all possible developing features that will make it developer and user friendly.

Strut2 contains the combined features of Struts Ti and WebWork 2 projects that advocates higher level application by using the architecture of WebWork2 with features including a plugin framework, a new API, Ajax tags etc. So the Struts communities and the WebWork team brought together several special features in WebWork2 to make it more advance in the Open Source world. Later the name of WebWork2 has changed to Struts2. Hence, Apache Strut 2 is a dynamic, extensible framework for a complete application development from building, deploying and maintaining.

WebWork is a framework for web-application development that has been included in Struts framework 2.0 release. It has some unique concepts and constructs like its compatibility of working within existing Web APIs in Java rather than trying to replace them completely. It has been built specifically taking into account the developer's productivity and code simplicity. Furthermore it is completely context dependent that provides a wrapper around XWork. When working on web applications the web work provides a context that helps web developer in specific implementations.
While, XWork provides a mechanism that is used for configuration and factory implementation management. This mechanism is dependencies inject mechanism.

Struts and webwork has joined together to develop the Struts 2 Framework. Struts 2 Framework is very extensible and elegant for the development of enterprise web application of any size.

Here we are going to explain you the architecture of Struts 2 Framework.

Request Lifecycle in Struts 2 applications

1. **User Sends request:** User sends a request to the server for some resource.

2. **FilterDispatcher determines the appropriate action:** The FilterDispatcher looks at the request and then determines the appropriate Action.

3. **Interceptors are applied:** Interceptors configured for applying the common functionalities such as workflow, validation, file upload etc. are automatically

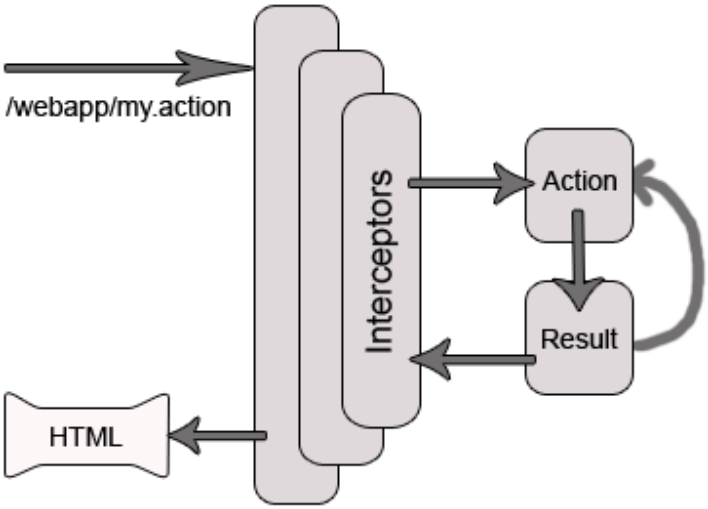
applied to the request.

4. **Execution of Action:** Then the action method is executed to perform the database related operations like storing or retrieving data from the database.

5. **Output rendering:** Then the Result renders the output.

6. **Return of Request:** Then the request returns through the interceptors in the reverse order. The returning request allows us to perform the clean-up or additional processing.
7. **Display the result to user:** Finally the control is returned to the servlet container, which sends the output to the user browser.

Image: Struts 2 high level overview of request processing:



Struts 2 Architecture

Struts 2 is a very elegant and flexible front controller framework based on many standard technologies like Java Filters, Java Beans, ResourceBundles, XML etc.
For the **Model**, the framework can use any data access technologies like JDBC, EJB, Hibernate etc and for the **View**, the framework can be integrated with JSP, JTL, JSF, Jakarta Velocity Engine, Templates, PDF, XSLT etc.

Exception Handling:
The Struts 2 Framework allows us to define exception handlers and inceptors.

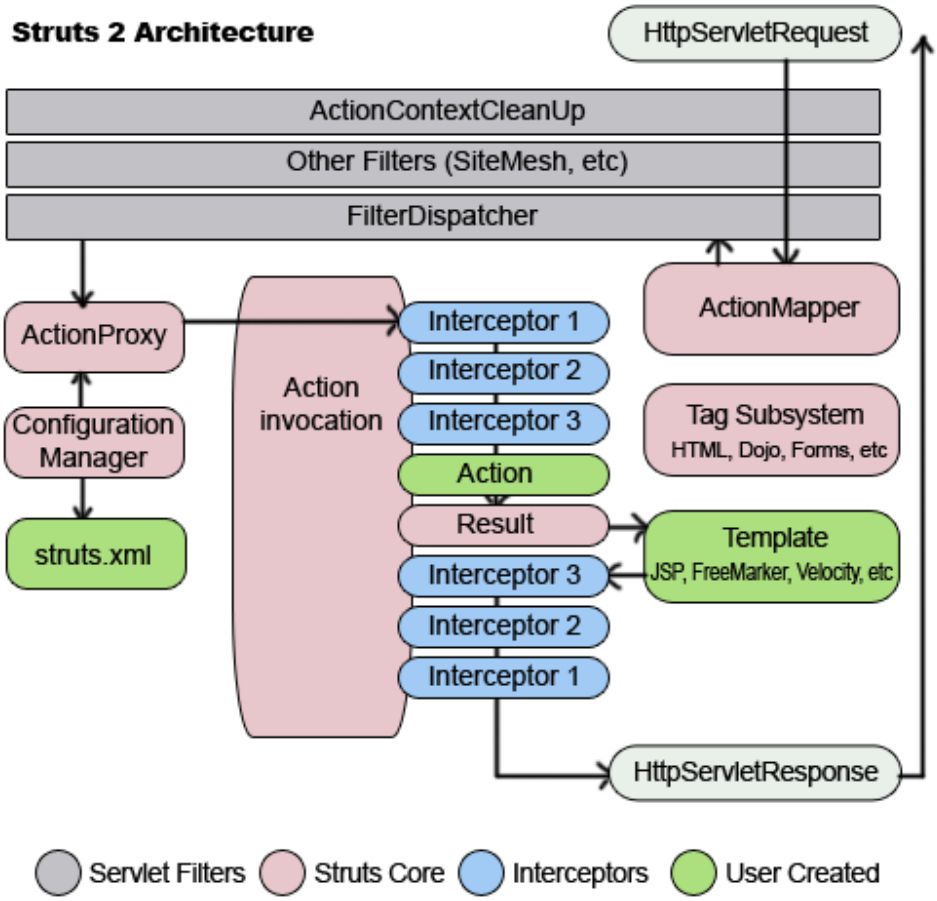
- **Exception Handlers:**
  Exception handlers allows us to define the exception handling procedure on global and local basis. Framework catches the exception and then displays the page of our choice with appropriate message and exception details.

- **Interceptors:**
  The Interceptors are used to specify the "request-processing lifecycle" for an action. Interceptors are configured to apply the common functionalities like workflow, validation etc.. to the request.

Struts 2 Architecture

The following diagram depicts the architecture of Struts 2 Framework and also shows the the initial request goes to the servlet container such as tomcat, which is then passed through standard filer chain.

Image: Struts 2 Architecture



The filter chain includes:

- **Action ContextCleanUp filter**:
  The ActionContextCleanUp filter is optional and it is useful when integration has to be done with other technologies like SiteMash Plugin.

- **FilterDispatcher:**
  Next the FilterDispatch is called, which in turn uses the ActionMapper to determine whether to invoke an Action or not. If the action is required to be invoked, the FilterDispatcher delegates the control to the **ActionProxy**.

- **ActionProxy:**
  The ActionProxy takes help from Configuration Files manager, which is initialized from the struts.xml. Then the ActionProxy creates an **ActionInvocation,** which implements the command pattern. The ActionInvocation process invokes the Interceptors (if configured) and then invokes the action. The the ActionInvocation looks for proper result. Then the result is executed, which involves the rendering of JSP or templates.

  Then the Interceptors are executed again in reverse order. Finally the response returns through the filters configured in web.xml file. If the ActionContextCleanUp filter is configured, the FilterDispatcher does not clean the

ThreadLocal ActionContext. If the ActionContextCleanUp filter is not present then the FilterDispatcher will cleanup all the ThreadLocals present.

Why Struts2:

The new version Struts 2.0 is a combination of the Sturts action framework and Webwork. According to the Struts 2.0.1 release announcement, some key features are:

- **Simplified Design** - Programming the abstract classes instead of interfaces is one of design problem of struts1 framework that has been resolved in the struts 2 framework. Most of the Struts 2 classes are based on interfaces and most of its core interfaces are HTTP independent. Struts 2 Action classes are framework independent and are simplified to look as simple POJOs. Framework components are tried to keep loosely coupled.
- **Simplified Actions** - Actions are simple POJOs. Any java class with execute() method can be used as an Action class. Even we don't need to implement interfaces always. Inversion of Control is introduced while developing the action classes. This make the actions to be neutral to the underlying framework .
- **No more ActionForms** - ActionForms feature is no more known to the struts2 framework. Simple JavaBean flavored actions are used to put properties directly. No need to use all String properties.
- **Simplified testability** - Struts 2 Actions are HTTP independent and framework neutral. This enables to test struts applications very easily without resorting to mock objects.
- **Intelligent Defaults** - Most configuration elements have a default value which can be set according to the need. Even there are xml-based default configuration files that can be overridden according to the need.
- **Improved results** - Unlike ActionForwards, Struts 2 Results provide flexibility to create multiple type of outputs and in actual it helps to prepare the response.
- **Better Tag features** - Struts 2 tags enables to add style sheet-driven markup capabilities, so that we can create consistent pages with less code. Struts 2 tags are more capable and result oriented. Struts 2 tag markup can be altered by changing an underlying stylesheet. Individual tag markup can be changed by editing a FreeMarker template. Both JSP and FreeMarker tags are fully supported.
- **Annotations introduced** : Applications in struts 2 can use Java 5 annotations as an alternative to XML and Java properties configuration. Annotations minimize the use of xml.
- **Stateful Checkboxes** - Struts 2 checkboxes do not require special handling for false values.
- **QuickStart** - Many changes can be made on the fly without restarting a web container.
- **customizing controller** - Struts 1 lets to customize the request processor per module, Struts 2 lets to customize the request handling per action, if desired.
- **Easy Spring integration** - Struts 2 Actions are Spring-aware. Just need to add Spring beans!
- **Easy plugins** - Struts 2 extensions can be added by dropping in a JAR. No manual configuration is required!
- **AJAX support** - The AJAX theme gives interactive applications a significant boost.
  The framework provides a set of tags to help you ajaxify your applications, even on Dojo. The AJAX features include:
  1. AJAX Client Side Validation

2. Remote form submission support (works with the submit tag as well)
3. An advanced div template that provides dynamic reloading of partial HTML
4. An advanced template that provides the ability to load and evaluate JavaScript remotely
5. An AJAX-only tabbed Panel implementation
6. A rich pub-sub event model
7. Interactive auto complete tag

Comparison between Struts1 and Struts2

we are going to compare the various features between the two frameworks. Struts 2.x is very simple as compared to struts 1.x, few of its excelent features are:

1. Servlet Dependency:
Actions in Struts1 have dependencies on the servlet API since the **HttpServletRequest** and **HttpServletResponse** objects are passed to the execute method when an Action is invoked but in case of Struts 2, Actions are not container dependent because they are made simple POJOs. In struts 2, the servlet contexts are represented as simple Maps which allows actions to be tested in isolation. Struts 2 Actions can access the original request and response, if required. However, other architectural elements reduce or eliminate the need to access the HttpServetRequest or HttpServletResponse directly.

2. Action classes
Programming the abstract classes instead of interfaces is one of design issues of struts1 framework that has been resolved in the struts 2 framework.

Struts1 Action classes needs to extend framework dependent abstract base class. But in case of Struts 2 Action class *may* or may not implement interfaces to enable optional and custom services. In case of Struts 2, Actions are not container dependent because they are made simple POJOs. Struts 2 provides a base ActionSupport class to implement commonly used interfaces. Albeit, the Action interface is **not** required. Any POJO object with an execute signature can be used as an Struts 2 Action object.

3. Validation
Struts1 and Struts 2 both supports the manual validation via a validate method. Struts1 uses validate method on the ActionForm, or validates through an extension to the Commons Validator. However, Struts 2 supports manual validation via the validate method and the XWork Validation framework. The Xwork Validation Framework supports chaining validation into sub-properties using the validations defined for the properties class type and the validation context.

4.Threading Model
In Struts1, Action resources must be thread-safe or synchronized. So Actions are singletons and thread-safe, there should only be one instance of a class to handle all requests for that Action. The singleton strategy places restrictions on what can be done with Struts1 Actions and requires extra care to develop. However in case of Struts 2, Action objects are instantiated for each request, so there are no thread-safety issues. (In practice, servlet containers generate many throw-away objects per request, and one more object does not impose a performance penalty or impact garbage collection.)

5. Testability

Testing Struts1 applications are a bit complex. A major hurdle to test Struts1 Actions is that the execute method because it exposes the Servlet API. A third-party extension, Struts TestCase, offers a set of mock object for Struts1. But the Struts 2 Actions can be tested by instantiating the Action, setting properties and invoking methods. Dependency Injection support also makes testing simpler. Actions in struts2 are simple POJOs and are framework independent, hence testability is quite easy in struts2.

6. Harvesting Input

Struts1 uses an ActionForm object to capture input. And all ActionForms needs to extend a framework dependent base class. JavaBeans cannot be used as ActionForms, so the developers have to create redundant classes to capture input.

However Struts 2 uses Action properties (as input properties independent of underlying framework) that eliminates the need for a second input object, hence reduces redundancy. Additionally in struts2, Action properties can be accessed from the web page via the taglibs. Struts 2 also supports the ActionForm pattern, as well as POJO form objects and POJO Actions. Even rich object types, including business or domain objects, can be used as input/output objects.

7. Expression Language

Struts1 integrates with JSTL, so it uses the JSTL-EL. The struts1 EL has basic object graph traversal, but relatively weak collection and indexed property support. Struts 2 can also use JSTL, however it supports a more powerful and flexible expression language called "Object Graph Notation Language" (OGNL).

8. Binding values into views

In the view section, Struts1 uses the standard JSP mechanism to bind objects (processed from the model section) into the page context to access. However Struts 2 uses a "ValueStack" technology so that the taglibs can access values without coupling your view to the object type it is rendering. The ValueStack strategy allows the reuse of views across a range of types which may have the same property name but different property types.

9. Type Conversion

Usually, Struts1 ActionForm properties are all Strings. Struts1 uses Commons-Beanutils for type conversion. These type converters are per-class and not configurable per instance. However Struts 2 uses OGNL for type conversion. The framework includes converters for basic and common object types and primitives.

10. Control Of Action Execution

Struts1 supports separate Request Processor (lifecycles) for each module, but all the Actions in a module must share the same lifecycle. However Struts 2 supports creating different lifecycles on a per Action basis via Interceptor Stacks. Custom stacks can be created and used with different Actions as needed.

FAQ'S

Q.What is MVC?

Model-View-Controller (MVC) is a design pattern put together to help control change. MVC decouples interface from business logic and data.

Model: The model contains the core of the application's functionality. The model enca psulates the state of the application. Sometimes the only functionality it contains is state. It knows nothing about the view or controller.

View: The view provides the presentation of the model. It is the *look* of the application. The view can access the model getters, but it has no knowledge of the setters. In addition, it knows nothing about the controller. The view should be notified when changes to the model occur.

Controller: The controller reacts to the user input. It creates and sets the model.

Q.What is a framework?

framework is made up of the set of classes which allow us to use a library in a best possible way for a specific requirement.

Q.What is Struts framework?

Struts framework is an open-source framework for developing the web applications in Java EE, based on MVC-2 architecture. It uses and extends the Java Servlet API. Struts is robust architecture and can be used for the development of application of any size. Struts framework makes it much easier to design scalable, reliable Web applications with Java. Struts provides its own Controller component and integrates with other technologies to provide the Model and the View. For the Model, Struts can interact with standard data access technologies, like JDBC and EJB, as well as most any third-party packages, like Hibernate, iBATIS, or Object Relational Bridge. For the View, Struts works well with JavaServer Pages, including JSTL and JSF, as well as Velocity Templates, XSLT, and other presentation systems.

Q:What is Jakarta Struts Framework?

Jakarta Struts is open source implementation of MVC (Model-View-Controller) pattern for the development of web based applications. Jakarta Struts is robust architecture and can be used for the development of application of any size. Struts framework makes it much easier to design scalable, reliable Web applications with Java.

Q: What is ActionServlet?

The class org.apache.struts.action.ActionServlet is the called the ActionServlet. In the the Jakarta Struts Framework this class plays the role of controller. All the requests to the server goes through the controller. Controller is responsible for handling all the requests.

Q.What is role of ActionServlet?

ActionServlet performs the role of Controller:

Process user requests
Determine what the user is trying to achieve according to the request
Pull data from the model (if necessary) to be given to the appropriate view,
Select the proper view to respond to the user
Delegates most of this grunt work to Action classes
Is responsible for initialization and clean-up of resources

Q: What is Action Class?

The Action is part of the controller. The purpose of Action Class is to translate the HttpServletRequest to the business logic. To use the Action, we need to Subclass and overwrite the execute() method. The ActionServlet (commad) passes the parameterized class to Action Form using the execute() method. There should be no database interactions in the action. The action should receive the request, call business objects (which then handle database, or interface with J2EE, etc) and then determine where to go next. Even better, the business objects could be handed to the action at runtime (IoC style) thus removing any dependencies on the model. The return type of the execute method is ActionForward which is used by the Struts Framework to forward the request to the file as per the value of the returned ActionForward object..

Q:Write code of any Action Class?

```
package com.durgasoft;
import javax.servlet.http.*;
import org.apache.struts.action.*;
public class TestAction extends Action
{
public ActionForward execute(ActionMapping mapping, ActionForm form,
 HttpServletRequest request,HttpServletResponse response) throws Exception
  {
    return mapping.findForward("success");
  }
}
```

Q: What is ActionForm?

An ActionForm is a JavaBean that extends org.apache.struts.action.ActionForm. ActionForm maintains the session state for web application and the ActionForm object is automatically populated on the server side with data entered from a form on the client side.

Q.Describe validate() and reset() methods ?

validate() : Used to validate properties after they have been populated; Called before FormBean is handed to Action. Returns a collection of ActionError as ActionErrors. Following is the method signature for the validate() method.

public ActionErrors validate(ActionMapping mapping, HttpServletRequest request)

reset(): reset() method is called by Struts Framework with each request that uses the defined ActionForm. The purpose of this method is to reset all of the ActionForm's data members prior to the new request values being set.

Public void reset() {}

Q: How you will make available any Message Resources Definitions file to the Struts Framework Environment?

Message Resources Definitions file are simple .properties files and these files contains the messages that can be used in the struts project. Message Resources Defini ions files can be added to the struts-config.xml file through **<message-resources/>** tag.

Example:

```
<message-resources parameter="MessageResources" />
```

Q.What are the important tags of struts-config.xml ?

The five important sections are:


```
<struts-config>
  <form-beans>
    <form-bean  name="CustomerForm"
                type="mybank.example.CustomerForm"/>

    <form-bean  name="LogonForm"
                type="mybank.example.LogonForm"/>
  </form-beans>
  <global-forwards>
    <forward   name="logon"  path="/logon.jsp"/>
    <forward   name="logoff" path="/logoff.do"/>
  </global-forwards>
  <action-mappings>
    <action   path="/submitDetailForm"
              type="mybank.example.CustomerAction"
              name="CustomerForm"
              scope="request"
              validate="true"
              input="/CustomerDetailForm.jsp">
      <forward name="success"
               path="/ThankYou.jsp"
               redirect="true" />
      <forward name="failure"
               path="/Failure.jsp"  />
    </action>
    <action path="/logoff" parameter="/logoff.jsp"
            type="org.apache.struts.action.ForwardAction" />
  </action-mappings>
  <controller
    processorClass="org.apache.struts.action.RequestProcessor" />
  <message-resources parameter="mybank.ApplicationResources"/>
</struts-config>
```

Q: What is Struts Validator Framework?

Struts Framework provides the functionality to validate the form data. It can be use to validate the data on the users browser as well as on the server side. Struts Framework emits the java scripts and it can be used validate the form data on the client browser. Server side validation of form can be accomplished by sub classing your From Bean with **DynaValidatorForm** class.

The Validator framework was developed by David Winterfeldt as third-party add-on to Struts. Now the Validator framework is a part of Jakarta Commons project and it can be used with or without Struts. The Validator framework comes integrated with the Struts Framework and can be used without doing any extra settings.

Q. Give the Details of XML files used in Validator Framework?

The Validator Framework uses two XML configuration files **validator-rules.xml** and **validation.xml**. The **validator-rules.xml** defines the standard validation routines, these are reusable and used in **validation.xml**. to define the form specific validations. The **validation.xml** defines the validations applied to a form bean.

Q. How you will display validation fail errors on jsp page?

Following tag displays all the errors:

```
<html:errors/>
```

Q. How you will enable front-end validation based on the xml in validation.xml?

The <html:javascript> tag to allow front-end validation based on the xml in validation.xml. For example the code: <html:javascript formName="logonForm" dynamicJavascript="true" staticJavascript="true" /> generates the client side java script for the form "logonForm" as defined in the validation.xml file. The <html:javascript> when added in the jsp file generates the client site validation script.

Q. What is RequestProcessor and RequestDispatcher?

The controller is responsible for intercepting and translating user input into actions to be performed by the model. The controller is responsible for selecting the next view based on user input and the outcome of model operations. The Controller receives the request from the browser, invoke a business operation and coordinating the view to return to the client.The controller is implemented by a java servlet, this servlet is centralized point of control for the web application. In struts framework the controller responsibilities are implemented by several different components like

The ActionServlet Class
The RequestProcessor Class
The Action Class

The ActionServlet extends the **javax.servlet.http.httpServlet** class. The ActionServlet class is not abstract and therefore can be used as a concrete controller by your application.

The controller is implemented by the ActionServlet class. All incoming requests are mapped to the central controller in the deployment descriptor as follows.

```
<servlet>
  <servlet-name>action</servlet-name>
  <servlet-class>org.apache.struts.action.ActionServlet</servlet-class>
</servlet>
```

All request URIs with the pattern *.do are mapped to this servlet in the deployment descriptor as follows.

```
<servlet-mapping>
    <servlet-name>action</servlet-name>
    <url-pattern>*.do</url-pattern>
<servlet-mapping>
```

A request URI that matches this pattern will have the following form. http://www.my_site_name.com/mycontext/actionName.do

The preceding mapping is called extension mapping, however, you can also specify path mapping where a pattern ends with /* as shown below.

```
<servlet-mapping>
  <servlet-name>action</servlet-name>
  <url-pattern>/do/*</url-pattern>
<url-pattern>*.do</url-pattern>
```

A request URI that matches this pattern will have the following form.

http://www.my_site_name.com/mycontext/do/action_Name The class **org.apache.struts.action.requestProcessor** process the request from the controller. You can sublass the RequestProcessor with your own version and modify how the request is processed.

Once the controller receives a client request, it delegates the handling of the request to a helper class. This helper knows how to execute the business operation associated with the requested action. In the Struts framework this helper class is descended of org.apache.struts.action.Action class. It acts as a bridge between a client-side user action and business operation. The Action class decouples the client request from the business model. This decoupling allows for more than one-to-one mapping between the user request and an action. The Action class also can perform other functions such as authorization, logging before invoking business operation. the Struts Action class contains several methods, but most important method is the execute() method.

public ActionForward execute(ActionMapping mapping, ActionForm form, HttpServletRequest request, HttpServletResponse response) throws Exception

The execute() method is called by the controller when a request is received from a client. The controller creates an instance of the Action class if one doesn?t already exist. The strut framework will create only a single instance of each Action class in your application.

Action are mapped in the struts configuration file and this configuration is loaded into memory at startup and made available to the framework at runtime. Each Action element is represented in memory by an instance of the org.apache.struts.action. ActionMapping class. The ActionMapping object contains a path attribute that is matched against a portion of the URI of the incoming request.

```
<action>
      path= "/somerequest"
      type="com.somepackage.someAction"
      scope="request"
      name="someForm"
      validate="true"
      input="somejsp.jsp"
   <forward name="Success" path="/action/xys" redirect="true"/>
   <forward name="Failure" path="/somejsp.jsp" redirect="true"/>
</action>
```

Once this is done the controller should determine which view to return to the client. The execute method signature in Action class has a return type org.apache. struts.action.ActionForward class. The ActionForward class represents a destination to which the controller may send control once an action has completed. Instead of specifying an actual JSP page in the code, you can declaratively associate as action forward through out the application. The action forward are specified in the configuration file.

```
<action>
      path= "/somerequest"
      type="com.somepackage.someAction"
      scope="request"
      name="someForm"
      validate="true"
      input="somejsp.jsp"
   <forward name="Success" path="/action/xys" redirect="true"/>
   <forward name="Failure" path="/somejsp.jsp" redirect="true"/>
</action>
```

The action forward mappings also can be specified in a global section, independent of any specific action mapping.

```
<global-forwards>
   <forward name="Success" path="/action/somejsp.jsp" />
   <forward name="Failure" path="/someotherjsp.jsp" />
</global-forwards>
```

public interface RequestDispatcher.

Defines an object that receives requests from the client and sends them to any resource (such as a servlet, HTML file, or JSP file) on the server. The servlet container creates the RequestDispatcher object, which is used as a wrapper around a server resource located at a particular path or given by a particular name.

This interface is intended to wrap servlets, but a servlet container can create Request Dispatcher objects to wrap any type of resource.

getRequestDispatcher

public RequestDispatcher getRequestDispatcher(java.lang.String path)

Returns a RequestDispatcher object that acts as a wrapper for the resource located at the given path. A RequestDispatcher object can be used to forward a request to the resource or to include the resource in a response. The resource can be dynamic or static. The pathname must begin with a "/" and is interpreted as relative to the current context root. Use getContext to obtain a RequestDispatcher for resources in foreign contexts. This method returns null if the ServletContext cannot return a Request Dispatcher.

Parameters:

path - a String specifying the pathname to the resource

Returns:

a RequestDispatcher object that acts as a wrapper for the resource at the specified path

See Also:

RequestDispatcher, getContext(java.lang.String)

getNamedDispatcher

public RequestDispatcher getNamedDispatcher(java.lang.String name)

Returns a RequestDispatcher object that acts as a wrapper for the named servlet.

Servlets (and JSP pages also) may be given names via server administration or via a web application deployment descriptor. A servlet instance can determine its name using ServletConfig.getServletName().

This method returns null if the ServletContext cannot return a RequestDispatcher for any reason.

Parameters:

name - a String specifying the name of a servlet to wrap

Returns: a RequestDispatcher object that acts as a wrapper for the named servlet

See Also:

RequestDispatcher, getContext(java.lang.String), ServletConfig.getServletName()

Q.What is the difference between perform() and execute() methods?

Perform method is the method which was deprecated in the Struts Version 1.1. In Struts 1.x, Action.perform() is the method called by the ActionServlet. This is typically where your business logic resides, or at least the flow control to your

JavaBeans and EJBs that handle your business logic. As we already mentioned, to support declarative exception handling, the method signature changed in perform. Now execute just throws Exception. Action.perform() is now deprecated; however, the Struts v1.1 ActionServlet is smart enough to know whether or not it should call perform or execute in the Action, depending on which one is available.

Q. What are the various Struts tag libraries?

Struts is very rich framework and it provides very good and user friendly way to develop web application forms. Struts provide many tag libraries to ease the development of web applications. These tag libraries are:

* Bean tag library - Tags for accessing JavaBeans and their properties.
* HTML tag library - Tags to output standard HTML, including forms, text boxes, checkboxes, radio buttons etc..
* Logic tag library - Tags for generating conditional output, iteration capabilities and flow management
* Tiles or Template tag library - For the application using tiles
* Nested tag library - For using the nested beans in the application

Q. How Struts relates to J2EE?

Struts framework is built on J2EE technologies (JSP, Servlet, Taglibs), but it is itself not part of the J2EE standard.

Q. What is action mappings?

An action mapping is a configuration file entry that, in general, associates an action name with an action. An action mapping can contain a reference to a form bean that the action can use, and can additionally define a list of local forwards that is visible only to this action.

An action servlet is a servlet that is started by the servlet container of a Web server to process a request that invokes an action. The servlet receives a forward from the action and asks the servlet container to pass the request to the forward's URL. An action servlet must be an instance of an org.apache.struts.action.ActionServlet class or of a subclass of that class. An action servlet is the primary component of the controller.

Q. What are the difg0'qrPkQB'b6k'BQZbQ'qePggbq Pkgrence between <bean:message> a

Struts provides a number of tag libraries that helps to create view components easily. These tag libraries are:

a) Bean Tags: Bean Tags are used to access the beans and their properties.
b) HTML Tags: HTML Tags provides tags for creating the view components like forms, buttons, etc...
c) Logic Tags: Logic Tags provides presentation logics that eliminate the need for scriptlets.
d) Nested Tags: Nested Tags helps to work with the nested context.

Q. What are the core classes of the Struts Framework?
A: Core classes of Struts Framework are ActionForm, Action, ActionMapping, Action Forward, ActionServlet etc.

Q. What are difference between ActionErrors and ActionMessage?
ActionMessage: A class that encapsulates messages. Messages can be either global or they are specific to a particular bean property.
Each individual message is described by an ActionMessage object, which contains a message key (to be looked up in an appropriate message resources database), and up to four placeholder arguments used for parametric substitution in the resulting message.
ActionErrors: A class that encapsulates the error messages being reported by the validate() method of an ActionForm. Validation errors are either global to the entire ActionForm bean they are associated with, or they are specific to a particular bean property (and, therefore, a particular input field on the corresponding form).

Q: How you will handle exceptions in Struts?
In Struts you can handle the exceptions in two ways:
a) Declarative Exception Handling: You can either define global exception handling tags in your struts-config.xml or define the exception handling tags within <action>..</action> tag.

Example:
```
<exception
    key="database.error.duplicate"
    path="/UserExists.jsp"
    type="mybank.account.DuplicateUserException"/>
```
b) Programmatic Exception Handling: Here you can use try{}catch{} block to handle the exception.

Q.What are the different kinds of actions in Struts?
The different kinds of actions in Struts are:
ForwardAction, IncludeAction, DispatchAction, LookupDispatchAction, SwitchAction

Q.What is DispatchAction?
The DispatchAction class is used to group related actions into one class. Using this class, you can have a method for each logical action compared than a single execute method. The DispatchAction dispatches to one of the logical actions represented by the methods. It picks a method to invoke based on an incoming request parameter. The value of the incoming parameter is the name of the method that the DispatchAction will invoke.

Q.How to use DispatchAction?

To use the DispatchAction, follow these steps :

1. Create a class that extends DispatchAction (instead of Action)
2. In a new class, add a method for every function you need to perform on the service – The method has the same signature as the execute() method of an Action class.
3. Do not override execute() method – Because DispatchAction class itself provides execute() method.
4. Add an entry to struts-config.xml

Q.What is the use of ForwardAction?

The ForwardAction class is useful when you're trying to integrate Struts into an existing application that uses Servlets to perform business logic functions. You can use this class to take advantage of the Struts controller and its functionality, without having to rewrite the existing Servlets. Use ForwardAction to forward a request to another resource in your application, such as a Servlet that already does business logic processing or even another JSP page. By using this predefined action, you don't have to write your own Action class. You just have to set up the struts-config file properly to use ForwardAction.

Q.What is IncludeAction?

The IncludeAction class is useful when you want to integrate Struts into an application that uses Servlets. Use the IncludeAction class to include another resource in the response to the request being processed.

Q.What is the difference between ForwardAction and IncludeAction?

The difference is that you need to use the IncludeAction only if the action is going to be included by another action or jsp. Use ForwardAction to forward a request to another resource in your application, such as a Servlet that already does business logic processing or even another JSP page.

Q.What is LookupDispatchAction?

The LookupDispatchAction is a subclass of DispatchAction. It does a reverse lookup on the resource bundle to get the key and then gets the method whose name is associated with the key into the Resource Bundle.

Q.What is the use of LookupDispatchAction?

LookupDispatchAction is useful if the method name in the Action is not driven by its name in the front end, but by the Locale independent key into the resource bundle. Since the key is always the same, the LookupDispatchAction shields your application from the side effects of I18N.

Q.What is difference between LookupDispatchAction and DispatchAction?

The difference between LookupDispatchAction and DispatchAction is that the actual method that gets called in LookupDispatchAction is based on a lookup of a key value instead of specifying the method name directly.

Q.What is SwitchAction?

The SwitchAction class provides a means to switch from a resource in one module to another resource in a different module. SwitchAction is useful only if you have

multiple modules in your Struts application. The SwitchAction class can be used as is, without extending.

Q.What if <action> element has <forward> declaration with same name as global forward?

In this case the global forward is not used. Instead the <action> element's <forward> takes precendence.

Q.What is difference between ActionForm and DynaActionForm?

An ActionForm represents an HTML form that the user interacts with over one or more pages. You will provide properties to hold the state of the form with getters and setters to access them. Whereas, using DynaActionForm there is no need of providing properties to hold the state. Instead these properties and their type are declared in the struts-config.xml.

The DynaActionForm bloats up the Struts config file with the xml based definition. This gets annoying as the Struts Config file grow larger.

The DynaActionForm is not strongly typed as the ActionForm. This means there is no compile time checking for the form fields. Detecting them at runtime is painful and makes you go through redeployment.

ActionForm can be cleanly organized in packages as against the flat organization in the Struts Config file.

ActionForm were designed to act as a Firewall between HTTP and the Action classes, i.e. isolate and encapsulate the HTTP request parameters from direct use in Actions. With DynaActionForm, the property access is no different than using request.get Parameter(..).

DynaActionForm construction at runtime requires a lot of Java Reflection (Introspection) machinery that can be avoided.

Q.What are the steps need to use DynaActionForm?

Using a DynaActionForm instead of a custom subclass of ActionForm is relatively straightforward. You need to make changes in two places:

In struts-config.xml: change your <form-bean> to be an org.apache.struts.action.Dyna ActionForm instead of some subclass of ActionForm

```
<form-bean name="loginForm"
        type="org.apache.struts.action.DynaActionForm" >
   <form-property name="userName" type="java.lang.String"/>
   <form-property name="password" type="java.lang.String" />
</form-bean>
```

In your Action subclass that uses your form bean:

import org.apache.struts.action.DynaActionForm
downcast the ActionForm parameter in execute() to a DynaActionForm
access the form fields with get(field) rather than getField()

Q.What is the life cycle of ActionForm?

The lifecycle of ActionForm invoked by the RequestProcessor is as follows:

Retrieve or Create Form Bean associated with Action
"Store" FormBean in appropriate scope (request or session)
Reset the properties of the FormBean
Populate the properties of the FormBean
Validate the properties of the FormBean
Pass FormBean to Action

Log4J

Log4j is an OpenSource logging API developed under the Jakarta Apache project. It provides a robust, reliable, fully configurable, easily extendible, and easy to implement framework for logging Java applications for debugging and monitoring purposes. Log4j allows developers to insert log statements in their code and configure them externally. This article covers the need for logging; a brief introduction to log4j; an explanation of its components and terminology, implementation, and configuration; its advantages and shortcomings; and how to use it to log Java applications.

The Need for Logging

Logging, or writing the state of a program at various stages of its execution to some repository such as a log file, is an age-old method used for debugging and monitoring applications. By inserting simple yet explanatory output statements (such as system.out.println() in the case of Java) in the application code that write to a simple text file, console, or any other repository, a reliable monitoring and debugging solution can be achieved. Although low-level, this is the mechanism to fall back upon when sophisticated debugging tools are either unavailable for any reason or useless; such as in a distributed application scenario.

Inserting log statements manually is tedious and time-consuming, not to mention managing them (such as modifying and updating) down the road due to various reasons such as ongoing upgrading and bug-fixing process for application code, and so forth. To ease this process, there is a useful, efficient, and easy-to-use utility available, called **log4j API**.

What Is log4j?

Log4j is an OpenSource logging API for Java. This logging API, currently in version 1.2.8, became so popular that it has been ported to other languages such as C, C++, Python, and even C# to provide logging framework for these languages.

What Can log4j Do?

1. Log4j handles inserting log statements in application code and managing them externally without touching application code, by using external configuration files.
2. Log4j categorizes log statements according to user-specified criteria and assigns different priority levels to these log statements. These priority levels decide which log statements are important enough to be logged to the log repository.
3. Log4j lets users choose from several destinations for log statements, such as console, file, database, SMTP servers, GUI components etc.; with option of assigning different destinations to different categories of log statements. These log destinations can be changed anytime by simply changing log4j configuration files.
4. Log4j also facilitates creation of customized formats for log output and provides default formats in which log statements will be written to log destination.

How Does log4j Work?

Logically, log4j can be viewed as being comprised of three main components: **Logger**, **Appender**, and **Layout** namely. The functionalities of each of these components are accessible through Java classes of the same name. Users can extend these basic classes to create their own loggers, appenders, and layouts.

Logger

The component logger accepts or **enables** log requests generated by log statements (or **printing methods**) during application execution and sends their output to appropriate destination, i.e. appender(s), specified by user.

The logger component is accessible through the **Logger** class of the log4j API. This class provides a static method Logger.getLogger(name) that either retrieves an existing logger object by the given name, or creates a new logger of given name if none exists. This logger object is then used to set properties of logger component and invoke printing methods debug(), info(), warn(), error(), fatal(), and log(). These methods generate log requests during application execution. These methods and their respective usage are discussed in following section.

Each class in the Java application being logged can have an individual logger assigned to it or share a common logger with other classes. One can create any number of loggers for the application to suit specific logging needs. It is a common practice to create one logger for each class, with a name same as the fully-qualified class name. This practice helps organize log outputs in groups by the classes they originate from, and identify origin of log output, which is useful for debugging.

Log4j provides a default **root logger** that all user-defined loggers inherit from. Root logger is at the top of the logger hierarchy; in other words, root logger is either **parent** or **ancestor** of all logger objects created. If an application class doesn't have a logger assigned to it, it can still be logged using the root logger.

For example: A class MyClass in com.foo.sampleapp application package can have a logger named com.foo.sampleapp.MyClass instantiated in it by using the Logger.getLogger("com.foo.sampleapp.MyClass") method. This logger will implicitly inherit from its **nearest existing ancestor** (maybe com.foo.sampleapp or com.foo or ...; or root logger if none exists), follow the same parent-child relationship as the class-subclass they log and have same package hierarchy as these classes.

Priority levels of log statements

Loggers can be assigned different levels of priorities. These **priority levels** decide which log statement is going to be logged. There are five different priority levels: **DEBUG**, **INFO**, **WARN**, **ERROR**, and **FATAL**; in ascending order of priority. As we can see, log4j has corresponding printing methods for each of these priority levels. These printing methods are used to generate log requests of corresponding priority level for log statements. For example: mylogger.info("logstatement-1"); generates log request of priority level INFO for logstatement-1.

The root logger is assigned the default priority level DEBUG. All loggers inherit priority level from their parent or nearest existing ancestor logger, which is in effect until they are assigned another priority level. A logger object can be assigned a priority level either programmatically by invoking its method setLevel(Level.x) where *x* can be any of the five priority levels, or through external configuration files. The latter is the most preferred way to do so.

After assigning a priority level to a logger, it will enable only those log requests with a priority level equal to or greater than its own. This technique helps prevent log statements of lesser importance from being logged. This concept is the core of log4j functionality.

Listing 1: Example of priority level of logger and log requests.

```
/* Instantiate a logger named MyLogger */
Logger mylogger = Logger.getLogger("MyLogger");
...
```

```
/* Set logger priority level to INFO programmatically. Though this is better done
externally  */
mylogger.setLevel(Level.INFO);
...

/* This log request is enabled and log statement logged,
   since INFO = INFO */
mylogger.info("The values of parameters passed to do_something( ) are: " + a, b);
...

/* This log request is not enabled, since DEBUG < INFO */
mylogger.debug("Operation performed successfully");
...

/* this log request is enabled and log statement logged, since
   ERROR > INFO*/
mylogger.error("Value of X is null");
...
```

Appender

Appender component is interface to the destination of log statements, a repository where the log statements are written/recorded. A logger object receives log request from log statements being executed, enables appropriate ones, and sends their output to the appender(s) assigned to it. The appender writes this output to repository associated with it. There are various appenders available; such as ConsoleAppender(for console), FileAppender (for file), JDBCAppender (for database), SMTPAppender (for SMTP server), SocketAppender (for remote server) and even Instant Messenger (for IMAppender).

An appender is assigned to a logger using the addAppender( ) method of the Logger class, or through external configuration files. A logger can be assigned one or more appenders that can be different from appenders of another logger. This is useful for sending log outputs of different priority levels to different destinations for better monitoring. For example: All log outputs with levels less than FATAL and ERROR being sent to files, while all those with levels equal to ERROR and FATAL sent to console for faster detection.

A logger also implicitly inherits appenders from its parents (and from ancestors, in that effect). Therefore, the log requests accepted by logger are sent to its own appenders along with that of all its ancestors. This phenomenon is known as **appender additivity**.

Layout

The Layout component defines the format in which the log statements are written to the log destination by appender. Layout is used to specify the style and content of the log output to be recorded; such as inclusion/exclusion of date and time of log output, priority level, info about the logger, line numbers of application code from where log output originated, and so forth. This is accomplished by assigning a layout to the appender concerned.

Layout is an abstract class in log4j API; it can be extended to create user-defined layouts. Some readymade layouts are also available in a log4j package; they are PatternLayout, SimpleLayout, DateLayout, HTMLLayout, and XMLLayout.

Implementing and Configuring log4j

Implementing and configuring log4j is quite easy. The following sections show how to do it.

Requirement

The only requirement for installing and using log4j is the source of log4j API, freely available for download in compressed (tar or zip) files (see Resources).

Installation and running log4j

Download the compressed log4j source, uncompress it, save the resulting log4j-1.2.4.jar at any desired location and include its absolute path in the application's CLASSPATH. Now, log4j API is accessible to user's application classes and can be used for logging.

To log an application class, follow these steps:

1. Import log4j package in the class.
2. Inside the class, instantiate a logger object using Logger.getLogger( ) static method.
3. Instantiate layouts (readymade or user-defined) to be assigned to appenders.
4. Instantiate appenders and assign desired layout to them by passing the layout object as parameter to their constructors.
5. Assign the instatiated appenders to the Logger object by invoking its addAppender( ) method with desired appender as parameter.
6. Invoke appropriate printing methods on Logger object to perform logging.

Steps 3, 4, and 5 can be skipped in case of external configuration.

Listing 2: A class com.foo.sampleapp.MyClass being logged with log4j.

```
/* Application package */
package com.foo.sampleapp;

/*Import necessary log4j API classes
import org.apache.log4j.*;
public class MyClass {
/* get a static logger instance with name
   com.foo.sampleapp.MyClass   */
static Logger myLogger =
      Logger.getLogger(MyClass.class.getName( ));
Appender myAppender;
SimpleLayout myLayout;
/* Constructor */
public MyClass(){
...
/* Set logger priority level programmatically. Though this is better done externally  */
myLogger.setLevel(Level.INFO);
...
/* Instantiate a layout and an appender, assign layout to
   appender programmatically */
myLayout = new SimpleLayout();
myAppender = new ConsoleAppender(myLayout);    // Appender is
                                    // Interface
...
/* Assign appender to the logger programmatically */
myLogger.addAppender(myAppender);
...
...
```

```
} //end constructor
public void do_something( int a, float b){
/* This log request enabled and log statement logged, since
   INFO = INFO */
myLogger.info("The values of parameters passed to method
            do_something are: " + a, b); */
...
/* this log request is not enabled, since DEBUG < INFO*/
   myLogger.debug("Operation performed successfully");
...
if (x == null){
/* this log request is enabled and log statement logged, since
   ERROR > INFO*/
myLogger.error("Value of X is null");
...
}
}    //end do_something()
}    // end class MyClass
```

Upon application execution the resulting log output will look like Listing 3:

Listing 3 Log output generated by logging the class MyClass.

```
INFO - The values of parameters passed to method do_something are:
      21, 34.8f
ERROR - Value of X is null
```

Configuring log4j

The log4j can be configured both programmatically and externally using special configuration files. External configuration is most preferred, because to take effect it doesn't require change in application code, recompilation, or redeployment. Configuration files can be XML files or Java property files that can be created and edited using any text editor or XML editor, respectively.

The simplest configuration file will contain following specifications that can be modified, both programmatically and externally, to suit specific logging requirements.

- The priority level and name of appender assigned to root logger.
- The appender's type (for example ConsoleAppender or FileAppender, and so forth).
- The layout assigned to the appender (as SimpleLayout or PatternLayout and the like).

Listing 4 gives an example of configuration file config-simple.properties (in Java property format).

Listing 4: A simple configuration file config-simple.properties in Java property format.

```
# The root logger is assigned priority level DEBUG and an appender
# named myAppender.
log4j.rootLogger=debug, myAppender
# The appender's type specified as FileAppender, i.e. log output written to a file.
log4j.appender.myAppender=org.apache.log4j.FileAppender
# The appender is assigned a layout SimpleLayout.
# SimpleLayout will include only priority level of the log
# statement and the log statement itself in log output.
log4j.appender.myAppender.layout=org.apache.log4j.SimpleLayout
```

Listing 5 shows an XML configuration file with similar specifications.

Listing 5: Configuration file log4j.xml in XML format.

```
<?xml version="1.0" encoding="UTF-8" ?>
<!DOCTYPE log4j:configuration SYSTEM "log4j.dtd">
<log4j:configuration xmlns:log4j="http://jakarta.apache.org/log4j/">
   <appender name="myAppender"
         class="org.apache.log4j.FileAppender">
      <layout class="org.apache.log4j.SimpleLayout"/>
   </appender>
   <root>
      <priority value="debug" />
      <appender-ref ref="myAppender"/>
   </root>
</log4j:configuration>
```

To use a log4j configuration file, it should be loaded using following code, preferably inserted in startup class of the application.

```
import org.apache.log4j.PropertyConfigurator;
...
PropertyConfigurator.configure("path/to/configuration_file");
```

Advantages and Shortcomings

The advantages of using log4j are listed below:

- The log4j printing methods used for logging can always remain in application code because they do not incur heavy process overhead for the application and assist in ongoing debugging and monitoring of application code, thus proving useful in the long term.
- Log4j organizes the log output in separate categories by the name of generating loggers that in turn are same as the names of the classes they log. This approach makes pinpointing the source of an error easy.
- Log4j facilitates external configuration at runtime; this makes the management and modification of log statements very simple and convenient as compared to performing the same tasks manually.
- Log4j assigns priority levels to loggers and log requests. This approach helps weed out unnecessary log output and allows only important log statements to be logged.

The shortcomings of log4j are listed below:

- Appender additivity may result in the log requests being unnecessarily sent to many appenders and useless repetition of log output at an appeneder. Appender additivity is countered by preventing a logger from inheriting appenders from its ancestors by setting the additivity flag to false.
- When configuration files are being reloaded after configuration at runtime, a small number of log outputs may be lost in the short time between the closing and reopening of appenders. In this case, Log4j will report an error to the stderr output stream, informing that it was unable send the log outputs to the appender(s) concerned. But the possibility of such a situation is minute. Also, this can be easily patched up by setting a higher priority level for loggers.

Although log4j has received competition from new a logging API integrated into JSDK 1.4, log4j's strengths of being a mature, feature-ric, and efficient logging API framework, and wide usage for a long time are bound to hold against any competition. Also, compatibility with JSDK 1.4's logging API for easy to-and-fro migration, possibility for further improvements in this API, and new features to suit growing needs will surely make log4j's use continue for a long time to come.