

# **Developing Applications Using Java Web Frameworks**

# **Developing Applications Using Java Web Frameworks**

## **Trainer's Guide**

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**APTECH LIMITED**

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**Dear Learner,**

We congratulate you on your decision to pursue an Aptech course.

Aptech Ltd. designs its courses using a sound instructional design model – from conceptualization to execution, incorporating the following key aspects:

- Scanning the user system and needs assessment

Needs assessment is carried out to find the educational and training needs of the learner.

Technology trends are regularly scanned and tracked by core teams at Aptech Ltd. TAG\* analyzes these on a monthly basis to understand the emerging technology training needs for the Industry.

An annual Industry Recruitment Profile Survey<sup>#</sup> is conducted during August - October to understand the technologies that Industries would be adapting in the next 2 to 3 years. An analysis of these trends & recruitment needs is then carried out to understand the skill requirements for different roles & career opportunities.

The skill requirements are then mapped with the learner profile (user system) to derive the Learning objectives for the different roles.

- Needs analysis and design of curriculum

The Learning objectives are then analyzed and translated into learning tasks. Each learning task or activity is analyzed in terms of knowledge, skills and attitudes that are required to perform that task. Teachers and domain experts do this jointly. These are then grouped in clusters to form the subjects to be covered by the curriculum.

In addition, the society, the teachers, and the industry expect certain knowledge and skills that are related to abilities such as learning-to-learn, thinking, adaptability, problem solving, positive attitude etc. These competencies would cover both cognitive and affective domains.

A precedence diagram for the subjects is drawn where the prerequisites for each subject are graphically illustrated. The number of levels in this diagram is determined by the duration of the course in terms of number of semesters etc. Using the precedence diagram and the time duration for each subject, the curriculum is organized.

- Design & development of instructional materials

The content outlines are developed by including additional topics that are required for the completion of the domain and for the logical development of the competencies identified. Evaluation strategy and scheme is developed for the subject. The topics are arranged/organized in a meaningful sequence.

The detailed instructional material – Training aids, Learner material, reference material, project guidelines, etc.- are then developed. Rigorous quality checks are conducted at every stage.

- Strategies for delivery of instruction

Careful consideration is given for the integral development of abilities like thinking, problem solving, learning-to-learn etc. by selecting appropriate instructional strategies (training methodology), instructional activities and instructional materials.

The area of IT is fast changing and nebulous. Hence, considerable flexibility is provided in the instructional process by specially including creative activities with group interaction between the students and the trainer. The positive aspects of Web based learning –acquiring information, organizing information and acting on the basis of insufficient information are some of the aspects, which are incorporated, in the instructional process.

- Assessment of learning

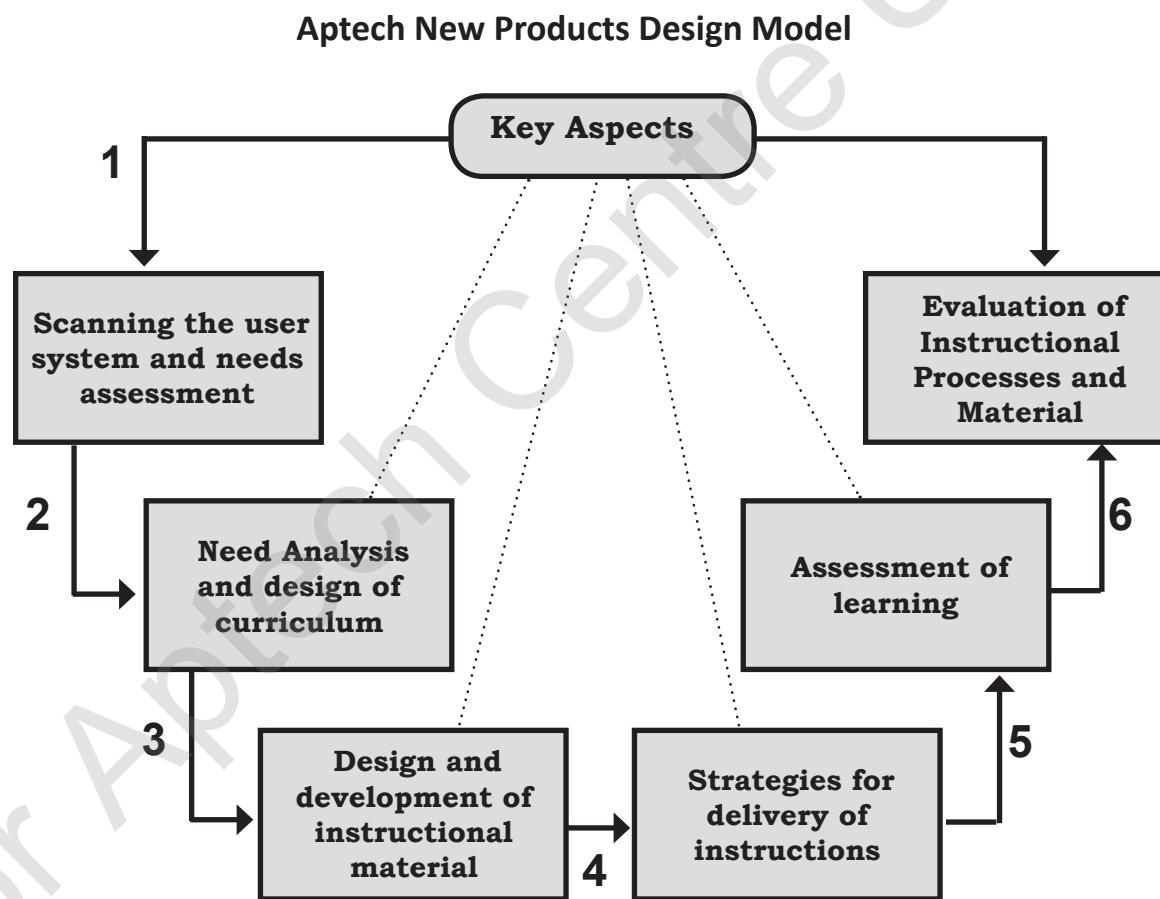
The learning is assessed through different modes – tests, assignments & projects. The assessment system is designed to evaluate the level of knowledge & skills as defined by the learning objectives.

- Evaluation of instructional process and instructional materials

The instructional process is backed by an elaborate monitoring system to evaluate - on-time delivery, understanding of a subject module, ability of the instructor to impart learning. As an integral part of this process, we request you to kindly send us your feedback in the reply pre-paid form appended at the end of each module.

\*TAG – Technology & Academics Group comprises of members from Aptech Ltd., professors from reputed Academic Institutions, Senior Managers from Industry, Technical gurus from Software Majors & representatives from regulatory organizations/forums.

Technology heads of Aptech Ltd. meet on a monthly basis to share and evaluate the technology trends. The group interfaces with the representatives of the TAG thrice a year to review and validate the technology and academic directions and endeavors of Aptech Ltd.



“

A little learning is a dangerous thing,  
but a lot of ignorance is just as bad.

”

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## Preface

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The book 'Developing Applications Using Java Web Frameworks' Trainer's Guide aims to teach the students how to develop rich and interactive Web applications using JSF and Struts frameworks. The faculty/trainer should teach the concepts in the theory class using the slides. This Trainer's Guide will provide guidance on the flow of the module and also provide tips and additional examples wherever necessary. The trainer can ask questions to make the session interactive and also to test the understanding of the students.

This book is the result of a concentrated effort of the Design Team, which is continuously striving to bring you the best and the latest in Information Technology. The process of design has been a part of the ISO 9001 Certification for Aptech-IT Division, Education Support Services. As part of Aptech's quality drive, this team does intensive research and curriculum enrichment to keep it in line with industry trends.

We will be glad to receive your suggestions.

Design Team

“ Practice is the best of  
all instructors.



## Table of Contents

### Sessions

1. Introduction to Struts Framework
2. Working with Struts 2 Framework
3. Struts 2 - Interceptors and Tags
4. Struts 2 - OGNL, Validation, and Internationalization
5. Introduction to JavaServer Faces
6. Expression Language, Facelets, and Data Table

**“ The future depends on what  
we do in the present.**

# Session 1 – Introduction to Struts Framework

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## 1.1 Pre-Class Activities

Familiarize yourself with the topics of this session in-depth. Prepare a question or two which will be a key point to relate the current session objectives.

### 1.1.1 Objectives

By the end of this session, the learners will be able to:

- Explain Model-View-Controller (MVC) architecture
- Explain the role of components involved in MVC architecture
- Explain JSP Model 1 and JSP Model 2 approaches
- Describe Struts framework
- List the features and components of Struts 1 framework
- Explain the architecture of Struts 1 framework
- Explain the process of developing Web applications using Struts 1 components

### 1.1.2 Teaching Skills

To teach this session successfully, you should be aware of Model-View-Controller (MVC) architecture and the role of components involved in MVC architecture. Familiarize yourself with Struts framework, features and components of Struts 1 framework, and the architecture of Struts 1 framework.

To teach this session, you should also aware yourself with the process of developing Web applications using Struts 1 components.

For teaching in the class, you are expected to use slides and LCD projectors.

### Tips:

It is recommended that you test the understanding of the students by asking questions in between the class.

### In-Class Activities:

Follow the order given here during In-Class activities.

### **Overview of the Session:**

Give the students a brief overview of the current session in the form of session objectives.

Show the students slide 2 of the presentation.

**Objectives**

- Explain Model-View-Controller (MVC) architecture
- Explain the role of components involved in MVC architecture
- Explain JSP Model 1 and JSP Model 2 approaches
- Describe Struts framework
- List the features and components of Struts 1 framework
- Explain the architecture of Struts 1 framework
- Explain the process of developing Web applications using Struts 1 components

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2

Tell the students that they will be introduced to Model-View-Controller (MVC) architecture and the role of components involved in MVC architecture. Explain JSP Model 1 and JSP Model 2 approaches.

In this session, they will learn Struts framework, features and components of Struts 1 framework, and the architecture of Struts 1 framework. Finally, the session discusses about the process of developing Web applications using Struts 1 framework components.

## 1.2 In-Class Explanations

### Slides 3 and 4

Let us understand about design patterns.

**Introduction 1-2**



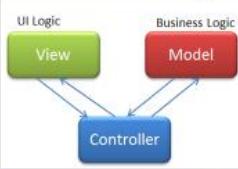
- ❑ Powerful Websites have become an absolute necessity to everyone, be it an individual or a big corporation.
  - Example: A Bank Website containing interactivity and dynamic options based on customers expectations.
- ❑ How do architects involved in Web application design complex such Websites?
  - By adopting Design Patterns.
- ❑ A Design Pattern is the one which describes a proven solution to a recurring problem in application development.

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**Introduction 2-2**



- ❑ The most widely acceptable Website designing pattern is the **Model-View-Controller (MVC)**.
- ❑ **Model-View-Controller (MVC)**
  - Is an architectural pattern whose main concern is to separate data from the user interface.
  - Changes to the user interface can be made without affecting the underlying data handling logic.



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Use slides 3 and 4 to introduce the design patterns.

Tell them that the use of Internet has brought a major shift in the ways of performing trade and communication over the large networks. Today, every business feels the need to have a presence in the virtual world through the Internet. Thus, building of powerful Websites have become an absolute necessity to everyone.

Then, to prove the use of Internet and influenced businesses, discuss the example of Bank Website. Almost all popular banks have hosted their Websites. These Websites provide various interactive and dynamic options based on the customized needs and requirements of the customers. One of the key areas of designing a bank Website is its offerings provided on the various business needs. Thus, designing a Website with reusable software components is a difficult task.

Normally to handle complex needs of the business, applications are designed based on design patterns. A design pattern is a well-proved solution for solving the repetitive problems occurring in the application development.

Design Patterns is used for two main purposes in software development. They are as follows:

1. Design patterns provide a standard terminology and are specific to particular scenario.
2. Design patterns provide best solutions to certain problems faced during software development.

In software designing, design patterns are strategies which are language-independent and used for solving commonly encountered object-oriented design problems. Design patterns are proven techniques for implementing robust, reusable, and extensible object-oriented software. In more technical terms, a pattern is a proven solution to a problem which has been documented so that it can be used to easily handle similar problems in the future.

One such design pattern, is Model–view–controller (MVC) is a software architectural pattern for implementing user interfaces. MVC is adopted as a popular architecture for World Wide Web (WWW) applications. It divides a given software application into three interconnected parts, so as to separate internal representations of information from the ways that information is presented to or accepted from the user.

## Slides 5 and 6

Let us understand MVC architectural pattern.

**MVC Architectural Pattern 1-2**

Following figure shows the MVC architectural pattern.

```

graph TD
    MVC[Model-View-Controller Architecture] --> Model[Model]
    MVC --> View[View]
    MVC --> Controller[Controller]
  
```

**Controller** - Defines how the user interfaces react to the user input.

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**MVC Architectural Pattern 2-2**

The relationship between the three components of MVC:

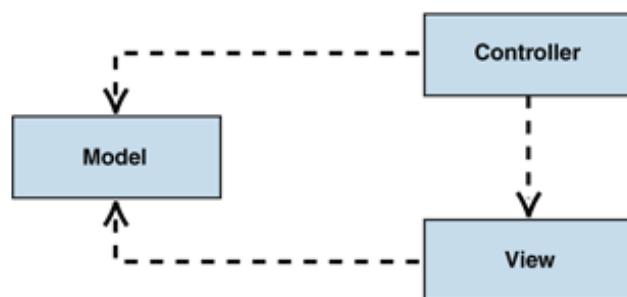
- View and Controller**
  - Creation and selection of views is the responsibility of the controller.
- Model and View**
  - The view is dependent on the model.
  - If any change is to be made to the model, then there may be a requirement to make parallel changes in the view also.
- Model and Controller**
  - The controller is dependent on the model.
  - If any change is to be made to the model, then there may be a requirement to make parallel changes in the controller also.

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Use slides 5 and 6 to explain MVC architectural pattern.

Tell them that MVC architectural pattern enables the separation of data (Model) from the user interface (View). This is made possible by introducing an intermediate component called the Controller. The Controller defines how the user interfaces react to the user input.

The following figure depicts the structural relationship between the three objects:



Then, describe how these components are related to each other.

- **Model** - The model manages the behavior and data of the application domain. The View is dependent on the Model. If any change is to be made to the Model, then there may be a requirement to make parallel changes in the View also. The Controller is dependent on the Model. If any change is to be made to the Model, then there may be a requirement to make parallel changes in the Controller also.
- **View** - The View manages the display of information to the client.
- **Controller** - The Controller interprets the inputs from the user, informing the Model and/or the View to change as appropriate. Creation and selection of View is the responsibility of the Controller.

## Slide 7

Let us understand the role of Components in MVC.

**Role of Components in MVC**

❑ The role of the three components of MVC architecture in developing Web applications:

**Model**

- Encapsulates the domain logic of an application.
- Manages information and notifies observers whenever that information changes.
- Contains only data and functionality that are related by a common purpose.
- Makes it very easy to map real-world entities into a model.

**View**

- Obtains data from the model and presents it to the user.
- Represents the output and/or input of the application.
- Has free access to the model, but should not change the state of the model.
- It reads data from the model using query methods provided by the model.

**Controller**

- Receives and translates input to requests on the Model or View.
- Provides the means by which a user can interact with the application.
- Accepts input from the user and instructs the Model and View to perform actions based on that input.
- Responsible for calling methods on the model that changes the state of the model.

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Use slide 7 to explain the role of the components in MVC.

### Model

- It encapsulates the domain logic of an application.
- It manages information and notifies observers whenever that information changes.
- It contains only data and functionality that are related by a common purpose. If you need to model two groups of unrelated data and functionality, you create two separate models.
- It makes it very easy to map real-world entities into a model.
  - View renders contents of model for user.
  - When model changes, view must be updated.

### Controller

- It receives and translates input to requests on the Model or View.
- It provides the means by which a user can interact with the application.
- It accepts input from the user and instructs the Model and View to perform actions based on that input.
- It maps the end-user action to the application response. For example, if the user chooses a menu item, the Controller is responsible for determining how the application should respond.

- It is responsible for calling methods on the model that changes the state of the model.

### **View**

- It obtains data from the model and presents it to the user. The View represents the output and/or input of the application.
- It generally has free access to the model, but should not change the state of the model.
- It reads data from the model using query methods provided by the model.

## Slide 8

Let us understand Java Web development models.



The slide has a purple header bar with the title "Java Web Development Models" and a coffee cup icon. Below the title is a bulleted list of three points. At the bottom, there are two colored boxes labeled "Model 1" (purple) and "Model 2" (orange). The footer contains copyright information and the number 8.

**Java Web Development Models**

- ❑ With the introduction of JSP technology, Sun Microsystems provided a road map for developing JSP-based Web applications.
- ❑ Java platform has defined two models which provided two approaches for designing Java-based Web applications.
- ❑ These are as follows:

Model 1

Model 2

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8

Use slide 8 to explain the Java Web development models.

Tell them that Sun Microsystems defined two models which provided approaches for designing Java-based Web applications.

These are as follows:

- **Model 1** – This was provided as a primary solution which was given, when JSP technology was introduced.
- **Model 2** – This model was introduced and presented as a correct way for designing the Web applications based on Servlet and JSP technology. Further, Model 2 was adopted as base model by many MVC-based Web frameworks such as Struts.

## Slides 9 to 11

Let us understand JSP Model 1 architecture.

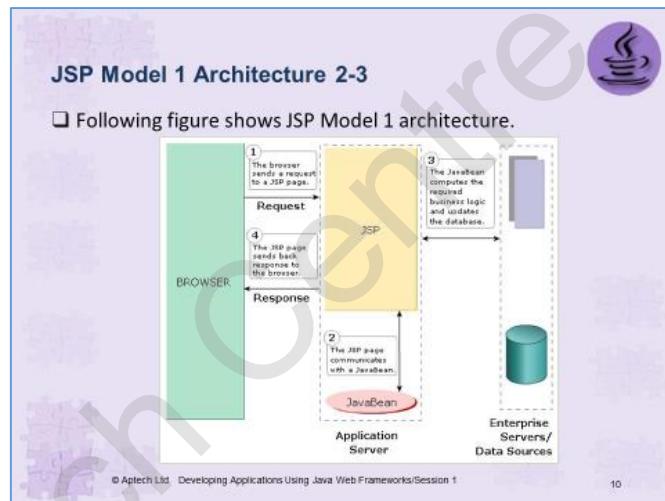
### JSP Model 1 Architecture 1-3



- Is a page-centric architecture.
- Provides JSP page as the main component.
  - JSP page is responsible for processing requests and sending back replies to the clients.
  - JSP page is also responsible for extracting the HTTP request parameters, invoking the business logic, and handling the HTTP session.

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9



### JSP Model 1 Architecture 3-3



The disadvantages of JSP Model 1 Architecture are as follows:

<p><b><u>It suffers from navigation problem</u></b></p> <ul style="list-style-type: none"> <li>• If you change the name of a JSP page that is referenced by other pages, you must change the name in many locations.</li> </ul>	<p><b><u>It is difficult to maintain an application and is inflexible</u></b></p> <ul style="list-style-type: none"> <li>• If an application requires a number of request processing events then, it will lead to a large Java code being embedded within the JSP page.</li> </ul>
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11

Use slides 9 to 11 to explain JSP Model 1 architecture.

Model 1 architecture is one of the approaches for developing a Web application. In Model 1 architecture, the JSP page is not only responsible for processing requests and sending back replies to the clients but also for extracting the HTTP request parameters, invoking the business logic and handling the HTTP session. Figure 1.2 shows Model-1 architecture.

### **Purpose of Model 1**

The purpose of Model 1 architecture is to enable Web designers to develop Web applications such that it separates ‘business logic’ from ‘presentation logic’.

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

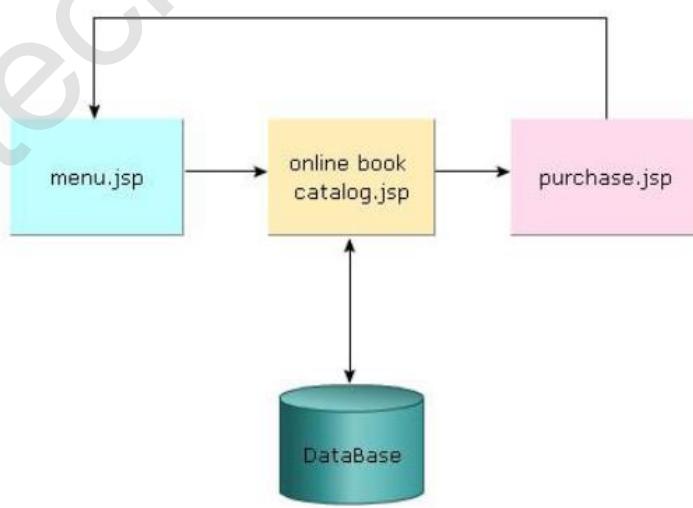
Presentation logic deals with methods of displaying these objects. For example, decisions related to displaying user accounts in a list form.

### **Model 1 - Architecture**

Using slide 10, explain the model 1 architecture. Tell them that in this model, there is no extra servlet involved in the process. The client request is sent directly to a JSP page, which may communicate with JavaBeans or other services, but ultimately the JSP page selects the next page for the client to view.

JSP Model 1 architecture has a page centric architecture. In this architecture, the application is composed of a series of interrelated JSP pages and these JSP pages handle all aspects of application including presentation, control, and the business logic.

In page-centric architecture, the business process logic and control decisions are hard-coded inside JSP pages in the form of JavaBeans, scriptlets, and expressions. The following figure shows an example of Model 1 architecture:



The main problem in Servlet technology is that Servlet needs to recompile when any modification is done in the Servlet code. It does not provide separation of concern. The presentation and business logic are mixed up in the Servlet code.

JSP removes all the problems of Servlet. It provides better separation of concern, so that presentation and business logic is separated. User does not need to redeploy the application if JSP page is modified. JSP provides support to develop Web application using JavaBean, custom tags, and JSTL so, that user can put the business logic separate from the JSP and it is also easier to test and debug.

The Model 1 architecture is commonly used in smaller, simple task applications due to its ease of development.

Some of the advantages of using JSP Model 1 Architecture are as follows:

- It provides a more lightweight design for small and static applications.
- It is suitable for applications that have very simple page flow, have little need for centralized security control or logging, and changes little over time.
- It provides separation of presentation from content.

Model 1 applications can often be refactored to Model 2 when application requirements change.

Then using slide 11, explain the disadvantages of Model 1 architecture.

#### In-Class Question:

After you finish explaining Model 1 architecture, you will ask the students an In-Class question. This will help you in reviewing their understanding of the topic.



Which of the following statements with respect to JSP Model 1 Architecture are true?

- a. Model 1 architecture suffers from navigation problem.
- b. Model 1 architecture business logic and control-decisions are hard-coded inside JSP pages.
- c. In Model 1 architecture the presentation logic cannot be displayed.
- d. In Model 1 architecture it is inefficient to model the business logic.
- e. Model 1 architecture can process business logic.

#### Answer:

a-true, b-true, c-false, d-false, and e-true

## Slides 12 to 14

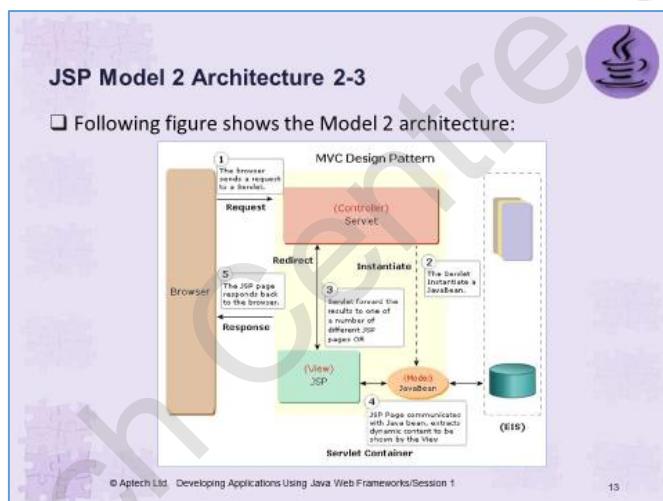
Let us understand JSP Model 2 Architecture.

### JSP Model 2 Architecture 1-3

- Is a Servlet-centric architecture.
- Separates the 'Business Logic' from the 'Presentation Logic'.
- Provides Controller Servlet as main component.
  - Responsibility of the Controller Servlet is to process the incoming request and instantiate a Model - a Java object or a bean to compute the business logic.
  - Responsible for deciding to which JSP page the request should be forwarded.

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12



### JSP Model 2 Architecture 3-3

Advantages and disadvantages of JSP Model 2 Architecture:

Advantages	Disadvantages
<ul style="list-style-type: none"> <li>• Easier to build, maintain, and extend.</li> <li>• Provides a single point of control for security and logging.</li> <li>• Encapsulates incoming data into a form usable by the back-end MVC model.</li> </ul>	<ul style="list-style-type: none"> <li>• Increases the design complexity as it introduces some extra classes/code due to the separation of model, view, and controller components.</li> </ul>

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14

Use slides 12 to 14 to explain JSP Model 2 Architecture.

Model 2 architecture is an approach used for developing a Web application. It separates the ‘Business Logic’ from the ‘Presentation Logic’. Besides this, Model 2 has an additional component - a Controller.

Here, a Servlet acts as a Controller. The responsibility of the Controller Servlet is to process the incoming request and instantiate a Model - a Java object or a bean to compute the business logic. It is also responsible for deciding to which JSP page the request should be forwarded.

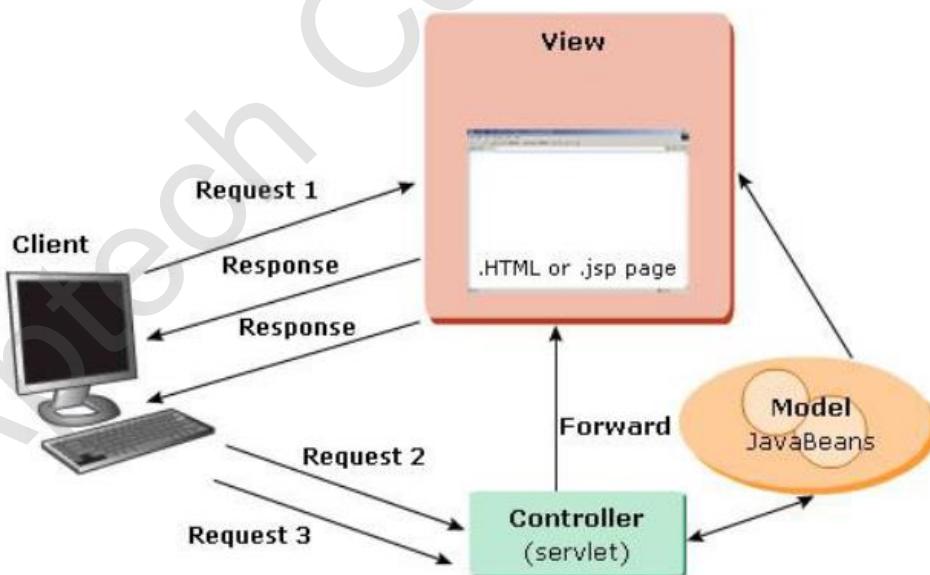
JSP page is responsible for the View component and retrieves the objects created by the Servlet and extracts dynamic content for insertion within a template for display.

Explain the figure provided on slide 13 to explain the components of the Model 2.

### **Model 2 - Architecture**

Model 2 has Servlet-centric architecture. The Servlet acts as controller and selects suitable business logic to handle the request. It also redirects the results to appropriate view. JSP acts as View for response generation. Such a separation of business and presentation logic makes it possible to accommodate multiple interfaces to a Web application. These may include Web or wireless or GUI.

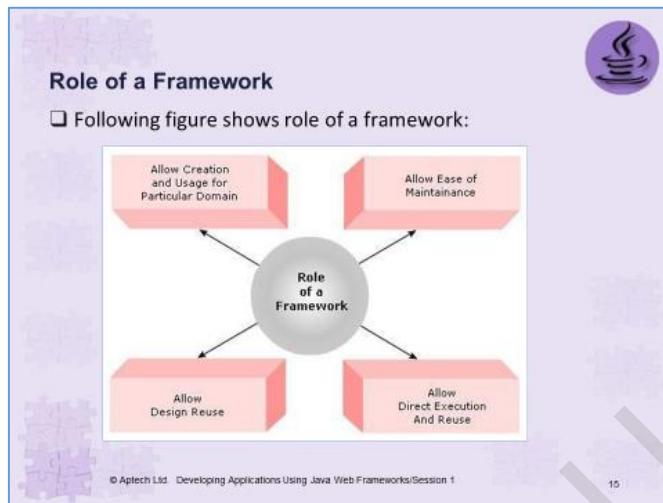
The following figure shows the components of MVC architecture:



Then, using slide 14, explain the advantages and disadvantages of JSP Model 2.

## Slide 15

Let us understand the role of a framework.



Use slide 15 to explain the role of a Framework. A software framework is a universal, reusable software environment. It provides particular functionality as part of a larger software platform to facilitate development of software applications, products, and solutions. Software frameworks includes support programs, compilers, code libraries, tool sets, and Application Programming Interfaces (APIs) that bring together all the different components to enable development of a project or solution.

Role of a framework are as follows:

- They propagate design reuse over code reuse.
- They can be written in any programming language such as Java and C++ and thus can be executed and reused directly.
- They are created and used for a particular application domain.
- They not only allow building application faster, but the applications have similar structure and are easier to maintain.

## Slide 16

Let us understand the characteristics of a framework.

**Characteristics of a Framework**

- A Framework consists of various classes and components.
- Framework classes or component gives an abstraction of a specific concept.
- Framework also gives a definition of how these classes or components work with each other to provide a solution to a problem.
- Framework components and classes can be reused.
- Framework provides an organized pattern of an application.

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16

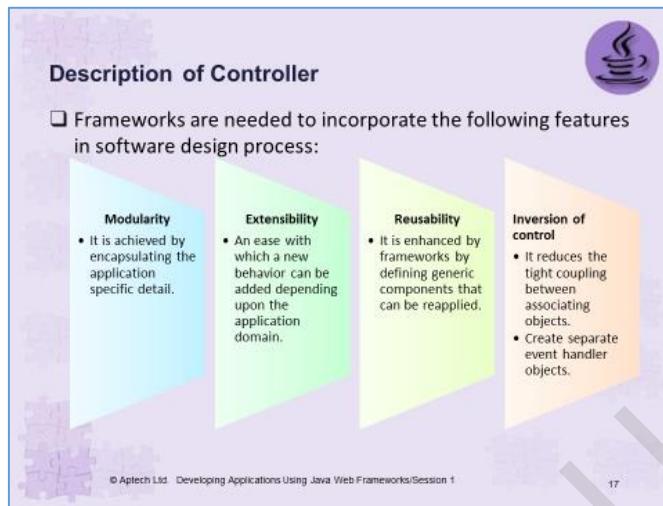
Use slide 16 to explain the characteristics of a framework.

The different characteristics of a framework are as follows:

- A framework consists of various classes and components. Each of these classes or component gives an abstraction of a specific concept.
- A framework also gives a definition of how these classes or components work with each other to provide a solution to a problem.
- Framework components and classes can be reused. This is because framework provides a general behavior that various applications can use it.
- Framework provides an organized pattern of an application.

## Slide 17

Let us understand Controller.



Use slide 17 to explain Controller.

Following features are incorporated in software design process:

- **Modularity** - Modularity is achieved by encapsulating the application specific detail, which may change and separate it from a stable interface.
- **Reusability** - Design level reusability is enhanced by frameworks by defining generic components that can be reapplied to create new applications.
- **Inversion of control** - Inversion of Control is the design pattern, which reduces the tight coupling between associating objects by creating separate event handler objects.
- **Extensibility** - Extensibility in design means the ease with which a new behavior can be added depending upon the application domain.

## Slides 18 and 19

Let us understand Struts.

**Introduction to Struts 1-2**

- Is an open source Java-based framework provided by Apache Software Foundation.
- Simplifies the development of Java Enterprise Edition (Java EE) Web applications based on MVC architecture.
- Extends the Java Servlet API.
- Has become the default standard for building Web applications in Java.
- Resides in the Web tier.
- Managed by the Web or Servlet container residing in the Web server.



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18

**Introduction to Struts 2-2**

- Struts framework is available in two versions.
  - Struts 1 is the first version of Apache Struts framework.
  - In the year 2007, Apache released Struts 2 framework combining the features of WebWork framework to offer new enhancements and refinements in the original Struts framework.



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19

Use slides 18 and 19 to explain Struts. The purpose of this framework is to simplify the development of Java Enterprise Edition (Java EE) Web applications based on MVC architecture. Struts extends the Java Servlet API and has become the default standard for building Web applications in Java.

The Struts framework was developed by Craig McClanahan and supported by Apache Software Foundation's (ASF) Jakarta group. Struts 1 is the first version of Apache Struts framework. Later in the year 2007, Apache released Struts 2 framework combining the features of WebWork framework to offer new enhancements and refinements in the original Struts framework.

Struts framework basically consists of two entities - first, it is an MVC Web application that can be extended or added by the applications. Second, it provides a set of libraries, as tool set to build Web applications.

## Slide 20

Let us understand the features of Struts.

### Features of Struts

❑ The main features of Struts are:

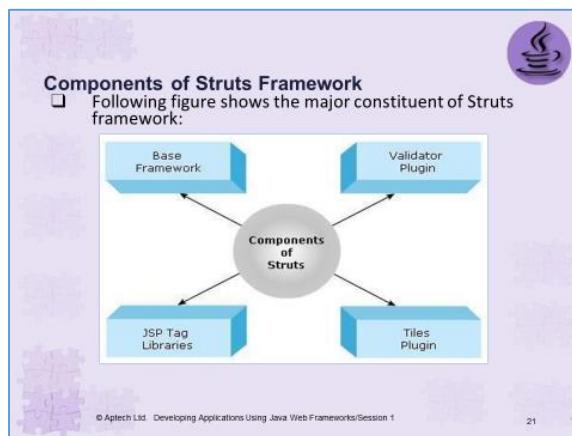
- Code Extensibility**
  - Struts values are represented in XML or in property files.
  - Changes can be made to the file without recompiling the Java code.
- Support for localization and internationalization**
  - Struts support localization and internationalization in the form of ResourceBundle.
- Simpler request process mechanism**
  - Struts provides several utilities, such as StrutValidatorUtil, MessageResource class, and so on.
- Model-view communication**
  - Struts provide a set of custom JSP tags which allows you to create HTML forms.
  - These forms directly associates with Java Bean component.
- Input validation**
  - Struts provides built-in capability for validation of form values.

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Use slide 20 to explain the features of struts.

## Slide 21

Let us understand the components of Struts Framework.



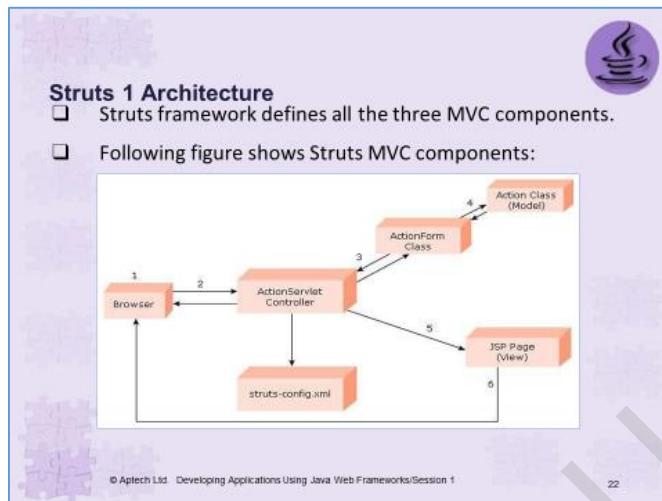
Use slide 21 to explain the components of Struts Framework.

The Struts framework is a rich collection of Java libraries and can be broken down into the following major pieces:

- Base framework: The base framework provides the core MVC functionality and is comprised of the building blocks for a user's application. At the foundation of the base framework is the Controller servlet: `ActionServlet`. The rest of the base framework is comprised of base classes that a user's application will extend and several utility classes.  
Most important base classes are the `Action` and `ActionForm` classes. These two classes are used widely in all Struts applications. `Action` classes are used by `ActionServlet` to process specific requests. `ActionForm` classes are used to capture data from HTML forms and to be a conduit of data back to the View layer for page generation.
- JSP tag libraries:
  - **HTML:** Used to generate HTML forms that interact with the Struts APIs.
  - **Bean:** Used to work with Java bean objects in JSPs, such as accessing bean values.
  - **Logic:** Used to cleanly implement simple conditional logic in JSPs.
  - **Nested:** Used to allow arbitrary levels of nesting of the HTML, Bean, and Logic tags that otherwise do not work.
- Tiles plugin: Tiles is a rich JSP templating framework that facilitates the reuse of presentation (HTML) code.
- Validator plugin: Validator provides a rich framework for performing data validation on both the server side and client side (browser).

## Slide 22

Let us understand Struts 1 architecture.



Use slide 22 to explain Struts 1 architecture.

- ActionServlet: ActionServlet resides in the package `org.apache.struts.action` and it is the only one controller servlet for the entire Web application. The struts framework provides a controller servlet (ActionServlet) which is defined in the Struts libraries that are included in the IDE and it is configured as Servlet in the web.xml file.

The ActionServlet instantiates a Handler. The Handler class name is obtained from an XML file based on the URL path information. This XML file is referred to as Struts configuration file and by default named as `struts-config.xml`. The Handler is called Action in the Struts terminology. This class is created by extending the Action class in `org.apache.struts.action.Action` package.

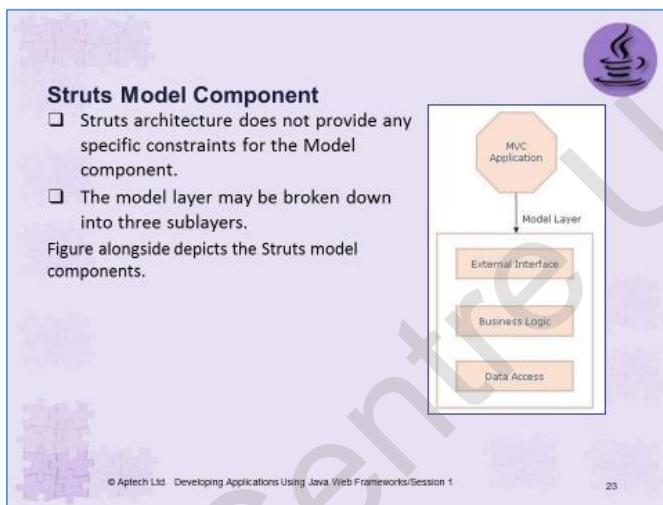
The controller Servlet uses a `struts-config.xml` file to map incoming requests to Struts Action objects and instantiate any ActionForm objects.

- ActionForm: A Struts ActionForm is used to persist data between requests.

- Action class: This class is created by extending the Action class in `org.apache.struts.action` package. The Action object processes the data stored in the form bean using `execute()` method. Once the Action object processes a request, it forwards the results to the appropriate view.

## Slide 23

Let us understand Struts Model Component.



Use slide 23 to explain Struts Model Component.

Tell the students that in an MVC application, application developer may use technology such as Enterprise Java Bean (EJB), Java Data Object (JDO), or the Data Access Objects (DAO) pattern to implement the Model component.

The Model layer is divided into three sub layers:

- **External interface:** Composed of code that provides an interface that external code uses to interact with the Model.
- **Business logic:** Encompasses the bulk of the Model code and provides the business functionality for an application.
- **Data access:** Composed of code for communicating with an application's data sources such as databases.

## Slide 24

Let us understand Struts View Component.

**Struts View Component**

❑ Components of a Struts View are as follows:

- JSP Pages**
  - Provide JSP tag library which allow creating HTML forms for capturing data and also displaying the data.
  - Contain static HTML and JSP library tags to
- Form Beans**
  - Provide a channel for data transfer between the view and control layers of Struts application.
- JSP Tag Libraries**
  - Provide a means to create HTML forms whose data will be captured and stored in Form beans.
  - Contain utility tags which help to implement conditional logic, iteration, and many more.
- Resource bundles**
  - Allow internationalization of Java application.

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Use slide 24 to explain Struts View Component. Tell the students in an MVC application, the View component provides an interface to the user's application. It does not contain business logic, such as calculating interest for a financial application.

The View layer also does not contain any code for persisting data to or retrieving data from a data source. There are many forms that the View component of a Struts application can take. It can be HTML/JSP or it can be XML/XSLT, Velocity, Swing, or whatever the application requires.

Struts' HTML/JSP View layer support is divided into the following major components:

- JSP pages
- Form Beans
- JSP tag libraries
- Resource bundles

### JSP Pages

JSP are used mainly for displaying data and capturing data. Struts provide a set of tag libraries that supports displaying data and creating HTML forms that capture data. Additionally, the tags support displaying content stored in resource bundles. Therefore, JSP with Form Beans provide the bulk of the Struts View layer. The JSP tag libraries connects those two together and the resource bundles provide a means of content management.

## **Form Beans**

Form Beans are basic Java beans with getter and setter methods for each of their properties, allowing their data to be set and retrieved easily. The `org.apache.struts.action.ActionForm` class is the base abstract class that all Form Beans must subclass.

Form Beans are principally comprised of fields, and getter and setter methods for those fields. Business logic and data access code should not be placed in these classes. That code goes in Model layer classes. The only other methods that should be in these classes are helper methods or methods that override `ActionForm`'s base `reset()` and `validate()` methods.

## Slides 25 and 26

Let us understand Struts Controller Component.

**Struts Controller Component 1-2**

- ❑ The core of Struts framework is Struts Controller Servlet called ActionServlet.
- ❑ ActionServlet class:
  - ❑ Handles run-time events in accordance with a set of rules.
  - ❑ Delegates its processing of a request to a RequestProcessor class.
- ❑ RequestProcessor class:
  - ❑ Selects the Form Bean, populates the Form Bean, performs validation.
  - ❑ The Struts framework then access with the Action class.

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**Struts Controller Component 2-2**

- ❑ Following figure shows the Struts Controller components:

```

graph TD
    Browser[Browser] --> ActionServlet[ActionServlet]
    ActionServlet --> RequestProcessor[RequestProcessor]
    RequestProcessor --> Action[Action]
    Action <--> Model[Model]
    Action <--> View[View]
  
```

- ❑ Struts follow same control flow as that of the MVC architecture.

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Use slides 25 and 26 to explain Struts Controller Component. Tell the students the Controller component of an MVC application is responsible for creating the abstraction between the Model and View layers. This abstraction is the foundation of the MVC design pattern. The Controller is the central point of access to the application. All requests to an MVC Web application flow through the controller. Controller layer provides processing common to all requests, such as security, caching, logging, and so on.

Controller servlet, `ActionServlet`, is responsible for initializing a Struts application's configuration from the Struts configuration file and for receiving all incoming requests to the application. Upon receiving a request, `ActionServlet` transfers its processing to the `RequestProcessor` class. The `RequestProcessor` class processes all aspects of the request, including selecting the Form Bean associated with the request, populating the Form Bean with data, validating the Form Bean, and then selecting the correct Action class to execute for the request.

**In-Class Question:**

After you finish explaining Struts Controller Component, you will ask the students an In-Class question. This will help you in reviewing their understanding of the topic.



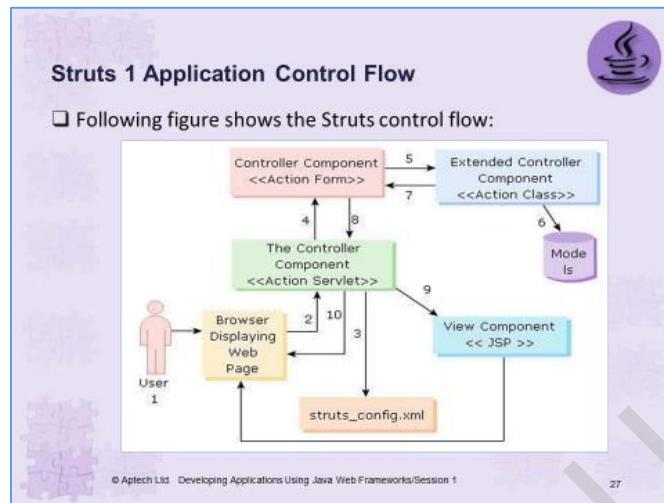
Which Controller Servlet is responsible for initializing a Struts application's configuration from the Struts configuration file and for receiving all incoming requests to the application?

**Answer:**

ActionServlet

## Slide 27

Let us understand Struts 1 application control flow.



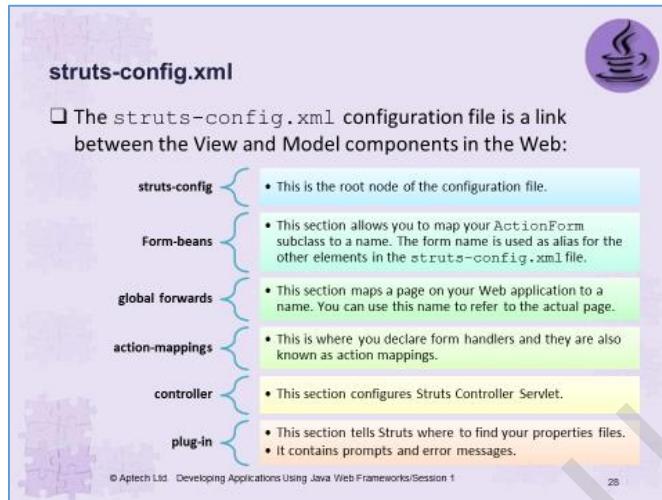
Use slide 27 to explain Struts 1 application control flow.

The control flow `ActionServlet` is as follows:

- Initially, the user sends a request to the Controller Servlet through a View.
- The Controller Servlet looks up the requested URI in the XML configuration file and determines the name of the Action class that will process the business logic.
- The Action class acts on the Model component as per the application's logic.
- On completion of processing the request, the Action class returns the results to the ActionServlet class.
- Based on the results provided, class decides which View to be forwarded with these results.
- The selected View displays the result thus, completing the request-response cycle.

## Slide 28

Let us understand struts-config.xml.



Use slide 28 to explain struts-config.xml.

The struts-config.xml configuration file is a link between the View and Model components in the Web application. The Struts configuration file is an XML-based file. The format of Struts configuration file is based on a Document Type Definition (DTD) file that specifies how the configuration tags must be ordered in the file, what settings are required, and so on.

The configuration file basically contains three main elements:

- <form-beans>
- <global-forwards>
- <action-mappings>

**Form-beans:** Contains form bean definitions. The Form beans create ActionForm instances at runtime. The details of each form bean are provided in the <form-bean> element. The <form-property> elements within the form bean contain the property names and the property types declared in the form bean.

Attributes of <form-bean> are as follows:

**name:** Must have a unique form bean name. The name specified is used as a reference in the action configuration.

**type:** The value is a fully-qualified classname of the ActionForm class used with the form bean.

**Global forwards:** Contains the global forward definitions. The forward name is the logical name used to map to a specific JSP. The `<forward>` element contains the logical name and the name of the corresponding resource which it maps to.

Attributes of `<forward>` are as follows:

- `name`: Contains the logical name of the forward. This name is used in the `ActionForm` class's `execute()` method to forward it to the next resource.
- `path`: Contains the context relative path of the resource to which the forward name maps.
- `contextRelative`: This takes the value true or false implying, whether the resource specified in the path attribute is relative to the context.

**Action-mappings:** Contains the action definitions. Each action mapping is defined in an `<action>` element. The `<forward>` definition within `<action>`, maps the result of the action to the JSP page invoked. If there is no forward defined in the global forwards, it is specified in the `<action-mapping>` element.

Attributes of `<action-mappings>` are as follows:

- `path`: Contains the name of the request received.
- `type`: Contains the name of the action class invoked.
- `scope`: Specifies the scope in which the Controller (`ActionServlet`) must look for the bean.

Attributes of `<forward>` within `<action-mappings>` are the same as that of the global `<forward>`.

**Controller:** This section configures Struts controller servlet.

The following figure shows the struts-config.xml file:

```
<struts-config>

    <!-- ===== Form Bean Definitions ===== -->
    <form-beans>
        <form-bean name="login" type="test.struts.LoginForm" />
    </form-beans>

    <!-- ===== Global Forward Definitions ===== -->
    <global-forwards>
    </global-forwards>

    <!-- ===== Action Mapping Definitions ===== -->
    <action-mappings>
        <action
            path="/login"
            type="test.struts.LoginAction" >

            <forward name="valid" path="/jsp/MainMenu.jsp" />
            <forward name="invalid" path="/jsp/LoginView.jsp" />
        </action>
    </action-mappings>

    <!-- ===== Controller Definitions ===== -->
    <controller
        contentType="text/html;charset=UTF-8"
        debug="3"
        maxFileSize="1.618M"
        locale="true"
        nocache="true"/>

</struts-config>
```

## Slides 29 and 30

Let us understand developing Struts 1 Web application.

**Developing Struts 1 Web Application 1-2**



- ❑ Step 1: Configure Controller – ActionServlet
  - org.apache.struts.action.ActionServlet class is the core class of all Struts based application.
  - The purpose of the ActionServlet class is to receive all incoming HTTP requests for the application and determine which Action will process the incoming request.
- ❑ The developer needs to configure the ActionServlet class in web.xml file of the Web application.

The web.xml file is an deployment descriptor XML file with several elements. It is this file in which the ActionServlet class is configured.

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29

**Developing Struts 1 Web Application 2-2**



- ❑ Following code snippet shows how to configure the Servlet name and class in the web.xml file.

```

<web-app>
  <!-- ActionServlet Configuration -->
  <Servlet>
    <Servlet-name>actionExample</Servlet-name>
    <Servlet-class>org.apache.struts.action.ActionServlet</Servlet-class>
  </Servlet>
  <Servlet-mapping>
    <Servlet-name>actionExample</Servlet-name>
    <url-pattern>*.do</url-pattern>
  </Servlet-mapping>
</web-app>

```

❑ The pattern matches the ActionServlet named 'actionExample' and services all requests having an extension of .do.

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30

Use slides 29 and 30 to explain developing Struts 1 Web application. The org.apache.struts.action.ActionServlet class is the core class of all Struts based application. In Struts based Web applications, the purpose of the ActionServlet class is to receive all incoming HTTP requests for the application and determine which Action class will process the incoming request.

The ActionServlet class is not an abstract class and can be used for assembling simple application. However, a specialized ActionServlet class may be created for specific application. ActionServlet class is derived from javax.Servlet.http.HttpServlet class and implements the life cycle methods of the Servlet class such as doGet(), doPost(), and so on.

ActionServlet class is responsible for initializing the Struts framework for a Web application and receiving all the requests. It is a concrete class and may be used as it is in an application or can be extended. Every Struts based Web application will have a deployment descriptor named web.xml. A web.xml file is an XML file with several elements. It is this file in which the ActionServlet class is configured.

Slide 30 shows how to configure servlet name and class in the web.xml file.

```
<web-app>
< ! -- ActionServlet Configuration -- >
<Servlet>
<Servlet-name>actionExample</Servlet-name>
<Servlet-
class>org.apache.struts.action.ActionServlet</Servlet-class>
</Servlet>
<Servlet-mapping>
<Servlet-name> actionExample</Servlet-name>
<url-pattern>*.do</url-pattern>
</Servlet-mapping>
</web-app>
```

Tell them that the given code shows the configuration of a servlet class with the URL pattern. It shows that the Servlet name is configured as '**actionExample**' and Servlet class is the default ActionServlet class which is the controller class of the Struts framework.

Further, in the **<Servlet-mapping>** description, the tag **<url-pattern>** describes a pattern to resolve URLs. A portion of HTTP request is compared to the **<url-pattern>**. If the pattern matches, then this means that the **ActionServlet** named '**actionExample**' should service all the requests having an extension of **.do**.

## Slides 31 to 39

Let us understand developing Action class.

**Developing Action 1-9**



**□ Step 2: Developing an Action class**

- org.apache.struts.action package provides the Action class.
- Action class does not contain business logic, rather it is designed to delegate business logic to the Model component.
- Action class is acting as a bridge between the View and Model layer.
- When a request is made to the ActionServlet class with a given path, the appropriate action for processing the request is invoked.

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31

**Developing Action 2-9**



**□ Following figure shows the class diagram of Action class.**



```

classDiagram
    class Action {
        #servlet: ActionServlet
        #Action()
        #execute():ActionForward()
        #getLocale(): Locale
        #getResources(): MessageResources
        #saveMessage(): void
    }
  
```

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32

**Developing Action 3-9**



**□ To use the Action class, developer has to subclass and overwrite the execute() method.**

**□ The execute() method has two functions:**

<b>execute() method</b>	It performs the business logic for the application.	It helps Framework to determine where it should next route the request.
-------------------------	---	---

**□ When a user performs an action, the execute() method, Action class is invoked to process the request based on user's action.**

**□ The execute() method may throw any business logic exceptions.**

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33

### Developing Action 4-9



**Syntax:**

```
public ActionForward execute(ActionMapping map,
ActionForm form, javax.servlet.ServletRequest req,
javax.servletServletResponse resp) throws
java.lang.Exception
```

where,

- **map:** represents an object of ActionMapping
- **form:** refers to an object of ActionForm class
- **req:** refers to the HTTP request object
- **resp:** refers to the HTTP response object
- **Exception:** raises an exception only when the business code throws an exception

### Developing Action 5-9



The Struts Framework defines two implementations for the `execute ()` method:

Implementation - I	Implementation - II
Define custom Actions that are non-HTTP specific.	Define custom Actions that are HTTP specific.
It is to be overridden in order to service request that are not HTTP specific.	It is to be overridden in order to service HTTP specific requests.

### Developing Action 6-9



Following table shows the parameters of `Action.execute ()` method:

Parameter	Description
ActionMapping	It contains all of the deployment information for a particular Action bean.
ActionForm	It represents the Form inputs containing the request parameters from the View referencing this Action bean.
ServletRequest or HttpServletRequest	It is a reference to current request object either Http specific or non-Http specific respectively.
ServletResponse or HttpServletResponse	It is a reference to current response object either Http specific or non-Http specific respectively.



### Developing Action 7-9

- To derive an Action class, following steps are to be executed:

Create a class that extends the Action class of org.apache.struts.action package.

Override the execute() method in order to specify the desired business logic.

It returns the ActionForward object which is used to route the request to the specified view.

To describe the new action add an <action> element in the Struts configuration file.

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37


### Developing Action 8-9

- Following code snippet demonstrates the development of LoginAction class:

```
public class LoginAction extends org.apache.struts.action.Action {
    /* forward name="success" path="" */
    private final static String SUCCESS = "success";
    private final static String FAILURE = "failure";
    /**
     * This is the action called from the Struts framework.
     * @param mapping The ActionMapping used to select this
     * instance.
     * @param request The HTTP Request we are processing.
     * @param response The HTTP Response we are processing.
     * @throws java.lang.Exception
     * @return
     */
}
```

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38


### Developing Action 9-9

```
public ActionForward execute(ActionMapping mapping, ActionForm
form,
HttpServletRequest request, HttpServletResponse response)
throws Exception {
LoginForm loginForm = (LoginForm) form;

if (loginForm.getUserName().equals(loginForm.getPassword())) {
    return mapping.findForward(SUCCESS);
} else {
    return mapping.findForward(FAILURE);
}
}
```

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39

Use slides 31 to 39 to explain developing Action class. Tell the students that Struts framework ends and application code begins in the Action class. The Action class does not contain business logic, rather it is designed to delegate business logic to the Model component. It transfers the data from the view layer to the specific business process layer and then, returns the processed data from business layer to the view layer.

Every action is mapped to a path in the Struts configuration file. When a request is made to the `ActionServlet` class with a given path, the action for processing the request is invoked.

Then, explain the figure given on slide 32, defining the methods of Action class. Tell them that the execution of the business logic begins with the `execute()` method. It is similar to the `service()` method provided in the life cycle methods of the servlet.

The `execute()` method has two functions:

1. It performs the business logic for the application.
2. It helps framework to determine where it should next route the request.

The `ActionServlet` class uses the `execute()` method to pass the parameterized class to the `ActionForm` class. The `execute()` method returns an object of type `ActionForward` class. Based on the value returned by `ActionForward` class, the `RequestProcessor` class determines where to forward the request such as a JSP or another Action. If the response has already been completed, then the method simply returns null.

Then, explain the syntax of the `execute()` method given on slide 34. The following table explains the parameters of the `execute()` method:

Parameter	Description
<code>ActionMapping</code>	It contains all of the deployment information for a particular Action bean.
<code>ActionForm</code>	It represents the Form inputs containing the request parameters from the View referencing this Action bean.
<code>ServletRequest</code> or <code>HttpServletRequest</code>	It is a reference to current request object either Http specific or non-Http specific respectively.
<code>ServletResponse</code> or <code>HttpServletResponse</code>	It is a reference to current response object either Http specific or non-Http specific respectively.

Then, tell them that Struts framework provides two implementations of the `execute()` method. The first `execute()` implementation is used to define custom Actions that are non-HTTP specific. This version is to be overridden in order to service requests that are not HTTP specific. The second `execute()` implementation is used to define custom Actions that are HTTP specific. This version is to be overridden in order to service HTTP specific requests. Finally, explain the code snippet given on slides 38 and 39 that demonstrates the `LoginAction` class.

## Slides 40 to 42

Let us understand ActionForward Class.

### ActionForward Class 1-3



- It is a destination where the controller (RequestProcessor) can process the forward request.
- The execute () method when executed returns an object of ActionForward class.
- This object has been mapped to the name of the forward.
- One change to forward definition is sufficient to reflect all places in application.

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40

### ActionForward Class 2-3



- Following table shows the properties supported by an ActionForward class:

Property	Description
<code>contextRelative</code>	It specifies if URL value for path represents the absolute path or path is relative to the module under consideration.
<code>name</code>	It is the logical name by which the instance may be looked up in relationship to a particular ActionMapping.
<code>path</code>	It has the value that interpreted as Module-relative or context-relative URL to which the control should be forwarded or an absolute or relative URL to which control should be redirected.
<code>redirect</code>	It is set to true if the controller servlet should call <code>HttpServletResponse.sendRedirect()</code> on the associated path; otherwise should be set to false.

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41

### ActionForward Class 3-3



- Following code snippet declares the configuration of action along with the forward:

```
<action-mappings>
    <action input="/login.jsp" name="LoginForm" path="/Login"
scope="session" type="com.example.LoginAction">
        <forward name="success" path="/success.jsp" />
        <forward name="failure" path="/failure.jsp" />
    </action>
</action-mappings>
</struts-config>
```

- Code Snippet defines a URL to be used as forward with local scope. Here, the action will be forwarded to the `success.jsp` page, whenever the forward named 'Success' is found.

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42

Use slides 40 to 42 to explain ActionForward class.

The `execute()` method of the Action class when executed, returns an object of `ActionForward` class. This object has been mapped to the name of the forward from Struts configuration file. Rather than hard-coding URLs inside the application, a developer can use forward to define logical names for URLs and then, use these logical names to reference the URLs. Referencing URLs by logical names gives the benefit of shielding.

Using slide 41, explain the properties of an `ActionForward` class. Then, using slide 42, explain the code snippet that shows configuration of action along with the forward to the result pages.

## Slides 43 and 44

Let us understand developing Model.

**Developing Model 1-2**

- Model component of struts framework represents application's business data and the rules.
- The purpose of having a separate model component is to ensure that the model remains independent and reusable.
- The model components are accessed from the subclass of struts Action class.
- The Action sub class via its Action interface uses its Data Transfer Object to pass and retrieve data from model.
- Business specific model code should not refer to Struts code or object.

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43

**Developing Model 2-2**

- Following figure shows the Struts model:

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44

Use slides 43 and 44 to explain developing Model. The purpose of having a separate Model component is to ensure that the model remains independent of the client that is accessing it and thus is reusable. It is very essential for any application to ensure data integrity within the model. In a Struts-based application, the Model components are accessed from the subclass of Struts Action class that is part of the Struts Controller layer. Then, show the figure given on slide 44 that shows different Struts model.

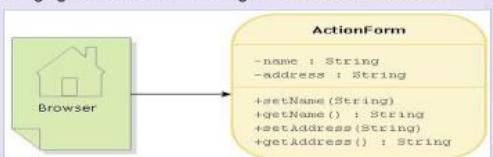
## Slides 45 to 50

Let us understand developing ActionForm.

**Developing ActionForm 1-6**



- ❑ Struts framework supports the functionality for retrieving the data entered by Web application user.
- ❑ Store data temporarily for validation and displaying an error message for invalid data.
- ❑ JSP page provide the input fields for an HTML form.
- ❑ HTML form takes data from the ActionForm class and not from Java Beans.
- ❑ Following figure shows the class diagram of ActionForm class:



```

classDiagram
    class Browser {
        --> ActionForm
    }
    class ActionForm {
        -name : String
        -address : String
        +setName (String)
        +getName () : String
        +setAddress (String)
        +getAddress () : String
    }
  
```

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**Developing ActionForm 2-6**



- ❑ The `org.apache.struts.action.ActionForm` is the abstract base class supporting this functionality.
- ❑ Basic Java beans with 'get' and 'set' methods are defined for each of their properties and are used for supporting the functionality.
- ❑ The abstract `ActionForm` class has two methods which a subclass may override for customized `ActionForm` class:

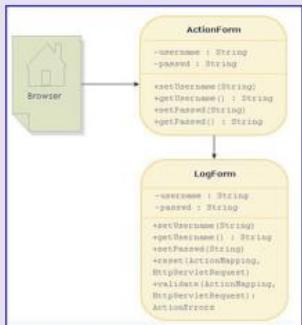
<b>validate</b> <ul style="list-style-type: none"> <li>• Is called by the <code>RequestProcessor</code> class.</li> <li>• Performs data validation on <code>ActionForm</code> attributes before data is sent to <code>Action</code> class.</li> </ul>	<b>reset</b> <ul style="list-style-type: none"> <li>• Is used to reset the <code>ActionForm</code> attributes.</li> <li>• Is called for each new request, before the <code>ActionForm</code> is populated.</li> </ul>
---	---

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**Developing ActionForm 3-6**



- ❑ Following figure shows the `LoginForm` class extending from `ActionForm`:



```

classDiagram
    class Browser {
        --> ActionForm
    }
    class ActionForm {
        -username : String
        -password : String
        +setUsername (String)
        +getUsername () : String
        +setPassword (String)
        +getPassword () : String
    }
    class LogForm {
        -username : String
        -password : String
        +setUsername (String)
        +getUsername () : String
        +setPassword (String)
        +getPassword () : String
        +execute (ActionMapping,
                  HttpServletRequest)
        +forward (ActionMapping,
                  HttpServletRequest)
        +actionForward
    }
  
```

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### Developing ActionForm 4-6

Following code snippet demonstrates the development of `LoginForm` class:

```
public class LoginForm extends org.apache.struts.action.ActionForm {
    private String userName;
    private String password;

    public LoginForm() {
        super();
        // TODO Auto-generated constructor stub
    }

    /**
     * This is the action called from the Struts framework.
     * @param mapping The ActionMapping used to select this instance.
     * @param request The HTTP Request we are processing.
     * @return
     */
}
```

The `LoginForm` class declares two properties – the `userName` and `password` corresponding to the form fields.

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### Developing ActionForm 5-6

```
public ActionErrors validate(ActionMapping mapping, HttpServletRequest request) {
    ActionErrors errors = new ActionErrors();
    if (userName == null || userName.length() < 1) {
        errors.add("userName", new ActionMessage("error.userName.required"));
        // TODO: add 'error.name.required' key to your resources
    }
    if (password == null || password.length() < 1) {
        errors.add("password", new ActionMessage("error.password.required"));
        // TODO: add 'error.name.required' key to your resources
    }
    return errors;
}
*/
public String getUserName() {
    System.out.println("Inside getter " + userName);
    return userName;
}
```

The `validate()` method checks if the `userName` and `password` have been assigned value or not.  
It returns an error if these attributes have null value.

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### Developing ActionForm 6-6

```
/**
 * Set the userName to set */
public void setUserName(String userName) {
    System.out.println("Inside setter " + userName);
    this.userName = userName;
}

/**
 * Return the password */
public String getPassword() {
    return password;
}

/**
 * Set the password to set */
public void setPassword(String password) {
    this.password = password;
}
```

Getter and setter method is specified for `userName` and `password` attributes.

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Use slides 45 to 50 to explain developing ActionForm.

Struts framework supports the functionality for retrieving the data entered by Web application user (that is from View layer), storing it temporarily for validation and displaying

an error messages for invalid data or sending valid data to Action class (that is to Controller layer).

Also, when the model layer returns data for display, the `ActionForm` class is populated. This is then used by JSP page to provide the input fields for an HTML form. Then, tell them that a subclass of `org.apache.struts.action.ActionForm` is created to capture the application specific form data as well as to display the required data on the presentation page.

To override the `ActionForm` class, you need to override two methods that are as follows:

- The `reset()` method is used to reset the `ActionForm` attributes to whatever state the application wants.
- The `validate()` method for performing data validation on `ActionForm` attributes before data is sent to `Action` class.

Using slides 48 to 50, explain the code snippet that demonstrates the `LoginForm` class. Tell them that the code creates a `LoginForm` class which is extended from `ActionForm` class. The `LoginForm` class declares two properties - the `userName` and `password` corresponding to the form fields. A getter and setter method is specified for both the attributes. Next, the `validate()` method checks if the `userName` and `password` have been assigned value or not. It returns an error if these attributes have null value.

## Slides 51 to 54

Let us understand JSP tag libraries.

### JSP Tag Libraries 1-4



The JSP tag libraries are fundamental building blocks in Struts applications:

- Since, they provide a convenient mechanism for creating HTML forms whose data will be captured in Form Beans and for displaying data stored in Form Beans.

The list of Struts tag libraries are as follows:

- **HTML**
- **Bean**
- **Logic**

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51

### JSP Tag Libraries 2-4



Purpose of HTML and Nested tags is as follows:

<b>HTML</b> <ul style="list-style-type: none"> <li>• It is used to generate HTML forms that interact with the Struts APIs.</li> <li>• The tags in this library can automatically populate form controls with data from Form Beans.</li> <li>• Save time and several lines of code.</li> </ul>	<b>Nested</b> <ul style="list-style-type: none"> <li>• It is used to allow arbitrary levels of nesting of HTML, Bean, and Logic tags.</li> </ul>
---	--

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52

### JSP Tag Libraries 3-4



Purpose of Bean and Logic tags are as follows:

<b>Bean</b> <ul style="list-style-type: none"> <li>• It is used to work with Java bean objects in JSPs, such as to access bean values.</li> <li>• It is a collection of utility tags that provides convenient access for interacting.</li> <li>• The remaining tags are used to render objects to the JSP output.</li> <li>• Most of the tags are used to capture references to specific objects and store them in JSP scripting variables.</li> </ul>	<b>Logic</b> <ul style="list-style-type: none"> <li>• It is used to implement simple conditional logic in JSP.</li> <li>• It provides a rich set of tags for cleanly implementing simple conditional logic in JSP.</li> <li>• You can wrap content that will be processed only when a particular condition is true.</li> </ul>
--	--

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53

**JSP Tag Libraries 4-4**

Some of the logic tags are as follows:

- present
- notPresent
- Equal
- notEqual
- greaterThan
- lessThan
- greaterEqual
- lessEqual

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54

Use slides 51 to 54 to explain JSP tag libraries. The JavaServer Pages Standard Tag Library (JSTL) contains core functionality that provides common functionalities for many JSP applications. JSTL helps the user to employ a single, standard set of tags. This standardization helps to deploy the user's applications on any JSP container supporting JSTL.

JSTL has tags such as iterators and conditionals for handling flow control, tags for manipulating XML documents, internationalization tags, tags for accessing databases using SQL, and commonly used functions.

Using slide 52, explain the purpose of HTML and nested tags.

Using slide 53, explain the purpose of Bean and Logic tags. Also, mention the list of the various Logic tags.

## Slides 55 and 56

Let us understand developing View.

**Developing View 1-2**

Following code snippet form shows login.jsp page containing one text field to get the user name and one password field to get the password:

```
<%@taglib uri="/WEB-INF/struts-html.tld" prefix="html" %>
<html>
<head>
<title>Login Page</title>
</head>
<body>
<div style="color:red">
<html:errors />
<html:form action="/Login" >
    user Name :<html:text name="LoginForm" property="userName" />
    Password :<html:password name="LoginForm" property="password" />
    <html:submit value="Login" />
</html:form> </body> </html>
```

The action is /begin, the input page is login.jsp and the corresponding action class is LoginAction.java.

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**Developing View 2-2**

Following code snippet shows the success.jsp and failure.jsp pages:

```
<!--success.jsp -->
<html>
  .
  .
<body>
  <h1>Login Success. Welcome <bean:write name="LoginForm" property="userName"></bean:write></h1>
</body>
</html>
<!--failure.jsp -->
<html>
  .
  .
  <div style="color:red">
  <h1>Invalid user name <bean:write name="LoginForm" property="userName"></bean:write></h1>
</div>
</html>
```

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Use slides 55 and 56 to explain how to develop View. The login.jsp page has one text field to get the user name and one password field to get the password. The form also has one Submit button, which when clicked calls the login action. `<html:errors/>` tag is used to display the error messages to the user.

Using slide 56, show the creation of success.jsp and failure.jsp pages.

## Slide 57

Let us summarize the session.

**Summary**

- ❑ The MVC is an architectural pattern whose main concern is to separate data from the user interface.
- ❑ In Model 1 architecture, the JSP page is not only responsible for processing requests and sending back replies to the clients, but also for extracting the HTTP request parameters, invoking the business logic, and handling the HTTP session.
- ❑ Model 2 architecture is an approach used for developing a Web application. It separates the 'Business Logic' from the 'Presentation Logic'. Besides this, Model 2 has an additional component - a Controller.
- ❑ The responsibility of the Controller Servlet is to process the incoming request and instantiate a Model - a Java object or a bean to compute the business logic.
- ❑ A framework provides a structural support in the form of classes that can be extended for reuse and a functional toolkit in the form of software libraries.
- ❑ Struts provides the foundation along with libraries and utilities to develop MVC based applications easily and faster.
- ❑ The major constituents of Struts framework are: base framework, JSP tag libraries, tiles plugin, and validator plugin.
- ❑ In Struts, Controller component is in the form of ActionServlet which executes Action object. Action object interacts with the Model and prepares the data for View.
- ❑ Struts come packaged with a set of its own custom JSP tag libraries that aids in the development of JSPs.

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In slide 57, you will summarize the session. You will end the session, with a brief summary of what has been taught in the session.

### 1.3 Post Class Activities for Faculty

You should familiarize yourself with the topics of the next session. You should also explore with Struts 2 framework that is the next version of Struts 1 framework.

#### Tips:

You can also check the Articles/Blogs/Expert Videos uploaded on the OnlineVarsity site to gain additional information related to the topics covered in the next session. You can also connect to online tutors on the OnlineVarsity site to ask queries related to the sessions.

# Session 2 – Working with Struts 2 Framework

---

## 2.1 Pre-Class Activities

Before you commence the session, you should familiarize yourself with the topics of this session in-depth. You should revisit topics of the previous session for a brief review.

Here, you can ask students the key topics they can recall from previous session. Prepare a question or two which will be a key point to relate the current session objectives.

### 2.1.1 Objectives

By the end of this session, the learners will be able to:

- Explain the features of Struts 2 framework
- Explain the architecture of Struts 2 framework
- Explain the components and request life cycle of Struts 2 framework
- Explain the difference between Struts 1 and Struts 2 framework
- Explain how to implement Struts 2 actions using Action interface and ActionSupport class
- Explain the process of managing data from forms to JavaBean properties
- Explain how to configure Struts 2 components in the configuration file
- Explain Result and Result Types
- Explain the annotations provided by Struts 2 framework
- Explain how to develop a Java Web application using Struts 2 framework

### 2.1.2 Teaching Skills

To teach this session successfully, you should be aware of the features of Struts 2 framework and its architecture. Familiarize yourself with the components and request life cycle of Struts 2 framework and the implementation of Struts 2 actions using Action interface and ActionSupport class.

Aware yourself with process of managing data from forms to JavaBean properties and how to configure Struts 2 components in the configuration file. You should know how to configure Result and Result Types for the actions. Finally, aware yourself with annotations for configuring actions and develop a Java Web application using Struts 2 framework.

For teaching in the class, you are expected to use slides and LCD projectors.

#### Tips:

It is recommended that you test the understanding of the students by asking questions in between the class.

### **In-Class Activities:**

Follow the order given here during In-Class activities.

### **Overview of the Session:**

Give the students a brief overview of the current session in the form of session objectives.

Show the students slide 2 of the presentation.

**Objectives**

- Explain the features of Struts 2 framework
- Explain the architecture of Struts 2 framework
- Explain the components and request lifecycle of Struts 2 framework
- Explain the difference between Struts 1 and Struts 2 framework
- Explain how to implement Struts 2 actions using Action interface and ActionSupport class
- Explain the process of managing data from forms to JavaBean properties
- Explain how to configure Struts 2 components in the configuration file
- Explain Result and Result Types
- Explain the annotations provided by Struts 2 framework
- Explain how to develop a Java Web application using Struts 2 framework

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2

Tell the students that they will be introduced to the features of Struts 2 framework and its architecture. Explain the components and request lifecycle of Struts 2 framework and the implementation of Struts 2 actions using Action interface and ActionSupport class.

In this session, they will learn the process of managing data from forms to JavaBean properties and how to configure Struts 2 components in the configuration file. Discuss about Result and Result Types supported for actions. Finally, the session discusses about the action annotations and develops a Java Web application using Struts 2 framework.

## 2.2 In-Class Explanations

### Slides 3 and 4

Let us understand Struts 2 framework.

**Introduction 1-2**



**Apache Struts Framework**

Java-based framework that separates the business logic from the presentation layer.

Based on MVC design paradigms, which separate the application development into three namely, **Model**, **View**, and **Controller**.

Struts 2 is a thorough revision of Struts architecture containing features of **WebWork** and **Struts 1**.

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3

**Introduction 2-2**



- ❑ **Struts 2 = WebWork + Struts 1**
- ❑ **Struts 2 framework**
  - ❑ Is a flexible framework for creating enterprise-ready Java Web applications based on cleaner implementation of MVC.
  - ❑ Is designed to simplify the entire development cycle, including building, deploying, and maintaining applications over time.

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4

Use slides 3 and 4 to explain Struts 2 framework.

The main limitation of Struts 1 is that it encourages a fix approach to MVC approach when designing Web applications. It provides a standard component template defined for the applications. Thus, resulting in a rigid approach.

The next generation of Apache Struts 2 came with the launching of Struts 2 which made the Web application development easier. It is the second generation of Web application framework based on WebWork framework created by OpenSymphony. After working independently for several years, OpenSymphony joined with Apache to create Struts 2 framework. Thus, Struts 2 is not just the next version of Struts 1, but it is a thorough revision of the Struts architecture containing features of WebWork and Struts 1.

Struts 2 is a flexible framework for creating enterprise-ready Java Web applications based on cleaner implementation of MVC. The framework is designed to simplify the entire development cycle, including building, deploying, and maintaining applications over time.

Tell the students that Struts 2 framework renders supports to POJO-based actions, Validation Support, AJAX Support, Integration support to various frameworks such as Hibernate, Spring, Tiles, and so on. It provides support for various Views such as Velocity, Freemarker, JSP, and so on.

**In-Class Question:**

After you finish explaining Struts 2 framework, you will ask the students an In-Class question. This will help you in reviewing their understanding of the topic.



What are the different technologies used as Views in Struts 2.0?

**Answer:**

Velocity, Freemarker, and JSP.

**Tips:**

**WebWork** was a Java-based Web application framework developed by OpenSymphony that was later on merged into the current Struts 2 framework. It was designed to improve developer productivity and simplify code. WebWork was built on top of XWork, which provided a generic command pattern framework as well as an Inversion of Control container.

## Slide 5

Let us understand the features of Struts 2.

The slide has a purple header bar with the title 'Features of Struts 2' and a coffee cup icon. Below the header is a list of ten features. At the bottom left is a small Aptech logo, and at the bottom right is the number '5'.

**Features of Struts 2**

- Simplified Design
- Configurable MVC Components
- POJO-based Actions and Forms
- Enhanced Tags
- Object Graph Navigation Language (OGNL) and ValueStack
- Easy Integration
- Annotation Support
- Minimal Configurations
- AJAX Support
- View Technologies

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Use slide 5 to explain the features of Struts 2.

Struts 2 is an advanced version of Struts framework. It provides many new features that were not in Struts 1.

Some of the important features of Struts 2 are as follows:

### Simplified Design

Struts 2 framework classes are based on interfaces and most of its core interfaces are HTTP independent and framework neutral. This enables the users to test Struts application very easily without referring the low-level HTTP Request and HTTP Response objects in the application.

### Configurable MVC Components

In Struts 2 framework, the component information is configured in struts.xml file. Therefore, any change in the information can be made by simply changing it in the xml file.

### POJO-based Actions and Forms

Struts 2 Action classes are POJOs which are simple java class. The action class acts as a model in the Web application. They are not required to implement any interface or inherit any class. Therefore, testing of the code is highly simplified. Even, to capture user input from the form, developers can use JavaBeans instead of ActionForms provided in Struts 1.

### Enhanced Tags

Struts 2 tags enable to add stylesheet-driven markup capabilities. Here, the user can create consistent pages with fewer codes. Markup tags can be changed by changing an underlying

stylesheet in Struts 2. In addition, it is very easy for the developer to extend the tags and write one's own functionality. Struts 2 provide various types of tags such as Data tags, UI tags, Control tags, and so on which simplify the application development.

### **Object Graph Navigation Language (OGNL) and ValueStack**

Struts 2 uses an elegant expression language called Object Graph Navigation Language (OGNL) which is more powerful and flexible than Java Standard Tag Library (JSTL) expression language used by Struts 1 framework. OGNL supports Asynchronous JavaScript and XML (AJAX) implementation in User Interface (UI). OGNL allows the developer to refer and manipulate the data present on the ValueStack. ValueStack is simply a storage area that holds application data associated with the processing of a request.

### **Easy Integration**

Struts 2 is an extensible framework can be easily integrated with any other frameworks. A framework must provide an abstraction layer for integrating with other frameworks. The frameworks that can be integrated with the Struts 2 applications include Hibernate, Spring, Tiles, and so on.

### **Theme and Template Support**

Struts 2 provides three types of themes: xhtml, simple, and css\_xhtml. The default theme of struts 2 is xhtml. These themes and templates can be used for common look and feel across the application. Using these themes and templates, a user can change the overall look of a Website, simply by changing the theme files.

### **Annotation Support**

Struts 2 uses annotations. The advantage of using annotations is that it eliminates the manual task of configuring the components of the application in the XML configuration file. Annotations allow the developers to add meta-data information into the Java source code declaring Actions. This meta-data information is translated into components during runtime.

### **Minimal Configurations**

For the Struts 2 application, minimal configuration is required as most of the settings will take the default values. Configuration is required only if there are any modifications in the default settings.

### **AJAX Support**

Struts 2 integrates AJAX support into the framework by creating AJAX tags.

### **View Technologies**

Struts 2 provide a great support for presenting the results on the Web pages. The multiple view technologies include JSP, FreeMarker, Velocity, and XSLT.

## Slide 6

Let us understand the architecture of Struts 2.

**Architecture of Struts 2**

Struts 2 is based on a Pull-MVC framework.

- ❑ Pull-MVC framework means:
  - Data that is to be displayed is pulled from Action class, which acts as a model in the Web application.
- ❑ Struts 2 also provides powerful APIs for configuring the Validators, Interceptors, and so on that reduces the processing on the Action class.

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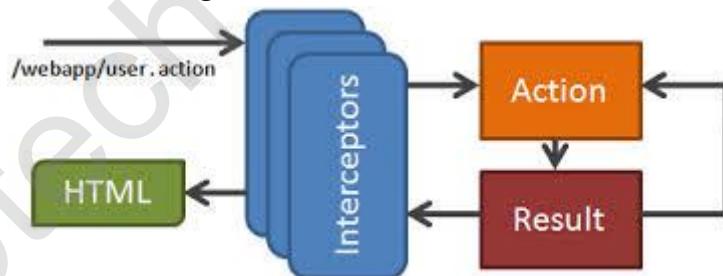
6

Use slide 6 to explain the architecture of Struts 2.

Struts 2 is based on a pull-MVC framework. It means that the data that is to be displayed is pulled from Action class, which acts as a model in the Web application.

However, Struts 1 was based on action-based MVC framework. In action-based framework, a Servlet act as a controller and provides a centralized point of control for client page requests.

The following figure shows the high-level architecture of Struts 2.0 framework:



The steps for user's request life cycle in Struts 2 is as follows:

1. User sends a request to the server, requesting for some resource. The request is send to the servlet container on the Struts configured Web server.
2. The servlet filter looks at the request and then determines the appropriate Action.
3. Configured interceptors functionalities are applied before and after the execution of the action class.
4. Then, the selected action is executed to perform the requested operation.

5. The result is prepared by the view and returns the result to the user.

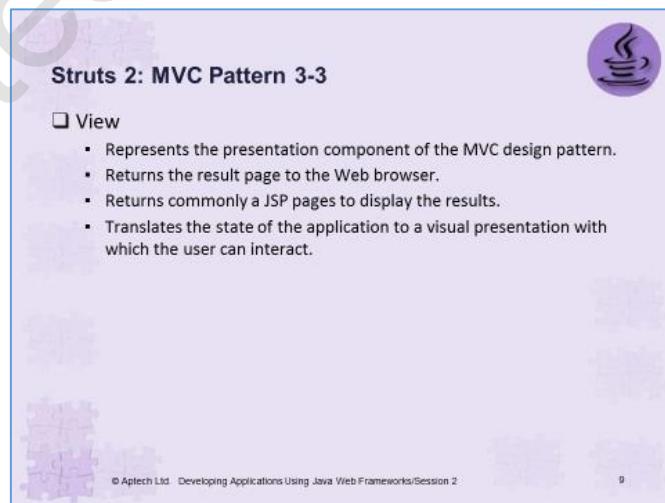
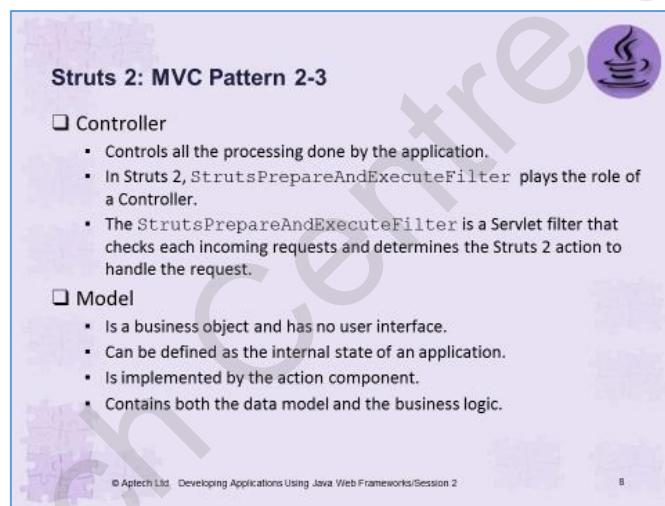
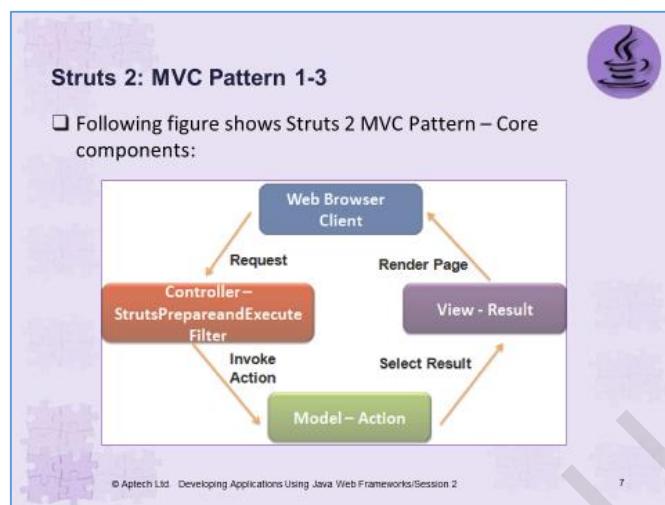
**Tips:**

Normally, frameworks are divided into two types that are as follows:

- Invasive - It will force the programmers to create their classes by extending or implementing from pre-defined classes or interfaces provided by that framework. Struts 1.0 is the type of invasive framework.
- Non-Invasive - It does not force the programmer to extend or implement its own classes or interfaces. Struts 2.0 is the type of non-invasive framework.

## Slides 7 to 9

Let us understand Struts 2: MVC Pattern.



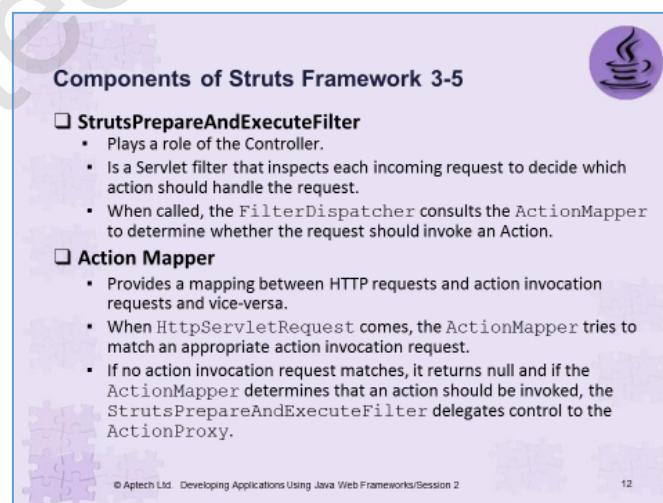
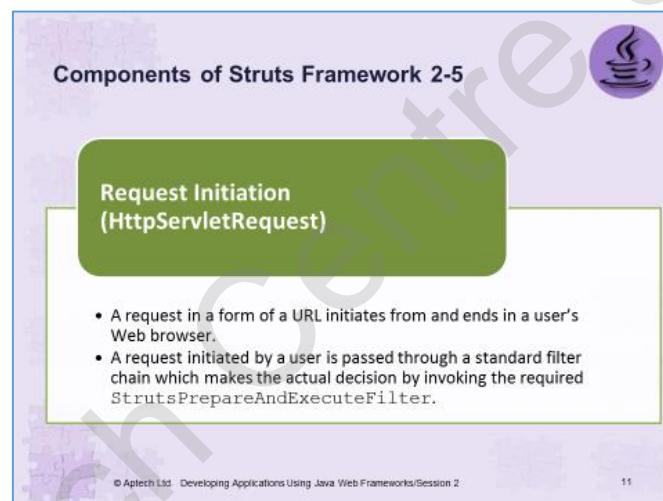
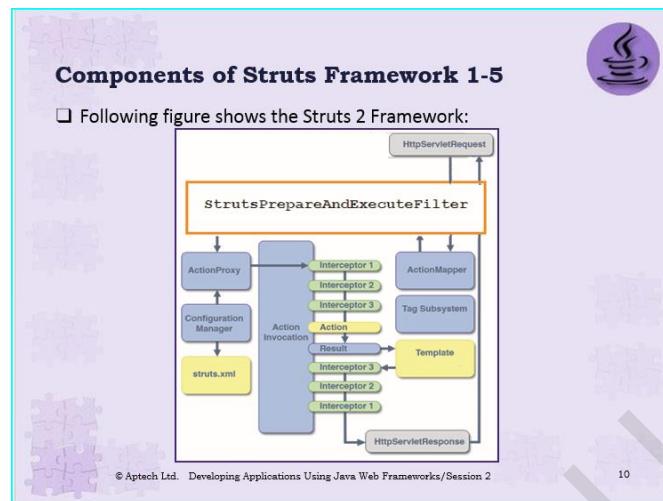
Use slides 7 to 9 to explain Struts 2: MVC Pattern.

Struts 2 follows the MVC design pattern which helps to define the coding pattern or style. The components defined for MVC architecture of Struts 2.0 framework are as follows:

- **Controller:** The main task of the Controller is to map the incoming request to appropriate set of actions. Controller is the first component that will process the HTTP request coming from the client. In Struts 2, `StrutsPrepareAndExecuteFilter` plays the role of a Controller. It is a Servlet filter that checks each incoming requests and determines the Struts 2 action to handle the request. It is important to note that earlier version of Struts framework that is Struts 1.0 provided `FilterDispatcher` as a Controller.
- **Model:** The model in MVC design pattern in Struts 2 framework is implemented by the action component. The model is the core of an application, as it contains both the data model and the business logic. A Web application can have a number of actions mapping to various requests. Thus, after receiving a request the Controller checks the mapping to determine the correct action that will handle the request. Once the correct action is found, the Controller invokes the action and hands over control of the request processing to the action. Once the action class completes the request processing, it forwards the result to the Struts 2 View component.
- **View:** The JSP page is used to commonly display the results. Usually, it is the outcome of the action processing such as success or error.

## Slides 10 to 14

Let us understand the components of Struts framework.



**Components of Struts Framework 4-5**



**❑ Action Proxy**

- Reads the framework configuration files manager, such as the struts.xml file.
- Holds the configuration and context information to process the request and the execution results after the request has been processed.
- Creates an instance of `ActionInvocation` class and delegates the control.

**❑ Action Invocation**

- Responsible for command pattern implementation.
- In a request-response model, the request is routed to the invoker.
- Invoker sends it to the encapsulated command object and is then sent to the suitable method of the receiver to initiate proper action.
- The receiver object is then generated and attached to the command.
- The configured Interceptors are invoked one by one in sequence and then the Action is invoked.

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**Components of Struts Framework 5-5**



**❑ Interceptors**

- Provides pre-processing logic before invoking the action.
- Interacts with the action and set the request parameter on the action.
- Provides post-processing logic after invoking the action.
- Modifies the results.
- Catches exceptions to perform alternate processing or return different results.
- Core functionalities such as handling exception, type conversion, file upload, page preparation, and so on is implemented using pluggable Interceptors.
- Invokes both before and after the execution of the action and the results are rendered back to the user.

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Use slides 10 to 14 to explain the components of Struts framework.

Using the figure as shown on slide 10, explain the steps that will come under the life cycle of a Struts 2 based application.

1. Client sends the request to the Web or servlet container available in the Web server such as Tomcat. The Web container hands over the request to the application requested by the client.
2. The application passes the request to the front controller (`FilterDispatcher` or `StrutsPrepareAndExecuteFilter`) based on configured `web.xml` file. Tell them, from Struts 2.1 onwards,  
`org.apache.struts2.dispatcher.ng.filter.StrutsPrepareAndExecuteFilter` plays a role of the Controller. This important object is a Servlet filter that inspects each incoming request to decide which action should handle the request.

3. The `StrutsPrepareAndExecuteFilter` gets the Action information to be executed from `ActionMapper` class. It is an interface which provides a mapping between HTTP requests and action invocation requests and vice-versa.
4. The Controller calls the `ActionProxy`. The `ActionProxy` obtains the information of action and interceptor stack based on `struts.xml` and `struts-default.xml` file. The `struts-default.xml` is part of the struts 2 core jar file.
5. The `ActionProxy` forwards the request to the `ActionInvocation`.
6. The `ActionInvocation` is responsible to execute all the interceptors and respective action and result is generated and sent back to the `ActionInvocation`.
7. The `ActionInvocation` hands over the response to `HttpServletResponse` object with the help of controller and result is sent to the client.
8. The client reads the values from `ValueStack` using expression language and display output on the screen.

Then, discuss on the use of Interceptors that allow the developers to develop the code specification that can be executed before or after the execution of an action.

Using interceptors, the developer can perform the following:

- Provide pre-processing logic before invoking the action.
- Interact with the action and set the request parameter on the action.
- Provide post-processing logic after invoking the action.
- Modify the results.
- Catch exceptions to perform alternate processing or return different results.

The configured Interceptors are invoked one by one in sequence and then the Action is invoked. Once the Action returns, it looks for a proper result associated with the Action result code mapped in the `struts.xml` file.

**In-Class Question:**

After you finish explaining components of Struts framework, you will ask the students an In-Class question. This will help you in reviewing their understanding of the topic.



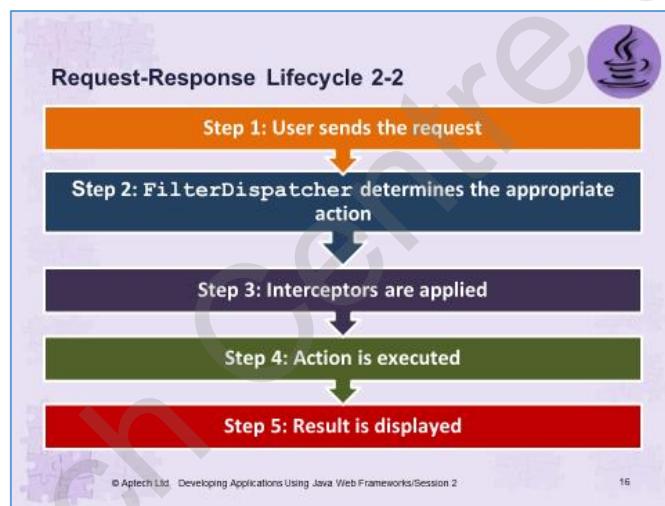
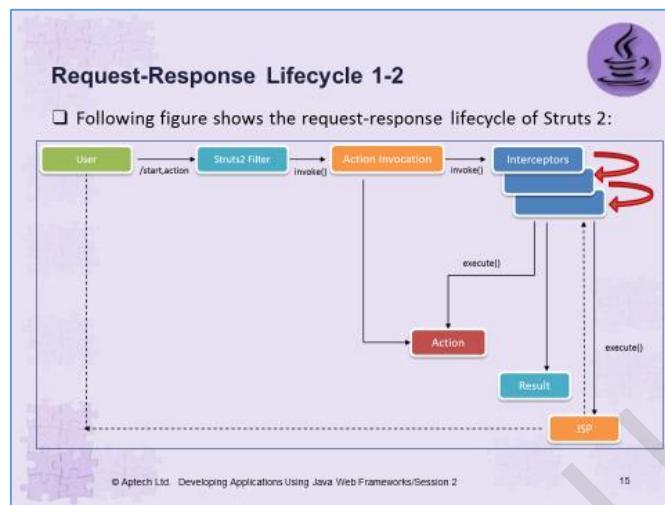
Which component maps HTTP request to the action invocation request?

**Answer:**

Action Mapper

## Slides 15 and 16

Let us understand the Request-Response life cycle.



Use slides 15 and 16 to explain the Request-Response life cycle.

The following step shows Request-Response life cycle in Struts 2:

### Step 1: User sends the request

The request-response cycle starts and ends from the user's Web browser. A request is in the form of an URL. This request URL represents an Action.

The request processing life cycle of Struts 2 follows the given order:

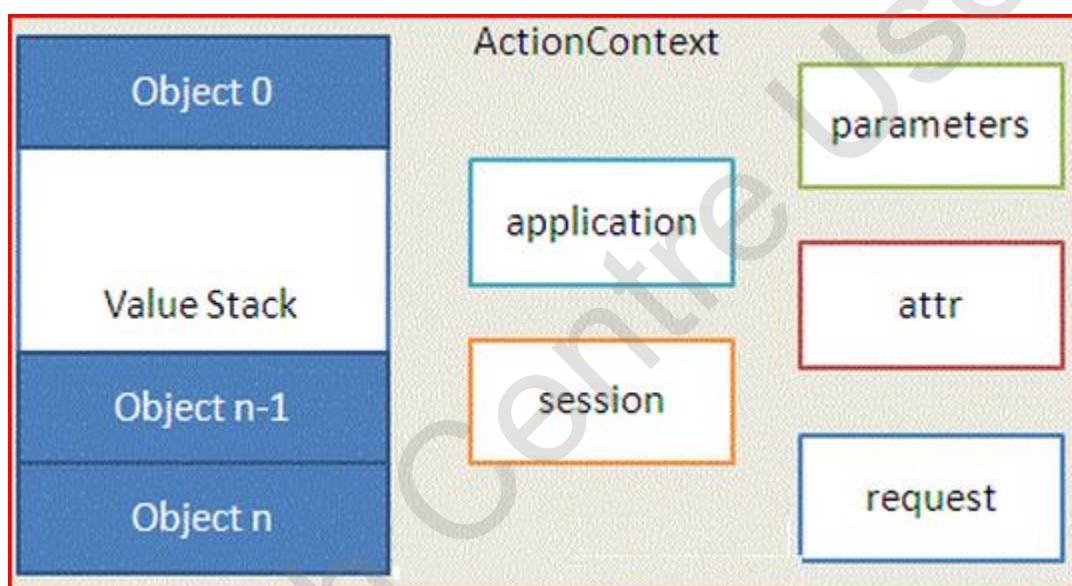
- Displays static content through user interface provided by the View.
- Determines the action configuration, that is, determines which action maps to the URL from the incoming request.
- Creates the action context as it converts the request to a protocol independent format for the actions to use.

- Creates the action proxy class containing the configuration and context information for processing of the request. It also contains the execution results after the requests have been processed.
- Performs cleanup of the `ActionContext` object and ensures no memory leak.

### ActionContext

`ActionContext` is a global storage area that holds all the data associated with the processing of a request. In Struts 2, the action resides on the `ValueStack` which is a part of the `ActionContext`. `ActionContext` is thread local which means that the values stored in the `ActionContext` are unique per thread, this makes the Struts 2 actions as thread safe.

The following figure depicts the `ActionContext`:



### Step 2: StrutsPrepareAndExecuteFilter determines the appropriate action

The `StrutsPrepareAndExecuteFilter` accepts the request and then consult `ActionMapper` to determine the suitable Action. If `ActionMapper` discovers an action to be invoked, then `StrutsPrepareAndExecuteFilter` delegates the control to `ActionProxy`.

### ActionProxy

The `ActionProxy` class stores the configuration and context information for request processing and execution results after the request has been processed. `ActionProxy` class then creates an instance of the `ActionInvocation` class and delegates the control. The `ActionInvocation` object manages the execution environment and contains the conversational state of the action being processed. This class is the core of the `ActionProxy` class. Actions, interceptors, and results are the three environmental components.

**Step 3: Interceptors are applied**

The developer is required to write code around each and every action. The `ActionInvocation` class creates an instance of the action class. Struts 2 create a new instance for each and every request that is received. This instance behaves as POJO. The interceptors help to specify the ‘request processing life cycle’ for an action.

**Step 4: Action is executed**

The action method is executed to carry out the database related operations like storing or retrieving data from the database. After processing of the request by the `execute()` method, a String result is returned which is mapped to an implementation of the `Result` interface.

**Step 5: Result is displayed**

The result is sent to the Servlet container which sends the output to the user browser.

## Slides 17 and 18

Let us understand configuring Struts 2 in web.xml File.

**Configuring Struts 2 in web.xml File 1-2**



The developer configures the Struts 2 Web application in web.xml file present in the WEB-INF folder of the application.

Struts 2 Web configuration uses <filters> in place of <servlet>.

The URI pattern should be specified as “/\*” so as to ensure that all kind of request patterns are served by org.apache.struts2.dispatcher.ng.filter.StrutsPrepareAndExecuteFilter.

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17

**Configuring Struts 2 in web.xml File 2-2**



Following figure shows the implementation of the Controller Servlet filter in web.xml file:

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18

Use slides 17 and 18 to explain configuring Struts 2 in web.xml file.

Tell the students that the web.xml configuration file is an XML configuration file that determines how elements of the HTTP request are processed by the servlet container. The web.xml file renders an entry point for any Web application. The entry point of Struts 2 application will be a filter defined in deployment descriptor (web.xml). Struts 2 Web configuration uses <filters> in place of <Servlet>. The URI pattern should be specified as ‘/\*’ so as to ensure that all kind of request patterns are served by org.apache.struts2.dispatcher.ng.filter.StrutsPrepareAndExecuteFilter.

The following figure shows the implementation of the filter Controller in web.xml.

```
<?xml version="1.0" encoding="UTF-8"?>
...
<filter>
    <filter-name>struts2</filter-name>
    <filter-class>
        org.apache.struts2.dispatcher.ng.filter.StrutsPrepare
        AndExecuteFilter
    </filter-class>
</filter>
<filter-mapping>
    <filter-name>struts2</filter-name>
    <url-pattern>/*</url-pattern>
</filter-mapping>

<session-config>
    <session-timeout> 30 </session-timeout>
</session-config>

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

## Slides 19 to 21

Let us understand the difference between Struts 1 and Struts 2.

**Difference Between Struts 1 and Struts 2 1-3**



Following Table lists the differences between Struts 1 framework and Struts 2 framework:

Feature	Struts 1	Struts 2
Controller	Struts 1 uses a Servlet Controller such as ActionServlet class.	Struts 2 uses a Filter to act as a Controller.
Form Input	In Struts 1 an HTML form mapped to an ActionForm object is used to capture inputs.	In Struts 2 Action properties are used for capturing input and thus eliminating the need for creating another class for obtaining input. The HTML form maps directly to a POJO class in Struts 2.

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19

**Difference Between Struts 1 and Struts 2 2-3**



Feature	Struts 1	Struts 2
Model	In Struts 1 the Action interface is implemented. It acts as an adapter between the contents of an HTTP request and the corresponding business logic that executes to process the request.	Struts 2 action classes do not require to implement the Action interface. The Action object is a POJO object that can be easily tested.
Thread Model	In Struts 1, only one instance of the user-defined Action class is created for handling all incoming requests and so it is required to be thread-safe.	Struts 2 creates instance of user-defined Action class for each incoming request.
Tag Library	Struts 1 provides several tag libraries such as HTML, Bean, and Logic.	Struts 2 provide a single tag library.

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20

**Difference Between Struts 1 and Struts 2 3-3**



Feature	Struts 1	Struts 2
Expression Language	Struts 1 provided Java Standard Tag Library (JSTL) Expression Language (EL).	Struts 2 uses OGNL as an expression language.
Type Conversion	Struts 1 uses JSP mechanism of binding object into the page contexts for access.	Struts 2 uses ValueStack for the taglibs to access values.
Control Of Action Execution	Struts 1 has a separate lifecycle for each of the module. All actions share same lifecycle in the module.	Struts 2 create separate lifecycles for each action using the Interceptor Stack.

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21

Use slides 19 to 21 to explain the difference between Struts 1 and Struts 2.

## Slide 22

Let us understand Struts 2 Action.

**Introduction to Struts 2 Action**



- The action classes act as controller in the MVC pattern.
- The main functions of Struts 2 action classes includes responding to a user request, executing business logic, and then returning a result to the user based on configuration file (`struts.xml`) to render the view page.
- Struts 2 actions serve in two other important capacities:
  - Transferring the data from the request to the view, irrespective of the type of result.
  - Assisting the framework to determine which result should render the view that will be returned in response to the request.

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22

Use slide 22 to explain Struts 2 Action. Tell the students that in struts 2, action class is Plain Old Java Object (POJO). Each URL is mapped to a specific action, which provides the processing logic necessary to service the request from the user.

Action helps to the transfer of data from the request to the view, whether it is a JSP or other type of result. The action helps the framework in determining which result will provide the view that will be returned in the response to the request.

In Struts 2 action class, `execute ()` method should be specified that represents the business logic.

### Requirements of Action class

The only requirement for actions in Struts 2 is that there must be one no-argument method that returns either a String or Result object and must be a POJO. If the no-argument method is not specified, the default behavior is to use the `execute ()` method.

### Difference between Struts 1 and Struts 2 Action class

The Action class is a singleton class in struts 1.0 framework. Thus, it is not a thread safe and to make it thread safe, the developer needs to apply synchronization. However, in Struts 2.0, an Action class object will be created for each request, so it is by default thread safe.

## Slides 23 to 28

Let us understand using Action classes.

### Using Action Classes 1-6

- ❑ Contains business logic, handles client's data, retrieve resources, perform validation, and select appropriate result page for the view.
- ❑ As Struts 2 POJO-based actions, the class must implement an `execute()` method.
- ❑ The code specification inside the `execute()` method should only hold the logic of the work associated with the request.
- ❑ The `execute()` method returns a String value.
- ❑ The String value specifies the result page which has to be returned as a View to the client.

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23

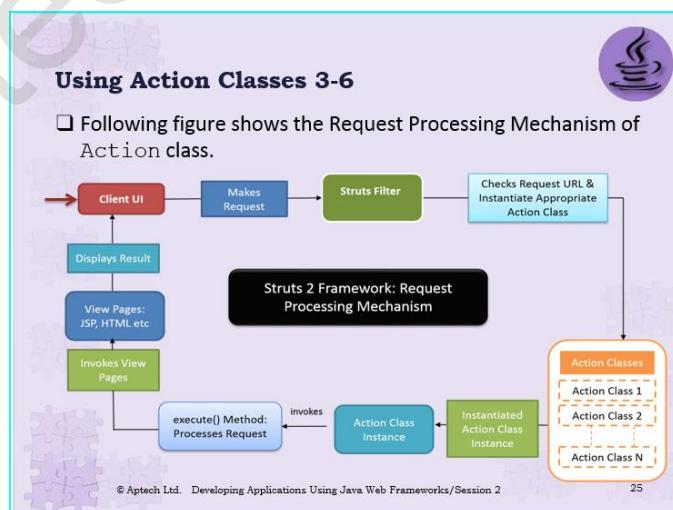
### Using Action Classes 2-6

- ❑ Following code snippet shows how a POJO class can be implemented as Action class in Struts 2:

```
public class MessageAction{
    // execute() method containing business logic
    public String execute() {
        return "success";
    }
}
```

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24



### Using Action Classes 4-6



Following are helpers of Action class:

- **Action interface.** – It can be implemented by the Action class. It is provided in the package `com.opensymphony.xwork2` in the Struts 2 framework.
- **ActionSupport Class** – It is defined in the `com.opensymphony.xwork2` package and can be extended by the Action class.

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### Using Action Classes 5-6



**Action Interface**

- Exposes the `execute()` method to the action class implementing it.
- Declares five constants that can be returned from the Action class.
- Following figure shows the Action interface defined by Struts framework:

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### Using Action Classes 6-6



**ActionSupport Class**

- Adds useful utilities to the class that extends it.
- Provides a default implementation for the `execute()` method.
- The default implementation of the `execute()` method in the `ActionSupport` class returns `Action.SUCCESS` String object.
- Following figure shows the `ActionSupport` class declaration semantics.

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Use slides 23 to 28 to explain how to use action classes.

Tell them that there are two helpers for actions. They can be used:

- By implementing Action interface. The Action interface is provided in the package `com.opensymphony.xwork2` in the Struts 2 framework.

- By extending `ActionSupport` class defined in the `com.opensymphony.xwork2` package.

Explain that the `Action` interface has five constants that can be returned from the action class. They are as follows:

1. `SUCCESS` - indicates that action execution is successful and a success result should be shown to the user.
2. `ERROR` - indicates that action execution is failed and an error result should be shown to the user.
3. `LOGIN` - indicates that user is not logged-in and a login result should be shown to the user.
4. `INPUT` - indicates that validation is failed and an input result should be shown to the user again.
5. `NONE` - indicates that action execution is successful but no result should be shown to the user.

Similarly, `ActionSupport` class can be extended by the user-defined action class. It provides default implementation of the `execute()` method. In addition, it implements many interfaces such as `Action`, `Validateable`, `ValidationAware`, `TextProvider`, `LocaleProvider`, and so on. It is mostly used instead of `Action` interface.

The description is as follows:

- `Validateable` and `ValidationAware` interfaces that provide programmatic, annotation-based, and declarative XML-based validation.
- `TextProvider` and `LocaleProvider` interfaces that provide support for localization and internationalization.
- `Serializable` interface that helps to create classes for easy transfer of binary data over a communication channel.

The following code snippet shows the use of `ActionSupport` class:

```
public class HelloWorldAction extends ActionSupport {  
    private String name;  
  
    public String execute() throws Exception {  
        if ("john".equals(name))  
        {  
            return SUCCESS;  
        }  
    }  
}
```

```
        } else{
            return ERROR;
        }
    }

    public String getName() {
        return name;
    }

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

As shown in the given code snippet, the `execute()` method can return String constants such as `SUCCESS` and `ERROR`, as the class is extended from `ActionSupport` class.

## Slides 29 and 30

Let us understand actions and form data.

### Actions and Form Data 1-2



- ❑ The Struts 2 framework follows the JavaBean paradigm.
- ❑ Struts 2 framework, automatically moves the request parameters from the form to the JavaBeans properties that have matching names.
- ❑ The data from the form fields is stored locally in the Action class by using the class instance variables or properties.
- ❑ The getter and setter methods help to retrieve and assign the data values to the properties respectively.
- ❑ The execute () method references the data using these properties.

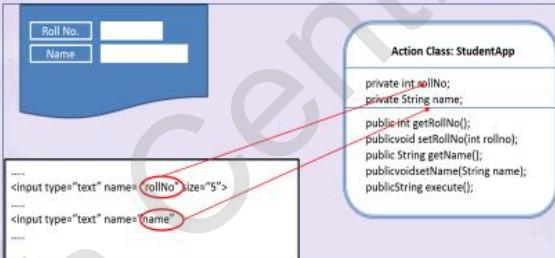
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29

### Actions and Form Data 2-2



- ❑ Following figure shows the mapping of the form field with the JavaBeans properties:



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30

Use slides 29 and 30 to explain actions and form data.

Tell them that the data from the form fields is stored locally in the Action class by using the class instance variables or properties. The getter and setter methods help to retrieve and assign the data values to the properties respectively. The execute () method references the data using these properties.

Using the figure as shown on slide 30, explain that the rollNo and name parameters from the form are automatically assigned to the rollNo and name property of the JavaBean. In Struts 2, each request string or form value is a name-value pair. Struts 2 provides automatic type conversion between string and other data types using OGNL expression language.

## Slide 31

Let us understand Actions return value.

**Actions Return Value**

- ❑ After the completion of action, the `execute()` method returns a control string.
- ❑ The string helps the Struts 2 filter to decide the result/view page that should be rendered.
- ❑ The mapping of the resultant string and the view page to be rendered is defined in the configuration file named `struts.xml`.
- ❑ Following figure displays the `execute()` method code specification:

```
.....  
publicString execute () {  
    setMessage("Welcome"+getName());  
    return "success";  
}  
.....
```

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Use slide 31 to explain actions return value. After the completion of action, the `execute()` method returns a control string. This string helps the Struts 2 filter to decide the result/view page that should be rendered.

The mapping of the resultant string and the view page to be rendered is defined in the configuration file named `struts.xml`.

## Slide 32

Let us understand configuring actions.

**Configuring Actions**

- ❑ The struts.xml is the configuration file used in Struts 2.
- ❑ Following code snippet shows the implementation of struts.xml file:

```
<!DOCTYPE struts PUBLIC
. . .
<struts>
<include file="example.xml"/>
    <!-- Configuration for the default package. -->
    <package name="default" namespace="/" extends="struts-default"
method="execute">
        <action name="StudentApp"
            class="com.demo.myApp.StudentApp">
            <result name="success">/SuccessView.jsp</result>
            <result name="error">/ErrorView.jsp </result>
        </action>
    </package>
</struts>
```

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Use slide 32 to explain configuring actions. Struts framework contains two main configuration files, struts.xml file and struts.properties file.

The struts.properties file is used to override the default values of default.xml file provided by struts framework.

The following code snippet shows an example for struts.xml file:

```
<?xml version="1.0" encoding="UTF-8" ?>
. . .
<struts>
<package name="default" extends="struts-default">
    <action name="StudentApp" class="com.demo.myApp.StudentApp">
        <result name="success">/SuccessView.jsp</result>
        <result name="error">/ErrorView.jsp </result>
    </action>
</package>
</struts>
```

The <package> tag is used to group together configuration information that share common attributes such as Interceptor stacks or URL namespace. Thus, packages help to group together the application's components based on commonality of function or domain. Packages group the following components into a logical configuration unit:

- Actions
- Result Types
- Interceptors

- Interceptor stacks

The `extends` attribute indicates the name of the parent package. It specifies the package name whose components will be inherited by the current package that is being defined. This attribute is similar to the `extends` keyword in Java. In the given code snippet, the `extends` attribute contains the value ‘`struts-default`’.

By extending the `struts-default` package, the action will by default inherit the commonly needed Struts 2 components ranging from complete Interceptor stacks to all the common result types.

The `<action>` tag maps an identifier with an action class. The framework uses action’s name to process the request. This action name is mapped with the request URL. The attributes of the `<action>` tag are `name`, `class`, and `method`.

The `<result>` tag specifies the name of the result page. Every action element can have one or more result elements. The `<include>` tag allows the inclusion of other configuration files.

## Slide 33

Let us understand result and result types.



Result and ResultTypes	
Following table shows the configured Result Types provided by Struts 2 framework:	
Method	Description
Dispatcher	Rendered using JSP.
Chain	Chains actions with each other.
HttpHeader	Returns a configured HTTP header response.
Redirect	Redirects the user to a configured URL.
RedirectAction	Redirects the user to a configured action.
Stream	Streams raw data to the browser.
PlainText	Returns the content as plain text.
FreeMarker	The page is rendered as FreeMarker.
XSL	Renders XML to the browser, which is transformed using XSLT.

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Use slide 33 to explain result and result types.

After processing of the action, the result is sent in two parts, the result type and the result. Result defines the next action after the processing of the action is completed. The action returns a String value such as ‘success’ or ‘error’, as a result which is used to select the result element.

The default result type `dispatcher` is used to dispatch to JSP pages. Struts allows to use other markup languages for the view to present the results that includes Velocity, Freemarker, XSLT, and Tiles. The default type, `dispatcher` result is used if no other result type is specified. It is used to forward to a servlet, JSP, HTML page, and so on, on the server. It uses the `RequestDispatcher.forward()` method.

Then, explain the different result types provided by Struts 2 framework as explained on slide 33.

## Slide 34

Let us understand configuring result.

The slide has a purple header bar with the title 'Configuring Result' and a coffee cup icon. The main content area has a light blue background with a puzzle piece watermark. It contains two bullet points and a code snippet:

- ❑ The developer can set the result types in the struts.xml configuration file.
- ❑ Following code snippet shows the setting of default result type in struts.xml:

```
<result-types>
    <result-type name="dispatcher" default="true"
        class="org.apache.struts2.dispatcher.ServletDispatcherResult"
    />
</result-types>
```

Below the code snippet, there are two more bullet points:

- ❑ The code declares dispatcher as the default result type for the package.
- ❑ This means each request will be forwarded to a Web resource such as JSP to render the result to the client.

At the bottom left: © Aptech Ltd. Developing Applications Using Java Web Frameworks/Session 2. At the bottom right: 34.

Use slide 34 to explain configuring result.

Tell the students when method of action class completes, it returns a String value. The value of the String 'success', 'input', and 'error', and so on is used to select a result element in struts.xml configuration file.

The String value matched with an action mapping will often have a set of results representing different outcomes. A standard set of result tokens are defined by the ActionSupport base class.

Then, explain the code snippet as given on slide 34 to set the default result types in struts.xml file. The code declares dispatcher as the default result type for the package. This means each request will be forwarded to a Web resource such as JSP to render the result to the client.

## Slides 35 to 37

Let us understand user-defined results.

### User-defined Results 1-3



- ❑ Consider a scenario where the application needs to perform the Create, Read, Update, and Delete (CRUD) operations.
- ❑ Depending on the operation performed, the appropriate page needs to be rendered in the result.
- ❑ The `execute()` method of the action class defines the logical name of the action.
- ❑ Action class returns a bunch of logical result strings which can be mapped to appropriate result pages in the configuration file.

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35

### User-defined Results 2-3



- ❑ Following code snippet shows the `execute()` method with different logical results:

```
public class CRUDAction
{
    public String execute() {
        if(createOper())
        { return "create"; }
        else if (deleteOper())
        { return "delete"; }
        else if (readOper())
        { return "read"; }
        else if (writeOper())
        { return "write"; }
        else
        { return "error"; }
    }
}
```

❑ The code evaluates the invoked methods and return the appropriate result value from the `execute()` method.

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36

### User-defined Results 3-3



- ❑ Following code snippet shows the mapping of the results with their corresponding view pages configured in the `struts.xml` file:

```
<struts>
    <action name="CRUDAction" class="actions.CRUDAction">
        <result name = "create">/create.jsp</result>
        <result name = "delete">/delete.jsp</result>
        <result name = "read">/read.jsp</result>
        <result name = "update">/update.jsp</result>
    </action>
```

- ❑ Based on the return result value, the appropriate View is displayed to the user.

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37

Use slides 35 to 37 to explain user-defined results.

The `execute()` method of the action class defines the logical name of the action. Apart from the pre-defined CONSTANTS result names, the action class can also return a bunch of logical result strings which can be mapped to appropriate result pages in the configuration file.

Then, explain the code snippet as given on slide 36 that evaluates the invoked methods and return the appropriate result value from the `execute()` method. Based on the return result value, the appropriate View is displayed to the user.

Then, explain the mapping of the results with their corresponding view pages configured in the `struts.xml` file as shown on slide 37.

## Slides 38 to 40

Let us understand Action annotations.

### Action Annotations 1-3



- ❑ Some of the Action annotations are as follows:

**@Action**

- Used to mark the action class.
- Maps to some URL called as action path.
- The action path is made up of package, class, and method name of an action.
- Struts 2 will automatically create action for classes name ending with Action.
- The action name is determined by removing the Action suffix and converting first letter to lowercase.
- If the class is not annotated with @Result annotation to provide the result, then result pages are looked into **WEB-INF/content** directory of the project directory.
- The name of the result page should be `{action}-{return_string}.jsp`.

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38

### Action Annotations 2-3



**@Namespace**

- Helps to set the path of the action URL.
- Placed before the action class.
- Applies to all actions defined in the class, even if the fully qualified URLs are not specified.
- If no namespace annotation is used, the namespace will be generated from the package name.

**@Result and @Results**

- Used for configuring a result for the return value.
- Can be declared at global or local level.
- If it is added at the class level, it is a global annotation.
- If it is defined at the method level, then it is local.
- The annotation accepts four parameters for configuration - name, value, type, and parameters.

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39

### Action Annotations 3-3



- ❑ To use Struts 2 annotations, we need to add `struts2-convention-plugin` library in the classpath and in `web.xml`.
- ❑ Following code snippet displays the configuration setting of the `web.xml` configuration file.

```
...
<filter>
    <filter-name> struts 2 </filter-name>
    <filter-class>org.apache.struts2.dispatcher.ng.filter.
StrutsPrepareAndExecuteFilter</filter-class>
<init-param>
    <param-name>actionPackages</param-name>
    <param-value>com.book.session2.actions</param-value>
</init-param>
</filter>
...

```

❑ The `<param-name>` and the `<param-value>` elements have been used to specify the location of the packages containing the action classes using annotations.

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40

Use slides 38 to 40 to explain action annotations.

Use of the Zero Configuration terminology means departure from XML based configuration to an annotation-based configuration. The requirement for `struts.xml` is eliminated with the introduction of the annotation.

Annotations allow the developers to add meta-data information into the Java source code. Struts 2 uses annotations. Annotations are added on Java classes that implement the `Action` interface.

To use Struts 2 annotations, we need to add `struts2-convention-plugin` library in the classpath and in `web.xml`. Struts 2 filter configuration provide the Java package that contains action classes.

Some of the action annotations are as follows:

- `@Actions` Annotation - Group of `@Action` annotations, maps multiple URLs to the same action.
- `@Action` Annotation - Defines the URL of an action. This annotation is used to mark the action class. It maps to a URL called as action path.
- `@InterceptorRefs` Annotation - Group of `@InterceptorRef` annotations.
- `@InterceptorRef` Annotation – Interceptor or interceptors stack to be applied to an action.
- `@Results` Annotation - Group of `@Result` annotations.
- `@Result` Annotation - Defines a result for an action.
- `@ParentPackage` Annotation - Set the parent package of the actions.
- `@ExceptionMappings` - Group of `@ExceptionMapping` annotations.
- `@ExceptionMapping` - Defines an exception mapping.
- `@Namespace` - Helps to set the path of the action URL.

The following example shows the use of `@Action` annotation:

```
...
public class LoginAction extends ActionSupport{
{
private String name;
private String pwd;
public String getName() {
```

```
return name;
}

public void setName(String name) {
this.name = name;
}

public String getPwd() {
return pwd;
}

public void setPwd(String pwd) {
this.pwd = pwd;
}

// Applying action annotation
@Action(value="/login")
public String execute() throws Exception {
if("admin".equals(getName()) && "admin".equals(getPwd()))
return "SUCCESS";
else
return "ERROR" ;

}
}
```

If the class is not annotated with `@Result` annotation to provide the result, then result pages are looked into `WEB-INF/content` directory of the project directory. The name of the result page should be `{action}-{return_string}.jsp`. So, if `LoginAction` action class is returning 'SUCCESS', the request will be forwarded to `WEB-INF/content/login-success.jsp` page. Thus, to avoid default naming conventions, the developers should apply proper annotation to the class with proper configuration.

## Slide 41

Let us understand creating a Web application using Struts 2.

**Creating a Web Application Using Struts 2**

❑ Struts 2 application is based on MVC design pattern.

❑ To create a Web application in Struts 2, the steps to be followed are as follows:

- Create views which will provide user interface for the applications.
- Create an action class; define the input properties and its getter/setter methods within the action class and define the `execute()` method to perform the action implementation.
- Establish relationship between the Views and Controllers using configuration file, `struts.xml`, or using annotations.
- Modify the `web.xml` file to enable the Web application.
- Build and run the Web application.

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41

Use slide 41 to explain creating a Web application using Struts 2.

Tell the students that when you click a hyperlink or submit an HTML form in a Struts 2 Web application, the input is collected by the Controller which is sent to a Java class called Actions. After the Action is executed, a Result selects a resource to render the response. The resource is basically a JSP, it can also be a PDF file, an Excel spreadsheet, or a Java applet window.

Struts 2 application is based on MVC design pattern. To create a Web application in Struts 2, you need to identify the Model, View, and Controller.

The steps to be followed are:

- Create views which will provide user interface for your applications.
- Create an action class; define the input properties and its getter/setter methods within the action class and define the `execute()` method to perform the action implementation.
- Establish relationship between the Views and Controllers using configuration file, `struts.xml`, or using annotations.
- Modify the `web.xml` file to enable the Web application with Struts 2 filter.
- Build and run the Struts 2 Web application.

## Slides 42 to 45

Let us understand creating Views.

### Create Views 1-4



- ❑ Views represent the presentation layer of the application.
- ❑ Consider that there are three views - index.jsp, AcceptDetails.jsp, and DisplayDetails.jsp.
- ❑ Following code snippet shows the inclusion of Struts 2 tag library in the JSP page:

```
...
<%@taglib prefix="s" uri="/struts-tags" %>
...
<%@taglib uri="/struts-tags" prefix="s" %>
```

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42

### Create Views 2-4



- ❑ Following code snippet shows the implementation of index.jsp page:

```
...
<head>
<meta http-equiv="Content-Type" content="text/html; charset=UTF-8">
<title>Welcome Page</title>
</head>
<body>
<h1>Welcome to Struts 2 Example!</h1>
Click to enter <s:a href="example/AcceptDetails.jsp"> Details
</s:a>
</body>
</html>
...
```

- ❑ The index.jsp page uses Struts 2-specific HTML tag.
- ❑ The <s:a href> tag is used to emulate an HTML link.

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43

### Create Views 3-4



- ❑ Following code snippet shows the implementation of the AcceptDetails.jsp page:

```
...
<body>
<h1> User Details Page </h1>
<s:form action="WelcomeMessage">
<s:textfield name="FirstName" label="First Name"/>
<s:textfield key="LastName" label="Last Name"/>
<s:submit/>
</s:form>
</body>
</html>
...
```

- ❑ The <s:textfield/> emulates an HTML text field.
- ❑ The <s:submit/> tag emulates an HTML submit button.

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44



### Create Views 4-4

Following code snippet shows the implementation of the `DisplayDetails.jsp` page:

```
<%@page contentType="text/html" pageEncoding="UTF-8"%>
<%@taglib uri="/struts-tags" prefix="s" %>
<html>
    ...
<body>
    <h1>User Details:</h1>
    <h3> <s:property value="message"/></h3>
</body>
</html>
```

- The view is displayed only after the successful submission of form by the user.
- The `<s:property value="message"/>` tag is used to automatically find the `message` property and print the value in the `message` property.

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45

Use slides 42 to 45 to explain creating Views.

Explain the code snippet as given on slides 42 and 43 demonstrating the `index.jsp` page. The `index.jsp` page uses Struts 2-specific HTML tag. This is the first page of the application where the user sees a Welcome Message and a link. The `<s:a href>` tag is used to emulate an HTML link. On clicking this link the user is taken to another JSP page.

Then, explain the code snippet given on slide 44 that demonstrates the `AcceptDetails.jsp` page. The `<s:textfield>` emulates an HTML text field. This text field allows the user to enter text. The `<s:submit>` tag emulates an HTML Submit button. On clicking the Submit button, the `<s:form>` tag is created and populated with the values from the `<s:textfield>` tag.

Finally, explain the code snippet given on slide 45 that accepts the user details. When the user submits the form, the `firstname` and `lastname` entered in the `AcceptDetails.jsp` page. The view is displayed only after the successful submission of the form by the user.

In this code, the `<s:property value="message"/>` tag is used to automatically find the `message` property and print the value in the `message` property.

## Slides 46 to 48

Let us understand creating the Action Class.

### Creating the Action Class 1-3



- ❑ The data sent from `AcceptDetails.jsp` page is processed by action class.
- ❑ The action class extends the `ActionSupport` class.
- ❑ Following code snippet shows the implementation of the action class:

```
...
public class WelcomeMessage extends ActionSupport {
    /*
     * Declaring properties
     */
    private String firstName;
    private String lastName;
    private String message;
    ...
}
```

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46

### Creating the Action Class 2-3



```
...
public String getFirstName() {
    return firstName;
}
public void setFirstName(String firstName) {
    this.firstName = firstName;
}
public String getLastName() {
    return lastName;
}
public void setLastName(String lastName) {
    this.lastName = lastName;
}
public String getMessage() {
    return message;
}
...
}
```

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47

### Creating the Action Class 3-3



```
...
public String getMessage() {
    return message;
}
public void setMessage(String message) {
    this.message = message;
}
public String execute() throws Exception {
    java.util.Date dt = new java.util.Date();
    //Defining temporary variable for storing the result message
    String tmpmessage;
    tmpmessage = "Hello " + getFirstName() + " " + getLastName();
    tmpmessage = tmpmessage + " You have logged in at " + dt.toString();
    ...
    //Setting the result message to the message variable
    setMessage(tmpmessage);
    return SUCCESS;
}
}
```

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48

Use slides 46 to 48 to explain creating the Action class.

Tell the students that Action class responds to a user action when user clicks a URL. One or more of the Action class's methods are executed and a String result is returned. A specific JSP page is provided based on the value of the result.

In the code, all the input fields submitted in the **AcceptDetails.jsp** page are declared as properties in the **WelcomeMessage** action class. The getter/setter methods for these properties have been declared. The OGNL expression language maps the input fields of the **AcceptDetails.jsp** page with the properties in the **WelcomeMessage** action class. Thus, for this reason the input field names of the **AcceptDetails.jsp** page are the same as the names of the properties in the **WelcomeMessage** action class.

## Slides 49 to 52

Let us understand actions in struts.xml file.

### Actions in struts.xml File 1-4

- ❑ Following code snippet shows the implementation of the struts.xml file.
 

```
<package name="example" namespace="/example" extends="struts-default">
<action name="WelcomeMessage" class="example.WelcomeMessage">
<result name="success"/>/example/DisplayDetails.jsp</result>
</action>
</package>
</struts>
...
```
- ❑ The <action /> element maps an identifier to handle an action class.
- ❑ The mapping determines how to process the request when it is matched.

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49

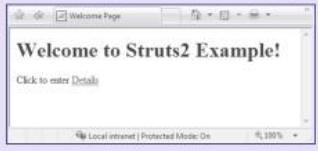
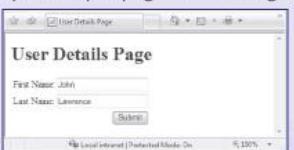
### Actions in struts.xml File 2-4

- ❑ The attributes of action element are name and class.
- ❑ The name attribute identifies the name of the action which matches a part from the URL.
- ❑ The class attribute identifies the action class to be executed with full package description. The sub-element of action is result.
- ❑ The <result /> element displays the desired view.
- ❑ The execute() method of the action class returns a String value.
- ❑ The execute() method can return ERROR or INPUT for errors or conversion issues respectively.

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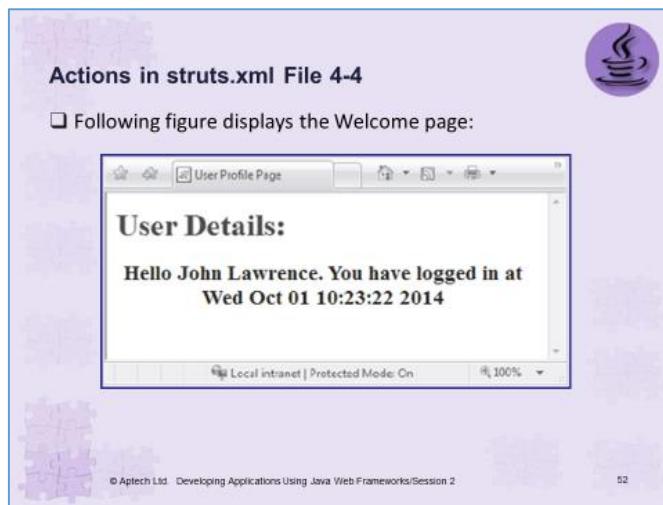
50

### Actions in struts.xml File 3-4

- ❑ Following figure displays the application startup page:
- ❑ Following figure displays the input page for entering the user details:


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51



Use slides 49 to 52 to explain configurations in `struts.xml` file.

The `<action />` element maps an identifier to handle an action class. The mapping is used by the action's name and framework to determine how to process the request when a request is matched.

The attributes of action element are `name` and `class`. The `name` attribute identifies the name of the action which matches a part from the URL. The `class` attribute identifies the action class to be executed with the full package description. The sub-element of **action** is **result**.

The `<result />` element displays the desired view. The `execute()` method of the action class returns a String value. This string value is used to select a `<result />` element. For example, if the `execute()` method of the action class named **WelcomeMessage.java** returns **SUCCESS**, then this value is matched with the result named, **success**. After matching the value, the **DisplayDetails.jsp** page is invoked to display the result. The `execute()` method can return **ERROR** or **INPUT** for errors or conversion issues, respectively. These values should then be matched with the particular result name present in the `<result />` element and a JSP page should be rendered.

The output of the code execution is given on slides 51 and 52.

## Slide 53

Let us summarize the session.

**Summary**



- ❑ Apache Struts is a Java-based framework that separates the business logic from the presentation layer.
- ❑ Some of the important features of Struts 2 framework are namely, simplified design, MVC components, POJO-based actions, enhanced tags, OGNL and ValueStack, easy integration, template support, annotations, AJAX support, and View technologies.
- ❑ In Struts 2, FilterDispatcher plays the role of a Controller. A Model is a business object and has no user interface. View component returns the result page to the Web browser.
- ❑ Various components of the Struts2 framework are namely FilterDispatcher, Action Mapper, Action Proxy, Action Invocation, and Interceptors.
- ❑ The FilterDispatcher accepts the request and then consult ActionMapper to determine the suitable Action.
- ❑ The main functions of Struts 2 action includes responding to a user request, executing business logic, and then returning a result to the user based on configuration file [struts.xml] to render the view page.
- ❑ Struts 2 framework also provides helper interfaces and classes which can be used for adding additional functionalities to an action class. They are Action interface and ActionSupport class.
- ❑ The data from the form fields is stored locally in the Action class by using the class instance variables or properties.

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53

In slide 53, you will summarize the session. You will end the session, with a brief summary of what has been taught in the session.

### 2.3 Post Class Activities for Faculty

You should familiarize yourself with the topics of the next session. You should also explore the concept and working of the interceptors and different types of tags in Struts 2.

#### Tips:

You can also check the Articles/Blogs/Expert Videos uploaded on the OnlineVarsity site to gain additional information related to the topics covered in the next session. You can also connect to online tutors on the OnlineVarsity site to ask queries related to the sessions.

# Session 3 – Struts 2 - Interceptors and Tags

---

## 3.1 Pre-Class Activities

Before you commence the session, you should familiarize yourself with the topics of this session in-depth. You should revisit topics of the previous session for a brief review.

Here, you can ask students the key topics they can recall from previous session. Prepare a question or two which will be a key point to relate the current session objectives.

### 3.1.1 Objectives

By the end of this session, the learners will be able to:

- Describe the purpose of Interceptors in Struts 2 framework
- Explain different types of built-in Interceptors
- Explain how to configure Interceptors in Struts 2 application
- Describe Interceptors Stacks
- Explain the process of creating custom Interceptors in Struts 2 framework
- List the different types of tags used in Struts 2 View page
- Explain various Data tags
- Explain various Control tags
- Explain various User Interface (UI) tags

### 3.1.2 Teaching Skills

To teach this session successfully, you should be aware of Interceptors and different types of built-in Interceptors in Struts 2 framework. Familiarize yourself with the configuration of Interceptors in Struts 2 application and the process of creating custom Interceptors in Struts 2 framework.

You should also know about interceptor stack and different types of tags used in Struts 2 View page. Aware yourself with Data tags, Control tags, and User Interface (UI) tags.

For teaching in the class, you are expected to use slides and LCD projectors.

#### Tips:

It is recommended that you test the understanding of the students by asking questions in between the class.

#### In-Class Activities:

Follow the order given here during In-Class activities.

### **Overview of the Session:**

Give the students a brief overview of the current session in the form of session objectives.  
Show the students slide 2 of the presentation.

The slide has a purple header bar with the title 'Objectives'. In the top right corner is a purple circular icon containing a white coffee cup with steam. The main content area is white with a light blue border. At the bottom left is a decorative graphic of overlapping puzzle pieces. At the bottom center is a small footer with the text '© Aptech Limited Developing Applications Using Java Web Frameworks/Session 3' and the number '2'.

Describe the purpose of Interceptors in Struts 2 framework  
 Explain different types of built-in Interceptors  
 Explain how to configure Interceptors in Struts 2 application  
 Describe Interceptors Stacks  
 Explain the process of creating custom Interceptors in Struts 2 framework  
 List the different types of tags used in Struts 2 View page  
 Explain various Data tags  
 Explain various Control tags  
 Explain various User Interface (UI) tags

Tell the students that they will be introduced to interceptors and different types of built-in Interceptors in Struts 2 framework. Explain the configuration of Interceptors in Struts 2 application and the process of creating custom Interceptors in Struts 2 framework.

In this session, they will learn about Interceptor stack and different types of tags used in Struts 2 View page. Finally, discuss about Data tags, Control tags, and User Interface (UI) tags.

## 3.2 In-Class Explanations

### Slide 3

Let us introduce interceptors.

**Introduction**

- Interceptor is an important feature introduced in the Struts 2 framework.
- Interceptors sit between controller and action.
- Interceptors intercepts the request and response, processes the request before and after invoking action.

The main aim of having Interceptors is to separate the core functionality that may be applicable to multiple actions.

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Use slide 3 to introduce interceptors.

Tell them that Interceptor is an important feature introduced in the Struts 2 framework. Interceptors sit between controller and action. They intercepts the request and response. In other words, Interceptors provide a mechanism to supply pre-processing and post-processing functionalities required by action classes.

Interceptor is an object which intercepts an action dynamically. It allows the developers to write a code which can be executed by the controller before and after invoking actions. Each and every Interceptor object is pluggable, so user can decide exactly which features an action need to support.

The main aim of having Interceptors is to separate the core functionality that may be applicable to multiple actions.

#### In-Class Question:

After you finish explaining interceptors, you will ask the students an In-Class question. This will help you in reviewing their understanding of the topic.



Which feature of Struts 2 intercepts the request and response and processes the request before and after invoking action?

#### Answer:

Interceptor

## Slides 4 and 5

Let us understand stack of interceptors and custom interceptors.

**Interceptors 1-2**



- ❑ An Interceptor is an object which intercepts an action dynamically.
- ❑ A stack of interceptors:
  - Can be configured for an action.
  - Are executed before the execution of the mapped action, to provide all the pre-processing functionalities to the request.
  - Are a set of built-in Interceptors provided by the Struts 2 framework, which can be used to provide the required functionalities to action.

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4

**Interceptors 2-2**



The Struts 2 framework also allows the developers to develop custom Interceptors for defining the specific functionalities for the Web application.

- ❑ A custom Interceptor can be created:
  - By implementing the `com.opensymphony.xwork2.interceptor.Interceptor` interface.
  - By extending the `com.opensymphony.xwork2.interceptor.AbstractInterceptor` class.

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5

Use slides 4 and 5 to explain stack of interceptors and custom interceptors.

Tell them that struts 2 framework provide a default interceptor stack which fulfils the needs of most of the struts applications. These interceptors are referred to as built-in interceptors.

These built-in Interceptors can be used to provide the required functionalities to action. The Struts 2 framework also allows the developers to develop custom Interceptors for defining the specific functionalities for the Web application.

**Tips:**

A custom Interceptor class can be created by implementing the `com.opensymphony.xwork2.interceptor.Interceptor` interface or by extending the `com.opensymphony.xwork2.interceptor.AbstractInterceptor` class.

The following code snippet shows the syntax of interceptor interface used for creating custom interceptors:

```
public interface Interceptor extends Serializable{  
    void destroy();  
    void init();  
    String intercept(ActionInvocation invocation) throws  
Exception;  
}
```

- `init()` method initializes the interceptor.
- `destroy()` method provides a facility for interceptor cleanup.
- `ActionInvocation` object provides access to the runtime environment. It allows access to the action itself and methods to invoke the action and determine whether the action has already been invoked.

## Slide 6

Let us understand about request and interceptors.

**Request and Interceptors**

- ❑ Every request that is received by the Struts 2 framework passes through each Interceptor.
- ❑ Once the request is received, the Interceptors can:
  - Ignore the request
  - Act on the request data
  - Short-circuit the request and prevent the Action class method to be executed

In Struts 2, the default Interceptors are configured in the struts-default.xml file.

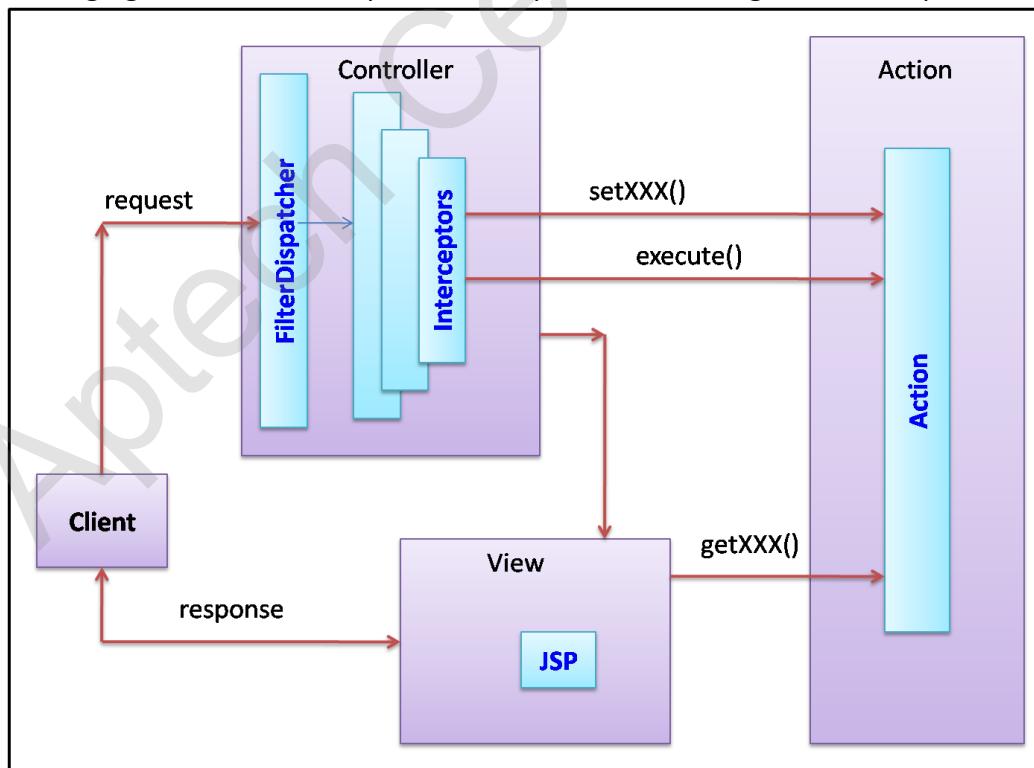
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6

Use slide 6 to explain request and interceptors.

Interceptors are responsible for most of the request processing. Every request that is received by the Struts 2 framework passes through each Interceptor.

The following figure shows the request and response with configured interceptors:



Some of the actions taken by interceptor on receiving the request are as follows:

- Ignore the request
- Act on the request data
- Short-circuit the request and prevent the Action class method to be executed

In Struts 2, the default Interceptors are configured in the `struts-default.xml` file. The `struts-default.xml` is included in the application's configuration by default, so all of the predefined interceptors are provided in the Struts 2 framework.

## Slides 7 and 8

Let us understand how Interceptors works.

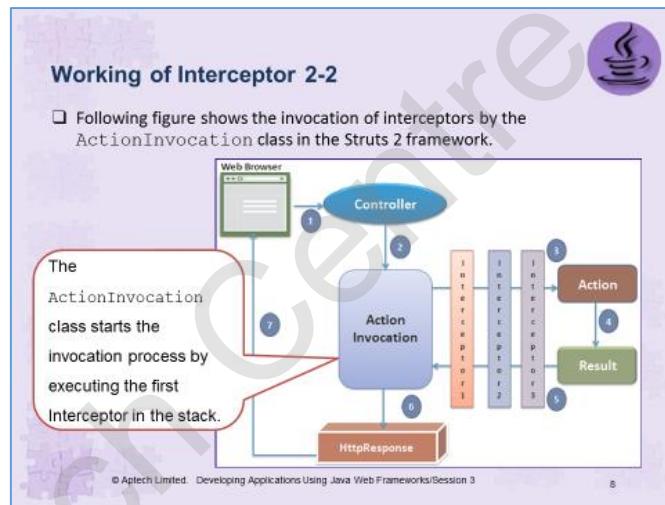
**Working of Interceptor 1-2**



- ❑ The ActionInvocation class is responsible for the execution of the action including the sequential invocation of the Interceptor stack.
- ❑ ActionInvocation class:
  - Encapsulates the processing details associated with the execution of a particular action.
  - On receiving a request, the framework decides to which action the URL maps.
  - Stores the references of the configured Interceptors.

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7



Use slides 7 and 8 to explain how Interceptors works.

### ActionInvocation Class

Tell them that the ActionInvocation class is responsible for the execution of the interceptors. ActionInvocation class encapsulates the processing details associated with the execution of a particular action. On receiving a request, the framework decides to which action the URL maps.

Struts 2 framework creates an object ActionInvocation that contains the action and all the interceptors configured for that action. Each interceptors are called before the action is called. Once the action is called and result is generated, each interceptors are again called in reverse order to perform post processing work. Interceptors can change the workflow of action. It can prevent the execution of action.

The `ActionInvocation` class stores the references of these Interceptors, besides storing other important information such as Servlet request objects and so on. Once the `ActionInvocation` class contains all the required information, it exposes the `invoke()` method to the framework. The framework invokes this method and the `ActionInvocation` class starts the invocation process by executing the first Interceptor in the stack.

All the Interceptors are invoked one after the other by recursively invoking the `invoke()` method of the `ActionInvocation` class. The `ActionInvocation` class checks the states and executes whichever Interceptor comes next. After all the Interceptors have been invoked, the `invoke()` method will cause the action to be executed.

## Slides 9 and 10

Let us understand how to configure interceptors.

**Configuring Interceptors 1-2**



□ The Interceptors can be configured using any one of the following approaches:

- By declaring all the Interceptors in the `struts.xml` configuration file. The Interceptor classes are defined using a name-class pair in the configuration file.
- By declaring all the Interceptors that are used for the Web application in an XML file and including that XML file in `struts.xml` configuration file.

□ All the Interceptors that are required to perform the pre-processing functionalities of the request for a given action should be defined in the action mapping for that specific action.

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**Configuring Interceptors 2-2**



□ Following code snippet shows the declaration of the Interceptors:

```
...
<include file="struts-default.xml">
<package name="default" extends="struts-default">
<interceptors>
    <interceptor name="timer1" class="timer1_class">
        <interceptor name="timer2" class="timer2_class">
    </interceptor>
...
<action name="Login" class="example.Login">
    <interceptor-ref name="timer1" />
    <interceptor-ref name="timer2" />
    <result name="success"/>/example/DisplayDetails.jsp</result>
    <result name="error"/>/example/error.jsp</result>
</action>
</package>
...
```

□ The `<interceptor-ref name="...">` element is used to declare the list of Interceptors that will intercept the action request.

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Use slides 9 and 10 to explain how to configure interceptors. The following approach can be used to configure interceptors:

- By declaring all the Interceptors in the `struts.xml` configuration file.
- By declaring all the Interceptors that are used for the Web application in an XML file and including that XML file in `struts.xml` configuration file.

Then, explain them how to configure interceptors in `struts.xml` file as explained in the given code snippet on slide 10. In the code, every Interceptor class is provided a name which is used for reference. The `<interceptor-ref name="...">` element is used to declare the list of Interceptors that will intercept the action request. Interceptors are executed in the same order in which they are declared in the action mapping.

In the code, the Interceptor classes will be executed to provide all pre-processing functionalities before the execution of the **Login** action class.

## Slides 11 and 12

Let us understand default interceptor configuration.

**Default Interceptor Configuration 1-2**



The struts-default.xml file is the base configuration file with default settings of the components in the Struts 2 framework.

- struts-default.xml file:
  - Is automatically included into struts.xml file to provide default configuration settings to the Web applications.
  - Contains the definitions of all Interceptors and Interceptor stacks.
  - Can be included in the struts-default.xml in the struts.xml configuration file by extending the package from the struts-default package.

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11

**Default Interceptor Configuration 2-2**



Following figure shows the list of interceptors defined in the struts-default.xml file:

```

<interceptors>
  <interceptor name="alias" class="com.opensymphony.module.spring_interceptor.SpringAliasInterceptor"/>
  <interceptor name="chain" class="com.opensymphony.module2.interceptor.ChainingInterceptor"/>
  <interceptor name="convert" class="com.opensymphony.module2.interceptor.ConvertorInterceptor"/>
  <interceptor name="cookie" class="org.apache.struts2.interceptor.cookieinterceptor.CookieInterceptor"/>
  <interceptor name="exception" class="com.opensymphony.module2.interceptor.ExceptionInterceptor"/>
  <interceptor name="clearSession" class="org.apache.struts2.interceptor.ClearSessionInterceptor"/>
  <interceptor name="debugging" class="org.apache.struts2.interceptor.DebuggingInterceptor"/>
  <interceptor name="fileUpload" class="com.opensymphony.module2.interceptor.FileUploadInterceptor"/>
  <interceptor name="exception" class="com.opensymphony.module2.interceptor.ExceptionLoggingInterceptor"/>
  <interceptor name="lifecycle" class="com.opensymphony.module2.interceptor.LifecycleInterceptor"/>
  <interceptor name="loggin" class="com.opensymphony.module2.interceptor.LoggingInterceptor"/>
  <interceptor name="methodinvocation" class="com.opensymphony.module2.interceptor.MethodInvocationInterceptor"/>
  <interceptor name="scopedModelDriven" class="com.opensymphony.module2.interceptor.ScopedModelDrivenInterceptor"/>
  <interceptor name="actionMappingParam" class="org.apache.struts.interceptor.ActionMappingParametersInterceptor"/>
  <interceptor name="staticParams" class="com.opensymphony.module2.interceptor.StaticParametersInterceptor"/>
  <interceptor name="token" class="com.opensymphony.module2.interceptor.TokenInterceptor"/>
  <interceptor name="sessionConfig" class="org.apache.struts2.interceptor.SessionConfigInterceptor"/>
  <interceptor name="tokenSession" class="org.apache.struts2.interceptor.TokensessionInterceptor"/>
  <interceptor name="tokenSession" class="com.opensymphony.module2.interceptor.TokensessionInterceptor"/>
  <interceptor name="workflow" class="com.opensymphony.module2.interceptor.DefaultWorkflowInterceptor"/>
  <interceptor name="workflow" class="com.opensymphony.module2.interceptor.CheckWorkflowInterceptor"/>
  <interceptor name="checkbox" class="org.apache.struts.interceptor.CheckboxInterceptor"/>
  <interceptor name="profiling" class="org.apache.struts.interceptor.ProfilingActivationInterceptor"/>
  <interceptor name="annotationWorkflow" class="com.opensymphony.module2.interceptor.Annotations.AnnotationWorkflowInterceptor"/>
  <interceptor name="annotationWorkflow" class="org.apache.struts.interceptor.Annotations.AnnotationWorkflowInterceptor"/>
  <interceptor name="ognlValidation" class="org.apache.struts.interceptor.OgnlValidationInterceptor"/>

```

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12

Use slides 11 and 12 to explain default interceptor configuration.

The struts-default.xml file is the base configuration file with default settings of the components in the Struts 2 framework. This file is automatically included into struts.xml file to provide default configuration settings to the Web applications.

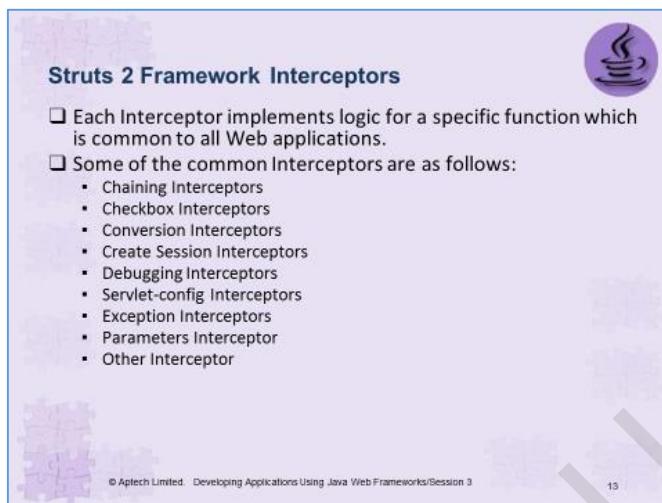
The struts-default.xml file contains the definitions of all Interceptors and Interceptor stacks. To use the Interceptors bundled with the framework, user can include struts-default.xml in the struts.xml configuration file by extending the package from the struts-default package. Discuss the list of interceptors mentioned in struts-default.xml as shown on slide 12.

### Tips:

The struts-default.xml file is contained in the struts2-core.jar present in the lib folder of the Struts 2 software package.

## Slide 13

Let us understand Struts 2 framework interceptors.



The slide has a purple header bar with the title "Struts 2 Framework Interceptors". To the right of the title is a purple circular icon containing a white coffee cup with steam. Below the title, there are two main bullet points:

- ❑ Each Interceptor implements logic for a specific function which is common to all Web applications.
- ❑ Some of the common Interceptors are as follows:
  - Chaining Interceptors
  - Checkbox Interceptors
  - Conversion Interceptors
  - Create Session Interceptors
  - Debugging Interceptors
  - Servlet-config Interceptors
  - Exception Interceptors
  - Parameters Interceptor
  - Other Interceptor

At the bottom left of the slide is a small watermark of a person working at a computer. At the bottom center, it says "© Aptech Limited - Developing Applications Using Java Web Frameworks|Session 3". At the bottom right, it says "13".

Use slide 13 to explain Struts 2 framework interceptors.

Tell the students that Interceptor classes are defined using a key-value pair specified in the Struts configuration file.

Further, discuss the interceptor element defined in the `struts-default.xml` file. All interceptor elements are nested within the `interceptors` element and are associated with a name and a qualified class name.

Following points are required to be taken care of when you are using framework Interceptors:

- `struts-default.xml` file should be included in the `struts.xml` file.
- Action mappings should be enclosed within the `<package>` element which extends `struts-default package`.

Then, list some of the common interceptors as mentioned on slide 13.

## Slides 14 and 15

Let us understand Chaining interceptors.

**Chaining Interceptors 1-2**



- ❑ Extends `AbstractInterceptor` class.
- ❑ Main requirement in action chaining is copying the parameters from `ValueStack` of one action to the `ValueStack` of the next action class.
- ❑ User can define a collection of include and exclude elements to control which parameter is to be copied and how it is to be copied.
- ❑ Following table lists the methods available in Chaining Interceptor class:

Method	Description
<code>Collection getExcludes()</code>	Returns a collection of excluded parameters.
<code>Collection getIncludes()</code>	Returns a collection of included parameters.
<code>String intercept(ActionInvocation action)</code>	Implements the code to handle interception.
<code>Avoid setExcludes(Collection excludes)</code>	Sets a collection of excluded parameters.
<code>void setExcludes(Collection excludes)</code>	Sets a collection of included parameters.

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14

**Chaining Interceptors 2-2**



- ❑ Following code snippet shows the implementation of the Chaining Interceptors:

```
...
<package>
<action name="Login" class="example.Login">
<interceptor-ref name="custom_stack" />
<result name="success" type="chain"><action1/></result>
<result name="error">/example/error.jsp</result>
</action>

<action name="action1" class="example.action1">
<interceptor-ref name="custom_stack" />
<result name="success" >/example/DisplayDetails.jsp</result>
</action>
</package>
...
```

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15

Use slides 14 and 15 to explain Chaining interceptors.

The Chaining class extends `AbstractInterceptor` class. The function of this Interceptor is to copy all the objects present in the `ValueStack` of the currently executing action class to the `ValueStack` of the next action class to be executed in action chaining.

Thus, the main requirement in action chaining is copying the parameters from `ValueStack` of one action to the `ValueStack` of the next action class. You can define a collection of include and exclude elements to control which parameter is to be copied and how it is to be copied.

The table as shown on slide 15 explains the methods of Chaining Interceptor class. If there are no objects in the `ValueStack`, the interceptor does nothing. It works with 'chain' result type in `struts.xml` file.

All objects including first action will be available in the target action's `ValueStack`.

The following additional code snippet shows how to configure the chain interceptors:

```
<package name="default" extends="struts-default">

    <action name="ValidateAction" class="example.ValidateAction">
        <interceptor-ref name="basicStack"/>
        <result name="success" type="chain">action1</result>
    </action>

    <action name="LoginAction" class="example.Action">
        <interceptor-ref name="chain"/>
        <interceptor-ref name="basicStack"/>
        <result name="success">Success.jsp</result>
    </action>

</package>
```

**In-Class Question:**

After you finish explaining Chaining interceptors, you will ask the students an In-Class question. This will help you in reviewing their understanding of the topic.



Which interceptor makes the previous Action's properties available to the current Action?

**Answer:**

Chaining interceptors

## Slide 16

Let us understand Checkbox interceptor.

**Checkbox Interceptors**

- ❑ Defined in the `CheckboxInterceptor` class.
- ❑ Implements the `Interceptor` interface.
- ❑ Has a field named `uncheckedValue` of `String` data type and a method `void setUncheckedValue (String unchecked)` to set value to this field.
- ❑ Is included in the default Interceptor stack such as `basicStack`, `defaultStack`, and `paramsPrepareParamsStack` which is defined in the `struts-default.xml` file.

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16

Use slide 16 to explain Checkbox interceptors.

Tell the students that Checkbox interceptors adds automatic checkbox handling code that detect an unchecked checkbox and add it as a parameter with a default value. The default value is usually false. The

`org.apache.struts2.interceptor.CheckboxInterceptor` class is in the `defaultStack`. The class has a field named `uncheckedValue` of `String` data type and a method `void setUncheckedValue (String unchecked)` to set value to this field.

It is included in the default Interceptor stack such as `basicStack`, `defaultStack`, and `paramsPrepareParamsStack` which is defined in the `struts-default.xml` file.

Checkbox interceptors uses a specially named hidden field to detect an un-submitted checkboxes.

### Tips:

The `CheckInterceptor` contains a parameter named `setUncheckedValue`. The default value of an unchecked box is false which can be overridden by setting the '`uncheckedValue`' property.

For an example on `CheckInterceptor`, you can refer to this link:

<http://www.mkyong.com/struts2/struts-2-scheckbox-checkbox-example/>

## Slides 17 and 18

Let us understand ConversionError interceptors.

**Conversion Error Interceptors 1-2**

- Defined in the `ConversionErrorInterceptor` class.
- Is the subclass of the `XWork 2` conversion error interceptor.
- Is used when the action implements the `ValidationAware` interface or the `ActionSupport` class.
- The value of all the fields is stored so that during subsequent requests, the values will be available for display.
- Maps errors as a field error.
- Contains the method, `ActionContext.getConversionErrors()` which will return a map containing all the conversion errors.

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**Conversion Error Interceptors 2-2**

- Is included in the default Interceptor stack such as `basicStack` and `defaultStack` which is defined in the `struts-default.xml` file.
- Following code snippet demonstrates the implementation of the `ConversionError` Interceptor:

```
...
<action name="Login" class="example.Login">
    <interceptor-ref name="params" />
    <interceptor-ref name="conversionError" />
    <result name="success">/example/DisplayDetails.jsp </result>
</action>
...
```

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Use slides 17 and 18 to explain ConversionError interceptors.

Mention that the Struts 2 Conversion Error interceptor is a subclass of the XWork 2 Conversion Error interceptor. Conversion Error interceptor adds conversion errors from the `ActionContext` to the Action's field errors.

This interceptor adds any error found in the `ActionContext`'s `conversionErrors` map as a field error provided the action implements `ValidationAware`. The method, `ActionContext.getConversionErrors()` will return a map containing all the conversion errors. In addition, any field that contains a validation error has its original value saved. Thus, any subsequent requests for that value return the original value rather than the value in the action.

Then, explain the configuration of `ConversionError` interceptor as shown on slide 18.

## Slide 19

Let us understand Create Session interceptors.



### Create Session Interceptors

- Defined in the `CreateSession` class.
- Extends the `AbstractInterceptor` class.
- Is used for creating an `HttpSession`.
- Defines the logic to be executed when the Interceptor invokes the `intercept()` method.
- Following code snippet shows the implementation of the `CreateSessionInterceptor` Interceptor:

```

    ...
<action name="Login" class="example.Login">
<interceptor-ref name="create-session" />
<interceptor-ref name="defaultStack" />
<result name="success"/>/example/DisplayDetails.jsp </result>
</action>
...
  
```

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19

Use slide 19 to explain Create Session interceptors.

Tell the students that this interceptor creates the `HttpSession` if it doesn't exist. `SessionMap` is also recreated and put in `ServletActionContext`. It does not have any parameters.

The following code snippet shows an example for Create Session interceptors:

```

<action name="LoginAction" class="example.LoginAction">
    <interceptor-ref name="createSession"/>
    <interceptor-ref name="defaultStack"/>
    <result name="enter"/>/example/DisplayDetails.jsp </result>
</action>
  
```

### In-Class Question:

After you finish explaining Create Session interceptors, you will ask the students an In-Class question. This will help you in reviewing their understanding of the topic.



Which interceptors creates an `HttpSession` automatically?

### Answer:

Create Session interceptors.

## Slide 20

Let us understand Debugging interceptors.

The slide has a purple header bar with the title 'Debugging Interceptors'. In the top right corner is a small icon of a steaming coffee cup. The main content area has a light purple background with a faint illustration of a person sitting at a desk. The text is organized into bullet points:

- ❑ Defined in the DebuggingInterceptor class.
- ❑ Implements the Interceptor interface.
- ❑ Provides developer with different debugging screens.
- ❑ Methods present in this Interceptor class are as follows:
  - String getParameter(String key)
  - String intercept(ActionInvocation action)
  - void printContext()
  - void setDevMode(String mode)
- ❑ The **devMode** should be enabled in the struts.properties file for the Interceptor to intercept the request.

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Use slide 20 to explain Debugging interceptors.

Tell the students that Debugging interceptor provides several different debugging screens to provide insight into the data behind the page.

This interceptor is activated only when `devMode` is enabled in `struts.properties`. The 'debug' parameter is removed from the parameter list before the action is executed. All operations occur before the natural Result has a chance to execute.

Some of the parameters of the Debugging interceptor are as follows:

- `xml`: An XML document is dumped with parameters, context, session, and ValueStack.
- `console` - Shows a popup 'OGNL Console' that allows the user to test OGNL expressions against the value stack.
- `command` - Tests an OGNL expression and returns the string result.
- `browser` - Shows field values of an object specified in the `object` parameter.

Then, explain the methods present in the Debugging interceptor as explained on slide 20.

The following code snippet shows the `struts.xml` configuration file with debugging setting:

```
<?xml version="1.0" encoding="UTF-8" ?>
. . .
<constant name="devMode" value="true"/>
<package name="default" extends="struts-default">
<action
```

```

ame="EmpDebugAction" class="techmyguru.actions.EmpDebugAction"
>
<interceptor-ref name="debugging"/>
<result name="success">/WEB-INF/pages/EmpSuccess.jsp
</result>
</action>
</package>
</struts>

```

## Slide 21

Let us understand Servlet Config interceptor.

**Servlet-config Interceptors**

- ❑ Defined in the `ServletConfig` class.
- ❑ Allows the developer to inject various objects from the Servlet environment in the `Action` class.
- ❑ Found in the `org.apache.struts2.interceptor` package.
- ❑ Supported interfaces are as follows:
  - `ServletContextAware` sets the `ServletContext`.
  - `ServletRequestAware` sets the `HttpServletRequest`.
  - `ServletResponseAware` sets the `HttpServletResponse`.
  - `ParameterAware` sets a map of the request parameters.
  - `RequestAware` sets a map of the request attributes.
  - `SessionAware` sets a map of session attributes.
  - `ApplicationAware` sets a map of application scope properties.
  - `PrincipalAware` sets the `Principal` object used for applying security.

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21

Use slide 21 to explain Servlet Config interceptor.

Tell the students that Servlet Config interceptor provides access to Maps representing `HttpServletRequest` and `HttpServletResponse`. Servlet Config interceptor sets action properties based on the interfaces an action implements. It is designed to set all properties an action needs if it is aware of servlet parameters, the servlet context, the session, and so on.

The following code snippet shows the configuration for Servlet Config interceptor.

```

<action name="someAction" class="com.examples.SomeAction">
  <interceptor-ref name="servletConfig"/>
  <interceptor-ref name="basicStack"/>
  <result name="success">good_result.ftl</result>
</action>

```

## Slides 22 and 23

Let us understand Exception interceptors.

### Exception Interceptors 1-2



- Defined in the `ExceptionMapping` class.
- Extends the `AbstractInterceptor` class.
- Provides the functionality of exception handling by displaying a page describing the real problem.
- Enables the mapping of the exception to a result code and does not throw an exception.
- Wrapped exception within an `ExceptionHandler` and pushed on the stack.
- Contains `Intercept()` method and getter/setter methods for its fields such as `logCategory`, `logEnabled`, and `logLevel`.

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### Exception Interceptors 2-2



- Following code snippet shows the implementation of the Exception Interceptor in the `struts.xml` file:

```

...
<global-exception-mappings>
    <exception-mapping exception="java.lang.Exception"
        result="exception" />
</global-exception-mappings>
<action name="Login" class="example.Login ">
    <interceptor-ref name="exception" />
    <interceptor-ref name="prepare" />
    <interceptor-ref name="debugging" />
    <interceptor-ref name="params" />
    <interceptor-ref name="defaultStack" />
    <result name="success">/example/DisplayDetails.jsp </result>
    <result name="exception">/example/exception.jsp </result>
</action>
...

```

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Use slides 22 and 23 to explain Exception interceptors. Tell the students that Exception interceptor maps exceptions to a result. The Interceptor enables the mapping of the exception to a result code and does not throw an exception. The encountered exception is wrapped within an `ExceptionHandler` and pushed on the stack and thus gives access to the exception from within the user's result.

Tell them that besides the `intercept()` method, the class has getter/setter methods for its fields such as `logCategory`, `logEnabled`, and `logLevel`.

Parameters of Exception interceptors are as follows:

- `logEnabled` (optional) – Whether exceptions should also be logged. It has values such as boolean true or boolean.

- `logLevel` – Specifies the log level. It can use trace, debug, info, warn, error, or fatal. The default is debug.
- `logCategory` – The default category to use is `com.opensymphony.xwork2.interceptor.ExceptionMappingInterceptor`.

Then, explain the implementation of Exception interceptor in the `struts.xml` file as shown on slide 23.

## Slide 24

Let us understand Parameters interceptor.

**Parameters Interceptor**

- ❑ Defined in the `ParametersInterceptor` class.
- ❑ Sets the values of all the parameters on the ValueStack.
- ❑ Provides `ActionContext.getParameters()` method that obtains all the parameters from the ValueStack.
- ❑ On invocation of the interceptor, the value in three flags are set: Those are as follows:
  - `XWorkMethodAccessor.DENY_METHOD_EXECUTION` restricts the invocation of methods when it is set ON.
  - `InstantiatingNullHandler.CREATE_NULL_OBJECTS` automatically creates null reference when it is set ON.
  - `XWorkConverter.REPORT_CONVERSION_ERRORS` reports errors when conversion of data type takes place provided it is set ON.

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24

Use slide 24 to explain Parameters interceptor. Tell the students that Parameters interceptor sets the request parameters onto the ValueStack. The `ActionContext.getParameters()` method obtains all the parameters from the ValueStack. The `ValueStack.setValue(String, Object)` method is used for setting the value in the ValueStack. The values are applied to the actions present in the ValueStack after the form requests are submitted.

Parameters of Parameters interceptor are as follows:

- `ordered` - set to true if user wants the top-down property setter behavior.
- `acceptParamNames` - a comma delimited list of regular expressions to describe a whitelist of accepted parameter names.
- `excludeParams` - a comma delimited list of regular expressions to describe a blacklist of not allowed parameter names.
- `paramNameMaxLength` - the maximum length of parameter names. Parameters with longer names will be ignored. The default length is 100 characters.

## Slides 25 and 26

Let us understand other interceptors used in Struts 2.

**Other Interceptors 1-2**



Following table lists some of the other Interceptors provided by Struts 2 framework:

Interceptor	Description
Alias Interceptor	Aliases a named parameter to a different parameter name.
Execute and Wait Interceptor	Displays an intermediary waiting page to the user while the action is executed in the background.
Message Store Interceptor	Stores and retrieves error messages, field errors, and action errors in the session for actions. These are used for actions implementing ValidationAware interface.
Roles Interceptor	Allows the execution of action provided the user belongs to one of the configured roles.

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**Other Interceptors 2-2**



Interceptor	Description
Validation Interceptor	Provides validation support for actions by checking the action against all the validation rules declared in the Validation framework configuration files such as Action-validation.xml.
Scope Interceptor	Looks for the specified parameters and pulls these parameters from the given scope.
Timer Interceptor	Logs the amount of time elapsed between the execution of action and the execution time of the Interceptors in the Interceptor stack of the action.
Model Driven Interceptor	This interceptor pushes the Model result on the ValueStack. However, to do so, the Action class must implement ModelDriven interface.

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Use slides 25 and 26 to explain other interceptors used in Struts 2.

### Tips:

The following link provides the example on Alias interceptor:

<http://techmyguru.com/struts2/index.php?section=81>

The following link provides the example on execAndWait interceptor:

<http://www.journaldev.com/2296/struts2-execandwait-interceptor-example-for-long-running-actions>

The following link provides the example on Scope interceptor:

<http://struts.apache.org/docs/scope-interceptor.html>

The following link provides the example on ModelDriven interceptor:

<http://www.javatpoint.com/struts-2-modeldriven-interceptor-example>

**In-Class Question:**

After you finish explaining other interceptors used in Struts 2, you will ask the students an In-Class question. This will help you in reviewing their understanding of the topic.



Which interceptor allows the execution of action provided the user belongs to one of the configured roles?

**Answer:**

Roles Interceptor

## Slides 27 to 29

Let us understand Interceptor stacks.

### Interceptor Stacks 1-3



- ❑ Set of Interceptors that can be grouped of Interceptors that are commonly used and required.
- ❑ The <interceptor-stack> element is used to define the stack of Interceptors.
- ❑ Following table lists some of the Interceptor stacks:

Interceptor Stack	Description
validationWorkflowStack	Adds to the basic stack feature the validation and workflow features.
fileUploadStack	Adds to the basic stack feature the file uploading feature.
chainStack	Adds to the basic stack feature the chaining feature.

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27

### Interceptor Stacks 2-3



Interceptor Stack	Description
defaultStack	Provides a complete stack, including debugging and profiling.
executeAndWaitStack	Provides an execute and wait stack by displaying a waiting page to the user. This is useful when file is being uploaded.
i18nStack	Handles the settings for the specified locale for the current action request..
jsonValidationWorkflowStack	Serializes validation and action errors into JSON.

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28

### Interceptor Stacks 3-3



- ❑ Following code snippet shows the declaration of Interceptor stack:

```

...
<include file="struts-default.xml">
<package name="default" extends="struts-default"> <interceptors>
    <interceptor name="timer1" class="timer1_class">
    <interceptor name="timer2" class="timer2_class">
    <interceptor-stack name="custom_stack">
        <interceptor-ref name="timer1" />
        <interceptor-ref name="timer2" />
    </interceptor-stack> </interceptors>
...
    <action name="Login" class="example.Login ">
        <interceptor-ref name="custom_stack" />
        <result name="success">/example/DisplayDetails.jsp</result>
        <result name="error">/example/error.jsp</result> </action>
</package>
...

```

❑ The defaultStack is defined in the struts-default.xml using <default-interceptor-ref name="defaultStack" /> element.

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29

Use slides 27 to 29 to explain interceptor stacks.

Interceptors are managed with interceptor stacks. The following code snippet shows an example for interceptor stacks:

```
<interceptor-stack name="mainStack">
    <interceptor-ref name="roles"/>
    <interceptor-ref name="token"/>
    <interceptor-ref name="prepare"/>
    <interceptor-ref name="alias"/>
    <interceptor-ref name="params"/>
    <interceptor-ref name="conversionError"/>
</interceptor-stack>
```

The given stack is called `mainStack`. Each `<interceptor-ref>` tag references either an interceptor or an interceptor stack that has been configured before the current interceptor stack. Therefore, the user have to ensure that the name is unique across all interceptor and interceptor stack configurations when configuring the initial interceptors and interceptor stacks.

The following code snippet shows how to apply interceptor stacks to the action:

```
<action name="newyear" class="com. struts2.MyAction">
    <interceptor-ref name="mainStack"/>
    <result>view.jsp</result>
</action>
```

The registration of '`mainStack`' will register complete stack of all the six interceptors with '`newyear`' action. Interceptors will be executed in the order, in which they have been configured.

## Slides 30 to 34

Let us understand Custom interceptor.

### Custom Interceptor 1-5



- ❑ The developer can create a custom Interceptor class by extending the class from the Interceptor class.
- ❑ The class should define `init()`, `destroy()`, and `intercept()` methods.
- ❑ The description of these methods are as follows:
  - `void destroy()` method is used to clean up resources allocated by the interceptor.
  - `void init()` method is called at the time of intercept creation, but before the request processed using intercept, and to initialize any resource needed by the Interceptor.
  - `String intercept(ActionInvocation invocation)` method allows the Interceptor to intercept processing and to do some processing before and/or after the processing `ActionInvocation`.

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30

### Custom Interceptor 2-5



- ❑ Following code snippet shows a simple example of creating an interceptor for the Struts 2 Web application:

```
public class MyFirstInterceptor implements Interceptor{
    @Override
    public void destroy() { }
    @Override
    public void init() { }
    @Override
    public String intercept(ActionInvocation actionInvocation)
    throws Exception {
        String startInterceptor="  Start Interceptor 1";
        System.out.println(startInterceptor);
        String result=actionInvocation.invoke();
        String endInterceptor="  End Interceptor 1";
        System.out.println(endInterceptor);
        return result;
    }
}
```

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31

### Custom Interceptor 3-5



- Following code snippet demonstrates creation of the Action class:

```
public class MyAction extends ActionSupport{
    public String execute()
    {
        System.out.println("In Action");
        return SUCCESS;
    }
}
```

- Following code snippet shows the configuration of custom interceptor in struts.xml file:

```
<!--
<package name="default" extends="struts-default" namespaces="/">
    <interceptors> <interceptor
        name="myfirstinterceptor"
        class="com.example.MyFirstInterceptor" />
    <interceptor name="secondinterceptor"
        class="com.example.MySecondInterceptor" />
</interceptors>
<action name="Action1"
        class="com.example.MyAction">
    <interceptor-ref
        name="myfirstinterceptor"/>
    <interceptor-ref
        name="mysecondinterceptor"/>
    <result
        name="success">Welcome.jsp</result>
    <result name="input">login.jsp</result>
</action> </package> </struts>
-->
```

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32

**Custom Interceptor 4-5**

Following code snippet shows the index.jsp page to call the appropriate action:

```
<html>
<head>
<meta http-equiv="Content-Type" content="text/html; charset=ISO-8859-1">
<title>Performed Action</title>
</head>
<body bgColor="lightBlue">
<s:form action="Action1">
<s:submit value="For calling Interceptor" align="center"/>
</s:form>
</body>
</html>
```

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**Custom Interceptor 5-5**

Following code snippet demonstrates the remaining part of struts.xml file:

```
...
<welcome-file-list>
<welcome-file><b>F</b></welcome-file>
</welcome-file-list>
...
```

The output of the custom interceptor application is as follows:

```
Start Interceptor 1
Start Interceptor 2
In Action
End Interceptor 2
End Interceptor 1
```

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Use slides 30 to 34 to explain custom interceptor.

The developer can create a custom Interceptor class by implementing the Interceptor interface. The class should define the following three methods: `init()`, `destroy()`, and `intercept()`. The `init()` and `destroy()` methods are used for initializing the interceptor and cleaning of the interceptor respectively. They are called once when the Struts 2 framework is initializing and when the framework is shutting down respectively. Interceptors are used across requests and needs to be thread-safe specially the `intercept()` method.

The code snippet as shown on slide 31 explains on creating an interceptor for the Struts 2 Web application. The code snippet defines three methods. The `init()` method will be invoked only once and will initialize the interceptor. The `intercept()` method defines the processing logic to be invoked at each request. Here, it returns `String` value, so the result View page will be invoked. The `intercept()` method can also return `invoke()` method which will result in the invocation of next interceptor configured in the action. Finally, the `destroy()` method is invoked. The `destroy()` method is invoked only once and destroys the interceptor.

Then, explain the code snippet as shown on slide 32 to create the Action class with the `execute()` method. Then, show them the configuration of custom interceptor as explained on slide 32. Finally, slide 33 shows the `index.jsp` page that call the appropriate action.

The output of the code is shown on slide 34.

**Tips:**

You can refer the following link to get additional example on configuring custom interceptor: <http://www.javatpoint.com/struts-2-custom-interceptor-example-tutorial>

## Slide 35

Let us understand Struts 2 tag library.

### Struts 2 Tag Library



- ❑ Struts 2 framework uses a set of tags for data reference.
- ❑ Before using the Struts 2 tags, the developer must have the statement, `<%@ taglib prefix="s" uri="/struts-tags" %>` that assigns the 's' prefix by which the Struts 2 tags will be identified.
- ❑ Struts 2 tags is divided into two types:
  - Struts Generic Tags
  - UI Tags

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35

Use slide 35 to explain Struts 2 tag library. Tell the students that Generic tags are used for controlling the execution flow when the pages are rendered. Generic tags allows data extraction from places other than user's action or the value stack, such as Localization, JavaBeans, and including additional URLs or action executions.

## Slides 36 to 39

Let us understand Control tags.

### Control Tags 1-4



- ❑ The control tags are used to control the flow of page execution.
- ❑ The most commonly used control tags are namely, if, elseIf, else, append, merge, and iterator.
- ❑ **Iterator Tag**
  - Is used to loop over collection of objects.
  - Can iterate over any Collection object, Map, Enumeration or Iterator, and Array object.
  - Attributes supported are as follows:
    - Value
    - Status

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36

### Control Tags 2-4



- ❑ **If and else Tag**
  - Is similar to if-else control structure provided in languages.
  - Attribute supported is, Test - contains the Boolean expression which is evaluated and tested. It returns either true or false.
- ❑ Following code snippet shows the Action class for accepting country:
 

```
public class CountryAction extends ActionSupport {
    private String country;
    public String getCountry() {
        return country;
    }
    public void setCountry(String country) {
        this.country = country;
    }
}
```

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37

### Control Tags 3-4



```
@Override
public String execute() throws Exception {
    return SUCCESS;
}
```

- ❑ Following code snippet shows the index.jsp page which displays message to the user based on the condition:
 

```
<form action="countryAction" method="post">
    Select Country : <select name="country">
        <option value="France">France</option>
        <option value="Nepal">Nepal</option>
        <option value="Russia">Russia</option>
        <option value="China">China</option>
        <option value="USA">USA</option>
    </select><br> <input type="submit">
</form>
```

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38

**Control Tags 4-4**

```
<html>
<s:if test="country!=null">
  <s:if test="country=='Russia'">
    <s:property value="country" /> is the selected country.
  </s:if>
  <s:elseif test="country=='USA'">
    <s:property value="country" /> is the selected country.
  </s:elseif>
  <s:elseif test="country=='China' or country=='Nepal'">
    <s:property value="country" /> is the selected country.
  </s:elseif>
  <s:else> <s:property value="country" /> is not the selected country.
  </s:else>
</s:if>
<hr>
<a href="index.jsp">Select Country Again</a>
</body>
</html>
```

Code displays the form with the selection list. Then, depending on the selected option, a message is displayed to the user, based on the evaluation of the condition.

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Use slides 36 to 39 to explain control tags.

Other tags comes under Control Tags are subset, sort, and generator tags.

- **Subset tag** - Takes an iterator and outputs a subset of it. It delegates to `org.apache.struts2.util.SubsetIteratorFilter` internally to perform the subset functionality.
- **Sort tag** - Sorts a list using a comparator both passed in as the tag attribute. For example, if 'var' attribute is specified, the sorted list will be placed into the `PageContext` attribute using the key specified by 'var'.
- **Generator tag** - Generates an iterator based on the value attribute supplied. The following code snippet shows an example for generator tag:

```
<s:generator val="%{'111,222,333,444,555'}">
<s:iterator>
<s:property /><br/>
</s:iterator>
</s:generator>
```

## Slides 40 to 50

Let us understand data tags.

### Data Tags 1-11



- ❑ Data manipulation or creation is done with the help of Data Tags.
- ❑ The most commonly used data tags are action tag, include tag, bean tag, date tag, param tag, property tag, push tag, set tag, text tag, and url tag.
- ❑ Action Tag
  - Helps the users to call actions directly from a JSP page by specifying the action name and an optional namespace.
  - The executeResult parameter must be specified in a program, otherwise any result processor defined for this action in struts.xml will be ignored.

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40

### Data Tags 2-11



- ❑ Following code snippet demonstrates the Action tag:

```
public class ActionTagAction extends ActionSupport {  
    public String execute() throws Exception {  
        return "done";  
    }  
  
    public String doDefault() throws Exception {  
        ServletActionContext.getRequest().setAttribute("stringByAction",  
        "This is a String put in by the action's doDefault()");  
        return "done";  
    }  
}
```

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41

### Data Tags 3-11



- ❑ Following code snippet shows the struts.xml file:

```
<!--struts.xml -->  
....  
    <action name="actionTagAction"  
    class="example.testing.ActionTagAction">  
        <result name="done">success.jsp</result>  
    </action>  
    <action name="actionTagAction2"  
    class="example.testing.ActionTagAction" method="default">  
        <result name="done">success.jsp</result>  
    </action>  
    ....
```

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42



### Data Tags 4-11

- ❑ Following code snippet demonstrates the `actiontag.jsp`:

```
...  
<s:action name="actionTagAction" executeResult="true" />  
<div> ... </div>  
...  
<s:action name="actionTagAction!specialMethod" executeResult="true">  
<div> ... </div>  
...  
<div> ... </div>  
<s:action name="actionTagAction!default" executeResult="false" />  
<s:property value="#attr.stringByAction" />
```

- ❑ The jsp page invokes two methods namely, `execute()` and `doDefault()`.

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43



### Data Tags 5-11

- ❑ **Include Tag**

- Is used to include a JSP file in another JSP page.

- ❑ Following code snippet demonstrates the use of `Include tag`:

```
...  
<!-- First Syntax --&gt;<br/><include value="AptechJsp.jsp">  
<!-- Second Syntax --&gt;<br/><include value="AptechJsp.jsp">  
<param name="param1" value="value2">  
<param name="param2" value="value2">  
  </include>  
<!-- Third Syntax --&gt;<br/><include value="AptechJsp.jsp">  
<param name="param1">value1</param>  
<param name="param2">value2</param>  
  </include>  
...
```

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44



### Data Tags 6-11

- ❑ **Bean Tag**

- Represents a class that applies to JavaBeans specification.

- ❑ Following code snippet demonstrates an example for bean tag:

```
...  
<bean name="org.apache.struts2.util.number" var="number">  
<param name="first" value="100">  
<param name="last" value="125">  
</bean>  
...
```

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45

## Data Tags 7-11



- ❑ Date Tag
  - ❑ Helps to modify a date. User can use a custom format or can use the predefined format in the properties file.
- ❑ Following code snippet demonstrates an example for date tag:

```
<s:date name="person.birthday" format="dd/MM/yyyy" />
<s:date name="person.birthday" format="%{getText('some.i18n.key')}" />
<s:date name="person.birthday" nice="true" />
<s:date name="person.birthday" />
```

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46

## Data Tags 8-11



- ❑ Param Tag
  - Is used to parameterize other tags.
  - Has two parameters - name (String) shows the name of the parameter and value (Object) shows the value of the parameter.
  - Following code snippet demonstrates an example for param tag:

```
<pre>
<ui:component>
  <ui:param name="key"      value="[0]" />
  <ui:param name="value"    value="[1]" />
  <ui:param name="context" value="[2]" />
</ui:component>
</pre>
```

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47

## Data Tags 9-11



- ❑ Property Tag
  - Gets the property of a value, which will default to the top of the stack if none is specified
  - Following code snippet demonstrates an example for property tag:

```
<s:push value="myBean">
  <!-- Example 1: -->
  <s:property value="myBeanProperty" />

  <!-- Example 2: -->TextUtils
  <s:property value="myBeanProperty" default="a default value"
/>
</s:push>
```

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48

**Data Tags 10-11**



□ **Push Tag** - Pushes value on stack for easier usage.

□ Following code snippet demonstrates an example for push tag:

```
...
<push value="employee">
<property value="userName1">
<property value="userName2">
</push>
...

```

□ **Set Tag** - Allocates a value to a variable in a more definite scope.

□ Following code snippet demonstrates an example for set tag:

```
<...>
<set name="Aptech" value="environment.name">
<property value="Aptech">
...

```

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**Data Tags 11-11**



□ **url Tag** - Is used to create a URL.

□ Following code snippet demonstrates an example for url tag:

```
<-- Example 1 -->
<s:url value="example.action">
<s:param name="id" value="${selected}" />
</s:url>
<-- Example 2 -->
<s:url action="myexample">
<s:param name="id" value="${selected}" />
</s:url>

<-- Example 3-->
<s:url includeParams="get">
<s:param name="id" value="${22}" />
</s:url>
```

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Use slides 40 to 50 to explain data tags. Other types of data tags are as follows:

- **debug tag** - Outputs the content of the ValueStack.
- **i18n tag** - Gets a resource bundle and place it on the ValueStack. It allows the text tag to access messages from any bundle, and also the bundle associated with the current action.
- **a tag** - Creates an HTML `<a>`. It supports the same attributes.

### Tips:

The following link shows the data tags with additional examples:

<http://www.journaldev.com/2230/struts-2-data-tags-example-tutorial>

## Slides 51 and 52

Let us understand Form UI tags.

### Form UI Tags 1-2



- ❑ Struts UI tags display the data on the HTML page and use the data from value stack or from Data tags.
- ❑ Struts UI tags are divided into three types Form Tags, Non-Form tags, and Ajax tags.
- ❑ **Form Tags:**
  - The most commonly used Form tags are checkbox, checkboxlist, combobox, doubleselect, head, file, form, hidden, label, and password.
  - These tags provide user interface for the Struts Web applications.
  - Form tags are categorised into three types namely, Simple UI tags, Group UI tags, and Select UI tags.

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### Form UI Tags 2-2



- ❑ Following code snippet demonstrates the use of `form` tags:

```

<%@ taglib prefix="s" uri="/struts-tags"%>
...
<body>  <s:div>Email Form</s:div>
    <s:text name="Please fill in the form :" />
    <s:form action="hello" method="post" enctype="multipart/form-data">
        <s:hidden name="secret" value="secretvalue"/>
        <s:textfield key="email.from" name="from" />
        <s:password key="email.password" name="password" />
        <s:textfield key="email.to" name="to" />
        <s:textfield key="email.subject" name="subject" />
        <s:textarea key="email.body" name="email.body" />
        <s:label for="attachment" value="Attachment"/>
        <s:file name="attachment" accept="text/html,text/plain" />
        <s:token />   <s:submit key="submit" />    </s:form>
</body> </html>

```

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Use slides 51 and 52 to explain Form UI tags.

Tell the students that the UI tags help in the rendering of the user interface required for the Struts based Web applications. Form tags are categorized into Simple UI tags, Group UI tags, and Select UI tags. Group UI tags helps to create radio button and checkbox.

Some of the Form tags are listed:

- **head tag** - Provides parts of the HEAD section for an HTML file.
- **file tag** - Provides an HTML file input element.
- **form tag** - Provides HTML an input form.
- **hidden tag** - Provides an HTML input element of type hidden, populated by the specified property from the ValueStack.

- `password` tag - Provides an HTML input tag of type password.
- `Checkbox` tag - Provides an HTML input element of type checkbox, populated by the specified property from the ValueStack.
- `radio` tag - Provides a radio button input field.
- `textfield` tag - Provides an HTML input field of type text.

**Tips:**

The following link shows the UI tags examples:

<http://www.journaldev.com/2266/struts2-ui-tags-example-tutorial>

## Slides 53 to 56

Let us understand Non-form UI tags.

### Non-Form UI Tags 1-4



- ❑ The most commonly used Non-Form tags are as follows:
- ❑ **Actionerror**
  - ❑ It is tag is used to send the error feedback message to user.
- ❑ **Actionmessage**
  - ❑ It is tag is used to send information feedback message to user.

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53

### Non-Form UI Tags 2-4



- ❑ **Component** tag renders custom UI widget using the specified templates.
- ❑ Following code snippet shows an example for component tag:

```
<!-- JSP -->
<s:component template="/my/custom/component.vm"/>
or
<s:component template="/my/custom/component.vm">
  <s:param name="key1" value="value1"/>
  <s:param name="key2" value="value2"/>
</s:component>
```

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54

### Non-Form UI Tags 3-4



```
<!-- Velocity -->
#s-component( "template=/my/custom/component.vm" )
or
#s-component( "template=/my/custom/component.vm" )
#s-param( "name=key1" "value=value1" )
#s-param( "name=key2" "value=value2" )
#end

<!-- Freemarker -->
<@s..component template="/my/custom/component.ftl" />
or
<@s..component template="/my/custom/component.ftl">
  <@s..param name="key1" value="${'value1'}" />
  <@s..param name="key2" value="${'value2'}" />
</@s..component>
```

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55



### Non-Form UI Tags 4-4

- ❑ **Div** generates an HTML div that loads its content using an ajax call, via the jQuery framework.
- ❑ Following code snippet shows an example for **div** tag:

```
<%@ taglib prefix="s" uri="/struts-tags"%>
<%@ taglib prefix="sj" uri="/struts-jquery-tags"%>
<html>
  <head>
    <sj:head/>
  </head>
  <body>
    <div id="div1">Div 1</div>
    <s:url var="ajaxTest" value="/AjaxTest.action"/>
    <sj:div href="<%{ajaxTest}%">Initial Content</sj:div>
  </body>
</html>
```
- ❑ **Fielderror** tag renders field errors if they exists.

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56

Use slides 53 to 56 to explain Non-form UI tags.

Explain the student about non-form UI tags such as **actionerror**, **actionmessage**, **component**, **div**, and **fielderror**.

## Slides 57 to 62

Let us understand Ajax UI tags.

### Ajax UI Tags 1-6



- ❑ Ajax tag is the new tag implemented in Struts 2 framework.
- ❑ In Struts 2, DOJO framework is used for the Ajax tag implementation.
- ❑ Commonly used Ajax tags are autocomplete, bind, head, div, submit, tree, and treenode.
- ❑ To use Ajax tags, you add the tag library in the JSP page as, <%@ taglib prefix="sx" uri="/struts-dojo-tags" %> to JSP page.
- ❑ The head tag included on the page, can be configured for performance or debugging purposes.

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57

### Ajax UI Tags 2-6



- ❑ Autocompleter tag is a combo box that can autocomplete text entered on the input box.
- ❑ To create autocompleter component in Struts 2, you have to follow two steps:
  - Add struts2-dojo-plugin.jar in your class path.
  - Include the struts-dojo-tags tag and its header in the jsp page.

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58

### Ajax UI Tags 3-6



- ❑ Bind tag generates event listeners for multiple events on multiple sources, making an asynchronous request to the specified href, and updating multiple targets.
- ❑ Following code snippet shows the example for bind tag:

```

<s:div id="parentDiv">
  <s:form action="actionName">
    <s:submit id="btn" />
    <sx:bind src="btn" events="onclick" targets="parentDiv"
showLoadingText="false" indicator="loadingImage"/>
  </s:form>
</s:div>
```

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59

### Ajax UI Tags 4-6



- ❑ Div tag generates an HTML div that loads its content using an XMLHttpRequest call, via the dojo framework.
- ❑ Following code snippet shows the example for div tag:

```

<sx:div href="#url" updateFreq="2000" indicator="indicator">
    Initial Content
</sx:div>
```

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60

### Ajax UI Tags 5-6



- ❑ Submit tag renders a submit button that can submit a form asynchronously.
- ❑ The submit tag have three different types of rendering:
  - input renders as html <input type="submit" ...>
  - image renders as html <input type="image" ...>
  - button renders as html <button type="submit" ...>
- ❑ Following code snippet shows the example for submit tag:

```
<sx:submit type="image" value="{'Submit'}" label="Submit the form"
src="submit.gif"/>
```

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61

### Ajax UI Tags 6-6



- ❑ The tree and treenode Ajax tags render a tree node within a tree widget with AJAX support.
- ❑ The tree and treenode of the two combinations are used depending on the requirement like the tree is needed to be constructed dynamically or statically.
- ❑ tree widget normally uses the 'id' attribute. The 'id' attribute is required, if the 'selectedNotifyTopic' or the 'href' attribute is going to be used.
- ❑ treenode renders a tree node within a tree widget with AJAX support.

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62

Use slides 57 to 62 to explain Ajax UI tags.

Ajax tag is the new tag implemented in Struts 2 framework. In Struts 2, DOJO framework is used for the Ajax tag implementation. Commonly used Ajax tags are autocomplete, bind, head, div, submit, tree, and treenode.

To use Ajax tags, you add the tag library in the JSP page as, `<%@ taglib prefix="sx" uri="/struts-dojo-tags" %>` to JSP page.

Then, explain the different AJAX tags as shown on slides 58 to 62.

The following is the additional code snippet for AJAX tags:

```
<%@ page contentType="text/html; charset=UTF-8"%>
<%@ taglib prefix="s" uri="/struts-tags"%>
<%@ taglib prefix="sx" uri="/struts-dojo-tags"%>
<html>
    . . .
<s:head />
<sx:head />
</head>
<body>
    <s:form>
        <sx:autocomplete label="Favourite Colour"
            list="{'red','green','blue'}" />
        <br />
        <sx:datetimepicker name="deliverydate" label="Delivery
Date"
            displayFormat="dd/MM/yyyy" />
        <br />
        <s:url id="url" value="/hello.action" />
        <sx:div href="#">
```

## Slide 63

Let us summarize the session.

**Summary**

- In Struts 2 framework, an Interceptor intercepts the request and processes the request before and after the execution of action and result.
- Interceptor Stacks save time as user do not have to repeatedly write the same list of Interceptors in every action mapping.
- Interceptor class acts as a reusable component and is used in different Web applications.
- Struts 2 framework uses a set of tags for data reference.
- Struts generic tags control the execution flow when pages are rendered and extract the data.
- Control tags control the flow of page execution.
- Data manipulation is done with the help of Data tags.
- Struts UI tags display the data on the HTML page and use the data from value stack.

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63

In slide 63, you will summarize the session. You will end the session, with a brief summary of what has been taught in the session.

### 3.3 Post Class Activities for Faculty

You should familiarize yourself with the topics of the next session. You should also explore the OGNL expression language, internationalization, and Validation API in Struts 2.

#### Tips:

You can also check the Articles/Blogs/Expert Videos uploaded on the OnlineVarsity site to gain additional information related to the topics covered in the next session. You can also connect to online tutors on the OnlineVarsity site to ask queries related to the sessions.

# Session 4 – Struts 2 - OGNL, Validation, and Internationalization

---

## 4.1 Pre-Class Activities

Before you commence the session, you should familiarize yourself with the topics of this session in-depth. You should revisit topics of the previous session for a brief review.

Here, you can ask students the key topics they can recall from previous session. Prepare a question or two which will be a key point to relate the current session objectives.

### 4.1.1 Objectives

By the end of this session, the learners will be able to:

- Explain the use of ValueStack
- Explain OGNL expression language
- Explain the flow of data in and out of the Struts 2 framework
- Explain the use of converters and their types
- Explain Validator framework in Struts 2
- Explain different types of validators present in the Validator framework
- Explain the implementation of validation framework in Struts 2
- Explain internationalization
- Explain the use of i18N interceptor and resource bundle in internationalization
- Explain how to create the Struts 2 Web application with internationalization

### 4.1.2 Teaching Skills

To teach this session successfully, you should be aware of OGNL expression language and the flow of data in and out of the Struts 2 framework.

Aware yourself with the use of converters and there types in Struts 2. Also, familiarize yourself with different types of validators present in the Validator framework and the implementation of validation framework in Struts 2. You should also know about internationalization and the use of i18N interceptor and resource bundle in internationalization. Aware yourself with the creation of Struts 2 Web application with internationalization.

For teaching in the class, you are expected to use slides and LCD projectors.

**Tips:**

It is recommended that you test the understanding of the students by asking questions in between the class.

**In-Class Activities:**

Follow the order given here during In-Class activities.

**Overview of the Session:**

Give the students a brief overview of the current session in the form of session objectives.

Show the students slide 2 of the presentation.

**Objectives**

- Explain the use of ValueStack
- Explain OGNL expression language
- Explain the flow of data in and out of the Struts 2 framework
- Explain the use of converters and their types
- Explain Validator framework in Struts 2
- Explain different types of validators present in the Validator framework
- Explain the implementation of validation framework in Struts 2
- Explain internationalization
- Explain the use of i18N interceptor and resource bundle in internationalization
- Explain how to create the Struts 2 Web application with internationalization

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2

Tell the students that they will be introduced to OGNL expression language and the flow of data in and out of the Struts 2 framework.

The session explains the use of converters, their types, and about Validator framework in Struts 2. In this session, they will learn different types of validators present in the Validator framework and the implementation of validation framework in Struts 2. Finally, the session explains about internationalization and the use of i18N interceptor and resource bundle in internationalization.

## 4.2 In-Class Explanations

### Slides 3 and 4

Let us introduce ValueStack.

**Introduction 1-2**

- ValueStack is a storage area that holds the data associated with the processing of a request.
- It is a stack of objects in the Struts 2 framework.
- All the core components interact with it to provide access to context information as well as elements of the execution environment.

The diagram illustrates the ValueStack as a stack of objects. At the top is a blue rounded rectangle labeled 'ValueStack'. Inside it is a purple square labeled 'Action'. Below the stack are two red rounded rectangles, one labeled 'Interceptor' and the other 'Result', connected by arrows pointing upwards towards the 'ValueStack'.

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**Introduction 2-2**

- The ValueStack is made up of the following objects:

<b>Temporary Object</b>	<ul style="list-style-type: none"> <li>• It requires temporary storage during request processing. For example, current iteration value for a collection object.</li> </ul>
<b>Model Object</b>	<ul style="list-style-type: none"> <li>• It represents a place of the current object on the stack before the action is being executed.</li> </ul>
<b>Action Object</b>	<ul style="list-style-type: none"> <li>• It represents the action that is being currently executed.</li> </ul>
<b>Named Object</b>	<ul style="list-style-type: none"> <li>• It represents any object that is identified by an identifier.</li> <li>• It can be developer created or existing such as #application, #session, #request, #attr, and #parameters.</li> </ul>

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Use slides 3 and 4 to introduce ValueStack.

ValueStack is a storage area that holds the data associated with the processing of a request. It is a stack of objects in the Struts 2 framework. All the core components interact with it to provide access to context information as well as elements of the execution environment.

Tell them ValueStack stores different types of objects such as:

1. Temporary objects - Are used to store values of temporary variables used during execution of a page. For example, value of iteration variable used for looping over a collection.
2. Model objects - You can create Model objects to be used by action class.
3. Action objects - Represents the currently executed action class.

4. Named objects – Represents the object that is identified by an identifier. It can be developer created or existing such as #application, #session, #request, #attr, and #parameters. Each of these existing named objects corresponds to an equivalent HTTP scoped object collection.

Tell them that they can access objects from the ValueStack using JSP tags. A ValueStack returns the value of a property in the order it stacks the property. In other words, when the ValueStack is queried for a property value, it returns the value provided the property exists in the stack.

#### **Tips:**

Tell the students that they can get ValueStack object inside the action class using the following statement:

```
ActionContext.getContext().getValueStack()
```

Some of the methods to work with the ValueStack objects are as follows:

- Object `findValue(String expr)` – Finds a value by evaluating the given expression against the stack in the default search order.
- CompoundRoot `getRoot()` – Get the CompoundRoot which holds the objects pushed onto the stack.
- Object `peek()` – Get the object on the top of the stack without changing the stack.
- Object `pop()` – Get the object on the top of the stack and remove it from the stack.
- void `push(Object o)` – Puts the object onto the top of the stack.
- void `set(String key, Object o)` – Sets an object on the stack with the given key so it is retrievable by `findValue(key k)` method.
- void `setDefaultType(Class defaultType)` – Sets the default type to convert to if no type is provided when getting a value.
- void `setValue(String expr, Object value)` – Attempts to set a property on a bean in the stack with the given expression using the default search order.
- int `size()` – Gets the number of objects in the stack.

**In-Class Question:**

After you finish explaining ValueStack, you will ask the students an In-Class question. This will help you in reviewing their understanding of the topic.



How to access the objects from ValueStack in a JSP page?

**Answer:**

JSP tags

## Slide 5

Let us understand ValueStack and OGNL.

**ValueStack and OGNL**

- ❑ **Object Graph Notation Language (OGNL)**
  - Allows the developer to refer and manipulate the data present on the ValueStack.
  - Helps in data transfer and type conversion between data forms and action class.
  - Provides a mechanism to navigate object graphs using dot notation and evaluate expression.
- ❑ For ValueStack, OGNL expression is tested at each level and a result is returned after evaluation of the expression.

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Use slide 5 to explain ValueStack and OGNL.

Tell them that in ValueStack, you search for or evaluate a particular expression using Object Graph Navigation Language (OGNL) syntax. OGNL is a powerful expression language that allows assigning and manipulating the data present on the ValueStack.

Tell the students that OGNL simplifies the accessibility of data stored in the ActionContext. ValueStack is set as the root object of OGNL in Struts 2.0 framework.

OGNL and ValueStack works together to handle a request. OGNL provides the Expression Language (EL), which can be a part of form tags and UI pages. EL maps the entered values to the destination properties of the Java Bean to which they have to be set.

When a form is submitted, the values are transmitted as Strings via HTTP Protocol. String values is converted to the respective primitive or custom java types to set them in the beans. During the process of setting the values, OGNL consults the type converters available in Struts 2 and converts form values to the destination types and will set into the Java Beans.

## Slides 6 to 8

Let us understand OGNL.

### OGNL 1-3



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- ❑ It is integrated into the Struts 2 framework to provide data transfer and type conversion.
- ❑ It is an expression and binding language used for getting and setting the properties of the Java objects.
- ❑ It acts as a glue between the frameworks string-based input and output and the Java-based internal processing.
- ❑ It is a binding language between the GUI elements and the model objects.
- ❑ OGNL is an open source framework from Apache Commons project.
- ❑ Using OGNL, you can set and get properties from Java Beans.

6

### OGNL 2-3



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- ❑ OGNL can be used as:
  - A binding language between GUI elements.
  - A TypeConverter to convert values from one type to another.
  - A data source language to map between table columns and a Swing TableModel.
  - A binding language between Web components and the underlying model objects.
- ❑ The three different OGNL expression parts are as follows:
  - Property name, such as `name` in a JavaBean.
  - Method call such as `toString()`, which returns the current object in a string format.
  - Array indices such as `employees[0]`, which returns the first value of the current object.

7

### OGNL 3-3



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- ❑ OGNL expressions are evaluated in the context of current object.
- ❑ Evaluating the expression chain, the previous link in the chain acts as the current object for the next one.
  - For example, consider the following expression and its order of evaluation:  
`Name.toCharArray()[0].numericValue.toString()`
- ❑ The steps followed to evaluate this expression are as follows:
  - The value stored in the `name` property of the object is extracted.
  - The `toCharArray()` method is invoked on the resulting `String`.
  - The first character from the resulting character array is extracted.
  - The numeric value is obtained from the character by invoking the `getNumericValue()` method of the `Character` class.
  - The `toString()` method is finally invoked on the `Integer` object to obtain the final result of the expression as `String`.
- ❑ The two most important parts of OGNL are expression language and type converters.

8

Use slides 6 to 8 to explain OGNL.

Tell the students that during the request handling process in Struts 2, OGNL helps in three areas.

1. A binding language between GUI elements such as text fields, check boxes, radio button, and so on to model objects.
2. A Type Converter to convert values from one type to another. For example, from String to numeric.
3. A data source language to map between table columns and a Swing TableModel.
4. A binding language between Web components and the underlying model objects.

It does this by moving data from the request parameter into the action's JavaBean properties and back from action's Java bean properties out into the rendering HTML pages.

Tell them that the ValueStack is a set of several objects. However, for OGNL, it appears to be a single object.

### **Working of OGNL and ValueStack**

OGNL and ValueStack work together in Struts 2 to handle a request. OGNL offers the expression language which can be part of form tags and UI pages. This expression language helps to map the entered values to the destination properties of the Java Bean to which they have to be set.

When a form is submitted, the values are transmitted as Strings through the HTTP Protocol. These String values have to be converted to the respective primitive or custom Java types to set them in the beans. During the process of setting the values, OGNL consults the type converters available in Struts 2 and helps in conversion of the form values to the destination types and will set into the JavaBeans.

Without the type converters, developers have to write the mapping beans which get the values from the form beans and then convert them to their appropriate data types. This leads to more code to handle a request and also puts more burden to test the code.

OGNL looks for the properties in the objects that are loaded in the ValueStack and when found, the values are converted and set to Model objects. This feature of Struts 2 is implemented by OGNL Expression Language (EL).

OGNL EL can refer many of the built-in objects present in a JSP page. It is the default expression language that is used to refer to data from various sections of the framework in a consistent manner. Struts 2 follows the MVC design pattern. The View component, which is responsible for displaying the model and other object in a JSP page, uses OGNL EL.

Following are the three different OGNL expression parts:

- Property name, such as name in a JavaBean.
- Method call such as `toString()` which returns the current object in a string format.
- Array indices such as `employee[0]`, which returns the first value of the current object.

Then, using slide 8, explain them that evaluation of OGNL expression.

## Slide 9

Let us understand EL.

The screenshot shows a slide titled "Expression Language". It includes a coffee cup icon in the top right corner. The slide contains the following content:

- ❑ OGNL's expression language is used in the form input field name and in JSP tags.
- ❑ Following code snippet shows the use of OGNL expression in Struts 2 tag:

```
...<h5>Congratulations! You have successfully created your login </h5><h3>The <s:property value="loginName" /> Login Details </h3>
```
- ❑ In the code:
  - A congratulation message is displayed after successful creation of the login page.
  - The OGNL expression language is specified within the double quotes of the value attribute.
  - The `<s:property>` tag of Struts 2 takes the value from the property of one of the Java objects and writes it into the HTML in place of the tag.

At the bottom left, there is a small watermark-like logo of a person working at a computer. At the bottom center, the text reads: "© Aptech Ltd. Developing Applications Using Java Web Frameworks/Session 4". At the bottom right, there is a small number "9".

Use slide 9 to explain EL.

Explain some of the examples of using OGNL EL as mentioned on slide 9.

Some of the additional EL notations are as follows:

- `<s:property value="#session.user.username" />` – Shows username property of the User object in the Session context.
- `<s:textfield name="username"/>` – A username property on the Value Stack.

### Tips:

To work with few more examples on OGNL EL, you can refer to this link:

[http://tutorials4u.net/struts2-tutorial/struts2\\_ognl\\_expression\\_language\\_example.html](http://tutorials4u.net/struts2-tutorial/struts2_ognl_expression_language_example.html)

## Slides 10 to 13

Let us understand type converter.

### Type Converter 1-4

- ❑ Struts 2 framework provides built-in OGNL type converters.

#### ❑ Data Type Conversion

- Is made from the Java type of the property referred by the OGNL expression language to the string format of the HTML output.

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### Type Converter 2-4

- ❑ Following figure shows how data moves in and out of the Struts 2 framework, helps to bind and convert the data:

The diagram illustrates the data flow in the Struts 2 framework. It starts with an **InputForm.html** page containing form fields. These fields are mapped to a **Servlet Request**, which contains parameter pairs like "username": "Aptech" and "age": "45". This request interacts with a **ValueStack** (represented as a stack of objects). The **ValueStack** contains an **Action** object with properties: "int age" and "String username". Above the ValueStack is the **OGNL Expression Language and Type Converter**. Finally, the data is rendered into a **ResultPage.jsp** page, which displays the message "Hello Welcome, Your age is 45".

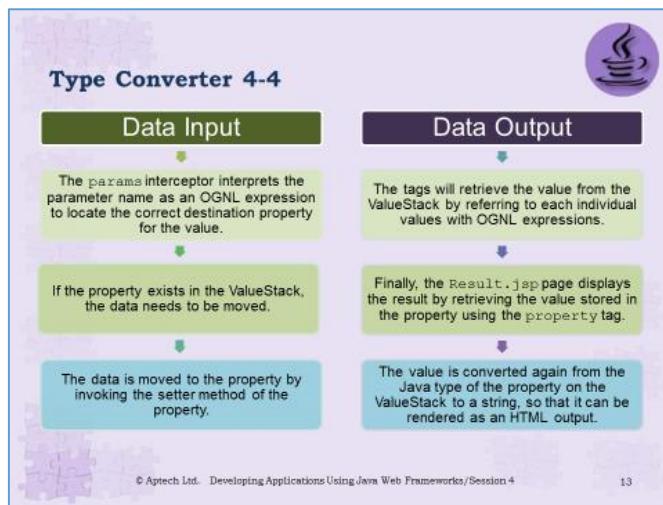
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### Type Converter 3-4

- ❑ The flow of data in and out of the Struts 2 framework is as follows:

<b>Data Input</b>	<b>Data Output</b>
<p>The request parameters are received by the framework as an <code>HttpServletRequest</code> object and are stored as name/value pairs.</p> <p>The <code>param</code> interceptor transfers this data from the request object to ValueStack because the action object is present in the ValueStack.</p>	<p>Once the data has been processed by the action, the result will be invoked.</p> <p>When the rendering process of the result starts, the result will access the ValueStack using the OGNL expression language tags.</p>

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Use slides 10 to 13 to explain type converter.

Tell them that even in a simple Web application, a data type conversion is made from the Java type of the property referred by the OGNL expression language to the string format of the HTML output.

Thus, always an appropriate conversion of data takes place when the data moves in and out of the Java environment and HTML. Struts 2 framework provides built-in OGNL type converters.

Then, explain the flow of data in and out of the Struts 2 framework using the figure given on slide 11. Explain the process of data in and out using the points given on slides 12 and 13.

### Data Input

The form, `InputForm.html` displays two input fields, which are valid HTML expressions. The field names are valid OGNL expression. Once the value is entered, the form is submitted to the framework. The request parameters are received by the framework as an `HttpServletRequest` object and are stored as name/value pairs. The name/value pair exists in a string format.

The `param` interceptor transfers this data from the request object to ValueStack because the action object is present in the ValueStack. The most important activity that takes place before transferring the data is mapping of the property name with actual property on the ValueStack. The `params` interceptor interprets the parameter name as an OGNL expression to locate the correct destination property for the value.

The OGNL resolves its expression against a default object, which is a type of virtual object created by the ValueStack. ValueStack holds the objects and their properties. In other words, ValueStack exposes the properties of the object it contains. Therefore, when the expression age is evaluated as an OGNL expression against the ValueStack, it checks whether the ValueStack has a `user` property. If the property is present, then it checks

whether the property named user has an age property. Each of the properties is separated by a period. If the age property exists in the ValueStack, the data needs to be moved.

Thus, the data is moved to the property by invoking the setter method of the property. However, since the value is in string format, it needs to be converted to the appropriate Java data type, that is, int. In order to do this conversion, OGNL type converters come into action and check whether this type conversion, that is, string to int is possible. If it is possible, then the type converter converts and sets the value on the object named user.

### **Data Out**

Once the data has been processed by the action, the result will be invoked, which will provide a new result view of the application to the user. During data processing of the request, the object remains on the ValueStack. When the rendering process of the result starts, the result will access the ValueStack using the OGNL expression language tags. The tags will retrieve the value from the ValueStack by referring to each individual values with OGNL expressions. Finally, the Result.jsp page displays the result by retrieving the value stored in the property using the property tag. The value is converted again from the Java type of the property on the ValueStack to a string, so that it can be rendered as an HTML output. Thus, the integer data type is converted back to String data type.

## Slides 14 and 15

Let us understand built-in type converters.

**Built-in Type Converters 1-2**



- ❑ Struts 2 framework provides built-in converters for converting an HTTP string data type to any of the Java data types.
- ❑ Following table shows the different data types in Java that are supported by built-in converters:

Built-in Type Converters	Description
String	Represents a string data type.
boolean/Boolean	Converts true and false strings to primitive or object version of Boolean data type.
char/Character	Converts string to primitive or object version of character data type.
int/Integer	Converts string to primitive or object version of integer data type.
float/Float	Converts string to primitive or object version of float data type.
long/Long	Converts string to primitive or object version of long data type.

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**Built-in Type Converters 2-2**



Built-in Type Converters	Description
double/Double	Converts string to primitive or object version of double data type.
Date	Converts string to SHORT format of current locale.
Arrays	Converts each string element to the array's type.
Lists	Populated with strings.
Maps	Populated with strings.

- ❑ The type converter does the data type conversion between the string-based HTTP form and the strictly typed Java objects.

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Use slides 14 and 15 to explain built-in type converters.

The different data types in Java that are supported by built-in converters are as follows:

- String - Represents a string data type.
- boolean/Boolean - Converts true and false strings to primitive or object version of Boolean data type.
- char/Character - Converts string to primitive or object version of character data type.
- int/Integer - Converts string to primitive or object version of integer data type.
- float/Float - Converts string to primitive or object version of float data type.
- long/Long - Converts string to primitive or object version of long data type.
- double/Double - Converts string to primitive or object version of double data type.

- Date - Converts string to SHORT format of current locale.
- Arrays - Converts each string element to the array's type.
- Lists and Maps - Populated with strings.

Consider an example where the framework will look for a converter of a particular type when it locates a Java property targeted by a given OGNL expression. The setter method provided in the action class can change from `setId(String Id)` to `setId(int Id)`.

The type converter does the data type conversion between the string-based HTTP form and the strictly typed Java objects.

**In-Class Question:**

After you finish explaining built-in type converters, you will ask the students an In-Class question. This will help you in reviewing their understanding of the topic.



Which converter is used for converting an HTTP string data type to any of the Java data types?

**Answer:**

Built-in type converters.

## Slides 16 to 27

Let us understand how to map form fields.

### Mapping Form Fields 1-12



- ❑ For automatic type conversion to take place, the developer needs to link the form field names with the Java properties of the action class and vice versa.
- ❑ This is a two-step process:
  - Developer writes the OGNL expression for the name attribute of the form field.
  - Developer creates the properties in Java code (Action class) that will receive the data.
- ❑ The different types of data type conversions are as follows:
  - Primitive and Wrapper Class:
    - The built-in conversion between the Java primitive and wrapper classes and OGNL expressions in the form fields are quite simple.

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16

### Mapping Form Fields 2-12



- ❑ Following code snippet shows the use of OGNL expressions in the form fields:
 

```
...
<h3> Registration Field </h3>
<s:form action="Register">
<s:textfield label="Username" name="username" />
<s:password label="Password" name="password" />
<s:textfield label="Enter your age...!" name="age" />
<s:textfield label="Enter your birthday.(mm/dd/yy)" name="birthdate" />
<s:submit/>
</s:form>
...
```
- ❑ In the code:
  - Each of the input field is an OGNL expression.
  - These expressions are resolved with respect to the action objects present in the ValueStack.

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17

### Mapping Form Fields 3-12



- ❑ Following code snippet shows the code in **Register.java**:
 

```
...
public class Register extends ActionSupport {
private String username;
private String password;
private String portfolioName;
private Double age;
private Date birthdate;

@Override
public String execute() {
return SUCCESS;
}

public String getPassword() {
return password;
}
public void setPassword(String password) {
```

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18



### Mapping Form Fields 4-12

```

this.password = password;
}
public String getUsername() { return username;
public void setUsername(String username) { this.username = username;
}
public Double getAge() { return age;
}
public void setAge(Double age) { this.age = age;
}
public Date getBirthdate() { return birthday;
}
public void setBirthdate(Date birthday) { this.birthday = birthday;
}
}
...

```

In the code:

- When the **Submit** button on the form is clicked, the request is sent to the framework as a name-value pair.
- The framework places the **Action** object in the ValueStack.

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19



### Mapping Form Fields 5-12

**Handling Multiple Values:**

- Multiple parameter values coming from a request can be mapped to a single parameter name.
- These multiple values can be mapped to Arrays, Lists, or Maps.

#### Array

- Struts 2 provides support for converting data to Java arrays.
- OGNL executes the type conversion for each element of the array.
- The framework provides unique names to OGNL, and are correctly interpreted as specific elements in an array.

#### Lists

- Struts 2 framework supports the conversion of sets of request parameter to properties of various collection types such as Lists.
- Lists need not be initialized.
- Elements in a List will be treated as String objects if the type is not specified.

#### Maps

- Struts 2 also support the conversion of a set of values from the request parameter to a Map property.
- Map stores the value in a key-value pair.
- The data types can be specified for the key-value pair in the Map.

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20



### Mapping Form Fields 6-12

Following code snippet shows the use of the array in the struts form:

```

...
<s:form action="ArraysDataTransferTest">
<s:textfield name="marks" label="Marks"/>
<s:textfield name="marks" label="Marks"/>
<s:textfield name="marks" label="Marks"/>
<s:textfield name="names[0]" label="names"/>
<s:textfield name="names[1]" label="names"/>
<s:textfield name="names[2]" label="names"/>
<s:submit/> </s:form>
...

```

In the code:

- There are two arrays named, **marks** and **names**.
- The two array properties named, **marks** and **names** will receive data from the first and the last three form fields respectively.

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21

### Mapping Form Fields 7-12

Following table displays the request parameter name with its value:

RequestParameter Name	Parameter Value
Marks	75, 65, 55
name [ 0 ]	Angel
name [ 1 ]	Jessica
name [ 2 ]	John



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### Mapping Form Fields 8-12

Following code snippet shows the implementation of the properties in the action class that will receive the data:

```
...  
private int[] marks ;  
public int[] getMarks() { return marks; }  
public void setMarks(int[] marks) { this.marks = marks; }  
private String[] names = new String[10];  
public String[] getNames() { return names; }  
public void setNames(String[] names){ this.names = names; }  
...
```

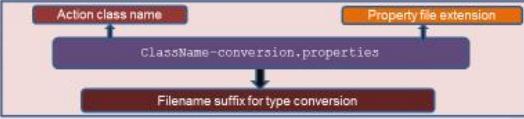
In the code:

- Arrays are displayed using the getter and setter methods.
- The framework, when it transfers the **marks** property, first, searches for the **marks** property and resolves the mapping of the property with the request parameter.

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### Mapping Form Fields 9-12

Following figure displays the creation of a properties file according to the naming convention:



Following code snippet shows the JSP page containing the weights property, which will be used as a List in the action class:

```
...  
<s:textfield name="weights[0]" label="weights"/>  
<s:textfield name="weights[1]" label="weights"/>  
<s:textfield name="weights[2]" label="weights"/>  
...
```

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### Mapping Form Fields 10-12

- Following code snippet demonstrates the use of the List property in the Action class:

```
...
private List weights;
public List getWeights() {
    return weights;
}
public void setWeights(List weight) {
    this.weights = weight;
}
...
```

- If you are using generics to specify the Collection type, then the properties file configuration need not be used.  
 With type specific List conversion, you cannot pre-initialize the List.

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25



### Mapping Form Fields 11-12

- Following code snippet demonstrates the implementation of the Map property in a JSP page:

```
...
<s:textfield name="maidenNames.mary" label="Maiden Name"/>
<s:textfield name="maidenNames.jane" label="Maiden Name"/>
<s:textfield name="maidenNames.hellen" label="Maiden Name"/>
<s:textfield name="maidenNames['beth']" label="Maiden Name"/>
<s:textfield name="maidenNames['sharon']" label="Maiden Name"/>
<s:textfield name="maidenNames['martha']" label="Maiden Name"/>
...
```

- In the code:
  - The specified key-value pair is of String data type.
  - The key-value pair can either be specified using the dot-notation expression or in an array format.
  - The `maidenNames` is the key and the different values such as `mary`, `jane`, and so on are the values.

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26



### Mapping Form Fields 12-12

- Following code snippet demonstrates the implementation of the Map property in the Java action page:

```
...
private Map maidenNames ;
public Map getMaidenNames() {
    return maidenNames;
}
public void setMaidenNames ( Map maidenNames ) {
    this.maidenNames=maidenNames;
}
...
```

- In the code:
  - The getter and the setter method for the map property have been defined.
  - You do not have to initialize the Map object explicitly.

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27

Use slides 16 to 27 to explain how to map form fields.

Discuss examples provided on the slides for conversion in Struts 2.

## Slide 28

Let us understand type conversion annotations.



### Type Conversion Annotations

- The type conversion annotations are used for generics defined in Maps and Collections.
- It is configured in the **\*-conversion.properties** file.
- Following table shows some of the type conversion annotations:

Annotation Name	Description
CreateIfNull	Checks if the new element should be created if it currently does not exist in the list or map.
Type Conversion	Determines the converter class to use. For collections, a rule of PROPERTY, MAP, KEY, KEY_PROPERTY, or ELEMENT can be used to specify which part to be converted.
Element	Used for generic type to specify the element type for Collection types and Map values.
Key	Used for generic types to specify the key type for Map keys.
KeyProperty	Used for generic types to specify the key property name value.

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Use slide 28 to explain type conversion annotations. Conversion annotation is also a type conversion annotation.

Tell them that to use annotation-based type conversion, annotate the class or interface with the **Conversion Annotation**.

Conversion Annotation – Is a marker annotation for type conversions at Type level. The conversion annotation is used at Type level. The code snippet for conversion annotation is as follows:

```
@Conversion()
public class ConversionAction implements Action {
}
```

Then, explain the **TypeConversion** annotation. This annotation is used for class and application wide conversion rules. It can be applied at property as well as method level. It has an attribute named **type** which takes an enum value. The value of the attribute determines whether the conversion should be applied at application level or class level. The enum constants are **ConversionType.CLASS** and **ConversionType.APPLICATION**. It also has another attribute named **rule**. The **rule** attribute takes a property from an enum. It specifies the conversion rule which can be a property, a collection, or a map.

The following code snippet shows the use of TypeConversion annotation:

```

@Conversion()
public class ConversionAction implements Action {
    private String convertInt;

    private String convertDouble;
    private List users = null;

    private HashMap keyValues = null;

    @TypeConversion(type = ConversionType.APPLICATION, converter
= "com.opensymphony.xwork2.util.XWorkBasicConverter")
    public void setConvertInt( String convertInt ) {
        this.convertInt = convertInt;
    }

    @TypeConversion(converter =
"com.opensymphony.xwork2.util.XWorkBasicConverter")
    public void setConvertDouble( String convertDouble ) {
        this.convertDouble = convertDouble;
    }

    @TypeConversion(rule = ConversionRule.COLLECTION, converter
= "java.util.String")
    public void setUsers( List users ) {
        this.users = users;
    }

    @TypeConversion(rule = ConversionRule.MAP, converter =
"java.math.BigInteger")
    public void setKeyValues( HashMap keyValues ) {
        this.keyValues = keyValues;
    }

    @TypeConversion(type = ConversionType.APPLICATION, property
= "java.util.Date", converter =
"com.opensymphony.xwork2.util.XWorkBasicConverter")
    public String execute() throws Exception {
        return SUCCESS;
    }
}

```

Then, explain them about other annotations such as:

#### **Element Annotation**

Sets an element for the type conversion. It can be applied at field level or method level.

#### **Key Annotation**

Sets the Key for type conversion.

**In-Class Question:**

After you finish explaining type conversion annotations, you will ask the students an In-Class question. This will help you in reviewing their understanding of the topic.



Which annotation is used for generic types to specify the key type for Map keys?

**Answer:**

Key annotation.

## Slides 29 and 30

Let us understand validation.

**Validation 1-2**

- ❑ User input needs to be validated so as to ensure that correct data has been entered as required by the application.
- ❑ One of the main features of the Struts 2 framework is its built-in validation support.
- ❑ **Validation Framework:**
  - The Struts 2 framework supports both server and client-side validation.
  - Validation is implemented by the framework using validation Interceptor which is configured in the default Interceptor stack.
  - Three layers present in the Validation Framework are Domain Data, Validation MetaData, and Validators.

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**Validation 2-2**

Domain Data	Validation Metadata	Validators
<ul style="list-style-type: none"> <li>• The data entered by the user using a browser exists as properties in an action class in Struts 2.</li> <li>• For example, in the Login Form, a user is required to enter username and password.</li> </ul>	<ul style="list-style-type: none"> <li>• This component will associate the individual data properties with the validators which are used for verifying the correctness of the values during runtime.</li> <li>• Mapping of validators to data properties can be done using Java annotations or XML files.</li> </ul>	<ul style="list-style-type: none"> <li>• Validators can be defined as a reusable component that contains the logic for performing fine-grained validations.</li> <li>• The validators have to be associated with the properties either through an XML file or through Java annotations.</li> </ul>

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Use slides 29 and 30 to explain Validation.

All Web applications require user input which range from a simple username and password to data entered in a complex form. Values entered in the application are required to be validated before they are stored in the database.

User input needs to be validated so as to ensure that correct data has been entered as required by the application. The task of validating user input is complex. One of the main features of the Struts 2 framework is its built-in validation support. Thus, this helps to reduce the code specification and makes the tasks of validating the user input easy and simple.

The Struts 2 framework supports both server and client side validation. It provides a wide range of validation rules and pre-defined validators which can be applied to form fields for validations.

Developers can also create custom validators based on the validation requirements. For using pre-defined validators, no initial configuration is required. Validation is implemented by the framework using validation Interceptor which is configured in the default Interceptor stack.

Then, explain them three layers present in the Validation framework as mentioned on slide 30.

## Slides 31 and 32

Let us understand the working of a validator.

### Working of a Validator 1-2



- An action class extends `ActionSupport` class which implements the `Validateable` and `ValidationAware` interfaces of the `com.opensymphony.xwork2` package.
- **Validateable Interface:**
  - The `validate()` method in the `Validateable` interface contains the validation code.
  - The validator interfaces work with workflow Interceptor.
  - Once the execution of the `validate()` method is completed, the workflow Interceptor will invoke the `hasErrors()` method of the `ValidationAware` interface.
- **ValidationAware Interface:**
  - The `ValidationAware` interface contains methods for storing the error messages generated when validation of a property fails.

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### Working of a Validator 2-2



- Following code snippet shows the sequence of interceptors from the `defaultStack` as defined in `struts-default.xml` file:

```
...<interceptor-ref name="params" />
<interceptor-ref name="conversionError" />
<interceptor-ref name="validation" />
<interceptor-ref name="workflow" />
...
```
- In the code:
  - The `params` and `conversionError` Interceptor are responsible for transferring and converting the values in the HTTP request parameter to correct Java types.
  - Both these Interceptors are fired before the validation Interceptors are fired.
  - The `validation` Interceptor is used for making an entry into the validation framework.

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Use slides 31 and 32 to explain the working of a validator.

An action class extends `ActionSupport` class which implements the `Validateable` and `ValidationAware` interfaces of the `com.opensymphony.xwork2` package.

The `validate()` method in the `Validateable` interface contains the validation code whereas the `ValidationAware` interfaces contains methods for storing the error messages generated when validation of a property fails.

Then, explain them about `Validateable` and `ValidationAware` interfaces as mentioned on slide 31.

The code snippet as shown on slide 32 explains the sequence of Interceptors from the `defaultStack` as defined in `struts-default.xml` file. In the given code, `params` and `conversionError` Interceptors are responsible for transferring and converting the values in the HTTP request parameter to correct Java types. Both these Interceptors are fired before the validation Interceptors are fired. The validation Interceptor is used for making an entry into the validation framework. When this Interceptor fires, all the validations are checked that have been defined in the validation metadata. If conversion and validation errors are encountered, then they are stored or added in the methods of the `ValidationAware` interface.

The `workflow` Interceptor works in two phases. In the first phase, it invokes the `validate()` method if present in the current action and performs the basic validation. In the second phase, it checks for errors in the `hasErrors()` method of the `ValidationAware` interface. If there are no errors, then the control passes to the rest of the action invocation process. When the `defaultStack` is used, both the validation and the workflow Interceptors fire every time. This means that both the forms of validation can be used. Thus, first the validation Interceptor runs all the validations that are defined with the validation framework metadata.

Next, when the workflow Interceptor runs, it checks whether the `validate()` method is implemented in the action class. The `validate()` method can contain some extra validation code.

## Slides 33 to 36

Let us understand validation scope.

### Validation Scope 1-4



- ❑ The two types of validators present in the Validator Framework are as follows:

Field Validators	Non-Field Validators
<ul style="list-style-type: none"> <li>• These validators operate on a single field accessible through an action.</li> <li>• It can perform validations in the full action context involving more than one field in validation rule.</li> <li>• It can be defined on each field.</li> <li>• There can be more than one validator on a single field.</li> <li>• The name of the validator file is derived from the name of the class that implements the action for which the validation rules apply.</li> </ul>	<ul style="list-style-type: none"> <li>• These are not restricted to a single specific field.</li> <li>• It applied to the whole action and often contain checks that apply to more than one field values.</li> <li>• The <code>expression</code> validator is the only non-field validator available in the built-in validators.</li> <li>• Complex validation logic can be written in the expression validator using OGNL EL.</li> </ul>

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33

### Validation Scope 2-4



- ❑ Steps for applying pre-defined validators:

**Create an XML Configuration file**

**Name it as per the guidelines**

**Place it in the correct directory**

- ❑ The naming rule for the XML validation metadata file is **ActionClass-validation.xml**.
- ❑ The action class is named as **Registration**, then the validation XML file is named as **Registration-validation.xml**.
- ❑ The file is placed in the package directory structure next to the action class and each `<field-validator>` is executed in the order of definition.

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34

### Validation Scope 3-4



- ❑ Following code snippet demonstrates the implementation of validators in an XML file:

```

...
<!DOCTYPE validators PUBLIC
  ...
<validators>
<field name="username">
<field-validator type="requiredstring">
<param name="trim">true</param>
<message key="errors.required" />
</field-validator>
</field>
<field name="password">
<field-validator type="requiredstring">
<param name="trim">true</param>
<message key="errors.required" />
</field-validator>
</field>

```

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35



### Validation Scope 4-4

```
<field name="age">
<field-validator type="required">
<message key="errors.required" />
<!-- <message> You must enter age </message> -->
</field-validator>
<field-validator type="int">
<param name="min">1</param>
<param name="max">100</param>
<message key="errors.range" />
</field-validator>
</field>
...
</validators>
```

In the code:

- The `doctype` element includes all the validation XML files.
- The `<validators>` element includes the declarations of the individual validators that should run when this action is invoked.

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Use slides 33 to 36 to explain validation scope. Tell the students that field validators act on single fields attainable through an action. Non-field validators are domain specific and provide custom implementations.

Slides 33 and 34 describes about field validators and non-field validators.

Then, tell them about the steps for applying pre-defined validators or field validators as explained on slides 35 and 36.

The name of the validator file is derived from the name of the class that implements the action for which the validation rules apply. The naming rule for the XML validation metadata file is `ActionClass-validation.xml`. Thus, if the action class is named as `Registration` then the validation XML file is named as `Registration-validation.xml`. The file is placed in the package directory structure next to the action class. Each `<field-validator>` is executed in the order of definition.

**Tips:**

- If you want to create to apply single validation to an action class, then the validation xml file will be named as `(Action class name)-validation.xml`.
- If you want to apply multiple set of validations for an action class, then validation file should be named as `(Action class name)-Alias-validation.xml`.

**In-Class Question:**

After you finish explaining validation scope, you will ask the students an In-Class question. This will help you in reviewing their understanding of the topic.



Which validators operate on a single field accessible through an action?

**Answer:**

Field validators.

## Slides 37 and 38

Let us understand built-in validators.

**Built-in Validators 1-2**

Following table displays a list of built-in validators:

Validator Name	Parameters	Description
required		Checks that the value is not null.
requiredstring	trim	Checks that the value is not null and is not empty. The default value for the attribute trim is true indicating that it trims white space.
double	minInclusive, maxInclusive, minExclusive, maxExclusive	Checks that the double value is within the inclusive or exclusive specified parameters.
int	min, max	Checks that the integer value is within the value specified by min and max.
email	-	Checks the format of the email address.
url		Checks the URL format.

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**Built-in Validators 2-2**

Validator Name	Parameters	Description
stringlength	trim, minlength, maxlength	Checks that the length of the string is within the parameters specified by minlength and maxlength.
date	min, max	Checks that the date value is within the specified date as specified by min and max attribute. Format of the date value is MM/DD/YYYY.
regex	expression(), caseSensitive, trim	Checks that the string confirms to the regular expression.
expression	expression()	Used at action level and is same as fieldexpression.

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Use slides 37 and 38 to explain built-in validators. The framework provides built-in validators to handle the validation requirements. The validators are present in XWork jar file which contains an XML file that declares all the built-in validators.

### Tips:

The other types of built-in validators are as follows:

- ConditionalVisitorField Validator – Forwards validation to the VisitorFieldValidator only if the expression will evaluate to true.
- VisitorFieldValidator – Forwards validation to object properties of user's action using the object's own validation files. It can handle either simple Object properties, Collections of Objects, or Arrays.
- Short validators – Field Validators that checks if the short specified is within a certain range.

## Slides 39 to 47

Let us understand how to use a validator.

### Using a Validator 1-9



- ❑ To demonstrate the use of Validators, a **NewsletterRegistration** application is created in NetBeans.
- ❑ Modify the default index.jsp page to contain a link to NewsLetterRegistration.jsp page.
- ❑ Create a registration form NewsLetterRegistration.jsp that accepts user details such as name, password, age, email, and telephone number.
- ❑ The steps are as follows:
  - Creation of the JSP page
  - Creation of an Action class
  - Declaration of the validation metadata with ActionClass-validation.xml
  - Creation of Properties file

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39

### Using a Validator 2-9



- ❑ Following code snippet demonstrates the code for **NewsLetterRegistration.jsp** page:

```
<html>
<head>
<meta http-equiv="Content-Type" content="text/html; charset=UTF-8">
<title>Newsletter Registration Page</title>
</head> <body> <h1>Newsletter Registration Page</h1>
<form action="NewsLetter" method="post" >
<s:textfield name="username" key="username" size="20" />
<s:textfield name="password" key="password" size="20" />
<s:textfield name="age" key="age" size="20" />
<s:textfield name="email" key="email" size="20" />
<s:textfield name="telephone" key="telephone" size="20" />
<s:submit /> </s:form> </body>
</html>
...
```

- ❑ In the code:
  - Five text fields have been defined to accept the username, password, age, email address, and telephone number respectively.

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40

### Using a Validator 3-9



- ❑ Following code snippet shows the code for the action form:

```
...
public class NewsLetter extends ActionSupport {
public String execute() throws Exception {
return "HelloWorld";
}
/*
- Provide default value for Message property.
*/
public static final String MESSAGE = "HelloWorld.message";
/*
- Field for Message property.
*/
private String message;
// Return Message property.
// Return Message property
public String getMessage() {
return message;
}
```

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41

### Using a Validator 4-9

```
    }
    public void setMessage(String message) {
        this.message = message;
    }
    private String username;
    private String password;
    private String telephone;
    private String email;
    private int age;
    public String getUsername() {
        return username;
    }
    public void setUsername(String userName) {
        this.username = userName;
    }
    public String getPassword() {
        return password;
    }
    public String getTelephone() {
        return telephone;
    }
    public void setTelephone(String telephone) {
        this.telephone = telephone;
    }
```

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42

### Using a Validator 5-9

```
this.telephone = telephone;
}
public String getEmail() {
    return email;
}
public void setEmail(String email) {
    this.email = email;
}
public int getAge() {
    return age;
}
public void setAge(int age) {
    this.age = age;
}
...
```

- In the code, the action class receives the data from the JSP page and sets the property value.

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43

### Using a Validator 6-9

- Following code snippet shows the NewsLetter action's validation metadata file, **NewsLetter-validation.xml**:

```
...
<!DOCTYPE validators PUBLIC
  "-//openide//DTD Validators 1.0//EN"
  "http://openide.netbeans.org/validators.dtd">
<validators> <field name="username">
<field-validator type="requiredstring">
    <param name="trim">true</param>
    <message key="errors.required" />
</field-validator> <field> <field name="password">
<field-validator type="requiredstring">
    <param name="trim">true</param>
    <message key="errors.required" /> </field-validator>
</field> <field name="age">
<field-validator type="required"> <message key="errors.required" />
<!-- <message> You must enter age </message> -->
</field-validator>
<field-validator type="int">
    <param name="min">1</param>
    <param name="max">100</param>
    <message key="errors.range" />

```

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44

### Using a Validator 7-9



```
</field-validator>
</field>
<field name="email">
<field-validator type="requiredstring">
<message key="errors.required" />
</field-validator>
<field-validator type="email">
<message key="errors.invalid" />
</field-validator>
</field>
<field name="telephone">
<field-validator type="requiredstring">
<message key="errors.required" />
</field-validator>
</field>
</validators>
```

□ In the code:

- Name of the file is derived from the name of the class that implements the action for which the validation rules apply.
- The file is placed in the package directory next to the action class.
- The doc\_type element must be included in the validation XMLfile.

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### Using a Validator 8-9



□ Following code snippet demonstrates the implementation of properties file:

```
HelloWorld.message=Welcome to Struts Validation ...
username=Username
age=Age
email=Email
telephone=Telephone
password=Password
errors.invalid=${getText(fieldName)} is invalid,
errors.required=${getText(fieldName)} is required.
errors.number=${getText(fieldName)} must be a number.
errors.range=${getText(fieldName)} is not in the range ${min} and ${max}.
```

□ In the code:

- The different error messages are stored for each of the text fields to be validated.
- For example, if the requiredstring validator encounters a null value for the username property of the action class, the respective error message is retrieved and displayed.

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### Using a Validator 9-9



□ Following figure shows the application startup page:



□ Following figure displays the error page showing the validation messages:



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Use slides 39 to 47 to explain how to use a validator.

## Slide 48

Let us understand how to create a custom validator.

**Creating a Custom Validator**

- ❑ A custom validator must implement the `Validator` or `FieldValidator` interface.
- ❑ These custom validator classes normally extend either the `ValidatorSupport` or the `FieldValidatorSupport` classes.

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Use slide 48 to explain how to create a custom validator. Tell the students that user can define their own custom validation by implementing the `Validateable` interface in the action class.

The method used in `Validateable` interface is `validate()`. `ValidationAware` interface can accept the field level or action class level error messages. It is overridden in the action class to define the validation logic.

Some methods of `ValidationAware` interface are as follows:

- `void addFieldError(String fieldName, String errorMessage)`  
– adds the error message for the specified field.
- `void addActionError(String errorMessage)` – adds an Action-level error message for this action.
- `void addActionMessage(String message)` – adds an Action-level message for this action.
- `void setFieldErrors(Map<String, List<String>> map)` – sets a collection of error messages for fields.
- `void setActionErrors(Collection<String> errorMessages)` – sets a collection of error messages for this action.
- `void setActionMessages(Collection<String> messages)` – sets a collection of messages for this action.

- `boolean hasErrors()` – checks if there are any field or action errors.
- `boolean hasFieldErrors()` – checks if there are any field errors.
- `boolean hasActionErrors()` – checks if there are any Action-level error messages.
- `boolean hasActionMessages()` – checks if there are any Action-level messages.

**Tips:**

You can work with an example on custom validator by referring this link:

<http://ddubbya.blogspot.in/2011/02/creating-custom-struts2-validator.html>

## Slides 49 and 50

Let us understand validation annotation.

**Validation Annotation 1-2**



- ❑ Validation annotation is used for configuring custom validators and to group validators for a property or a class.
- ❑ Following table describes the different validation annotations:

Annotation Name	XML Equivalent	Description
RequiredFieldValidator	Required	Ensures that the property is not null.
RequiredStringValidator	Requiredstring	Ensures that the String property is not null or empty.
StringLengthFieldValidator	stringlength	Checks that the String length is within the specific range.
IntRangeFieldValidator	Int	Checks that the integer property is within the specific range.

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**Validation Annotation 2-2**



Annotation Name	XML Equivalent	Description
DateRangeFieldValidator	Date	Checks that the date property is within the specific range.
ExpressionValidator	Expression	Evaluates the OGNL expression using the ValueStack.
FieldExpressionValidator	FieldExpression	Validates a field using the OGNL expression.
EmailValidator	Email	Ensures that the property is a valid email address.
UrlValidator	url	Ensures that the property is a valid URL.
RegexFieldValidator	Regex	Checks whether the property matches the regular expression.
Validation		Signifies that the class using annotation based validation can be used on interfaces or classes.
Validations		Groups multiple validations for a property or a class.

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Use slides 49 and 50 to explain validation annotation.

Some other types of validation annotations are as follows:

- DoubleRangeFieldValidator – Checks that a double field has a value within a specified range.
- VisitorFieldValidator – Invokes the validation for a property's object type.
- CustomValidator – Use this annotation for user's custom validator types.

**Tips:**

For more information on validation annotations, you can refer to this link:

<http://www.codejava.net/frameworks/struts/struts2-form-validation-basic-example-using-annotations>

**Slides 51 to 53**

Let us understand internationalization in Struts 2.

**Internationalization in Struts 2 1-3**



- ❑ Internationalization
  - Is the technique for developing applications that support multiple languages and data formats without the need to re-engineer the application.
  - Sometimes, the term 'Internationalization' is abbreviated as I18N, because there are 18 letters between the first 'I' and the last 'N.'
- ❑ Following table shows the list of few country and language codes:

Country Name	Country Code	Language	Language Code
Italy	IT	Italian	it
China	CN	Chinese	zh
France	FR	French	fr
Germany	DE	German	de
Japan	JP	Japanese	ja
Spain	ES	Spanish	es
United States	US	English	en

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51

**Internationalization in Struts 2 2-3**



- ❑ Struts 2 supports internationalization through:
  - i18n Interceptors
  - Message Resource Bundles
  - Tag Libraries

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52

**Internationalization in Struts 2 3-3**

□ Steps to use message resources are as follows:

- Create a properties file for the resources to be stored in the resource bundle.
- Save it with '.properties' extension.
- Provide the locale-specific information in the filename.
- To facilitate access to .properties file, store it on the classpath of application.
- Use <message-resources> element in the Struts configuration file to specify the location of file.

□ Following code snippet shows the use of `<s:text name="some.key" />`

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Use slides 51 to 53 to explain internationalization in Struts 2.

Internationalization is the technique for developing applications that support multiple languages and data formats without the need to re-engineer the application. By designing application ahead of time, developers need not write programming logic again when a new language or country is to be supported by the application. Sometimes the term Internationalization is abbreviated as i18N, because there are 18 letters between the first 'I' and the last 'N.'

Each language and country has unique codes representing the language and country respectively. These codes are assigned by International Organization for Standardization (ISO).

Then, tell them the i18n interceptor provides multi-lingual support for your application. It handles setting locale for the action. It can be used if user wants to set their location locale and get data according to the locale provided. The i18n allows the developer to set the locale for the action. A locale is an identifier and represents the local details of the user to the application. The local can be created by `java.util.Locale` class. When a user session begins, the Locale object is sent in the HTTP request as parameter.

There are two parameters defined for i18n interceptor. Both are optional.

- **parameterName** - It specifies the name of the HTTP request parameter. It is set to `request_locale` by default.
- **attributeName** – It specifies the name of the session key to store the locale. It is `WW_TRANS_I18N_LOCALE` by default.

Another component required for internationalization is Message Resource Bundle. Resource bundle is a flat file that contains key-value pairs. These bundles can be used as central repository for contents that have multiple uses. In order to use resource bundles one needs to create a property file that contains key/value pairs.

For example, to create a Struts 2 Web application for two locales, English and French. So, two resource bundles need to be created.

### **English Resource Bundle**

Key	Value
key_name	value_value
key_name	value_value

### **French Resource Bundle**

Key	Value
key_name	value_value
key_name	value_value

When we pass localization key, Struts 2 framework looks for resource bundles at various places in the given order:

- {ActionClassName}.properties (it should be in the same package with Action Class)
- Interface.properties (every interface and sub-interface)
- BaseClass.properties (all the way to Object.properties)
- ModelDriven's model (if implements ModelDriven)
- package.properties in the class package and then to the parent packages till the root
- Global resource properties configured in struts property file

To use message resources, the steps to be followed are:

1. Create a properties file for the resources to be stored in resource bundle.
2. Save it with '.properties' extension. Struts application use ApplicationResources.properties as standard way to refer to this file.
3. Provide the locale-specific information in the filename. For example, to create a Spanish version, name the file as Applicationresources\_es.properties. The class PropertyMessageResource of Struts will transparently select the required locale-specific resource bundle. In case of unavailability, Struts will load the resource from the default resource bundle.

4. To facilitate access to .properties file, store it on the classpath of application. (For example, in /WEB-INF/classes/ directory). This is because Java's class loader is used by Struts to load the properties file.
5. Use <message-resources> element in the Struts configuration file to specify the location of file. The value of parameter attribute of message-resources element is set to the location of .properties file. The key attribute of element can be used to specify each additional resource bundles.

**In-Class Question:**

After you finish explaining internationalization in Struts 2, you will ask the students an In-Class question. This will help you in reviewing their understanding of the topic.



Which technique helps in developing applications that support multiple languages and data formats without the need to re-engineer the application?

**Answer:**

Internationalization.

## Slides 54 to 58

Let us understand how to implement internationalization.

### Implementing Internationalization 1-5



- Following code snippet creates the common `index.jsp` page which will be displayed based on the selected language:

```
<%@ taglib prefix="s" uri="/struts-tags"%>
<body>
    <h1><s:text name="global_heading"/></h1>
    <s:url id="indexEN" namespace="/" action="locale" >
        <s:param name="request_locale" >en</s:param>
    <s:url id="indexFR" namespace="/" action="locale" >
        <s:param name="request_locale" >fr</s:param>
    </s:url>
    <a href="#">indexENindexFR

- In the code, the Struts 2 text tag retrieves a ResourceBundle message based on the key passed into the name attribute.



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```

54

### Implementing Internationalization 2-5



- Following code snippet shows the different resource bundle properties created for different languages:

```
# global.properties
global.name = Name
global.password = Password
global.submit = Submit
global.heading = Select Locale
global.success = Successfully authenticated

#global_fr.properties
global.name = Nom d'utilisateur
global.age = l'âge
global.submit = Soumettre des
global.heading = Sélectionnez Local
global.success = Authentifié avec succès

#global_fr.properties
global.name = Nom d'utilisateur
global.age = l'âge
global.submit = Soumettre des
global.heading = Sélectionnez Local
global.success = Authentifié avec succès
```

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55

### Implementing Internationalization 3-5



- Following code snippet shows the configuration of resource bundle in the `struts.xml` file:

```
<struts>
    <constant name="struts.custom.i18n.resources" value="global" />
    <package name="example" extends="struts-default" namespace="/" >
        <action name="login"
            class="com.example.LoginAction"
            method="execute">
            <result name="input">/index.jsp</result>
            <result name="success">/success.jsp</result>
        </action>

        <action name="locale"
            class="com.example.Locale" method="execute">
            <result name="success">/index.jsp</result>
        </action>
    </package>
</struts>
```

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56

**Implementing Internationalization 4-5**

Following code snippet shows the `LoginAction` and `Locale` class:

```
/*
 * LoginAction.java class */
public class LoginAction{
    private String name;
    private String password;
    public String execute()
    {
        return SUCCESS;
    }
    // getter and setter methods
}

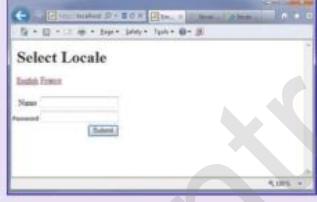
/*
 * Locale class */
public class Locale extends ActionSupport{
    public String execute()
    {
        return SUCCESS;
    }
}
```

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S7

**Implementing Internationalization 5-5**

Following figure shows the output of the code:



The screenshot shows a Java Swing application window titled "Select Locale". Inside the window, there is a label "Select Locale" and a section labeled "Basic Form". It contains two text input fields: one for "Name" and one for "Password", each with a placeholder "Enter". Below the fields is a "Submit" button.

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S8

Use slides 54 to 58 to explain how to implement internationalization.

## Slides 59 to 62

Let us understand lifecycle callback annotations.

### Lifecycle Callback Annotations 1-4



- They are invoked at a specified time during the processing of an action.
- There are three lifecycle callback annotations:

<b>@Before</b> • It marks an action method that should be executed before the main action method. • It is used at the method level. • It helps in pre-processing of common tasks.	<b>@After</b> • Marks an action that should be executed after the logic in the main action method. • Result is executed but before the result is returned to the user. • Applicable at the method level.	<b>@BeforeResult</b> • It is invoked after the method that executes the logic for the action but before the result is returned. • The return value is ignored. • This annotation is applied at the method level.
--	---	---

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59

### Lifecycle Callback Annotations 2-4



- Following code snippet shows the use of the @Before annotation:

```
...
public class SampleAction extends ActionSupport {
  @before
  public void isAuthorized() throws AuthenticationException {
    // authorize request, throw exception if failed
  }
  public String execute() {
    // perform secure action
    return SUCCESS;
  }
}
```

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60

### Lifecycle Callback Annotations 3-4



- Following code snippet shows the use of the @After annotation:

```
...
public class SampleAction extends ActionSupport {
  @After
  public void isValid() throws ValidationException {
    // validate model object, throw exception if failed
  }
  public String execute() {
    // perform action
    return SUCCESS;
  }
}
```

- In the code, the isValid() method will be executed after the execute() method.

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61

**Lifecycle Callback Annotations 4-4**



- Following code snippet shows the use of the @BeforeResult annotation:

```
...
public class SampleAction extends ActionSupport {
    @BeforeResult
    public void isValid() throws ValidationException {
        // validate model object, throw exception if failed
    }
    public String execute() {
        // perform action
        return SUCCESS;
    }
}
```
- In the code, the `isValid()` method will be executed after the `execute()` method but before the execution of the result.

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62

Use slides 59 to 62 to explain lifecycle callback annotations.

Life cycle callback annotations are invoked at a specified time during the processing of an action.

There are three life cycle callback annotations. To use these annotations, you have to specify the `AnnotationWorkflowInterceptor` to your Interceptor task.

Then, explain different types of life cycle callback interceptors as explained on slide 59.

Then, using slide 60, explain `@Before` annotation that marks an action method that should be executed before the main action method.

Then, using slide 61, explain `@After` annotation that marks an action that should be executed after the logic in the main action method and the result is executed before it is returned to the user.

Then, using slide 62, explain the `@BeforeResult` annotation that will be invoked after the method that executes the logic for the action, but before the result is executed. The return value is ignored. This annotation is applied at the method level.

## Slide 63

Let us summarize the session.

**Summary**

- ❑ OGNL is integrated into the Struts 2 framework to provide data transfer and type conversion.
- ❑ OGNL's expression language is used in the form input field name and in JSP tags.
- ❑ Struts 2 framework provides built-in converters for converting an HTTP string data type to any of the Java data types.
- ❑ Two types of validators present in the Validator Framework are Field Validators and Non-Field Validators.
- ❑ One of the main features of the Struts 2 framework is its built-in validation support.
- ❑ The validate() method in the Validateable interface contains the validation code whereas the ValidationAware interfaces contains methods for storing the error messages generated when validation of a property fails.
- ❑ Two types of validators present in the Validator Framework are Field Validators and Non-Field Validators.
- ❑ Struts 2 Web application support internationalization.
- ❑ Struts 2 supports internationalization through interceptors, resource bundles, and tag libraries, in the Web application.
- ❑ Life cycle callback annotations are invoked at a specified time during the processing of an action.

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In slide 63, you will summarize the session. You will end the session, with a brief summary of what has been taught in the session.

### 4.3 Post Class Activities for Faculty

You should familiarize yourself with the topics of the next session. You should also explore the JavaServer Faces technology introduced in the next session.

#### Tips:

You can also check the Articles/Blogs/Expert Videos uploaded on the OnlineVarsity site to gain additional information related to the topics covered in the next session. You can also connect to online tutors on the OnlineVarsity site to ask queries related to the sessions.

# Session 5 – Introduction to JavaServer Faces

---

## 5.1 Pre-Class Activities

Before you commence the session, you should familiarize yourself with the topics of this session in-depth. You should revisit topics of the previous session for a brief review.

Here, you can ask students the key topics they can recall from previous session. Prepare a question or two which will be a key point to relate the current session objectives.

### 5.1.1 Objectives

By the end of this session, the learners will be able to:

- Explain JSF framework
- Explain the components of JSF framework
- Explain the different types of configuration files used in JSF applications
- Describe JSF architecture and JSF lifecycle
- Explain the process of developing JSF application
- Explain UI components and the renderers in JSF
- Explain the concept of managed beans in JSF
- Explain basic tag, converter tag, and validator tag in JSF

### 5.1.2 Teaching Skills

To teach this session successfully, you should be aware of JSF framework and its components. Familiarize yourself with different types of configuration files used in JSF applications. Aware yourself with JSF architecture and JSF lifecycle. You should know the process of developing JSF application and also about UI components and the renderers in JSF.

Aware yourself with the concept of managed beans and about basic tag, converter tag, and validator tag in JSF.

For teaching in the class, you are expected to use slides and LCD projectors.

#### Tips:

It is recommended that you test the understanding of the students by asking questions in between the class.

#### In-Class Activities:

Follow the order given here during In-Class activities.

### **Overview of the Session:**

Give the students a brief overview of the current session in the form of session objectives.

Show the students slide 2 of the presentation.

The slide has a light purple background with a decorative border. In the top right corner is a purple circular icon containing a white coffee cup with steam. The word 'Objectives' is centered at the top in a dark blue font. Below it is a bulleted list of nine items, each preceded by a small square checkbox. At the bottom left is a graphic of four interlocking puzzle pieces. At the bottom center is a small line of text: '© Aptech Limited Developing Applications Using Java Web Frameworks/Session 5'. At the bottom right is a small number '2'.

**Objectives**

- Explain JSF framework
- Explain the components of JSF framework
- Explain the different types of configuration files used in JSF applications
- Describe JSF architecture and JSF lifecycle
- Explain the process of developing JSF application
- Explain UI components and the renderers in JSF
- Explain the concept of managed beans in JSF
- Explain basic tag, converter tag, and validator tag in JSF

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2

Tell the students that they will be introduced to JSF framework and its components. The session explains the different types of configuration files used in JSF applications. You should also know the process of developing JSF application and also about UI components and their renderers in JSF.

Further, the session will also explain them about JSF architecture and JSF lifecycle. Finally, discuss the process of developing JSF application.

Finally, discuss about the concept of managed beans and about basic tag, converter tag, and validator tag in JSF.

## 5.2 In-Class Explanations

### Slides 3 to 5

Let us understand the limitations of Servlet and JSP.

**Introduction 1-3**



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- ❑ Sun Microsystems provided two specifications for developing server-side components namely,
  - Servlet - Helps to generate dynamic contents
  - JSP pages - Separate presentation from the application logic
- ❑ **Limitations of Servlet and JSP**
  - Both the technologies fail to provide separation of User Interface (UI) components from the model.
  - Developers are dependent on client specific UI for designing the Web pages.
  - For example, for a Web client, HTML Web pages are designed.
  - Apart from static nature of HTML controls, there is a lack of event handling on the controls.
  - For example, a View component in MVC architecture should generate events on the controls that can be handled.

3

**Introduction 2-3**



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- ❑ Some of the challenges faced by the developer, while designing UI controls for the clients of the Web application are as follows:
  - **Rich client controls**
    - Based on the ability to query the model and updated the data with event-handling mechanism.
  - **Support for custom controls**
    - Web applications need to be customized with custom components, such as a grid viewer.




4

**Introduction 3-3**



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- ❑ Thus, a need was felt by the developers for a development environment that would allow them to:
  - Implement custom UI components and add or remove them dynamically.
  - Provide UI support to various clients such as Web browser, PDA, mobile phones, and so on.
  - Use an event model such as Swing to trap events fired by components or controls in Web pages.

**JSF is an open source, component based, event driven framework for building user interface for Web applications.**

5

Use slides 3 to 5 to explain the limitations of Servlet and JSP.

Tell them that Sun Microsystems provided two specifications for developing server-side components namely, Servlet and JSP.

Servlets help to generate dynamic contents, whereas JSP pages separate presentation from the application logic. However, both the technologies fail to provide separation of User Interface (UI) components from the model. Thus, developers are dependent on client specific UI for designing the Web pages. For example, for a Web client, HTML Web pages are designed. As HTML controls are static in nature, which means they are not powered with the dynamic functionalities of handling the data. Thus, developers access the data from the form controls using HTTP request and response objects.

Apart from static nature of HTML controls, there is a lack of event handling on the controls. For example, a view component in MVC architecture should generate events on the controls that can be handled. For example, Swing controls are developed with MVC architecture. When value changes in a UI component, the model gets updated based on the event fired on the control.

Then, discuss the challenges faced by the developer while designing UI controls for the Web applications designed using Servlet and JSP technology as discussed on slide 4.

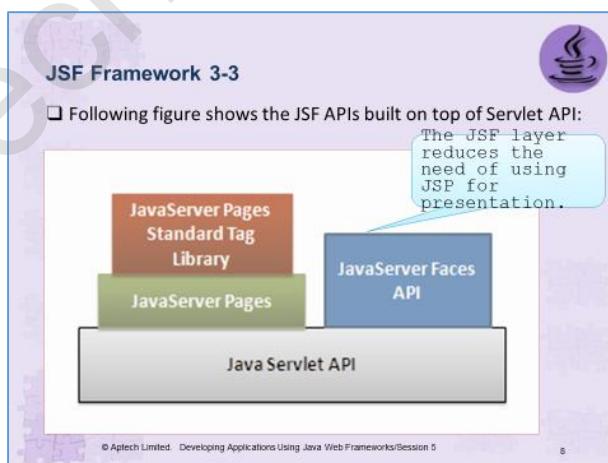
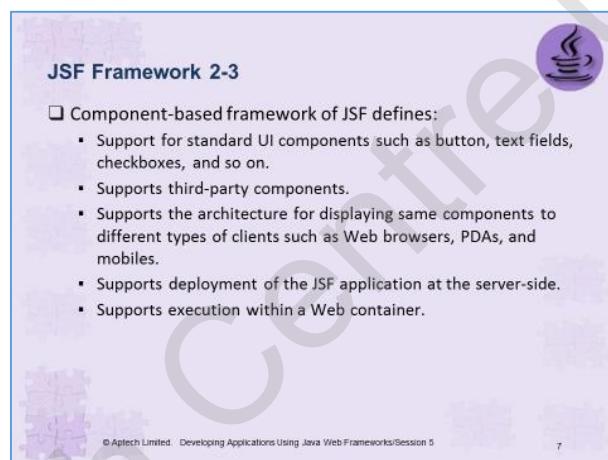
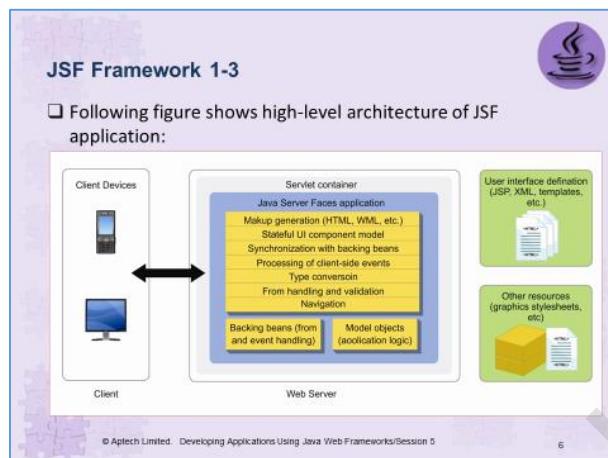
Thus, to deal with such requirements as mentioned on slide 4, the Sun Microsystems provided a server-side UI component framework named as JavaServer Faces (JSF). JSF is an open source, component based, event driven framework for building user interface for Web applications.

Then, discuss the main components of JSF technology that are as follows:

- A well-defined programming model that provides various UI components
- API to manage the state of UI controls on server-side with event-handling, validation, data conversion, and so forth.
- JSP custom tag libraries for providing UI components on a JSP page.

## Slides 6 to 8

Let us understand JSF framework.



Use slides 6 to 8 to explain JSF framework.

Tell the students that JSF helps to:

1. Create a Web page.
2. Drop components onto a Web page by adding component tags.
3. Bind components on a page to server-side data.
4. Wire component generated events to server-side application code.
5. Save and restore application state beyond the life of server requests.
6. Reuse and extend components through customization.

Using slides 6 and 7, explain the architecture of JSF. The component-based framework of JSF defines the support for standard UI components such as button, text fields, check boxes, and so on. It also supports third-party components. Components are based on event-driven programming model in which events are handled at the server-side. JSF supports the architecture for displaying same components to different types of clients such as Web browsers, PDAs, and mobiles. JSF applications are deployed at the server-side and are executed within a Web container.

Using slide 8, explain the JSF API that are built on top of Servlet API. Tell them that the JSF layer reduces the need of using JSP for presentation. This enables the use of component classes for creating the presentations for different types of client devices.

## Slides 9 to 13

Let us understand the components of JSF.

### Components of JSF 1-5



- ❑ Components of JSF are as follows:
  - Managed Beans
  - UI Components
  - Converter
  - Validator
  - Renderers
  - Other core components:
    - Events and listeners
    - Messages
    - Navigation

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9

### Components of JSF 2-5



- ❑ **Managed Beans**
  - Associates UI component with a JavaBean which defines UI component's properties.
  - Defines methods that perform functions such as event handling, validation, and navigation processing, associated with the component.
  - Gets instantiated at runtime using managed bean creation facility.
- ❑ **UI Components**
  - Focuses on interacting with the end user, also called controls or components.
  - Can remember their state automatically.
  - JSF UIComponent classes specify the UI component's functionality.

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10

### Components of JSF 3-5



- ❑ **Converter**
  - Converts form (UIComponent) data to Java objects for storing onto the model data and from model's Java object to presentation view.
  - Ensure that the user's input is in a specified format as specified by the converter.
  - Provides a set of standard Converter implementations as well as facility to customize the Converter implementations.
- ❑ **Validator**
  - Supports data validation before the form (UIComponent) values update the object data.
  - Defines a collection of standard classes for common data validations and a developer can also define custom validations.

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11

## Components of JSF 4-5



- Renderers**
  - JSF component architecture separates the functional aspect of a UIComponent from the rendering of UI components.
  - Separate classes called renderers handle the rendering process.
  - Collection of renderer classes forms a render kit.
  - The render kit defines mapping of component classes to component tags suitable for a specific client.
- Events and Listeners**
  - Events are represented by an instance of an event class and there is an event listener interface for every JSF component event.
  - When a component is used by activating it, such as **button clicked**, then an event is fired. JSF implementation then invokes the corresponding listener method to process the event.

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12

## Components of JSF 5-5



- Messages**
  - Display either information or errors.
  - Two types of error messages are Logical Error messages and Input Error messages.
  - **Logical Error messages** - Can be generated either due to errors in business logic or database errors or connection errors.
  - **Input Error messages** - Can be generated due to user input errors such as empty field or invalid text and so on.
- Navigation**
  - Allows the developer to use a configuration file to specify and control the page navigation.
  - Takes place when a user clicks either a command button or a command link.
  - Provides a default action listener for such navigational event.

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13

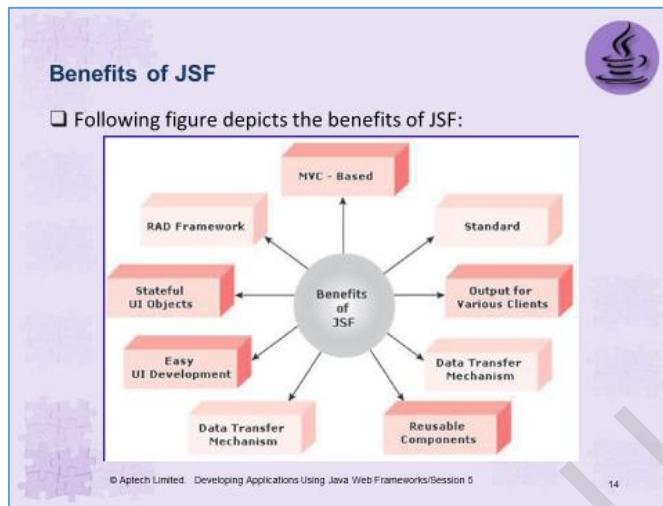
Use slides 9 to 13 to explain the components of JSF.

Explain them that the components of JSF that are as follows:

- Managed Beans
- UI components
- Converter
- Validator
- Renderers
- Events and listeners
- Navigation

## Slide 14

Let us understand the benefits of JSF.



Use slide 14 to explain the benefits of JSF.

The other advantages of JSF are as follows:

1. JSF application can map HTTP requests to component-specific event handling and can manage UI elements as stateful objects on the server.
2. JSF technology helps the user to build Web applications that implement the separation of behavior and presentation that is normally given by client-side UI architectures.
3. JSF technology leverages familiar UI-component and Web-tier concepts without limiting the user to a particular scripting technology or markup language.
4. The JSF technology APIs are layered directly on top of the Servlet API. These APIs enables several important application use cases, such as using another presentation technology instead of JSP pages, creating custom components directly from the component classes, and generating output for various client devices.
5. JSF has inbuilt template layout features.

## Slide 15

Let us compare JSP and JSF.

**Comparison between JSP and JSF**



Following table shows the comparison between JSP and JSF:

JavaServer Pages (JSP)	JavaServer Faces (JSF)
Java based technology that is utilized to develop and design dynamic Web pages.	Web application, which is used to simplify development and integration of Web based UIs.
Does not support Validator, Conversion, and Ajax support.	Supports Validator, Conversion, and Ajax support.
No features such as managed beans and template-based component system.	Core features such as managed beans and template-based component system.
Not a request-driven MVC. Accessed by the dynamically generated pages such as XML or HTML.	Request-driven MVC.
Compiled within the server, not within a view template.	Interface within a view template.

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15

Use slide 15 to explain the difference between JSP and JSF.

## Slide 16

Let us introduce JSF versions.

**Introduction to JSF Versions**



- Since its first release, JSF have gone through major and minor version enhancements:
- JSF 1.0**
  - Initial specification released which combines the MVC design pattern with a powerful component-based UI framework.
- JSF 1.2**
  - Release was introduced with many improvements and used on Java EE 5 platform.
- JSF 2.0**
  - Was introduced with the main focus of simplifying and building of UI components.
- JSF 2.1 and 2.2**
  - Facelets Views.
  - File Upload Component.

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16

Use slide 16 to explain JSF versions.

Since its first release, JSF have gone through major and minor version enhancements. JSF 1.0 was the initial specification released which combines the MVC design pattern with a powerful component-based UI framework. This simplifies the development of Web applications on Java EE platform. JSF 1.2 release was introduced with many improvements and used on Java EE 5 platform.

The later version JSF 2.0 was introduced with the main focus of simplifying and building of UI components. In version 2.0, JSF is released in two minor version namely, JSF 2.1 and JSF 2.2.

## Slide 17

Let us introduce JSF configuration files.

**Introduction to JSF Configuration Files**

- ❑ A developer needs to use minimum of two XML configuration files, while working with JSF.
- ❑ These two files are as follows:
  - web.xml
  - faces-config.xml
- ❑ The configuration files let the Java code to be easily shared between JSP pages.

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17

Use slide 17 to explain JSF configuration files.

JSF applications use one or more XML descriptor files to configure applications. A developer needs to use minimum of two XML configuration files, while working with JSF. These two files, namely, `web.xml` and `faces-config.xml` are crucial to the flexibility and provide flexible coupling for the JSF architecture. The configuration files let the Java code to be easily shared between JSP pages.

JSF 2.0 introduced the use of annotations to configure the Web application components based on JSF framework. This makes the use of `faces-config.xml` optional.

## Slides 18 and 19

Let us understand web.xml File.

**web.xml File 1-2**



- ❑ Located in the /WEB-INF/ directory of the Web application that is to be deployed, and configures the Web server end of the application.
- ❑ Configures FaceServlet.
- ❑ A FacesServlet is:
  - Responsible for handling JSF applications.
  - Central controller of JSF application.
  - Receives all requests for the JSF application.
  - Initializes the JSF components before the JSP is displayed.

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18

**web.xml File 2-2**



- ❑ Following code snippet displays the configuration of FacesServlet in web.xml:

```
<Servlet>
<Servlet-name>Faces Servlet</Servlet-name>
<Servlet-class>javax.faces.webapp.FacesServlet</Servlet-class>
<load-on-startup>1</load-on-startup>
</Servlet>
<!-- Servlet Mapping to URL pattern -->
<Servlet-mapping>
<Servlet-name>Faces Servlet</Servlet-name>
<url-pattern>.xhtml</url-pattern>
</Servlet-mapping>
<Servlet-mapping>
<Servlet-name>Faces Servlet</Servlet-name>
<url-pattern>*.jsf</url-pattern>
</Servlet-mapping>
<Servlet-mapping>
<Servlet-name>Faces Servlet</Servlet-name>
<url-pattern>*.faces</url-pattern>
</Servlet-mapping>
</web-app>
```

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- ❑ In JSF 2.0, the FacesServlet can map to different URL patterns, such as \*.xhtml, \*.jsf, and \*.faces.
- ❑ If web.xml is not present, then the FacesServlet is automatically mapped to the common URLs such as /faces/\*, /faces/\*.jsf, \*.faces, and so on.

19

Use slides 18 and 19 to explain web.xml file.

Tell the students that JSF needs the central configuration web.xml to configure the controller of the JSF application. The web.xml is present in the directory WEB-INF of the application.

Using slide 18, explain that in web.xml, you must specify that a FacesServlet is responsible for handling JSF applications. The central controller of JSF application is FacesServlet and it receives all requests for the JSF application. In addition, FacesServlet initializes the JSF components before the JSP is displayed.

Then, explain the code snippet showing the configuration of FacesServlet as shown on slide 19.

**In-Class Question:**

After you finish explaining web.xml file, you will ask the students an In-Class question. This will help you in reviewing their understanding of the topic.



Which feature receives all requests for the JSF application and initializes the JSF components before the JSP is displayed?

**Answer:**

FacesServlet

## Slides 20 and 21

Let us understand faces-config.xml.

**faces-config.xml 1-2**



- ❑ Contains the configuration of the JSF application.
- ❑ Allows the configuration of the application, converters, validators, managed beans, and navigation and also defines the behavior of the Faces Servlet.
- ❑ Tends to be more specific to a certain JSF application, whereas web.xml generally comprises common configuration options.

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20

**faces-config.xml 2-2**



- ❑ Following code snippet demonstrates the creation of a file called /WEB-INF/faces-config.xml:

```
<faces-config . . .
<!-- Configuring managed bean -->
<managed-bean>
    <managed-bean-name>messageBean</managed-bean-name>
    <managed-bean-class>JSF_SimpleController</managed-bean-class>
    <managed-bean-scope>request</managed-bean-scope>
</managed-bean>
<!-- Configuring navigation -->
<navigation-rule>
<from-view-id>/starting-page.xhtml</from-view-id>
<navigation-case>
    <from-outcome>return-value-1</from-outcome>
    <to-view-id>/result-page-1.xhtml</to-view-id>
</navigation-case>
</to-view-id>
<navigation-case> . . . </navigation-case>
</navigation-rule>
</faces-config>
```

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21

Use slides 20 and 21 to explain faces-config.xml.

Tell the students that faces-config.xml allows the user to configure the JSF application components such as managed beans, convertors, validators, and navigation.

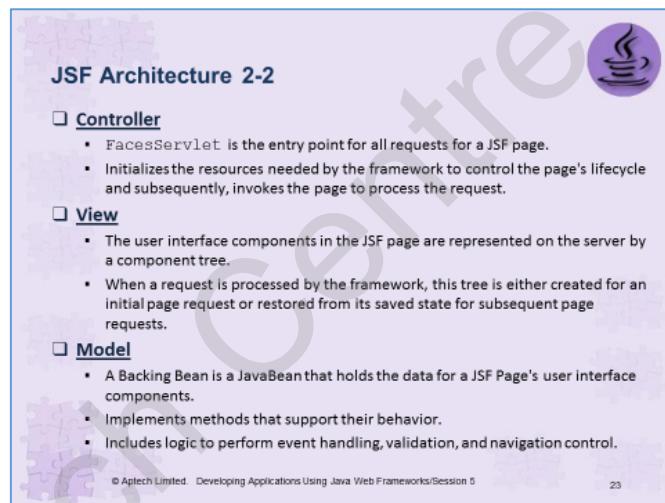
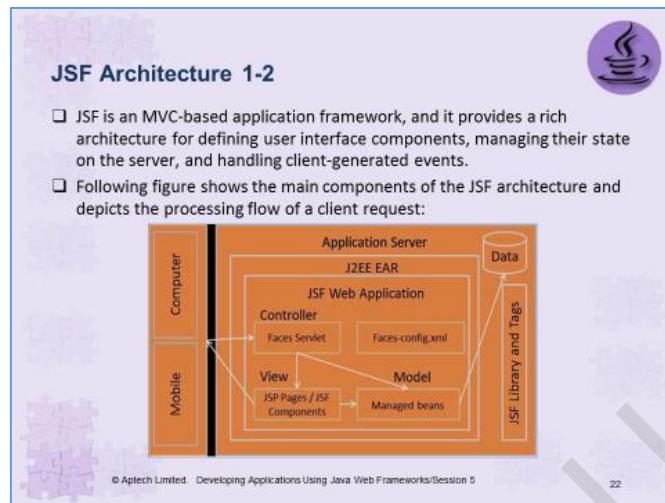
An application architect creates one or more files, called application configuration resource files that use the format to register and configure objects and to define navigation rules. An application configuration resource file is usually called faces-config.xml.

The faces-config.xml lists bean resources and navigation rules that are more specific to a certain application.

Explain the code snippet as shown on slide 21 to configure components in faces-config.xml file. However, from JSF 2.0, this file is optional, as all the information about the elements can be configured through annotations.

## Slides 22 and 23

Let us understand JSF architecture.



Use slides 22 and 23 to explain JSF Architecture.

Mention that JSF is an MVC-based application framework. It provides a rich architecture for defining user interface components, managing their state on the server, and handling client-generated events. It also provides support for validating user input and controlling page navigation.

All user interactions with the application are handled by a front-end 'Faces' servlet **Controller**.

### **Controller**

Explaining the figure as shown on slide 22, tell them the `FacesServlet` is the entry point for all requests for a JSF page. Then, using slide 23, explain that **Controller** initializes the resources needed by the framework to control the page's life cycle and subsequently, invokes the page to process the request.

### **View**

The user interface components in the JSF page are represented on the server by a component tree. This is also referred to as a **View**. When a request is processed by the framework, this tree is either created for an initial page request or restored from its saved state (for subsequent page requests).

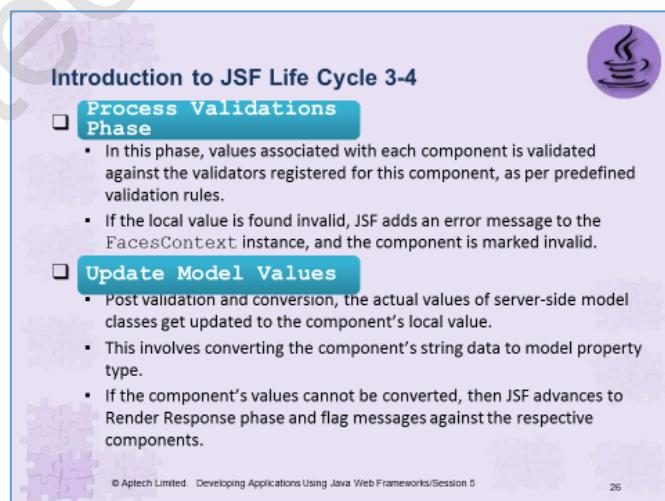
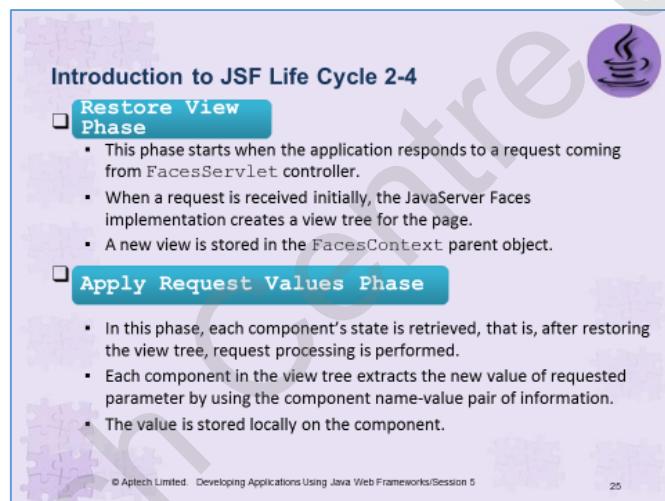
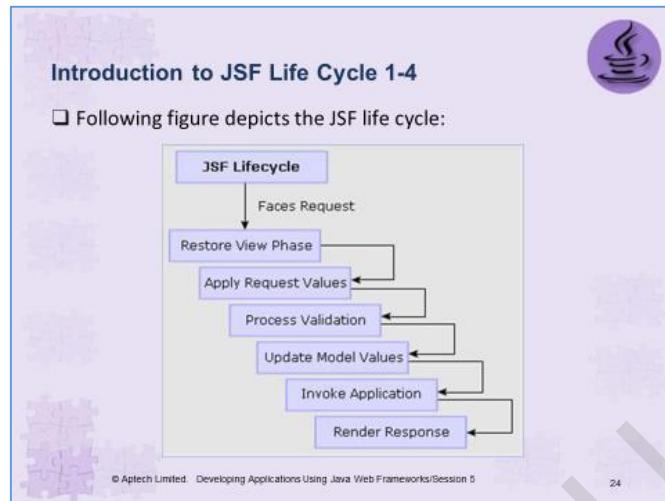
### **Model**

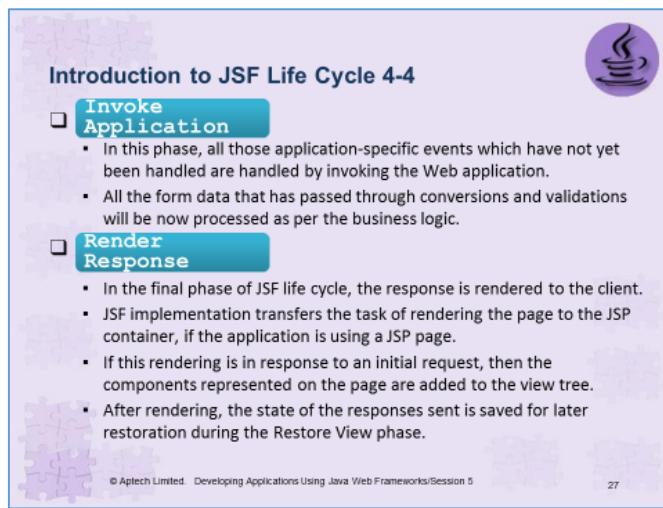
A Backing Bean is a JavaBean that holds the data for the user interface components on the JSF page. It implements methods that support their behavior. It includes logic to perform event handling, validation, and navigation control.

A Backing Bean usually invokes methods from a model object to perform business logic. JSF allows you to declare all the Backing Beans used by the page in the faces configuration file named as `face-config.xml`, so that they will be automatically instantiated by the Web container at application startup time. These beans are called **Managed beans**.

## Slides 24 to 27

Let us understand JSF life cycle.





**Introduction to JSF Life Cycle 4-4**

**Invoke Application**

- In this phase, all those application-specific events which have not yet been handled are handled by invoking the Web application.
- All the form data that has passed through conversions and validations will be now processed as per the business logic.

**Render Response**

- In the final phase of JSF life cycle, the response is rendered to the client.
- JSF implementation transfers the task of rendering the page to the JSP container, if the application is using a JSP page.
- If this rendering is in response to an initial request, then the components represented on the page are added to the view tree.
- After rendering, the state of the responses sent is saved for later restoration during the Restore View phase.

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Use slides 24 to 27 to explain JSF life cycle.

Tell them that **JSF Lifecycle** which dictates the entire flow of events between user requests. For example, upon an initial Web request to access a JSF application, the Faces Controller servlet handles the request by first preparing the JSF context, which is a Java object that holds all application data. The Controller then routes the user to the requested page. The page usually renders application data from the JSF context using a simple Expression Language (EL). Upon subsequent requests, the Controller updates any Model data, providing any new input has been entered. JSF developers have programmatic access to the entire JSF lifecycle at any time during its execution thus affording a high degree of control over the application's behavior at all times.

Tell the students that when a request for a JSF page is made, the JSF implementation starts the **Restore View** phase. In this phase, the JSF implementation builds the view of the page, wires event handlers, and validators to components in the view. It also saves the view in the FacesContext instance. The FacesContext instance contains all the information needed to process a single request. All the application's component tags, event handlers, converters, and validators have access to the FacesContext instance.

In **Apply Request Values** phase, the components are set to their new values, and messages and events is queued.

**Process Validations** phase processes all validators registered on the components in the tree. It examines the component attributes that defines the rules for the validation and compares those rules to the local value stored for the component.

Then, the **Update Model Values** phase determines whether the data is valid or not.

**Invoke Application** phase handles application-level events, such as submitting a form or linking to another page. If the application needs to redirect to a different Web application resource or generate a response that does not contain any JSF components, it can call `FacesContext.responseComplete`.

In the final phase of JSF life cycle, that is, **Render Response**, the response is rendered to the client. JSF implementation transfers the task of rendering the page to the JSP container if the application is using a JSP page. If this rendering is in response to an initial request, then the components represented on the page are added to the view tree. After rendering, the state of the responses sent is saved for later restoration during the Restore View phase.

**In-Class Question:**

After you finish explaining JSF life cycle, you will ask the students an In-Class question. This will help you in reviewing their understanding of the topic.



Which phase is started when the application responds to a request coming from FacesServlet controller?

**Answer:**

Restore View Phase

## Slide 28

Let us understand developing JSF applications.

The screenshot shows a presentation slide with a purple header bar. The title 'Developing JSF Applications' is at the top left, and a coffee cup icon is at the top right. Below the title is a bulleted list of functionalities. At the bottom left is a small puzzle piece graphic, and at the bottom center is copyright information: '© Aptech Limited - Developing Applications Using Java Web Frameworks|Session 5'. The slide number '28' is at the bottom right.

**Developing JSF Applications**

- ❑ Some of the functionalities performed by the components are as follows:
  - Custom tag library
  - JavaBean components
  - Custom tag libraries for managing event listeners, validators, converters, and other core actions
  - Server-side classes, also known as helper classes for obtaining the functionalities
  - Configuration file, faces-config.xml, for configuring application resources

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28

Use slide 28 to explain the steps for developing JSF applications.

Some of the functionalities performed by the components in a JSF application are as follows:

- Custom tag library used for embedding and rendering UI components within the View page.
- JavaBean components, also known as Backing beans which define the properties and functionalities of UI components.
- Custom tag libraries for managing event listeners, validators, converters, and other core actions.
- Server-side classes, also known as helper classes for obtaining the functionalities such as database access.
- A configuration file, faces-config.xml, for configuring application resources such as JavaBean, page navigation rules, and other custom objects used in the JSF application or applying annotations to the components.

## Slides 29 and 30

Let us understand user interface component model.

**User Interface Component Model 1-2**



- ❑ **UI Components:**
  - Are simple and reusable elements that are used to design the user interface of JSP applications.
  - Can be simple such as text field or button as well as complex such as trees or data table.
  - User interface controls are represented by `UIComponent` classes on the server-side.
  - Base class for all the UI components is `UIComponentBase` class which are defined in `javax.faces.component package`.
- ❑ **UIComponentBase class:**
  - Provides the default state and behavior for all UI components.

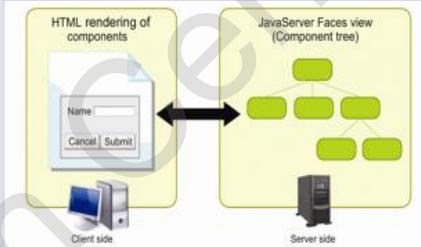
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29

**User Interface Component Model 2-2**



- ❑ JSF framework creates a tree of UI components at server-side, while displaying them on the page. The component tree is also called as **View**.
- ❑ Following figure displays the component tree managed on the server for the UI components displayed on the Web page:



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30

Use slides 29 and 30 to explain user interface component model.

Using slide 25, explain that the user interface components are simple and reusable elements that are used to design the user interface of JSP applications. These components can be simple such as text field or button as well as complex such as trees or data table. In JSF, user interface controls are represented by `UIComponent` classes on the server-side. The class defines the behavior of the components in the JSF application environment regardless of how it will be presented to the client. It not only includes the `UIComponent` class, but also the other helper components such as Renderer for rendering the component, Validator for registering validators onto a component, Converter for registering data converters on to a component, and so on.

The base class for all the UI components is `UIComponentBase` class defined in `javax.faces.component` package. The `UIComponentBase` class provides the default state and behavior for all UI components. There is a set of HTML component classes defined in `javax.faces.component.html` package. These components are derived from the `UIComponentBase` class.

The UI components are associated with UI tags used in designing the Web page of the application. The JSF framework creates a tree of UI components at server-side while displaying them on the page. This helps the components to remember the values between the requests forwarded to the server. The component tree is also called as View.

Explain that the component tree managed on the server for the UI components displayed on the Web page as shown on slide 30.

Some of the user interface component class included in JSF are as follows:

- `UICommand`: Represents a control that fires actions when activated.
- `UIData`: Represents a data binding to a collection of data represented by a `javax.faces.model.DataModel` instance.
- `UIGraphic`: Displays an image.
- `UIInput`: Takes data input from a user. This class is a subclass of `UIOutput`.
- `UIMessage`: Displays a localized error message.
- `UIMessages`: Displays a set of localized error messages.
- `UIOutcomeTarget`: Displays a hyperlink in the form of a link or a button.
- `UIOutput`: Displays data output on a page.
- `UIPanel`: Manages the layout of its child components.
- `UIParameter`: Represents substitution parameters.
- `UISelectBoolean`: Allows a user to set a boolean value on a control by selecting or deselecting it. This class is a subclass of the `UIInput` class.
- `UISelectItem`: Represents a single item in a set of items.
- `UISelectItems`: Represents an entire set of items.
- `UISelectMany`: Allows a user to select multiple items from a group of items.
- `UISelectOne`: Allows a user to select one item from a group of items.
- `UIViewParameter`: Represents the query parameters in a request.
- `UIViewRoot`: Represents the root of the component tree.

## Slides 31 and 32

Let us understand renderers.

**Renderers 1-2**



- ❑ The JSF API includes a standard HTML kit for rendering the component as HTML object to be sent to HTML client.
- ❑ Following table describes some of the UI component classes present in the JSF technology:

Component Class	Component Tag	Functionality	Rendered as HTML	Appearance on the Page
UIColumn	<h:column>	Represents a single column of data and is used with UIData component	A column of data in an HTML table	Column in a table
UICommand	<h:commandButton>/<h:commandLink>	Represents controls which submits the form data to an application or links to another location when activated	An HTML tag <input type="XXX" /> where XXX is a type value that can be a submit, reset, or image	A button or a hyperlink

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**Renderers 2-2**



Component Class	Component Tag	Functionality	Rendered as HTML	Appearance on the Page
UIForm	<h:form>	Collection of controls whose data is submitted to the application for processing. This tag resembles the <form> tag in HTML	An HTML <form> element	No appearance
UIGraphics	<h:graphicImage>	Used to display an image	An HTML <img> tag	An image
UIPanel	<h:panelGrid>	Manages the layouts of child components embedded in it	An HTML <table> element with <tr> <td> elements	A table

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Use slides 31 and 32 to explain renderers.

The components in JSF are not responsible for how they will be displayed to the Web client. They are designed to define the functionality of a component whereas the rendering is performed by separate renderer. The rendering model defines the way the components are displayed to the clients. For example, a `UISelectOne` component can be rendered as a set of radio buttons, as a combo box, or as a list box.

The JSF API includes a standard HTML kit for rendering the component as HTML object to be sent to HTML client.

Then, using slides 31 and 32, explain the UI component class with their rendered HTML element and its appearance on the Web page.

## Slides 33 to 36

Let us understand Navigation Model.

### Navigation Model 1-4



❑ Is an easy way to declare a set of rules that define the next view for user based on user actions.

❑ **Rules**

- Are specified using XML elements in the application's configuration resource file, often named as faces-config.xml.
- Uses action event invoked by clicking of button or hyperlink.
- Also handle additional processing required to select the correct sequence in which pages are to be loaded.

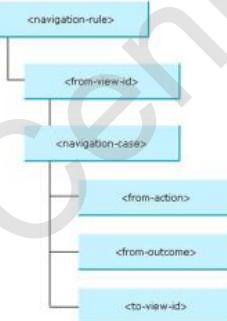
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33

### Navigation Model 2-4



❑ Following figure depicts a navigation model:



```
graph TD; A["<navigation-rule>"] --> B["<from-view-id>"]; A --> C["<navigation-case>"]; C --> D["<from-action>"]; C --> E["<from-outcome>"]; C --> F["<to-view-id>"];
```

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34

### Navigation Model 3-4

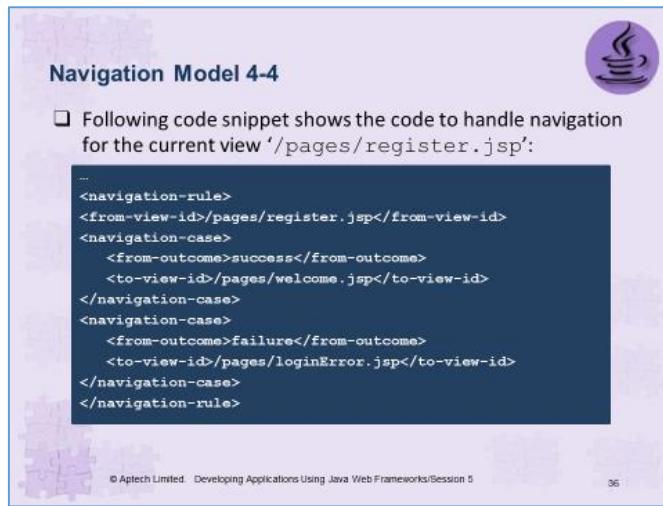


❑ To facilitate navigation, the Web developer performs the following steps:

- **Define set of navigation rules**
  - <navigation-rule> - defines which pages should be chosen from a set of pages.
  - <navigation-case> - represents each path to a page.
  - A navigation rule can optionally specify the page to which it is bound with the <from-outcome> tag.
  - Each rule must have the <to-view-id> to define which page to load next.
- **Bind these rules to the UI component** - The navigation occurs when the UIComponent within the page trigger an action event.

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35



**Navigation Model 4-4**

Following code snippet shows the code to handle navigation for the current view '/pages/register.jsp':

```

...
<navigation-rule>
<from-view-id>/pages/register.jsp</from-view-id>
<navigation-case>
    <from-outcome>success</from-outcome>
    <to-view-id>/pages/welcome.jsp</to-view-id>
</navigation-case>
<navigation-case>
    <from-outcome>failure</from-outcome>
    <to-view-id>/pages/loginError.jsp</to-view-id>
</navigation-case>
</navigation-rule>

```

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36

Use slide 33 to 36 to explain Navigation Model.

Tell them that any commercial Web application requires multiple Web pages that together serve the application functionality. A Web developer has to define a correct sequence of Web pages to be loaded based on user's action. This is a daunting task since the functionality is distributed across multiple pages.

Using slide 33, explain that the JSF Navigation model is an easy way to declare a set of rules that define the next view based on the actions. These rules are specified using XML elements in the application's configuration resource file, often named as `faces-config.xml`. The rules uses action event invoked by clicking of button or hyperlink. They can also handle additional processing required to select the correct sequence in which pages are to be loaded.

Explain the figure as given on slide 34 that shows the elements of a Navigational model. Tell them that the `<navigation-rule>` element defines which pages should be chosen from a set of pages. Then, within the `<navigation-rule>` element, the `<navigation-case>` element is given which represents each path to a page. A navigation rule can optionally specify the page to which it is bound with the `<from-outcome>` tag. Each rule must have the `<to-view-id>` to define which page to load next. The navigation case is selected based on logical outcome and/or the expression for action method.

JSF supports two kinds of Navigation models are namely, static and dynamic. Static navigation is useful when the response of the current page is known to the user. Dynamic Navigation is useful when the output of the current page is highly unpredictable and the output depends mainly on the execution of some Business logic.

For example, consider a Login application with `login.jsp` page displaying the input fields. On page submission, the control is transferred either to `success.jsp` or `failure.jsp` page in the application.

The following code snippet shows the configuration of Navigational model in the `faces-config.xml` file:

...

```
<navigation-rule>
    <description></description>
    <from-view-id>/login.jsp</from-view-id>

    <navigation-case>
        <from-outcome>loginSuccess</from-outcome>
        <to-view-id>/loginSuccess.jsp</to-view-id>
    </navigation-case>

    <navigation-case>
        <from-outcome>loginFailure</from-outcome>
        <to-view-id>/loginFailure.jsp</to-view-id>
    </navigation-case>
</navigation-rule>
...
```

Here, we have added two navigation cases, one for success and the other for failure.

Two of the most important changes in JSF 2.0 are the introduction of annotations and the new convention used for navigation. These new features essentially make the `faces-config.xml` file optional. With JSF 2.0, you can use annotations in managed beans, registering listeners, resource rendering, and so on. Now, any annotated POJO can be used as a managed bean and navigation rules can be defined in managed beans.

The runtime will consider annotations only if the `faces-config.xml` is not there or the `metadata-complete` attribute of the `faces-config.xml` file is not set to `true`.

### Implicit Navigation

Tell them that JSF also supports implicit navigation. Implicit navigation does not need the explicit navigation rules to be defined in the `faces-config.xml`. Implicit navigation allows the default navigation handler to choose the XHTML page with the matching name as specified in the `action` attribute of the UIComponent.

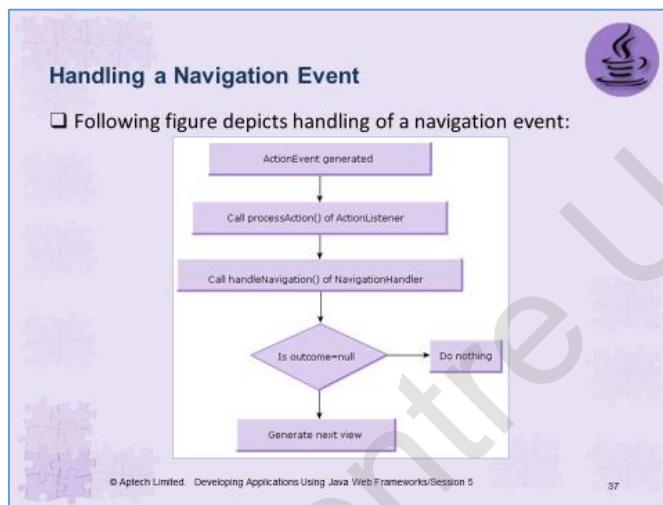
For example, consider that you are using Facelets technology, then to move the navigation control from `welcome.xhtml` to `home.xhtml` is as follows:

```
<h:commandLink value="Next" action="home"/>
```

Thus, the action attribute is treated as the to-view-id element in the faces-config.xml. The default navigation handler appends a '/' and .xhtml extension. This simplifies the Navigation model in JSF 2.0.

## Slide 37

Let us understand handling a navigation event.



Use slide 37 to explain handling a navigation event.

Explain the figure as shown on slide 37 that depicts the flowchart for handling the navigational events.

## Slides 38 to 40

Let us understand the concept of backing bean.

### Concept of Backing Bean 1-3



**Backing Bean:**

- Defines the objects that hold business data and perform application-specific processing on that data.
- Contains properties and methods of UIComponents appearing in the page are defined using the backing beans.

Some of the functions performed by managed bean methods comprise the following:

- Handle an event activated by a component.
- Execute the procedure of locating the next page where the application must navigate to.
- Validate the data of a component.

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38

### Concept of Backing Bean 2-3



Following code snippet demonstrates the creation of a backing bean:

```

...
public class Product {
    String name;
    float price;
    public Product() { }
    public void setName(String name) { this.name = name; }
    public String getName() { return name; }
    public void setPrice (float price) { this.price = price; }
    public float getPrice() { return price; }
}
...

```

The code creates a Java bean named 'Product' with 'name' and 'price' as its properties that store the name and price of the product.

...  
registered with application's configuration resource file, so that JSF implementation can create their instances automatically whenever

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39

### Concept of Backing Bean 3-3



Following code snippet registers this ProductBean to faces-config.xml file:

```

...
<managed-bean>
    <managed-bean-name>ProductBean</managed-bean-name>
    <managed-bean-class>com.aptech.Product</managed-bean-class>
    <managed-bean-scope>request</managed-bean-scope>
</managed-bean>

```

The <managed-bean-class> tag specifies fully qualified name of class implementing the business logic.  
The <managed-bean-scope> tag defines the scope of ProductBean to be within the request object.

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40

Use slides 38 to 40 to explain the concept of backing bean.

Tell the students that a typical JSF application includes one or more backing beans, each of which is a JSF managed bean that is associated with the UI components used in a particular page.

Backing bean class defines a set of UI component properties and a set of methods that perform functions for a component. Component properties are as follows:

- A component's value
- A component instance
- A converter instance
- A listener instance
- A validator instance

Configuring a Bean consists of the following steps:

1. Configure simple beans and more complex trees of beans.
2. Initialize bean properties with values.
3. Place beans in a particular scope.
4. Expose the beans to the unified EL so that page authors can access them.

Slide 39 shows the code snippet that demonstrates the creation of a backing bean. Then, using slide 40, explain how to register backing bean in the `faces-config.xml`. Tell them that the code is to be written in applications configuration resource file. The `<managed-bean-name>` tag sets the name of backing bean to '**ProductBean**'. The `<managed-bean-class>` tag specifies fully qualified name of class implementing the business logic. The `<managed-bean-scope>` tag defines the scope of **ProductBean** to be within the request object.

## Slide 41

Let us understand binding backing bean.

**Binding Backing Bean**



- ❑ The JSF framework supports Expression Language (EL) that can be used to access the application data stored in backing bean.
- ❑ The UIComponent can be bound to either the property or methods of backing bean.
- ❑ This is achieved by setting the value attribute of component tag to the EL expression augmented with '#'.
  - ❑ For example,
    - <h:inputText value="#{Productbean.name}"/>
    - <h:inputText value="#{Productbean.price}"/>

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41

Use slide 41 to explain binding backing bean.

The JSF framework supports Expression Language (EL) that can be used to access the application data stored in backing bean. Each UI component in the Web page is coupled with the property of associated backing bean. The UIComponent can be bound to either the property or methods of backing bean. This is achieved by setting the value attribute of component tag to the EL expression augmented with '#'.

### Tips:

Each of the managed bean properties can be bound to one of the following:

- A component value
- A component instance
- A converter instance
- A listener instance
- A validator instance

## Slide 42

Let us understand methods of backing beans.

**Methods of Backing Beans**

❑ The various functions performed by the methods of backing bean are as follows:

- **Handling Navigation**
- **Handling Action Event**
- **Performing Validation**
- **Handling ValueChange Event**

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42

Use slide 42 to explain the methods of Backing Beans.

Some other functions that backing bean methods performs are as follows:

- Validating a component's data.
- Handling an event fired by a component.
- Performing processing to determine the next page to which the application must navigate.

## Slides 43 and 44

Let us understand the annotations of managed beans.

**Annotations of Managed Beans 1-2**



- ❑ In JSF 2.0, managed beans can be registered through annotations.
- ❑ [@ManagedBean annotation](#)
  - Marks the bean as a managed bean.
  - Takes the name attribute to specify the bean name.
- ❑ [Scope annotations](#)
  - Define the scope in which the bean will be stored.
  - Some of the scope annotations are as follows:
    - @RequestScoped
    - @NoneScoped
    - @ViewScoped
    - @SessionScoped
    - @ApplicationScoped

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43

**Annotations of Managed Beans 2-2**



- ❑ Following code snippet demonstrates the creation of a backing bean:

```

...
@ManagedBean(name = "ProductBean", eager = "true")
@RequestScoped
public class Product {
    String name;
    float price;
    public Product() { }
    public void setName(String name) { this.name = name; }
    public String getName() { return name; }
    public void setPrice(float price) { this.price = price; }
    public float getPrice() { return price; }
}
  
```

The attribute eager="true" specifies that the managed bean is created before it is requested for the first time.

The life of the bean is as long as the HTTP request and response exists.

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44

Use slides 43 and 44 to explain the annotations of managed beans.

**Scope annotation** - Scope annotation set the scope into which the managed bean is stored. If scope is not given then bean will default to request scope.

Some of the scope annotations are as follows:

- @RequestScoped - gets created upon a HTTP request and get destroyed when the HTTP response associated with the HTTP request is finished.
- @NoneScoped - gets created upon an EL evaluation and get destroyed immediately after the EL evaluation.
- @ViewScoped - gets created upon a HTTP request and get destroyed once user postback to a different view.
- @SessionScoped - gets created upon the first HTTP request involving this bean in the session and get destroyed when the HTTP session is invalidated.

- `@ApplicationScoped` - gets created upon the first HTTP request involving this bean in the application and get destroyed when the Web application shuts down.
- `@CustomScoped` - Bean will be active as long as the bean's entry in the custom Map which is created for this scope is active.

`@ManagedProperty` annotation – With the help of `@ManagedProperty` annotation a managed bean's property can be injected in another managed bean.

Then, using slide 44, explain the code snippet to create a backing bean with annotations.

Tell them that the attribute `eager="true"` specifies that the managed bean is created before it is requested for the first time. The life of the bean is as long as the HTTP request and response exists. This means that the bean will be created when the HTTP request is sent and destroyed when the response is received.

## Slide 45

Let us understand JSF tag libraries.

**JSF Tag Libraries**

- ❑ A JSF tag library is a collection of related tags called **Component Tags**.
- ❑ Component tags are custom tags that define actions for the associated UI Component.
- ❑ JSF framework supports two types of libraries:
  - Core Tag library
  - HTML Tag library
- ❑ **HTML Tag library** - Consists of all the component tags that are specific to HTML clients.
- ❑ **Core Tag library** - Consists of all the component tags that are independent of any page markup language.

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45

Use slide 45 to explain JSF tag libraries.

The component tags are custom tags that define actions for the associated UI Component. A JSF-based Web application uses these component tags to interact with JSP pages in the application.

JSF framework supports two types of libraries named Core Tag library and HTML Tag library. The HTML Tag library consists of all the component tags that are specific to HTML clients.

The Core Tag library consists of all the component tags that are independent of any page markup language. These tags allow to take advantages of features of JSF framework, such as validation, conversion, and event handling.

## Slide 46

Let us understand the elements of JSF core tag library.

**Elements of JSF Core Tag Library**

- ❑ A Core Tag library also contains tags for views and sub-views, loading resource bundle, and adding arbitrary text to a page.
- ❑ Some of the tags defined in this library are as follows:
  - `<f:actionListener>`
  - `<f:attribute>`
  - `<f:convertDateTime>`
  - `<f:convertNumber>`

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Use slide 46 to explain the elements of JSF core tag library. Core tag library also contains tags for views and sub-views, loading resource bundle, and adding arbitrary text to a page. All the action elements in the core tag library are commonly prefixed with 'f'.

A JSF-based Web application must import the core tag library before it can use its custom tags by specifying a `taglib` directive at the top of JSP file. The value of `uri` attribute of `taglib` directive denotes the reference path to Sun Website from where the JSF Core library can be accessed. The value of `prefix` attribute indicates that prefix 'f' will be added to refer to each component tag under this library.

Then, explain some of the tags defined in the core tag library as shown on slide 46.

### Tips:

Some of the most commonly used JSF core tags are as follows:

- `valueChangeListener` - Registers a value-change listener on a parent component.
- `converter` - Registers an arbitrary converter on the parent component.
- `facet` - Signifies a nested component that has a special relationship to its enclosing tag.
- `loadBundle` - Specifies a ResourceBundle that is exposed as a Map.
- `param` - Substitutes parameters into a MessageFormat instance and adds query string name-value pairs to a URL.
- `selectItem` - Represents one item in a list of items in a `UISelectOne` or `UISelectMany` component.
- `selectItems` - Represents a set of items in a `UISelectOne` or `UISelectMany` component.
- `subview` - Contains all JSF tags in a page that is included in another JSP page containing JavaServer Faces tags.

- validateDoubleRange - Registers a DoubleRangeValidator on a component.
- validateLength - Registers a LengthValidator on a component.
- validateLongRange - Registers a LongRangeValidator on a component.
- validator - Registers a custom validator on a component.

## Slides 47 to 49

Let us understand basic tags.

### Basic Tags 1-3



The HTML tag library must be imported before use by specifying `taglib` directive at the top of your JSP file.

- The value of `uri` attribute refers to the path on Sun Website from where one can access this library.
- The value of `prefix` attribute denotes that prefix 'h' will be added to define each tag under this library.

Following figure shows the use of HTML tag library:

```
<%@ page contentType="text/html" %>
<%@ taglib uri="http://java.sun.com/jstl/html" prefix="h"%>
<html>
  <body>
    <h:form>
      <h:outputText value="Welcome to JSF"/>
    </h:form>
  </body>
</html>
```

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47

### Basic Tags 2-3



Following is the general syntax of specifying the html tag as a JSF tag:

```
<htmlprefixvalue:tagName attribute 1="value"
attribute n="value">
</htmlprefixvalue:tagName attribute 1="value"
attribute n="value">
```

Based upon the user interface components that are rendered, the html tags can be divided into following categories:

- **Inputs** - The tags under this category render HTML input elements that accepts an input from the user.
- **Outputs** - The tags under this category render HTML output elements that are used to output results to the user.

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48

**Basic Tags 3-3**

- **Commands** - The tags under this category render Submit buttons that perform user actions. These buttons can be associated with beans.
- **Selections** - The tags under this category render HTML selection components such as radio buttons, list boxes, and menu.
- **Layouts** - The tags under this category are used to define appearance of data to be displayed on the Web page.
- **Data Table** - The tags under this category render HTML tables.
- **Errors and Messages** - The tags under this category render customized error and informative messages associated with the UIComponent.

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49

Use slides 47 to 49 to explain basic tags.

The HTML tag library must be imported before use by specifying `taglib` directive at the top of your JSP file. The value of `uri` attribute refers to the path on Sun Web site from where one can access this library. The value of `prefix` attribute denotes that prefix 'h' will be added to define each tag under this library.

Some important HTML tags are as follows:

- `Column` - used as a child of the `dataTable` tag, to represent a column of data.
- `inputHidden` - displays as an HTML input tag with its type set to 'hidden'.
- `commandButton` - displays as an HTML input element.
- `commandLink` - displays as an HTML an element.
- `dataTable` - displays as an HTML table element. It has as its children `h:column` entities, which describe the columns of the table.
- `form` - displays an HTML form element.
- `graphicImage` - displays an HTML `img` element.
- `inputSecret` - displays as an HTML input tag with its type set to 'password'.
- `inputText` - displays an HTML input element.
- `inputTextarea` - displays an HTML `textarea` element.
- `message` - displays the first `FacesMessage` that is assigned to the component referenced by the 'for' attribute.
- `messages` - provides all or some `FacesMessages` depending on the 'for' and 'globalOnly' attributes.

### Tips:

Refer to the following link for more information on core and HTML tags:

<http://www.horstmann.com/corejsf/jsf-tags.html>

## Slides 50 to 53

Let us understand converter tag.

### Converter Tag 1-4



- ❑ The Converter tags convert data into appropriate types before the application processes the data.
- ❑ For example, data such as age, salary, and year can be represented by Integer, Double, and Date objects.
- ❑ Following are different types of converter tags:
  - **<f:convertNumber>**
    - Is used to convert numbers to different representations such as currency, percentage, and so on.
    - Contains attributes to format the display information.
    - For example, **Currency Code** and **Currency Symbol** are used to control the display of currency information.

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50

### Converter Tag 2-4



- Following code snippet demonstrates the **<f:convertNumber>** tag on the JSP page:

```
<f:convertNumber pattern = "patternFormat"
                 minIntegerDigits = "minDigits"
                 maxIntegerDigits = "maxDigits" minFractionDigits =
                 "minDigits"
                 maxFractionDigits = "maxDigits" groupingUsed =
                 "trueOrfalse" integerOnly = "trueOrfalse" type =
                 "numberOrCurrencyOrPercent"
                 currencyCode = "currencyCodeValue" currencySymbol =
                 "currencySymbol" locale = "locale">
</f:convertNumber>
```

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51

### Converter Tag 3-4



- **<f:convertDateTime>**
  - Converts the String to a Date/Time object. It has a set of attribute values to format both Date and Time values.
  - **Syntax:**

```
<f:convertDateTime dateStyle =
                     "default|short|medium|long|full"
                     timeStyle = "default|short|medium|long|full"
                     pattern = "pattern" type = "time|date|both">
</f:convertDateTime>
```

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52

The slide has a purple header bar with the title 'Converter Tag 4-4'. In the top right corner is a purple circular icon with a white coffee cup and steam. The main content area is white with black text. It starts with a bullet point: '• <f:converter>'. Below this are three more bullet points: '• Converts the user input.', '• For example, a string value that has to be converted into an object before being set as a property in the registered managed bean.', and '• Syntax:'. Under 'Syntax:' is a code block with a teal background: '<f:converter converterId = "ClassNameOfTheConverter"/>'. At the bottom left is a small watermark of a person working at a computer. At the bottom center is the text '© Aptech Limited - Developing Applications Using Java Web Frameworks/Session 5'. At the bottom right is the number '53'.

Use slides 50 to 53 to explain converter tag.

JSF tag library has a collection of pre-built converters to convert string to int, float, Boolean, and so on. Converter tags converts data into appropriate types before the application processes the data.

Explain the converter tags with the examples as mentioned on slides 50 to 53.

**Tips:**

Refer to the following link for more information on converter tags:

<http://www.javabeat.net/converter-tags-in-jsf/>

## Slides 54 to 57

Let us understand validator tag.

### Validator Tag 1-4



- ❑ Validator tags help in validating the data from the clients, before being processed by the Server Web Application.
- ❑ Some of these tags are as follows:
  - **<f:validateLength>**
    - Is identified by `<f:validateLength>` tag.
    - Specifies the maximum and the minimum characters, a JSF UI Component can accept.
  - **Syntax:**

```
<f:validateLength minimum = "minRange" maximum = "maxRange"> </f:validateLength>
```

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54

### Validator Tag 2-4



- **<f:validateLongRange>**
  - Validates on JSF UI Components whose value is expected to fall between certain integer (long) values.
- **Syntax:**

```
<f:validateLongRange minimum = "minLongValue" maximum = "maxLongValue"> </f:validateLongRange>
```

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55

### Validator Tag 3-4



- **<f:validateDoubleRange>**
  - Operates on floating data.
  - Executes range validations on UI Components that accepts floating values.
- **Syntax:**

```
<f:validateDoubleRange minimum = "minDoubleValue" maximum = "maxDoubleValue"> </f:validateDoubleRange>
```

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56

**Validator Tag 4-4**

- **<f:validator>**
  - Performs customized validations on UI Components.
  - For example, validating whether the entered user id is in the appropriate format or whether the stock symbol is available in the database.
- **Syntax:**

```
<f:validator validatorId = "IdForValidator">  
</f:validator>
```

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57

Use slides 54 to 57 to explain validator tags.

In JSF framework, binding between JSF UI components and validation logic is done with the help of Validator tags. Validator tags helps in validating the data from the clients, before being processed by the server Web application.

Then, explain the validator tags as mentioned on slides 54 to 57.

**Tips:**

Refer to the following link to get more information on validator tags:

<http://java.dzone.com/articles/jsf-validation-tutorial-error>

## Slide 58

Let us summarize the session.

### Summary



- ❑ JSF is an open source, component based, event driven framework for building user interface for Web applications.
- ❑ JSF components are based on event-driven programming model in which events are handled at the server-side.
- ❑ The components of JSF are namely, Managed Beans, UI components, convertor, validator, renderers, events and listeners, and navigation.
- ❑ The faces-config.xml file contains the configuration of the JSF application. The FacesServlet is the entry point for all requests for a JSF page.
- ❑ The JSF life cycle phases manage the input data, so that the Web developer does not need to write the code for processing the request manually.
- ❑ User interface components are simple and reusable elements that are used to design the user interface of JSP applications.
- ❑ The rendering model defines the way the components are displayed to the clients.
- ❑ The JSF Navigation model is an easy way to declare a set of rules that define the next view for user based on his actions.
- ❑ JSF tag library is a collection of tags that assist Web developer in performing common tasks such as creating user interface components, performing formatting of displayed data.

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In slide 58, you will summarize the session. You will end the session, with a brief summary of what has been taught in the session.

### 5.3 Post Class Activities for Faculty

You should familiarize yourself with the topics of the next session. You should also explore the JSF Expression Language and Facelets that are offered with the next session.

#### Tips:

You can also check the Articles/Blogs/Expert Videos uploaded on the OnlineVarsity site to gain additional information related to the topics covered in the next session. You can also connect to online tutors on the OnlineVarsity site to ask queries related to the sessions.

# Session 6 – Expression Language, Facelets, and Data Table

---

## 6.1 Pre-Class Activities

Before you commence the session, you should familiarize yourself with the topics of this session in-depth. You should revisit topics of the previous session for a brief review.

Here, you can ask students the key topics they can recall from previous session. Prepare a question or two which will be a key point to relate the current session objectives.

### 6.1.1 Objectives

By the end of this session, the learners will be able to:

- Describe the features of JSF 1.2 and JSF 2.0
- Explain Expression language and its types in JSF
- Explain the use of facelets View in JSF 2.0
- Explain JSF 2.0 DataTables
- Explain JSF 2.0 Event Handling
- Explain the code to integrate JSF 2.0 with JDBC API

### 6.1.2 Teaching Skills

To teach this session successfully, you should be aware of the features of JSF 1.2 and JSF 2.0.

Familiarize yourself with the Expression language and its types in JSF. You should also know about the use of facelets View in JSF 2.0 and also about JSF 2.0 DataTables.

Aware yourself with JSF 2.0 Event Handling and the code to integrate JSF 2.0 with JDBC API.

For teaching in the class, you are expected to use slides and LCD projectors.

#### Tips:

It is recommended that you test the understanding of the students by asking questions in between the class.

#### In-Class Activities:

Follow the order given here during In-Class activities.

**Overview of the Session:**

Give the students a brief overview of the current session in the form of session objectives. Show the students slide 2 of the presentation.

The slide has a light purple background with a blue border. In the top right corner is a purple circular icon containing a white coffee cup with steam. The word "Objectives" is centered at the top in a bold black font. Below it is a bulleted list of six items, each preceded by a small square checkbox. At the bottom left is a small watermark-like logo of a person sitting at a desk with a computer monitor. At the bottom center is the text "© Aptech Limited - Developing Applications Using Java Web Frameworks/Session 6". At the bottom right is a small number "2".

**Objectives**

- Describe the features of JSF 1.2 and JSF 2.0
- Explain Expression language and its types in JSF
- Explain the use of facelets View in JSF 2.0
- Explain JSF 2.0 DataTables
- Explain JSF 2.0 Event Handling
- Explain the code to integrate JSF 2.0 with JDBC API

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2

Tell the students that they will be introduced to the features of JSF 1.2 and JSF 2.0. The session explains Expression language (EL) and its types in JSF.

They will further learn how to use Facelets, DataTables, and event handling in JSF. Explain JSF 2.0 Event Handling. Finally, they will learn how to integrate JSF 2.0 code with JDBC API.

## 6.2 In-Class Explanations

### Slides 3 to 6

Let us understand the major features introduced in the JSF versions.

**Introduction 1-4**



- JSF provides enhanced UI components for development of View tier.
- JSF uses a powerful, component based UI development framework that simplifies J2EE Web development.
- JSF can also be viewed as MVC framework for:
  - Building Web forms
  - Validating the input
  - Invoking business logics from model
  - Displaying results

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**Introduction 2-4**



- Some of the major features introduced in the JSF versions are:
  - JSF 1.2**
    - It introduced Unified Expression Language (EL).
    - The new unified EL represents the union of JSP and JSF expression languages.
    - The new EL is more pluggable and flexible.
    - EL allows developers to use simple expressions to dynamically access data from JavaBeans components.
  - JSF 2.0**
    - JSF 2.0 introduced Facelets as the official view technology.
    - Facelets allows the developers to create components using XML markup language rather than writing Java code.
    - JSF 2.0 allows developers to use annotation for configuring the JSF components.
    - This removes the need for faces-config.xml from the JSF application.
    - Various annotations are provided for configuring navigation, managed bean, and page transition for the application.

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**Introduction 3-4**



- The main features of JSF 2.0 are as follows:
  - Includes bookmarking for URLs.
  - Expands the existing lifecycle mechanism.
  - Gives more support for the AJAX requests.
  - Allows development of custom component with little or no Java coding.
  - Provides default exception handling mechanisms.
  - Provides a mechanism to access persistent store.
  - Eliminates the need to author a JSP tag handler when writing JSF components.
  - Easily creates CRUD-based applications.
  - Separates the 'Build the tree' and 'render the tree' processes into two separate lifecycle phases.
  - Supports bundling and delivering static resources associated with images, style sheets, scripts, and so on.
  - Provides a mechanism to minimize the 'Lost Update' and 'Duplicate Button Press' problems.
  - Allows partial tree traversal during lifecycle execution with the help of Ajax.

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**Introduction 4-4**

- Leverages annotations to declare components, managed beans, navigation rules, and so on to the runtime.
- Provides date picker, tree, tab view, file upload components to the Standard HTML Render Kit.
- Streamlines the rendering process through caching.
- Improves the interceptor mechanism delivered through the Phase Listener Feature.
- Specifies command line interface for authoring JSF applications.
- Allows JSF application resources access through REST.
- Enables components that publish events through RSS/Atom.
- Improves the UI component specification to increase the interoperability of UI component libraries from different vendors.
- Adds support for REST.
- Gives support for passing values from page to page.

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Use slides 3 to 6 to explain the major features introduced in the JSF versions.

Summarize JSF in two major revisions that are as follows:

### **JSF 1.2**

JSF 1.2 introduced Unified Expression Language (EL). The new unified EL introduced in JSF 1.2 represents the union of JSP and JSF expression languages. This new EL is more pluggable and flexible. EL allows developers to use simple expressions to dynamically access data from JavaBeans components.

### **JSF 2.0**

JSF 2.0 introduced Facelets as the official view technology. Facelets allow the developers to create components using XML markup language rather than writing Java code. JSF 2.0 allows developers to use annotation for configuring the JSF components. This removes the need for faces-config.xml from the JSF application. Various annotations are provided for configuring navigation, managed bean, and page transition for the application.

The main features of JSF 2.0 are as follows:

- Includes bookmarking for URLs.
- Expands the existing life cycle mechanism.
- Gives more support for the AJAX requests.
- Use annotations instead of faces-config xml.
- Allows development of custom component with little or no Java coding.
- Provides default exception handling mechanisms. With this, all runtime errors will be forwarded to an error page.
- Provides a mechanism to access persistent store.
- Eliminates the need to author a JSP tag handler when writing JSF components.
- Easily creates CRUD-based applications.
- Separates the ‘build the tree’ and ‘render the tree’ processes into two separate life cycle phases.

- Supports bundling and delivering static resources associated with images, stylesheets, scripts, and so on.
- Provides a mechanism to minimize the ‘Lost Update’ and ‘Duplicate Button Press’ problems.
- Allows partial tree traversal during life cycle execution with the help of Ajax.  
Leverages annotations to declare components, managed beans, navigation rules, and so on to the runtime.
- Provides Date Picker, Tree, Tab View, and File Upload components to the Standard HTML Render Kit.
- Streamlines the rendering process through caching.
- Improves the interceptor mechanism delivered through the Phase Listener feature.
- This helps the developer to control the exact requests that are allowed to be processed by each Phase Listener instance.
- Specifies command line interface for authoring JSF applications.
- Allows JSF application resources access through REST.
- Enables components that publish events through RSSAtom.
- Improves the UI Component specification to increase the interoperability of UI component libraries from different vendors.
- Adds support for REST.
- Gives support for passing values from page to page.

## Slide 7

Let us understand Expression Language.

**Introduction to Expression Language**

- JSF framework has created its own Expression Language (EL).
- **Need for EL in JSF**
  - UI components are evaluated in different phases when the Web page containing them is rendered for the first time.
  - Once the user enters the value in the UI components and submits the page, these values are converted, validated, and transmitted to server-side data objects.
  - The component events are processed.
  - JSF divides these activities into phases to handle these tasks.
  - Also, JSF components need to get data from the server-side objects during the rendering phase and set the data in the server-side objects during postback phase.
  - JSF components need to invoke methods during their various life cycle stages.

To satisfy the mentioned tasks of validating data and handling events, JSF developed a powerful EL.

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7

Use slide 7 to explain Expression Language. Tell the students that EL allows the page authors to use simple expressions for dynamically accessing data from JavaBeans components.

JSF, being a UI framework, needed its own expression language. This expression language when used with JSP tags had its own limitations. Hence, the specification writers and experts have developed a new unified Expression Language in JSF 1.1, which aligned these technologies by adopting the features offered by JSF. The use of this new EL increased the productivity and made the maintenance easier.

Then, discuss the need for using EL in JSF as mentioned on slide 7.

The new unified EL introduced in JSF 1.2, which represents the union of JSP and JSF expression languages. The same EL is also used in JSF 2.0.

## Slides 8 to 12

Let us understand Expression Language in JSF.

### Expression Language in JSF 1-3

- ❑ The new unified EL introduced in JSF 1.2 is represented as follows:

The diagram illustrates the creation of the unified Expression Language (EL) in JSF 2.0. It shows a red circle labeled "JSP" plus a green circle labeled "JSF Expressions" equals a purple circle labeled "JSF 2.0 EL".

- ❑ JSF 2.0 EL allows developers to use simple expressions to dynamically access data from JavaBeans components.

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### Expression Language in JSF 2-3

- ❑ Following are the features of the new unified EL:

- Deferred evaluation of expression
- Supports expressions that can set values and invoke methods
- Supports usage of JSTL iteration tags with deferred expressions
- Provides a pluggable API for resolving expressions

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### Expression Language in JSF 3-3

- Read application data stored in JavaBeans components and data structures dynamically.
- Write data to forms and JavaBeans components dynamically.
- New EL expressions
- Invoke static and public methods arbitrarily.
- Perform arithmetic operations dynamically.

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**Immediate and Deferred Evaluation 1-2**



- ❑ The new EL supports both immediate and deferred evaluation of expressions.

<b>Immediate Evaluation</b> <p>The expression is evaluated immediately and the result is returned. They are used within template text or as a value of a tag attribute that will accept runtime. They are always evaluated as read-only value expressions.</p>	<b>Deferred Evaluation</b> <p>The expression is evaluated later during the page lifecycle. JSF uses this expression because of its different phases of a page lifecycle. They are evaluated at different phases of page lifecycle.</p>
--	--

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**Immediate and Deferred Evaluation 2-2**



- ❑ Following code snippet shows the use of deferred evaluation expression:

```
<h:inputText id="empname"
             value="#{employee.name}" />
```

- ❑ When an initial request is made for the page containing this tag, JSF evaluates the expression `#{employee.name}` during the render-response phase of the lifecycle.

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Use slides 8 to 12 to explain Expression Language in JSF.

Tell the students that EL is used for the following functions in JSF:

- Deferred and immediate evaluation of expressions.
- The ability to set as well as get data.
- The ability to invoke methods.
- Dynamically read application data stored in JavaBeans components, various data structures, and implicit objects.
- Dynamically write data, such as user input into forms, to JavaBeans components.
- Invoke arbitrary static and public methods.
- Dynamically perform arithmetic operations.

Use slides 11 and 12 to explain immediate and deferred evaluation. Tell the students that JSF mostly uses deferred evaluation expressions because of its multiphase lifecycle. During the lifecycle, component events are handled, data is validated, and other tasks are performed in a particular order. So JSF implementation

should defer evaluation of expressions until the appropriate point in the lifecycle. Deferred evaluation expressions can be either value expressions or method expressions. Further, tell them that the new EL supports both immediate and deferred evaluation of expressions.

### **Immediate Evaluation**

In immediate evaluation, the expression is evaluated immediately and the result is returned.

The \${ } syntax is used to represent immediate evaluation of EL expression.

Immediate evaluation expressions are used within a template text or as a value of a tag attribute that will accept runtime expressions. They are always evaluated as read-only value expressions.

For example, the tag whose value attribute references an immediate evaluation expression that gets the total price from the session-scoped bean named cart is as follows:

```
<fmt:formatNumber value="${sessionScope.cart.total}" />
```

The JSF implementation evaluates the expression \${sessionScope.cart.total}, converts it, and passes the returned value to the tag handler.

Immediate evaluation expressions are always read-only value expressions. This means in the given example expression cannot set the total price, but instead can only get the total price from the cart bean.

### **Deferred Evaluation**

In deferred evaluation, the expression is evaluated later during the page life cycle. JSF uses deferred evaluation expressions because of its different phases of a page life cycle.

The #{} syntax is used to represent immediate evaluation of EL expression.

Deferred evaluation expressions are evaluated at different phases of a page life cycle. In JSF, the controller evaluates the expression at different phases of the page life cycle, depending on how the expression is used in the page.

For example, the following example shows a JSF h:inputText tag, which represents a text field component into which a user enters a value.

```
<h:inputText id="name" value="#{customer.name}" />
```

The h:inputText tag's value attribute references a deferred evaluation expression that points to the name property of the customer bean.

For an initial request of the page containing this tag, the JSF implementation evaluates the #{customer.name} expression during the render-response phase of the life cycle. During this phase, the expression merely accesses the value of name from the customer bean, as is done in immediate evaluation.

A deferred expression can be a value expression and method expression.

## Slides 13 to 18

Let us understand the types of EL expressions.

### Types of EL Expressions 1-6

- ❑ Two types of expressions that the unified EL supports are value expressions and method expressions.

#### Value Expressions

- It refers to data present in a bean in the form of property or other data structure or as a literal value.
- It can be used to both read and write.
- It can either return a value or set a value.
- It allows to associate the name of the attribute or property with a value expression using the `setValueExpression()` method.
- It can be used to dynamically compute attributes and properties.

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13

### Types of EL Expressions 2-6

- ❑ Following code snippet shows the use of value expressions:

```
...
<h:outputText rendered="#{user.manager}"
               value="#{employee.salary}"/>
...
```

- ❑ Value expressions can be categorized into rvalue and lvalue expressions.

- rvalue expressions can only read data and are evaluated using the \${ } delimiter.
- lvalue expressions can both read as well as write data and evaluated using the # [ ] delimiter.

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14

### Types of EL Expressions 3-6

- ❑ Following code snippet shows the use of value expression:

```
...
<h:inputText value="#{employee.number}"/>
...
```

- In the code:
  - The expression is evaluated as an rvalue when the page is rendered and the `getNumber` method present in the `employee` JavaBean is invoked.
  - The result is displayed as the default value in the text field.

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15

### Types of EL Expressions 4-6

#### Method Expressions

- It invokes an arbitrary public method of an arbitrary JavaBean object by passing a specified set of parameters.
- It renders the returned results on the page containing the expression.
- For example, the component tag uses method expressions to invoke methods that do some processing for the component.

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16

### Types of EL Expressions 5-6

- Following code snippet shows the use of method expressions:

```
<h:form>
<h:inputText
    id="name"
    value="#{employee.name}"
    validator="#{employee.validateName}"/>
<n:commandButton id="submit"
    action="#{employee.submit}" />
</h:form>
```

In the code, the inputText tag is a text field and the validator attribute of this tag invokes the method named, **validateName** in the employee JavaBean.

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17

### Types of EL Expressions 6-6

- Different ways in which the method expressions can be used in tag attributes are as follows:

#### Single Expression Construct

In this, the method expression is written as  
`<some:tagvalue="#{bean.method}" />.`

#### Text Only

In this, the method expression is written as  
`<some:tag value="sometext"/>.`

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18

Use slides 13 to 18 to explain the different types of EL Expressions.

- **Value expressions** – It can either yield a value or set a value. Value expressions are divided into rvalue and lvalue expressions. Rvalue expressions can read data but cannot write it. Lvalue

expressions can both read and write data. Both rvalue and lvalue expressions can refer to the following objects and their properties or attributes:

- JavaBeans components
- Collections
- Java SE enumerated types
- Implicit objects

All expressions that are evaluated immediately use the \${ } delimiters and are always rvalue expressions. Expressions whose evaluation can be deferred use the #{} delimiters and can act as both rvalue and lvalue expressions.

Using slides 15 and 16, explain the code snippets to work with the value expression.

- **Method expressions** - It references methods that can be invoked and can return a value. They can be used only in tag attributes.

Using slides 17 and 18, explain the method expressions and the code snippet to use the method expressions.

## Slides 19 to 21

Let us understand JSTL tag.

### JSTL Tag 1-3

- ❑ Integration of JSTL tags provides `forEach` tag with JSF components.
  - ❑ In JSF,
    - JSTL defines the attribute named, `items` of the `forEach` and `forTokens` tag.
    - Two cases for execution of attribute, `items`:
- When runtime expression is specified**
- Expression is evaluated immediately.
- When a deferred value expression is specified**
- The tag handler adds a mapping for the `var` attribute into an EL VariableMapper instance during each iteration.

19

### JSTL Tag 2-3

- ❑ Following code snippet shows the use of `forEach` tag:

```
...
<table>
  <tr><th>Book Name</th> <th>Book Price</th>
  <th>Quantity</th></tr>
  <c:forEach var="book" books="#{shoppingCart.books}">
    <tr>
      <td><h:outputText value="#{book.name}" /></td>
      <td><h:outputText value="#{book.price}" /></td>
      <td><h:inputText value="#{book.quantity}" /></td>
    </tr>
  </c:forEach>
  <h:commandButton value="update quantities"
                  action="update" />
</table>
...
```

20

### JSTL Tag 3-3

- ❑ Similar to iteration tags, the `set` tag now accepts deferred value expression.
- ❑ Following code snippet shows the implementation of the `set` tag:

```
<c:set var="d" value="#{handler.everythingDisabled}" />
...
<h:inputText id="i1" disabled="#{d}" />
<h:inputText id="i2" disabled="#{d}" />
...
```

21

Use slides 19 to 21 to explain JSTL tag.

## Slides 22 to 24

Let us understand facelets declaration language for JSF 2.0.

**Facelets Declaration Language for JSF 2.0 1-3**



- ❑ JSF 2.0 introduced facelets as a replacement for JSP as a View declaration language.
- ❑ Facelets:
  - Is a powerful lightweight page declaration language that is used to build JSF views using HTML style templates.
  - Are used to create XHTML-based views for the application.

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22

**Facelets Declaration Language for JSF 2.0 2-3**



- ❑ Features of Facelets are as follows:

Provide a server-side template facility that allows the developer to compose a single View page out of several separate files.

Supports XHTML syntax for creating Web pages.

Provides an extended tag library.

Enforces clear separation of MVC by restricting the use of Java code in markup pages.

Code reusability that is achieved using templates and composite components.

Provides high performance rendering.

Reduces the time and effort required for development and deployment.

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23

**Facelets Declaration Language for JSF 2.0 3-3**



- ❑ Following code snippet shows how to build a single logical view for the user:

```
<!-- This is the main page for the application -->
<f:view>
  <include name="menubar" file="menubar.xml" user="#{currentUser}"/>
  <include name="sidebar" file="sidebar.xml" user="#{currentUser}"/>
  <include name="summary" file="summary.xml" user="#{currentUser}"/>
</f:view>
```

- ❑ The code:
  - Creates a single page by combining three parts: menubar, sidebar, and summary.
  - The URI, <http://java.sun.com/jsf/faces> is the JSF tag library that contains templating tags for the Facelets.
  - The EL expressions are used to reference properties and methods of managed beans, bind component objects, or to assign values to methods or properties of managed beans.

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24

Use slides 22 to 24 to explain facelets declaration language for JSF 2.0.

JSF 2.0 introduced facelets as a replacement for JSP as a View declaration language. Facelet is a powerful lightweight page declaration language that is used to build JSF views using HTML style templates. In other words, Facelets are used to create XHTML-based views for the application.

The features of Facelets are as follows:

- Provides a server-side template facility that allows the developer to compose a single view page out of several separate files.
- Supports XHTML syntax for creating Web pages.
- Provides an extended tag library.
- Enforces clear separation of MVC by restricting the use of Java code in markup pages.
- Code reusability that is achieved using templates and composite components.
- Provides high performance rendering.
- Reduces the time and effort required for development and deployment.
- Code reusability that is achieved using templates and composite components.
- Provides high performance rendering.
- Reduces the time and effort required for development and deployment.

**Tips:**

Some of the advantages of using Facelets are as follows:

- Facelets allow the developer to create templates and composite components. This in turn, allows code reuse. Templating is the process where the developer defines the look and feel of the Web application. This skeletal definition of the Web page is known as a template. Developers can reuse these templates and composite components for developing other Web pages.
- A composite component also comprises other components and tags which can later be reused in the Web pages.
- JSF allows for content reuse through referencing a file or through defining custom tags.
- The compilation tie for Facelets is less and it allows compile tie validation of EL expressions.
- Facelets are independently rendered and are compatible with any render kit.

Then, discuss the code snippet as shown on slide 24 to demonstrate how a single page development can be done by designing single logical view. Tell them this is just a pseudo-code for a markup language.

Tell them that the code snippet create a single page by combining three parts: menubar, sidebar, and summary. This can be reused in the multiple pages and can be further customized by using the EL. The similar composition of pages can be performed using Facelets in JSF.

**In-Class Question:**

After you finish explaining facelets declaration language for JSF 2.0., you will ask the students an In-Class question. This will help you in reviewing their understanding of the topic.



Which page declaration language is used to build JSF views using HTML style templates and to build component trees?

**Answer:**

Facelets

## Slides 25 and 26

Let us understand Facelet tags.

### Facelet Tags 1-2

- Facelet tags are used to create a page that acts as the base or template for the other pages in the JSF application.
- Following table shows the Facelets tags that are used to perform templating in JSF:

Tag	Syntax	Description
ui:composition	<code>&lt;ui:composition template="optionalTemplate"&gt;</code>	<ul style="list-style-type: none"> <li>It is used in files that are acting as a template client.</li> <li>It is used to enable templating in Facelets.</li> <li>It adds the component as the direct child of the <code>UIViewRoot</code>.</li> </ul>
ui:decorate	<code>&lt;ui:decorate template="requiredTemplate"&gt;</code>	<ul style="list-style-type: none"> <li>The tag provides features similar to ui:composition.</li> <li>It also includes the content surrounding the <code>&lt;ui:decorate&gt;</code> tag.</li> <li>The template attribute is required for this tag.</li> </ul>

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### Facelet Tags 2-2

Tag	Syntax	Description
ui:define	<code>&lt;ui:define name="requiredName"&gt;</code>	<ul style="list-style-type: none"> <li>The tag defines the content that is inserted into a page by a template.</li> <li>It is used inside the <code>ui:composition</code> tag.</li> <li>It defines the region that will be inserted at the location specified with the <code>ui:insert</code> tag.</li> </ul>
ui:insert	<code>&lt;ui:insert name="optionalName"&gt;</code>	<ul style="list-style-type: none"> <li>The tag inserts content into a template.</li> <li>It is used in the template file and the <code>name</code> attribute specifies the location where the template client needs to be inserted.</li> </ul>
ui:include	<code>&lt;ui:include src="requiredFilename"&gt;</code>	<ul style="list-style-type: none"> <li>The tag <code>ui:include</code> is used to combine and reuse content for multiple pages.</li> </ul>
Ui:remove	<code>&lt;ui:remove&gt;</code>	<ul style="list-style-type: none"> <li>The tag is mainly used during development to 'comment out' a portion of the markup.</li> </ul>
Ui:debug	<code>&lt;ui:debug hotkey="optionalHotKey"&gt;</code>	<ul style="list-style-type: none"> <li>The tag enables a hot key that pop ups a new window displaying the component tree.</li> </ul>

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Use slides 25 and 26 to explain facelet tags.

The URI, `http://java.sun.com/jsf/faces` is the JSF tag library that contains templating tags for the Facelets. To use these tags, the developer must prefix `ui:` on the page.

For example, the following code snippet shows the use of the namespace for using Facelets:

```
<html
    xmlns="http://www.w3.org/1999/xhtml"
    xmlns:ui="http://java.sun.com/jsf/faces"
>
```

For example, `ui:insert` or `ui:component`. The faces library also support tags for composite components.

Facelets support EL expressions to reference properties and methods of managed beans, bind component objects, or to assign values to methods or properties of managed beans.

Then, discuss the Faceletes tags that are used to perform templating as listed on slides 25 and 26.

Tell them to create a template, you can use these tags:

- <ui:insert> - Used in template file. It defines contents to be placed in a template. ui:define tag can be used to replace its contents.
- <ui:define> - Defines the contents to be inserted in a template.
- <ui:include> - Includes contents of one XHTML page into another XHTML page.
- <ui:composition> - Loads a template using **template** attribute. It can also define a group of components to be inserted in XHTML page.

Some of the other tags used in Facelet tags are as follows:

- ui:decorate – This tag is like ui:composition except that text not within the ui:decorate tags is included in the Facelets page.
- ui:component - This tag is like ui:composition except adds a new UIComponent as the root component in the UIComponents structure.
- ui:param - Specifies a variable when a facelets page is included within a template or a facelets page.

#### In-Class Question:

After you finish explaining facelet tags, you will ask the students an In-Class question. This will help you in reviewing their understanding of the topic.



Which tags helps to create common layout for a Web application?

#### Answer:

Facelet tags

## Slides 27 to 32

Let us understand templating with facelets.

### Templating with Facelets 1-6

- ❑ The facelet template consists of two main files such as template file and template client file.



Template file



Template Client file

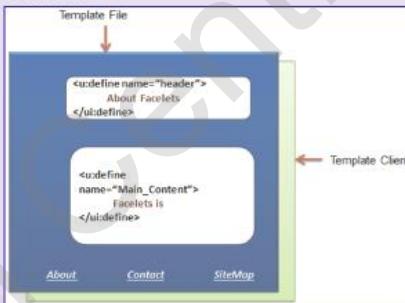
- This file corresponds to a view Id, such as greeting.xhtml.
- A template client uses one or more developed template to achieve reuse of the page content.

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27

### Templating with Facelets 2-6

- ❑ Following figure shows Facelet view with template and template client:



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28

### Templating with Facelets 3-6

- ❑ Following code snippet shows a template that defines the structure for a page:

```
<html xmlns="http://www.w3.org/1999/xhtml"
      xmlns:ui="http://java.sun.com/jsf/faces"
      xmlns:h="http://java.sun.com/jsf/html">
    <head>
        <meta http-equiv="Content-Type" content="text/html;
charset=UTF-8" />
        <h:outputStylesheet library="css" name="default.css"/>
        <h:outputStylesheet library="css" name="cssLayout.css"/>
        <title>Facelets Template</title>
    </head>
    <h:body>
        <div id="top" class="top">
            <ui:insert name="top">Top Section</ui:insert>
        </div>
        <div>
```

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29

### Templating with Facelets 4-6

```
<div id="left">
    <ui:insert name="left">Left Section</ui:insert>
</div>

<div id="content" class="left_content">
    <ui:insert name="content">Main Content</ui:insert>
</div>
</div>
</h:body>
</html>
```

- The code defines an XHTML page that is divided into three sections: a top, a left, and a main section.
- The `ui:insert` tag is used to define a default structure for a page.

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30

### Templating with Facelets 5-6

- Following code snippet shows the client page that invokes the template:

```
...
<html xmlns="http://www.w3.org/1999/xhtml"
      xmlns:ui="http://java.sun.com/jsf/facelets"
      xmlns:h="http://java.sun.com/jsf/html">

<h:body>
    <ui:composition template="./template.xhtml">
        <ui:define name="top">
            Welcome to Template Client Page
        </ui:define>
    </ui:composition>
</h:body>

```

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31

### Templating with Facelets 6-6

```
<ui:define name="left">
    <h:outputLabel value="You are in the Left Section"/>
</ui:define>

<ui:define name="content">
    <h:graphicImage
        value="#{resource['images:wave.med.gif']}'/>
    <h:outputText value="You are in the Main Content
Section"/>
</ui:define>
</ui:composition>
</h:body>
</html>
```

- The client invokes the template by using the `ui:composition` tag.
- The client page invokes the template page and inserts the content using the `ui:define` tag.

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32

Use slides 27 to 32 to explain templating with facelets.

Tell the students that facelets pages are XHTML pages by default.

Tell them that there are two main perspectives in templating with Facelets.

- a. Template file
- b. Template client file

The template client is the file whose name actually corresponds to the views such as greeting.xhtml. The template client employs one or more template files to achieve reuse of page content. Template file specifies the layout in facelets and consists of `<ui:insert>` tags to define the structure of a facelets composition that uses the template for defining UIComponents.

Explain the concept of templating with the help of figure as shown on slide 28.

Then, explain the code snippet given on slides 29 and 30 to create the template file named template.xhtml. This page is created with this tag allows to define a default structure for a page. A template page is used as a template for other pages, usually referred to as client pages.

```

<h:head>
    <meta http-equiv="Content-Type" content="text/html; charset=UTF-
8" />
    <h:outputStylesheet library="css" name="default.css"/>
    <h:outputStylesheet library="css" name="cssLayout.css"/>
    <title>Facelete Template</title>
</h:head>

<h:body>
<div id="top" class="top">
<ui:insert name="top">Top Section</ui:insert>
</div>

<div>

<div id="left">
<ui:insert name="left">Left Section</ui:insert>
</div>

<div id="content" class="left_content">
<ui:insert name="content">Main Content</ui:insert>
</div>

</div>
</h:body>

```

The corresponding CSSLayout.css file is as follows:

```

#top {
    position: relative;
    background-color: #036fab;
    color: white;
    padding: 5px;
    margin: 0px 0px 10px 0px;
}

```

```
#bottom {
    position: relative;
    background-color: #c2dfef;
    padding: 5px;
    margin: 10px 0px 0px 0px;
}

#left {
    float: left;
    background-color: #ece3a5;
    padding: 5px;
    width: 150px;
}

#right {
    float: right;
    background-color: #ece3a5;
    padding: 5px;
    width: 150px;
}

.center_content {
    position: relative;
    background-color: #dddddd;
    padding: 5px;
}

.left_content {
    background-color: #dddddd;
    padding: 5px;
    margin-left: 170px;
}

.right_content {
    background-color: #dddddd;
    padding: 5px;
    margin: 0px 170px 0px 170px;
}

#top a:link, #top a:visited {
    color: white;
    font-weight : bold;
    text-decoration: none;
}

#top a:link:hover, #top a:visited:hover {
    color: black;
    font-weight : bold;
    text-decoration : underline;
}
```

The structure of default.css is as follows:

```
body {
    background-color: #ffffff;
    font-size: 12px;
    font-family: Verdana, "Verdana CE", Arial, "Arial CE", "Lucida Grande CE",
    lucida, "Helvetica CE", sans-serif;
    color: #000000;
    margin: 10px;
```

```
}

h1 {
font-family: Arial, "Arial CE", "Lucida Grande CE", lucida, "Helvetica CE",
sans-serif;
border-bottom: 1px solid #AFAFAF;
font-size: 16px;
font-weight: bold;
margin: 0px;
padding: 0px;
color: #D20005;
}

a:link, a:visited {
color: #045491;
font-weight : bold;
text-decoration: none;
}

a:link:hover, a:visited:hover  {
color: #045491;
font-weight : bold;
text-decoration : underline;
}
```

Then, explain the code of the template client as given on slides 31 and 32. Tell them the client page invokes the template by using the `ui:composition` tag. In the code, a client page named `greeting.xhtml` invokes the template page named `template.xhtml`.

## Slides 33 to 39

Let us understand JSF 2.0 DataTable.

**Introduction to JSF 2.0 DataTable 1-7**



- ❑ JSF 2.0 DataTable helps to render and format html tables.
- ❑ **DataTable**
  - Iterates over an array of values to display data.
  - Provides attributes to modify the data.
- ❑ Following code snippet shows the tag library to be used for DataTable:

```
<html
    xmlns="http://www.w3.org/2014/xhtml"
    xmlns:h="http://java.sun.com/jsf/html">
</html>
```

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**Introduction to JSF 2.0 DataTable 2-7**



- ❑ The most important DataTable operations in JSF 2.0 are:
  - **Display DataTable:** It displays a datatable.
  - **Add data:** It adds a new row in a datatable
  - **Edit data:** It edits a row in a datatable.
  - **Delete data:** It deletes a row in datatable.
  - **Using Data Model:** It displays row numbers in a datatable.
- ❑ **Attributes of DataTable**
  - The main attribute at the h: dataTable is the value attribute.
  - value attribute represents the data over which h: dataTable iterates.

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**Introduction to JSF 2.0 DataTable 3-7**



- ❑ The data must be one of the following types:
  - A Java Object
  - An Array
  - An instance of java.util.List
  - An instance of java.sql.ResultSet
  - An instance of javax.servlet.jsp.jstl.sql.Result
  - An instance of javax.faces.model.DataModel

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### Introduction to JSF 2.0 DataTable 4-7



- Following code snippet shows the use of `h:DataTable` tag to loop over the array of `order` object:

```
<h:head>
<h:outputStylesheet library="css" name="table-style.css" />
</h:head>
<h:body>

<h1>JSF 2 dataTable example</h1>

<h:DataTable value="#{order.orderList}" var="o"
    styleClass="order-table"
    headerClass="order-table-header" >

    <h:column>
        <!-- column header -->
        <f:facet name="header">Order No</f:facet>
        <!-- row record -->
        #{o.orderNo}
    </h:column>
```

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36

### Introduction to JSF 2.0 DataTable 5-7



```
<h:column>
<f:facet name="header">Product Name</f:facet>
#{o.productName}
</h:column>

<h:column>
<f:facet name="header">Price</f:facet>
#{o.price}
</h:column>

<h:column>
<f:facet name="header">Quantity</f:facet>
#{o.qty}
</h:column>
</h:DataTable>
</h:body>
</html>
```

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37

### Introduction to JSF 2.0 DataTable 6-7



- Following code snippet shows the `table-style.css` page:

```
.order-table{
border-collapse:collapse;
border:1px solid #000000;
}
.order-table-header{
text-align:center;
background:none repeat scroll 0 0 #E45EA5;
border-bottom:1px solid #000000;
padding:3px;
}
```

- The `table-style.css` page contains the properties to change the appearance of the data table displayed on the page.

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38



### Introduction to JSF 2.0 DataTable 7-7

Following code snippet shows the OrderBean that will create a list of orders to be displayed in the data table component:

```
@ManagedBean(name = "orderbean", eager = true)
@SessionScoped
public class OrderBean implements Serializable {
    private static final ArrayList<Order> orderList
        = new ArrayList<Order>(Arrays.asList(
            new Employee("10", "Beverages", 30,5),
            new Employee("20", "Stationary", 35,3),
            new Employee("30", "Appliances", 25,25)
        ));
    ...
}
```

The code creates a managed bean named, OrderBean and initializes an ArrayList object with the instances of Order class.

The data from the Order are displayed in the data table.

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30

Use slides 33 to 39 to explain JSF 2.0 DataTable. JSF 2.0 DataTable helps to render and format html tables. DataTable iterates over an array of values to display data. It provides attributes to modify the data.

Then, using slides 33 to 35, explain them that JSF 2.0 support the use of h:dataTable by iterating a list of data filled inside a bean's list to create an HTML table. The main attribute at the h:dataTable is the value attribute that represents the data over which h:dataTable iterates, this data must be one of the following types:

- ≠ A Java Object
- ≠ An Array
- ≠ An instance of java.util.List
- ≠ An instance of java.sql.ResultSet
- ≠ An instance of javax.Servlet.jsp.jstl.sql.Result
- ≠ An instance of javax.faces.model.DataModel

The h:dataTable component will have only h:column and it discards all other component, though the h:column can render an unlimited number of the components. The h:dataTable component adds a header and footer for the dataTable that is created and thus, provides the developer capability.

Then, explain the code snippet given on slides 36 to 39 to create a DataTable in JSF.

#### Tips:

You can refer to this link for understanding on DataTable:

<http://www.mkyong.com/jsf2/jsf-2-datatatable-example/>

## Slides 40 and 41

Let us understand JSF 2.0 Event Handling.

**Introduction to JSF 2.0 Event Handling 1-2**

- ❑ JSF event handling is based on the JavaBeans event model.
- ❑ JavaBeans Event Model is based on:
  - Event classes
  - Event listener interfaces
- ❑ Some of the examples of events in an application includes:
  - Clicking a button.
  - Selecting an item from a menu or list.
  - Changing a value in an input field.

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40

**Introduction to JSF 2.0 Event Handling 2-2**

- ❑ The important event handlers in JSF 2.0 are as follows:

<b>ValueChangeListener</b>	<b>ActionListener</b>	<b>Application Events</b>
<ul style="list-style-type: none"> <li>• Value change events is invoked when user make changes in input components.</li> </ul>	<ul style="list-style-type: none"> <li>• Action event is invoked when user clicks a button or link component.</li> </ul>	<ul style="list-style-type: none"> <li>• Application is invoked during JSF lifecycle: PostConstructApplicationEvent, PreDestroyApplicationEvent, PreRenderViewEvent.</li> </ul>

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41

Use slides 40 and 41 to explain JSF 2.0 Event Handling.

Tell the students that JSF supports event handling throughout the JSF life-cycle.

JSF event handling is based on the JavaBeans event model, where event classes and event listener interfaces are used by the JSF application to handle events generated by components. Some examples of events in an application include clicking a button, selecting an item from a menu or list, and changing a value in an input field. When a user activity occurs, the component creates an event object that stores information about the event and identifies the component that generated the event. The event is added to an event queue.

JSF tells the component to broadcast the event to the corresponding registered listener, which invokes the listener method that processes the event.

Then, discuss the important event handlers in JSF which are as follows:

### ValueChangeListener

Value-change event - occurs when the user changes the value of a component such as UIInput, UISelectOne, UISelectMany, and UISelectBoolean components, that implements EditableValueHolder.

The `valueChangeListener` tag registers a `ValueChangeListener` instance on the `UIComponent` associated with the closest parent `UIComponent` custom action.

For example, the following shows a custom `ValueChangeListener` instance that is associated with an `inputText`.

```
<h:inputText id="inputText1">
    <f:valueChangeListener type="jsf.MyValChangeListener"/>
</h:inputText>
```

Some of the constraints are as follows:

- Must be nested inside a `UIComponent`.
- The corresponding `UIComponent` implementation class must implement `EditableValueHolder` and therefore, define a public `addValueChangeListener()` method that accepts a `ValueChangeListener` parameter.
- The specified listener class must implement `javax.faces.event.ValueChangeListener`.
- Type and/or binding must be specified.

### **Tips:**

To know more about `ValueChangeListener`, refer to this link:

<http://www.javatutorials.co.in/jsf-2-2-valuechangelistener-attribute-example/>

### ActionListener

Action event - occurs when the user activates a component like button or hyperlink, that implements `ActionSource`.

In button or link component, add a `f:actionListener` tag inside, and specify an implementation class of `ActionListener` interface, and override its `processAction()`.

For example, to register a button event, the JSF page will invoke the `ActionListener` on Submit button as shown in the following code snippet:

```
<h:body>
    <h1>JSF 2 actionListener example</h1>
```

```
<h:form id="form">

    <h:commandButton id="submitButton"
        value="Submit" action="#{normal.outcome}" >
        <f:actionListener type="com.listener.NormalActionListener" />
    </h:commandButton>

</h:form>

</h:body>
```

The managed bean is as follows:

```
@ManagedBean(name="normal")
@SessionScoped

public class NormalBean{

    public String outcome() {
        return "result";
    }
}
```

The implementation of the ActionListener is as follows:

```
public class NormalActionListener implements ActionListener{

    @Override
    public void processAction(ActionEvent event)
```

```
throws AbortProcessingException {  
  
    System.out.println("Any use case here?");  
  
}  
}
```

Tell them that JSF also provides application events that are used to perform application specific tasks during JSF application life cycle.

The following table shows the application events:

Event	Description
PostConstructApplicationEvent	Fires when application starts. It can be used to perform initialization tasks after application has started.
PreDestroyApplicationEvent	Fires when application is about to shut down. It can be used to perform a cleanup tasks before application is about to be shut down.
PreRenderViewEvent	Fires before a JSF page is to be displayed. It can be used to authenticate user and provide restricted access to JSF View.

#### Tips:

To implement application life cycle events, you can refer to this link:

<http://www.mkyong.com/jsf2/jsf-2-postconstructapplicationevent-and-predestroyapplicationevent-example/>

## Slides 42 to 44

Let us understand the integration of JDBC with JSF 2.0.

### Integrating JDBC with JSF 2.0 1-3

- Following code snippet shows the integration of JSF 2.0:

```
@ManagedBean(name = "customerData")
@SessionScoped
public class CustomerData implements Serializable {
    public List<Author> getCustomers() {
        ResultSet rs = null;
        PreparedStatement pst = null;
        Connection con = getConnection();
        String stm = "Select * from customers";
        List<Customer> records = new ArrayList<Customer>();
        try {
            pst = con.prepareStatement(stm);
            pst.execute();
            rs = pst.getResultSet();
            while(rs.next()){
                Customer customer = new Customer();
                customer.setId(rs.getInt(1));
                author.setName(rs.getString(2));
                records.add(customer);
            }
        } catch (SQLException e) {
            e.printStackTrace();
        }
        return records;
    }
    public Connection getConnection(){
        Connection con = null;
        String url = "jdbc:sqlserver://localhost/testdb";
        String user = "user1";
        String password = "user1";
        try {
            con = DriverManager.getConnection(url, user, password);
            System.out.println("Connection completed.");
        } catch (SQLException ex) {
            ...
        }
    }
}
```

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42

### Integrating JDBC with JSF 2.0 2-3

```
author.setName(rs.getString(2));
records.add(customer);
}
} catch (SQLException e) {
e.printStackTrace();
}
return records;
}
public Connection getConnection(){
Connection con = null;
String url = "jdbc:sqlserver://localhost/testdb";
String user = "user1";
String password = "user1";
try {
con = DriverManager.getConnection(url, user, password);
System.out.println("Connection completed.");
} catch (SQLException ex) {
...
}
}
```

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43

### Integrating JDBC with JSF 2.0 3-3

- Following code snippet shows the `cust.xhtml` page accessing customer data in a `DataTable` element:

```
<html
. .
<h2>JDBC Integration</h2>
<h: dataTable value="#{customerData.customers}" var="c"
styleClass="CustomerTable"
headerClass="CustomerTableHeader" >
<h: column><f: facet name="header">Customer ID</f: facet>
    #{c.id}
</h: column>
<h: column><f: facet name="header">Name</f: facet>
    #{c.name}
</h: column>
</h: dataTable>
</h: body>
</html>
```

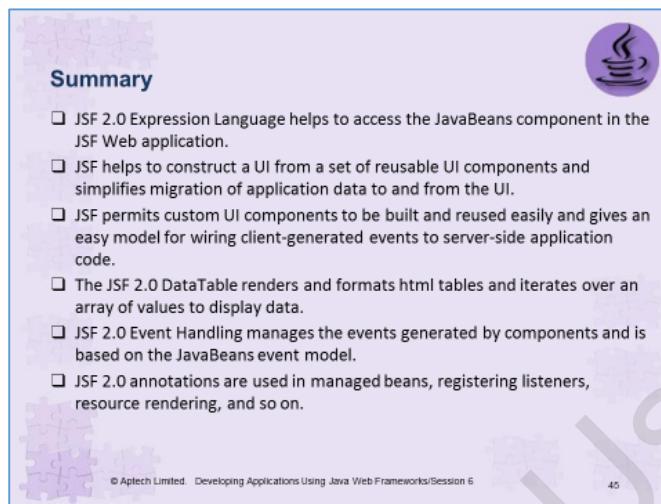
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44

Use slides 42 to 44 to explain the integration of JDBC with JSF 2.0.

## Slide 45

Let us summarize the session.



**Summary**

- JSF 2.0 Expression Language helps to access the JavaBeans component in the JSF Web application.
- JSF helps to construct a UI from a set of reusable UI components and simplifies migration of application data to and from the UI.
- JSF permits custom UI components to be built and reused easily and gives an easy model for wiring client-generated events to server-side application code.
- The JSF 2.0 DataTable renders and formats html tables and iterates over an array of values to display data.
- JSF 2.0 Event Handling manages the events generated by components and is based on the JavaBeans event model.
- JSF 2.0 annotations are used in managed beans, registering listeners, resource rendering, and so on.

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In slide 45, you will summarize the session. You will end the session, with a brief summary of what has been taught in the session.

### 6.3 Post Class Activities for Faculty

This session ends the **Developing Applications Using Java Web Frameworks** course. Ask the students some questions related from all the topics which will help you to know the learnings taken by the students. You can solve the queries related to other sessions taught in the course.

#### Tips:

You can also check the Articles/Blogs/Expert Videos uploaded on the OnlineVarsity site to gain additional information related to the topics covered in the course. You can also connect to online tutors on the OnlineVarsity site to ask queries related to the sessions.