Course Introduction

A web site can be defined as set of web pages that has been designed for specific organizational purpose. A web site consists of many web pages and can be hosted on one or more web servers, with a single web domain name. In general, the default web page of the web site is called an index page and can be accessed using the Uniform Resource Locator (URL). For example, you access IGNOU web site can be accessed using the URL- http://www.ignou.ac.in / which displays the index page of the IGNOU web site in your browser. From this page then you can access many other links provided by IGNOU's web site.Thus, a web site involves two aspects – client and the server. The client of a web site is a browser program which accesses the web site hosted on a web server through the Internet. The access of a web page by a client from a server, in addition to TCP/IP protocol which is the base protocol for Internet, would require additional protocol. The protocol for web page access involving transfer of a web page from web server to client browser is called HyperText Transfer Protocol (HTTP). In case, you are accessing a secure web page of a web site such as your bank account, then a secure HTTP called HTTPS is used. This protocol uses encryption of data to ensure security of data transfer. For more details on these concepts, you may go through the course BCS-052.

Web programming is the art of creating web pages of a web site. Web programming has two aspects – client side programming and server side programming. A client side program may be written in Markup languages like HTML. The display of these markup languages is controlled by a style sheet called Cascading Style Sheets (CSS). In addition, a browser can also run simple programs that may be written in a scripting language like JavaScript. Basic introduction to HTML and JavaScript has already been given to you in MCS016: Internet Concepts and Web Design Course.

The first Block of this course discusses the Client Side languages. This Block introduces the concept of Web 2.0 and HTML5. Web 2.0 has brought dynamisms to web site such that you are able to interact with the web sites or other users of the web sites. CSS are a flexible way of changing the look and feel of a web site. A good web site must use CSS. This block explains how you can create and use CSS. XML has become a standard for information interchange. It also has been discussed in this Block. You can make your website dynamic, if you are able to access its component and process them. Such processing would require interaction of the user in the form of events. This block explains the Document Object Model (DOM) that defines the component hierarchy and Events. You can use DOM, Events and JavaScript commands to create dynamic client pages. This block also covers aspects of Wireless markup language.

The second block of this course discusses the server side programming. When you access a web page, the browser displays the HTML code of that page under the control of CSS. The web page may also contain other scripts like JavaScript. These pagesare transferred from the server to the browser on your request. Are these web pages stored at the web server as same HTML, CSS, XML, JavaScript etc.pages or they are generated with the help of a programming language? Web sites on the server side use scripting languages that are used to create pages for clients as per their requirements. The languages that are used to create client pages at the server, based on clients requirements are called Server Side Scripting Languages. Some of the common server side scripting languages are PHP, JSP, SERVLET, ASP.NET, PYTHON and many more. In the second Block, we have explained the use of JSP as the server side scripting language.

Block Introduction

A web site is displayed on a web browser. Every browser provides an option by which you can view the page source of the web page that is being displayed. Look into it closely, you will find that the web page you have opened may consist of HTML, JavaScript and other code. This Block is an introduction about the code that is displayed on the client browser. In case you want to make good website then you should learn about these concepts in details. Please note that by just reading through the block you will not be able to learn. You must perform the practical as suggested in BCSL057:Web Programming Lab, in order to take best advantage of these Blocks.

The Unit 1 explains the Web 2.0 technology. It provides information about some of the newer products that have developed over the years. Some of these include applications like Rich Internet Applications, widgets, mashups, social networking, web services, blogs etc. The Unit also describes features of HTML 5. It also gives an example of use of different tags of HTML 5.

Unit 2 is devoted to Cascading Style Sheet (CSS). Style sheets are very important for creating flexible, consistent web pages along a web site. The Unit provides details on differnt ways of attaching style sheet to a web page. It also gives list of different kind of properties of styles. In addition to these, this Unit introduces the concept of box model. It also discusses two important tags and which are very useful in logical division of the content of a web page on a single display window. This Unit also demonstrates the use of style sheet with the help of an example.

Unit 3 provides a basic introduction to XML. XML has become a standard data format for exchange of data over the net. it allows you to create your own tags. Since you can create your own custom tags in XML, therefore, they need to be validated. You can define the XML validations using Document Type Declarations (DTD) or XML Schema. This Unit introduces both these mechanism. The Unit also discusses the ways of displaying XML documents.

Unit 4 introduces you to the concept of Document Object Model (DOM) which defines the structure of a HTML document. The elements of the document then can be consistently accessed and changed using event driven programming of JavaScript. This mechanism thus helps in updating specific portion of a document of a web page that is displayed in the browser.

Unit 5 of this Block introduces the concept of Wireless Markup Language (WML). WML are used for creating web pages for display on wireless devices. Although utility of such applications has reduces with the advent of high end smart devices, still many older web pages uses these concepts.

UNIT1 WEB 2.0 AND XHTML/HTML5

Structure

1.0 Introduction

Since the advent of World Wide Web (WWW) in 1990, the Internet and its uses are growing rapidly. The Web Programming technologies have changed in the past substantially. You have already been introduced to the process of designing web pages in the course MCSL-016. The collection of web pages is website. The way of writing a web page is web programming. Web development refers to building, creating, and maintaining websites. It includes aspects such as web design, web publishing, web programming, and database management. A web developer may use web programming languages viz., HTML, JavaScript, XML, ASP, JSP, PHP and maintains a database used by dynamic websites. The initial web was focussed on information. There was no or little need for user interaction. With the advent of Web 2.0, communication has changed. There are more than two billion Internet users worldwide exchanging ideas through social networking sites or using chat or any other two way or group communication software. Blogs, Wikis and Web Services are also components of Web 2.0. In this unit, you will learn about the concepts and characteristics of Web 2.0. This unit also explains the use of HTML5 tags for creating static web pages.

1.1 Objectives

After going through this unit, you should be able to:

- state the concepts applicable to Web 2.0

- define the technologies used in Web 2.0
- explain about the XHTML/HTML5
- differentiate between XHTML and HTML
- use XHTML/HTML5 tags to create simple static web pages
- add <audio>, <video> tags of HTML5

1.2 Web 2.0: An Introduction

Web 2.0 is a second generation of the World Wide Web. Web 2.0 refers to the transition from static web pages to dynamic web. Web 2.0 is more organized and is based on creating web applications to the specific needs of the users. Web 2.0 has improved communication among the users, with an emphasis on Web-based communities of users and more open sharing of information. Web 2.0 concepts highlight services that allow user to find and manipulate contents.

How is Web 2.0 different?

In early days of Web (Web 1.0), there was no or little need for different web applications to communicate and share data with each other. It was concerned with only creating and viewing online contents. However, web 2.0 has changed this scenario. Web 2.0 offers services that allow user to find and manipulate contents, coupled with all types of media services. Examples of web 2.0 are social networking sites, blogs, video sharing, wikis, web application, mashups etc. The basic idea of each of these websites is user interaction. On blogs, you can post comments; on social networking site, you can make a friend; on social news, you can vote for article and on wikis, you can create, edit and share information. The concept of web 2.0 is based on participation of user. This design encourages user interaction and community contribution.

Web 2.0 provides user with more interaction, better communication and storage facilities through their browsers. The client-side technologies used in Web 2.0 development include Ajax (Asynchronous JavaScript and XML), JavaScript, XML (eXtensible Markup Language-basis for XHTML), SOAP (Simple Object Access Protocol), JSON (JavaScript Object Notation). Ajax is used to create web application using XHTML, CSS, the DOM (Document Object Model) and XMLHttpRequest. You can use Ajax to create more dynamic and interactive Web pages without needing to refresh or reload the page. SOAP is an XML based protocol to allow you to activate an application across the internet. During the user's communication to the web, data is fetched by an Ajax application which is formatted in XML or JSON format; the two widely used structured data formats. JavaScript programs use DOM to dynamically update the web page data. For example, Google Docs uses this technology to create web based word processor.

In addition to Ajax and JavaScript, Adobe Flex is another technology often used in web 2.0 applications. It is used to populate large data grid, charts and other user interactions. It is used as a plugin component. Application build in flex is displayed as Flash in the browser. Now, HTML5 is capable for doing such things. HTML5 is used for gaming, mobile and business application.

On server side, you can use technologies like PHP, Ruby, ASP.Net and Java Server Pages for developing web applications. Over time Web 2.0 has been used more as a marketing term than a computer-science-based term.

One of the key points of web 2.0 development is the availability of open content access which means that you can modify the content with few or no restrictions. Some of the key web 2.0 websites are Google, YouTube, Twitter, Wikipedia etc. MySpace, Flickr and Wikipedia are the websites that provide platforms for users to create and modify the content.

Figure-1 shows the characteristics and techniques of web 2.0. The following subsection explains some of the important web 2.0 technologies.

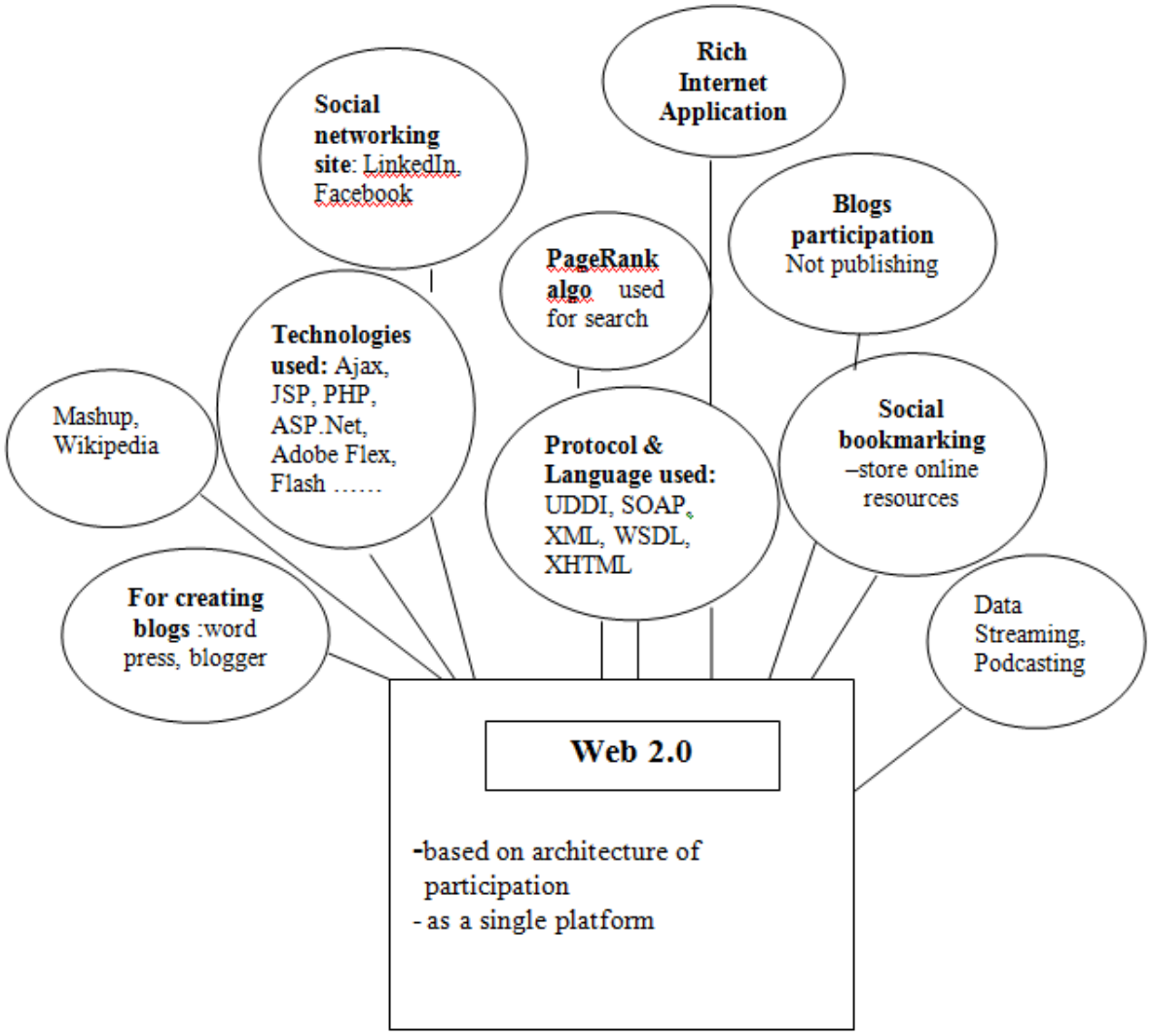

Fig.1: Web 2.0 Tree

1.2.1 Search

The term "Search" syntactically means *to look over carefully in order to find something*. In the context of Web, it is defined as - *to obtain information on the Internet using search engines*. Some of the popular search engines are Google, Yahoo, MSN, ASK, Bing, Alta Vista, Hot Bot etc. Search engines are the primary tools to find information on the web like text, images, news, videos, blogs and more. When you enter a keyword or phrase, the search engine finds the relevant web pages and shows in the order of ranking of pages. But, how does these search engines work?

In early days, search engines used text based ranking system to decide which pages are more relevant to given query. Modern search engines used different ranking methods to give best result. Google search is based on a priority rank called a PageRank. The PageRank algorithm

considers the web pages that match a given search string and display the sites with the highest PageRank at the top of the search results. Google's PageRank algorithm is based on the premise that a good page is the one that is pointed to by good pages. A detailed discussion on this algorithm is beyond the scope of this Unit.

1.2.2 Content Networks

A vast amount of information resides on the web. Searching a particular term is a complex problem because search engine are listed with number of links related to the search string. The solution of this problem is content networks. Content Networks are website or collection of websites that provide information in the form of articles, wikis, blogs, etc. These sites provide another way of filtering the vast amounts of information on the Internet by allowing users to go a trusted site that has already sorted through many sources to find the best content or has provided its own content. Some names of the content networks sites are eHow, About and HowStuffWorks.

1.2.3 Blogging

A blog or weblog is an informational website maintained by its blogger (or author). It contains discrete entries or post. It is displayed in reverse chronological order (the most recent post appears first). A typical blog contains text, images and links to other blogs or web pages. Most of the blogs are textual. Other blogs are on art (art blogs), music (MP3 blogs), videos (video blogs or 'vlog'), photographs (photoblogs) and audio (podcasts). In education, blogs can be used as instructional resources. These blogs are called as edublogs. WordPress and Blogger are the names of websites that enable anybody to start their own blog. WordPress is one such advanced blogging tool and it provides a rich set of features, through its administrative panels, you can set options for the behaviour and presentations of your blog and easily compose a blog post, push a button and be published on the internet instantly.

Micro-blogging is another type of blogging but it contains very short post. Micro-blogging is used in Twitter. The blogs are interactive as they allow readers to leave comments. Bloggers or blog author do not only produce content to post on their blog but also build social relations.

1.2.4 Social Networking

A Social Networking is an online platform that focuses on building the social network or social relation among the users who share their profiles, interests and activities. Friendster, Myspace, Xing, LinkedIn, Twitter, Orkut and Facebook are some popular social networking sites. Facebook is the largest social networking site. LinkedIn is a business oriented social networking site. It allows users to stay in touch with professional contacts. Social networks are also being used by teachers and students as communication tool. Some social networks have additional features such as to create groups or forums and upload photographs or videos. Using social networking site, you can interact by adding friends, commenting on profiles, joining groups and having discussions. Social networking sites allow two way interactions. You can make accounts, publish content and involve in two way communication.

1.25 Social Media

Social Media is a kind of interactive website that does not give any information but interact with you while giving you that information. In social media, user interaction is possible by commenting on photo, editing articles in wiki and voting on articles.

Here are some examples of social media websites:

- **Social Bookmarking:** allow internet users to organize and store to online resources. For example, Delicious, Blinklist. Some of the Bookmarking websites are free and some provide paid services. It allows users to save links to web pages with these bookmarking sites to remember and share.
- **Social News:** You may interact by voting for articles and commenting on them. For example, Digg, Propeller.
- **Social Photo and Video Sharing:** You may interact by sharing photos and videos. For example, YouTube, Flickr.
- **Wikis:** multi-lingual, web-based encyclopaedia Wikipedia. You may interact by adding and editing articles.

1.2.6 Rich Internet Applications (RIA's)

RIAs are a combination of user interface functionality of desktop applications; web applications and interactive multimedia communication techniques (refer to figure2). Rich Internet Applications are fast, powerful and user friendly. A Rich Internet Applications have same features and functions as the traditional desktop applications. A RIA runs inside a web server and does not require software installation on the client side. RIA split the application processing on different stages as:

- operations related to data manipulation are operated on the server side
- user interaction activity is performed on the client side within a special area of the client desktop called sandbox.

The basic idea of this approach is to decrease the frequency of client – server traffic for handling local activity, calculations and so forth.

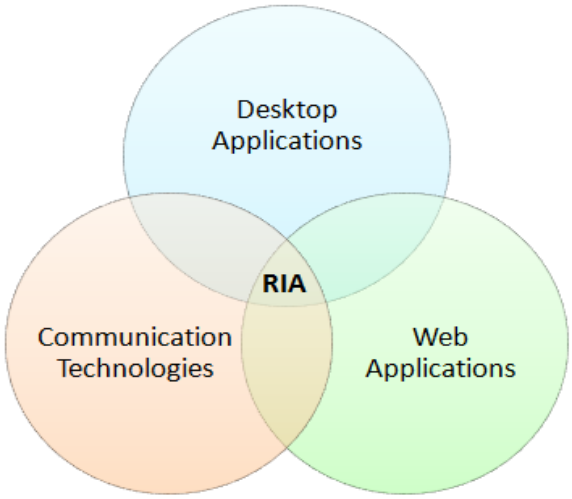

Fig.2: Rich Internet Application

For implementing the Rich Internet Applications, you can use different types of software such as Ajax, JavaScript, Adobe Flex, Flash, Ajax with PHP and many more. Using these

technologies, Rich Internet Applications (RIA) solutions provide good interactivity to the users.

1.2.7 Web Services

In Web 2.0, some of the websites are facing more user interaction such as YouTube and Facebook. Basically, these websites are facilitates the user for free interpersonal content sharing, it means that it involves person-to-person interactions through these websites that enables the users for content creation, sharing and manipulation. This is the key feature of the web 2.0. When these interactions are between two or more people and other resources on the Web, then the role of web services come. The Web services provide the improvements in terms of interactions or interconnections that may exist between two or more different web resources and hence between those organizations that deliver them. For example, if any organisation wants to include a feature of credit card payments online, it can either set its own setup or can integrate the web service of a Payment Service Provider e.g. Paypal into the website. The user will make their purchase from the Company's website but for payment, the control is automatically transferred to the Service Provider's website. All of this will happen automatically between two organisations.

Web services combines' different protocol to allow all components to interoperate entirely under the control of computer, without human intervention. It means that when a system requires a service, computer can implicitly find that service on the web. For example: In client/server model, a client sends a request to web service (in the server) for weather information. The web service return forecast through service response to the client as shown in the following figure3.

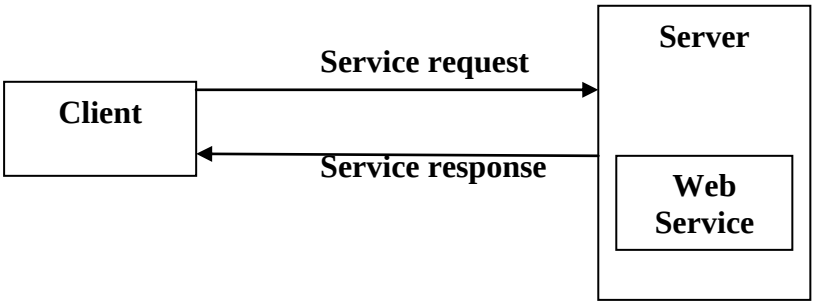

Fig.3: Client/Server Model for weather information

Web service has three roles for providing interaction between different components over web. These are:

- Servic e requestor,
- Servic e registry and
- Servic e provider.

These three roles are combined with find, publish and bind operation as seen in the following figure4. Different protocol and languages are used in web services such as XML, SOAP, WSDL and UDDI open standards over an Internet protocol backbone. The service provider

for providing services, write the services in WSDL (Web Services Definition Languages) and service registry uses UDDI (Universal Description Discovery and Integration Service) to listing what services are available. The service requestor for requesting service uses XML and SOAP standards over Internet Protocol backbone. XML is used to tag the data; SOAP is used to transfer the data. On the web, there are number of web services that use different standards.

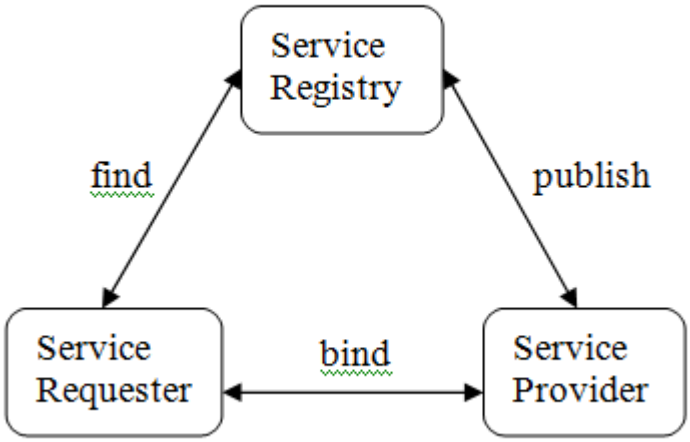

Fig.4: Web Services

1.28 Mashups

Mashups is a web application that retrieved data from two or more external sources to create entirely new and innovative services as shown in figure5. This is a new breed of web based data integration application. There are many types of mashups such as consumer mashups, data mashups and business mashups. Consumer mashups combine visual elements such as maps and data from multiple sources. For example, Wikipediavision is a site that combines Google Map and a Wikipedia API. Business mashups define applications that combine their own data and application with external web services to create single presentation. Data mashups combine data from multiple sources into single source on a similar type of media and information. Mash-ups are often created by using a development approach called Ajax.

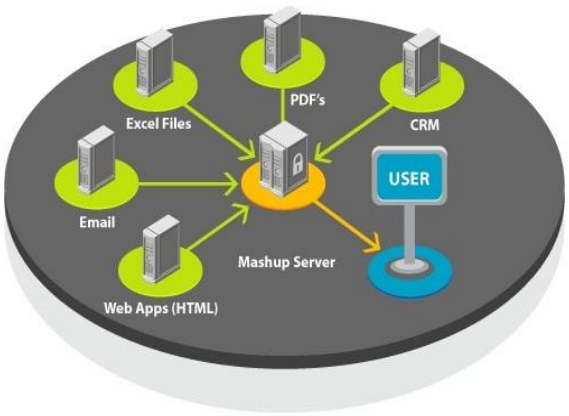

Fig.5: Mashups

1.29 Widgets and Gadgets

Widgets are also referred to as Gadgets. A web widget is a small piece of code that can be placed on a webpage, social media or blog. Widgets are useful application in the form of on-screen device viz., clocks, auction-trickers, event countdowns, flight arrival information and daily weather. A common example of a widget on a website is ad blocks such as Google Ads. YouTube also provides a widget, allowing you to make play list of your favourite videos. These dynamic widgets can be used in your website to enhance its appeal to the users.

Another kind of widget is desktop widget. A **desktop widget** is a small application that resides on your computer's desktop and does not require a web browser to be opened while a web widget is a component of web page, so it does require a web browser. Yahoo widgets are popular source of desktop widgets. Yahoo and Microsoft Vista also provide a widget toolbox to manage desktop widgets. Windows 8 operating system has number of desktop Gadgets as seen in figure 6.

Figure 6: Windows 8 Desktop Gadgets

1.2.10 Podcasting, Message Board and Data Streaming

Podcasting is a way to allow users to share their work over the web. A podcast is an audio file that is recorded and delivered over the web. User can listen to it any time. There are thousands of podcasts available on the web ranging from general topics to those which focus on specific topics such as computers, education and music. Teachers and library media experts are using podcasts to deliver their content to students.

A **message board or forum** is a Web 2.0 application that puts students in a web-based place where they can post a comment about any subject, and other students on the same message board or form can respond to the comments or post comments of their own. The message board is a good place for teachers and students for discussing a particular topic.

Data Streaming is a technique for transferring data at high speed rate so that it can be processed as a steady and continuous stream. The client side computers do not have fast access to download heavy media files quickly. With data streaming, the client browser can start displaying the data before the entire file has been transmitted.

Check Your Progress 1

1. Explain the term Web 2.0.

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2. Define the Search Engine.

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3. Explain Social media with examples.

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4. What is a Mashup?

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5. Differentiate between web widget and desktop widget.

1.3 Introduction to XHTML/HTML5

As discussed earlier, a web page is a document that contains information that is displayed on a browser. These web pages are created using the markup languages XHTML/HTML5. You have already gone through the basic concepts of HTML in MCSL-16 course. This section describes some of the basic entities used in the HTML in more details.

XHTML (Extensible Hypertext Markup Language) is a markup language. A markup language is a way of describing the meaning of and relationship between different parts of document. XHTML and its predecessor HTML (Hypertext Markup Language) are the most widely used languages on the web. XHTML defines a set of rules for encoding documents in a format that is both human-readable and machine-readable that reproduces all the features of HTML. XHTML documents can be processed by both Extensible Markup Language (XML) and HTML software. XHTML markup separates presentation details from the information. For this purpose they use style sheets called CSS, which you will learn in Unit 2.

Several features and structural rules of all XHTML document are similar to HTML document (pl. refer to MCSL-016 Block1) and for more details you may refer to the website http://www.w3schools.com.

HTML5 is the new standard for HTML. HTML5 is markup language for structuring and presenting content for web. HTML5 is a platform for mobile, gaming and enterprise applications. Major web browsers such as Internet Explorer, Mozilla Firefox, Apple Safari, Google Chrome, Opera support many of the new HTML5 elements to correctly display web pages. You must use the most recent version of browser to use HTML5.

HTML5 supports most interesting new features like <canvas> element for 2D drawing, <video> and <audio> elements for media playback, scalable vector graphics (SVG) content (that replaces the use of <object> tags) and MathML for mathematical formulas. In addition to this, some new content-specific elements like <header>, <footer>, <section> and <nav> are used to enrich the content of documents. Other new form controls such as calendar, date, time, email and search are to be added to the functionality of HTML5. A detailed discussion on all the features of HTML5 is beyond the scope of this Unit. You may refer to further readings for more details. Before explaining the new features of HTML5, let us first define some basic tags.

<!DOCTYPE html> Tag: In HTML5, there is only one <!doctype> declaration. This declaration must be first statement in your HTML document that is even before <html> tag. It

is not a HTML tag rather it is an instruction to the browser about the version of HTML in which the page is written.

<HTML> Tag: This is root element. It defines the content of web page. The opening HTML tag that is <*html*> immediately follows the DOCTYPE declaration and closing tag that is </html> is placed at the end of the document. The html element must contain head and body element.

<HEAD> Tag: In head portion of the document, you can write information about the document. You can define title, meta, style, script and link element. You will learn about the style, script and link element in the next units of this block. The head element is written immediately after the opening html tag and end with closing tag appears before the body tag.

<TITLE> Tag: It displays text at the top of browser window.

<META> Tag: The <meta> tag is used for declaring metadata (i.e. data about data) for html document. This element is placed between the head element and the basic use of meta element is to provide information about the page to search engine (i.e. Goggle, Yahoo), browsers and other web services. If you want top search engine rankings, just add meta tag in your web pages. You can use multiple meta element with different attributes on same page.

Some examples of usage of meta tags are given in the following three examples:

Example 1: Define keywords for Search engine

<meta name="keywords" content="HTML, CSS, XML, JavaScript" />

Example 2: Define description of your page

<meta name=”description” content=”Web Page Designing Issues” />

Example 3 - Refresh your document every 60 seconds:

<meta http-equiv="refresh" content="60">

<BODY> Tag: This tag contains the body of the web page that is displayed in the browser display area. In body tag, you can write those tags which are specific to the contents to be displayed in browser.

You can now create a simple web page with minimum but required tags. You can simply use a Notepad as a text editor to create a file of a webpage and save file with an .html file extension. To see the result of your work in one of the two ways:

1) Find the respective location of html file (prg1.html) and double click on it.

2) In your browser, click on File/Open File and browse to the name of file.

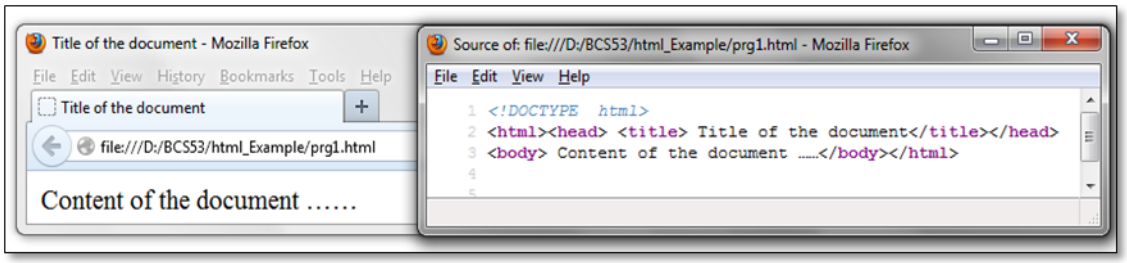


Figure 7: Display of a simple web page and the source code of this web page prg1.html

HEADING Elements: <h1>, <h2>, <h3>, <h4>, <h5> and <h6> heading elements are used for different level of heading. <h1> is the highest level of heading and <h6> is the lowest level of heading. <h1> is used once in web page and headings should be used in order. The output and source code of the program are as follows:

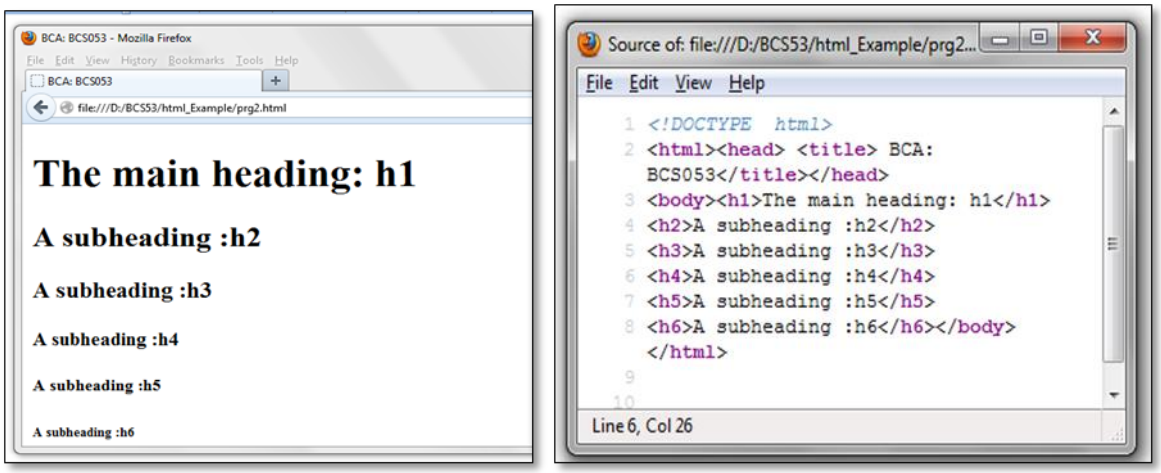


Figure 8: A page with headings and related source code.

<P> Tag: This tag is used for writing paragraph text.

<TABLE> Tag: As you know, table contains row and column. This tag is used to create a table within a web page. In conjunction with table tag, you can used <tr>(table row),<th> (table head cell), <td> (table data cell), <thead>(table header), <tfoot>(table footer) and <tbody>(table body) tags.

<TR> Tag: This tag is used for creating a row. It must appear inside the table element. Two types of cell used in table row. The first cell is <th> and other is <td>.

<Th> Tag: It defines a row or column header. It acts as a table header or data. <td> should be used instead <th>.

<TD> Tag: It creates a column that holds data of table such as text, images, links, lists and other table also. It appears within <tr> element. Table data cell has attributes like rowspan and colspan. The rowspan attribute defines the number of row a cell should span and colspan attributes specifies number of column should span. The syntax for colspan and rowspan are as follows:

<td colspan=”number”> and <td rowspan=”number”>

Attributes appear inside the opening tag and their values sit inside quotation marks.

<THEAD> Tag: This tag is used for table header along with < tfoot> and <tbody> tags.

<TFOOT> Tag: It can be used once within table and must appear before the <tbody> tag.

Consider the following example for table element:

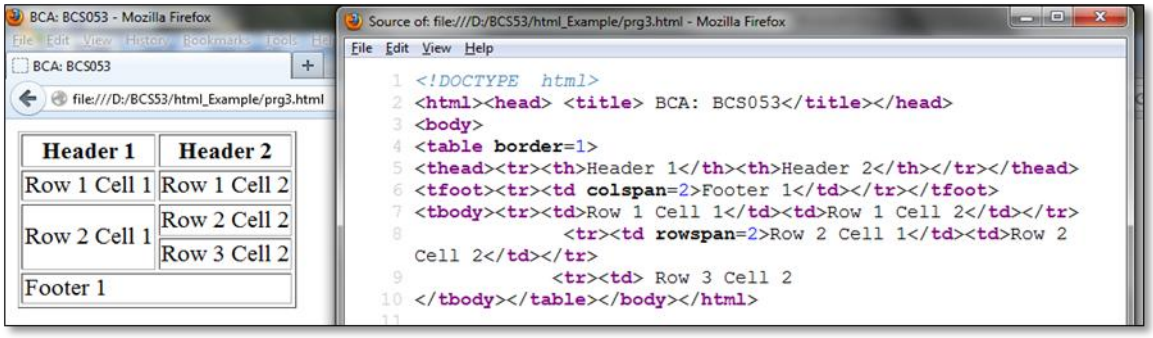


Figure 9: Web page and source code for a table

In the above example, two attribute colspan and rowspan of <TD> element are used. The colspan attribute is used to create a cell that spans more than one cell. The last row or footer of the table shows the result of colspan attribute - two cells are merged into one. The rowspan attribute is similar to colspan, except, it span across rows rather than columns.

ANCHOR Elements: If your website has several pages, you need to provide links between HTML pages, the tag is used to create link is called <a> which stands for anchor. The anchor <a> element is used to create a hyperlink which provides a link from one page to another or within the same page. The syntax of this tag is as follows:

In the above syntax, href attribute defines the url of linked resources or web page and target specifies where to open a linked file and name specify the name of intra link which is used within same page.

Some examples of usage of <a> element are given in the following two examples:

Example 1:

<!—linking to other pages-->

< a href=”head.html”> Header page

Example 2:

<!—links within a page-->

 The above example is used to provide links from one page to another page. Now, this example shows you how to use the same element to links within a page. This is used at top of the page and at end of the page, you can use following statement which transfer control back to top.

Back

Comments:

You can use the following two tags that enable you to add comments within the HTML code. These comments are not displayed by the browser.

Example:

<!--This is a HTML comment -->

<comment> This is also a comment </comment>

FORM Elements:

Form elements, as the name suggests, contain predefined field names with blank or default values which you can fill and submit to their respective website. You can create a form for your website using form elements such as input, password, text area, radio button, submit button, select with option, label, fieldset and legend. Forms can be used for filling information online. Some examples of forms include online examination form, feedback forms and so on. Forms are useful tool for client interaction on a website.

<INPUT> Element: The INPUT element is most important element. You can build an entire form using no other element due to its type attributes which have wide variety of values. The syntax is as follows:

```
< INPUT [type=text| password| checkbox| radio| submit| reset| image| button| hidden]
[name=controlName] [value=controlValue] [checked] [size=controlWidth]
[maxlength=word Length] >
```

In the above syntax, name attribute is used to define a name of control element and value attribute specifies value of input control element. The size attribute is used to define width of control element and maxlength attribute indicates a length of input element in characters. The type attribute is defined in the following sections:

The text value: The text value of type attribute enables you to input single line text in a text box. For example, define text box using input element

```
<input type=”text” name =”username” size=30 >
```

The password value: It is similar to text attribute except that the visible portion of text on screen is masked with other character so that no one can read the password. For example,

```
<input type=”password” name =”pwdname” size=10 maxlength=”8”>
```

In the above example, name attribute specify the name of input element and maxlength attribute specify the maximum numbers of characters allowed in input password control. The size attribute indicates width of input element.

In similar way, you can change only value of attribute type of input element for creation of other elements.

<TEXT AREA> Element: This element is similar to INPUT elements text type. Using this tag, user can type a larger section of text in multiple lines rather than a single line text in text boxes. The rows attribute of textarea is used to specify the viewable row and cols attribute is used to specify the viewable columns of the text. For example:

```
<textarea name =”username” rows=5 cols=20> </textarea>
```

<LABEL> Element: It is used to add label to form control. It is used with radio button or checkbox option element.

<SELECT> Element: The select form control element is used in conjunction with optgroup and option element to create a list of choices that the user can choose from. It may be drop down menu or list box. The optgroup (option group) is used to define group of elements in a <select> form element.

For this, you can see the following program. Three <select> elements are used in this example. The first <select> statement is used in conjunction with <optgroup> to define group of elements. The label attribute of <optgroup> element specifies the two names such as Maruti Cars and Germans Cars as group header. Each option group element have <option> element to describe the further options in the list such as Wagon R and Swift Dzire in Maruti Cars header. The second <select> element is displayed a simple drop down menu with two option i.e. male and female. The third <select> element is used as a list box.

```
<!DOCTYPE  html><html><head>
<title>BCA:BCS053</title>
<h2>Example for select element</h2>
<select><optgroup label="Maruti Cars">
        <option value="wagon R">Wagon R</option>
        <option value="Swift Dzire">Swift Dzire</option>
        </optgroup>  <optgroup label="German Cars">
        <option value="mercedes">Mercedes</option>
       <option value="audi">Audi</option>
       </optgroup>
</select>
<select name="Gender">
<option value="">Male</option>
<option value="">Female </option></select>
<select name="country" size="2">
<option value="">India</option>
<option value="">Nepal</option>
<option value="">Canada</option>
</select></body></html>
```

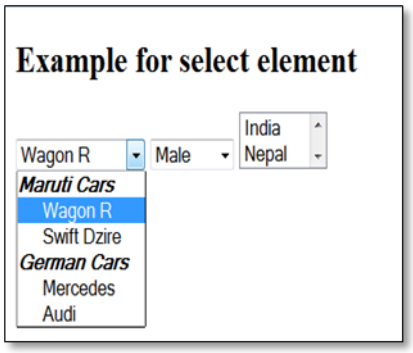


Figure 10: Source code and output screen for select element

<FIELDSET> Element: This element is used for grouping related form elements by drawing a box around the related elements.

<LEGEND> Element: It is used to display a title or caption for group of elements which is grouped by <fieldset> element. It is also used in conjunction with <figure> and <details> element. By using the both elements <fieldset> and <legend>, you can make your web page easier to understand for your user.

```
<!DOCTYPE html><html><head></head><body>
 <fieldset>
   <legend><b>Personal Information</b></legend>
   Name: <input type="text" size="20">
  Address<input type="text" size="20">
</fieldset>
```

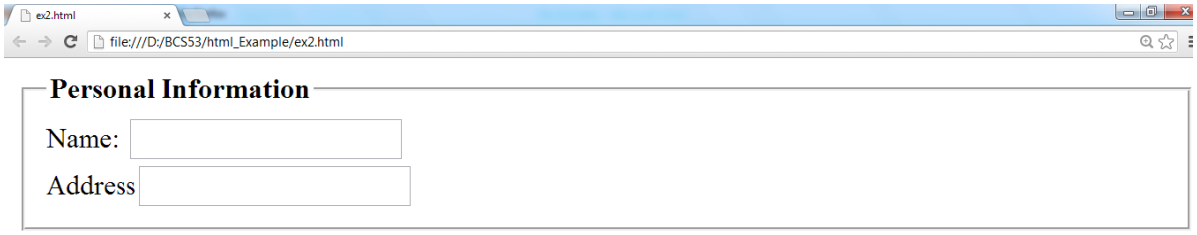


Figure 11: A web page showing Personal information and source code

The above example shows that the legend element creates a caption as 'Personal Information' for fieldset element. The fieldset element is used as grouping the form elements i.e. name and address.

A detailed example of these elements is given in section 1.6. In the remaining section, you can learn about the new features of the HTML5 markup language:

<ARTICLE> Tag: This tag is used to represent an article. It is used in blog for post entry, a newspaper article. The following example shows the result for anchor, article and paragraph elements.

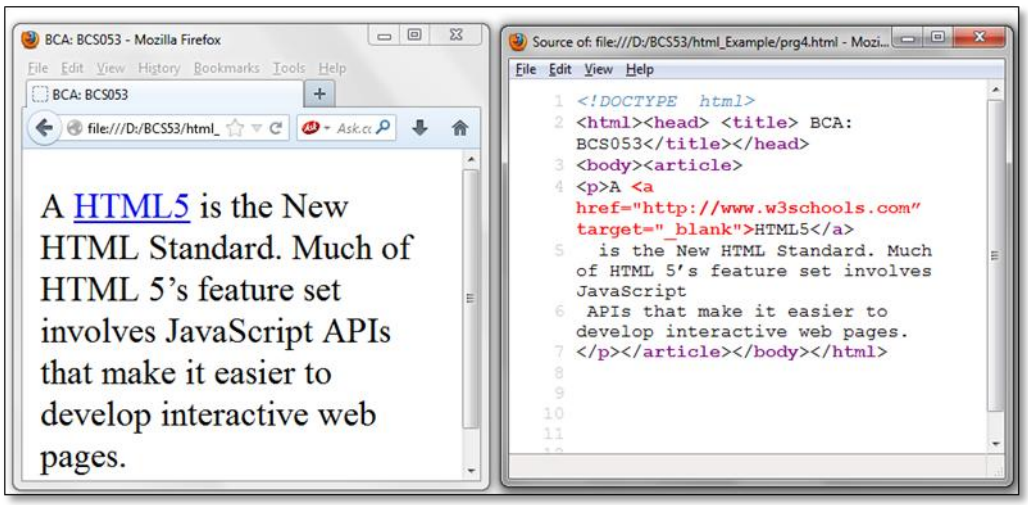


Figure 12: A web page and source code for article and anchor element

<HEADER> Tag: The <header> element is used to define section's heading. The <header> tag cannot be placed within a <footer>, <address> or another <header> element. It is used in a search form or any relevant logos.

<FOOTER> Tag: The HTML <footer> tag is used for defining the footer of an HTML document or section.

<HGROUP> Tag: It is used to group a set of <h1> to <h6> heading elements when a heading has multiple levels.

Example of <article>, <header>, <footer> and <hgroup> tags:

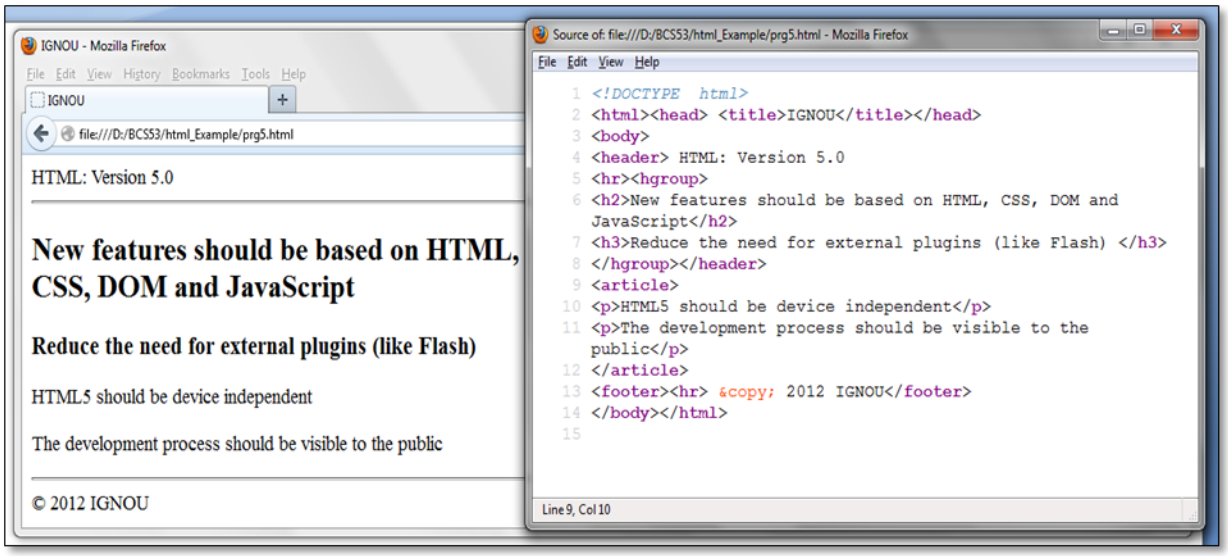


Figure 13: A web page and source code for different HTML5 tags

<AUDIO> Tag: The <audio> tag is used to specify audio on an HTML document.

<VIDEO> Tag: The HTML5 <video> tag is used to specify video on an HTML document.

Both the tag audio and video accepts attributes i.e. control, preload, autoplay, loop, src that specify how the video/audio should be played. The description is as follows:

- controls – it display the respective control on web page
- autoplay- makes the audio/video play automatically.
- loop – play again once it has finished.
- src – name of audio/video source file

This is an example of how you can make use of the HTML5 <video> and <audio> tag in a web page to include a video clip without the need of Flash or Silverlight to be installed in the browser.

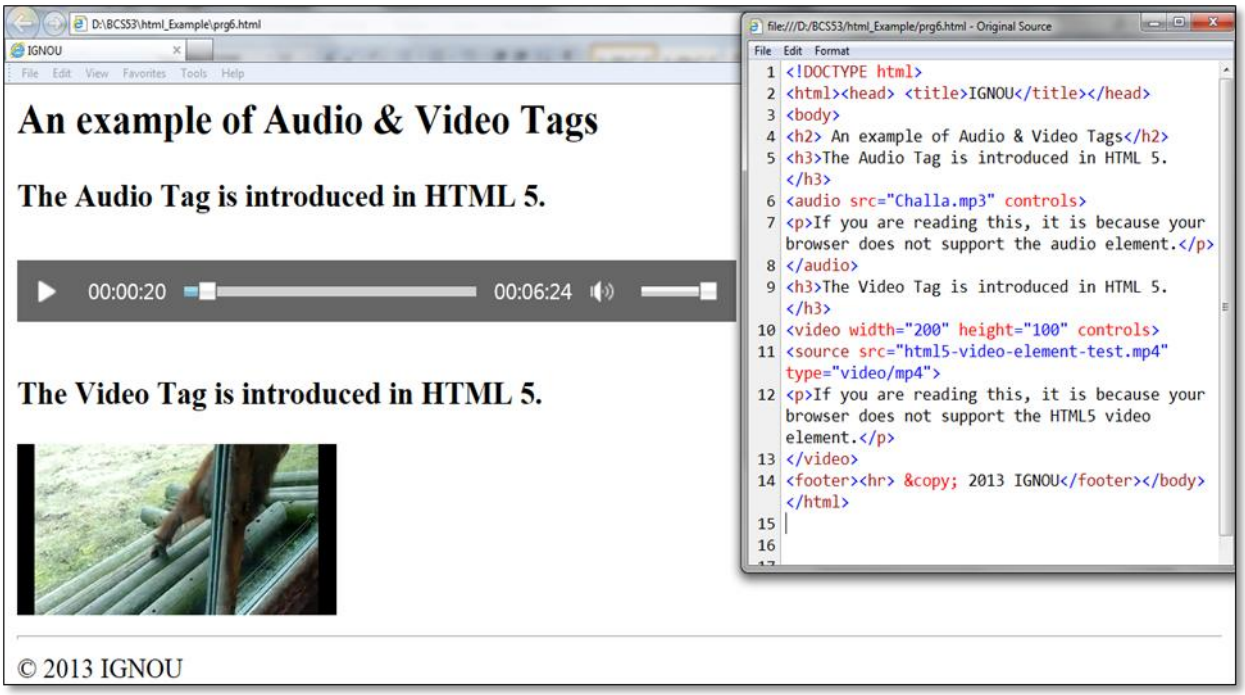


Figure 14: A web page for Audio and video tag

<SVG> Tag: Scalable Vector Graphics is used for describing 2D-graphics application. It is useful for vector type diagrams like Pie charts; Two-dimensional graphs in an X, Y coordinate system etc. For example:

```
<!DOCTYPE html>
<head><title>BCA:BCS053-SVG
</title></head>
<body>
<h3>HTML5 SVG Circle & Rectangle</h3>
<div>
<svg  >
   <circle cx="100" cy="50" r="40"
  stroke="green"  stroke-width="2"
  fill="yellow" />
</svg>
</div><div>
<svg  >
<rect  width="200" height="50" fill="cyan"
stroke="black" stroke-width="3" />
</svg></div></body></html>
```

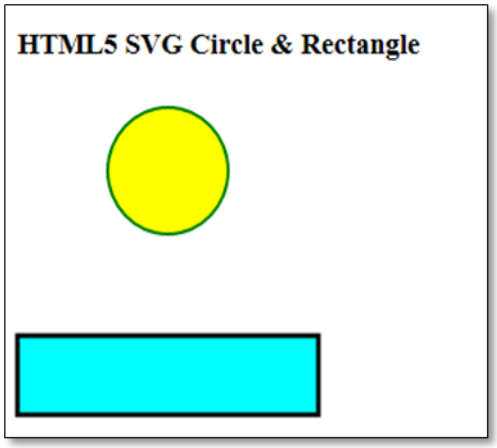


Figure 15: HTML5 program and output screen for Circle & Rectangle

The above program shows circle and rectangle which has drawn by <svg> element. For the creation of circle, a keyword 'circle' and x, y coordinate is defined. The <circle> element is written inside the <svg> element. In this example, cx attribute of circle specifies x coordinate, cy is y coordinate of the circle and r represents radius of the circle. The attribute stroke is used for fill the color and attribute stroke-width is used for defining the width size of outermost area of circle. The color of inner circle is filling using the fill attribute. In the same way for creation of rectangle, a keyword 'rect' and width, height is defined. The <rect> element is written inside the <svg> element.

<CANVAS> Tag: This element is used to for creating graphics via scripting (usually JavaScript). Canvas has several methods for drawing boxes, characters, path and adding images. Canvas is a rectangular area on which you can draw object using JavaScript.

<TIME> Tag: This tag is used for declaring the date/time within an HTML document.

<MENU> Tag: The HTML menu tag is used for specifying a list of commands.

<MARK> Tag: This tag is used for indicating text as marked or highlighted for further reference.

Consider the following code for <mark>, <time> and <menu> Tag.

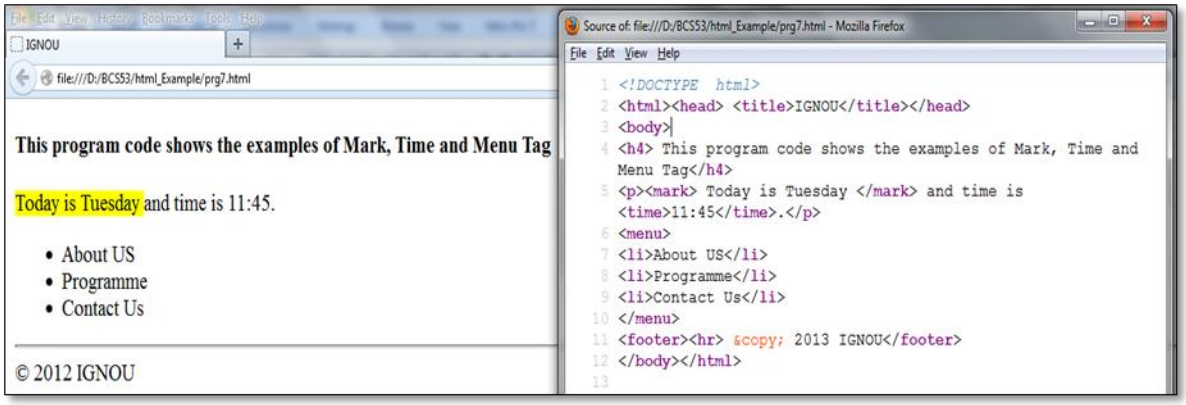


Figure 16: A HTML page with source code

<EMBED> Tag: If you want to play a video in a web page, you can upload the video to YouTube in proper HTML code to display the video.

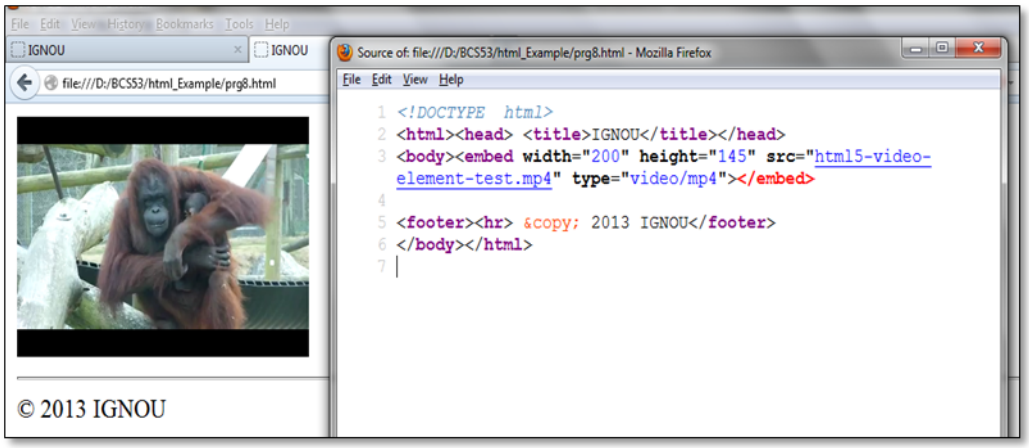


Figure 17: A web page source code and screen for embed tag

You can embed a video file in the following format:

<embed width=”300“ height = “150 “ src=”videofile.mp4” type=”video/mp4”></embed>

In the above code, src attribute define the url of the video file and using width, height attribute, you can defined the width and height of the video clip.

<DETAILS> Tag: This tag specifies additional details that the user can view or hide on demand. It can be used in conjunction with **<SUMMARY>** tag to provide a heading that can be clicked on to collapse/expand the details as required. You could use `<details>` to toggle the comments section of a blog, member profiles, and details of a download, complex forms, or in web applications. **Only browser Chrome supports the `<details>` and `<summary>` element**.

For Example:

```
<!DOCTYPE html><html>
<head><title>BCA:BCS053</title></head><body>
<details> <summary><label for="name">Name:</label></summary>
  <input type="text"  id="name" name="name" />
</details> </body></html>
```

In this program, detail element create a collapse/expend toggle mark on the page, whenever you clicked on this mark, it show/hide the text.

<ASIDE> Tag : This tag is used for defining the content aside from the page content. Basically this tag is used to represent quotation text that is related to page.

<MATHML> Tag: The MathML standard is used for mathematical notations on web page.

<BDI> Tag: This tag can be useful when the text direction is unknown such as in the case with user generated content.

<NAV> Tag : The <nav> tag defines a section of navigation links.

<FIGURE> Tag: This tag is used for annotating illustrations, photos and diagrams. The <figure> tag is used in conjunction with **<FIGCAPTION>** tag to provide a caption to the figure.

Consider the following code for <aside>, <bdi>, <figure>, <figcaption> and <nav> tags.

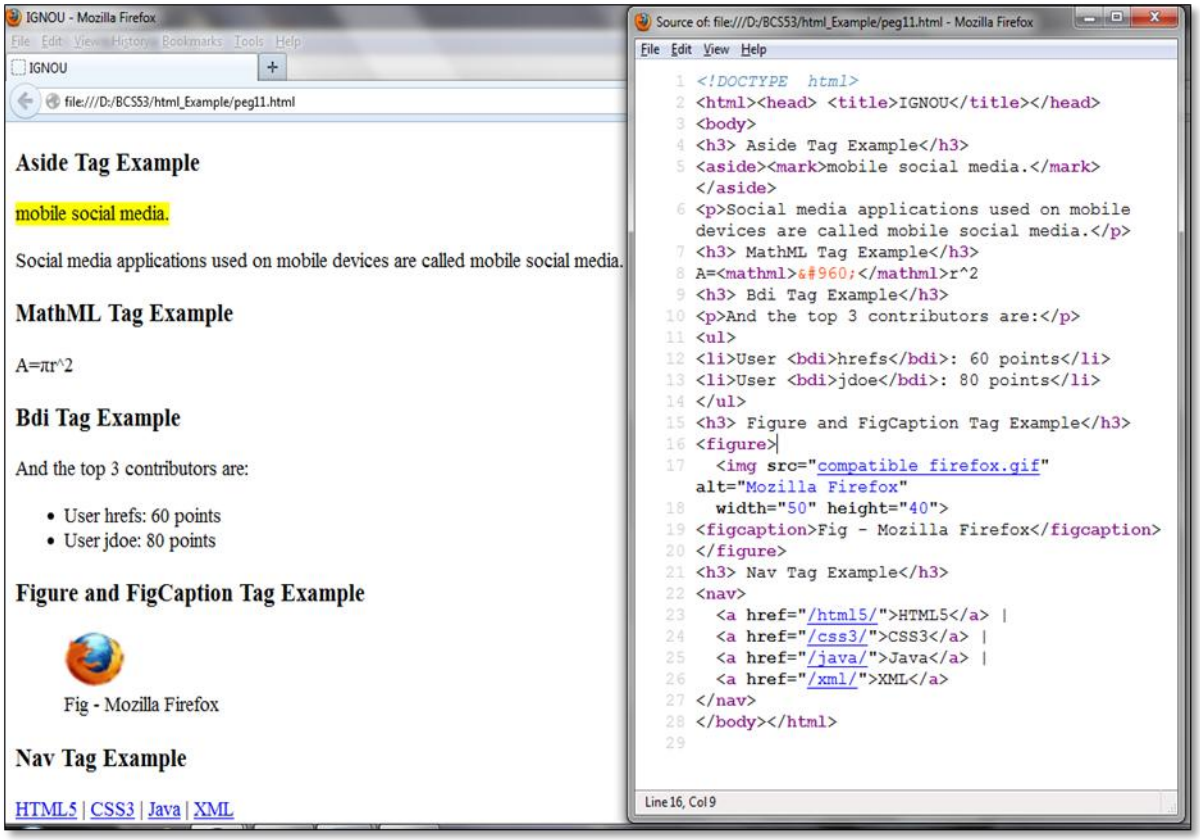


Figure 18: A web page display different tags of HTML 5

Check Your Progress 2

1. What is the use of <!DOCTYPE html> tag in HTML5?

---

2. Explain the SVG element in HTML5 with Example?

---

3. Write a HTML5 program using <details> and <summary> tag.

---

4. Differentiate between SVG and Canvas tag?

---

5. What is the purpose of aside tag in html5?

1.4 Syntactic Differences between HTML and XHTML

HTML (**H**yper**T**ext **M**arkup **L**anguage) and XHTML (E**X**tensible **H**yperText **M**arkup **L**anguage) are both languages in which web pages are written. HTML is based on SGML (Standard Generalized Markup Language) while XHTML is XML (eXtensible Markup Language) based. XML is discussed in details in the Unit 3 of this block.

There are some significant differences between the syntactic rules of HTML and XHTML. These are:

1. Case sensitivity: In HTML, it does not matter whether tags are lowercase, uppercase or a mixture of both. In XHTML, all tags must be lowercase. For example, use <head> instead of <HEAD>.

2. Closing tags: Closing tags are often optional in HTML but are always required in XHTML. For example, every paragraph must begin with tag and end with a tag. Likewise, every <tr> table row must have a closing </tr> and so forth.

3. HTML tags that do not enclose any content such as <hr>, <br> and <img>. In XHTML, it must contain a slash. For example, <hr />, <br />, . These statements are treated by XHTML interpreter as a closing tag.

4. Quoted attribute values: In XHTML, all attribute values must be enclosed in quotation marks regardless of what characters are included in the value. For example

   <img src=pic.gif border=1> is valid HTML but it must be written as
    to be valid in XHTML.

5. Explicit attribute value: All attributes must have values in XHTML. For example,

   <input type = “checkbox” checked> should be written as

   <input type=”checkbox” checked=”checked” />

6. id attribute : The id attribute is used to identify objects. For example,

   In XHTML, the use of id is encouraged and the use of name is deprecated.

7. Element nesting: Tags must be properly nested in XHTML. For example,

    _{This is bolded subscript} should be written as
    _{This is bolded subscript}.

8. Extra whitespace that appears in attribute values is stripped out. For example, If the following code is encountered

   <img src=” pic.gif “ >
   The XHTML processor will interpret it as <img src=”pic.gif” > .

1.5 Standard XHTML /HTML5 Document Structure

The previous section discussed rules for writing XHTML/HTML. In this section, you will learn about the structure of the document. Each document is structured into two parts, the HEAD, and the BODY. The head contains information about the document whereas the body contains the body of the text, and is where you place the document content to be displayed. Both of these are contained within the HTML element.

Three features in figure 19.0 are characteristic of XHTML/HTML5 documents. These are:

1. Every XHTML document must begin with an XML declaration. All XML documents should begin with the following line: <?xml version =”1.0” encoding = “utf-8” ?>

   This declaration states that the rest of the document is XML. The version attribute specify the version number, which is still 1.0. The encoding property defines the encoding in which the document is stored on a computer.

   In HTML5, every document must begin with <!DOCTYPE HTML>.

2. XHTML documents require a DOCTYPE declaration just after the XML declaration. A DOCTYPE declaration is the XML mechanism for specifying the document type declaration (DTD) relevant to the document. The DTD specifies the rules used by the markup language. You will learn more about the XML and DTD in the unit 3 of this block.

   For example,

   <!DOCTYPE html PUBLIC “-//w3c//DTD XHTML 1.1//EN”
   http://www.w3.org/TR/xhtml11/DTD/xhtml11.dtd> this declaration defines the location of the DTD specified via a URL.

   HTML5 does not define a DTD.

<?xml version =”1.0” encoding = “utf-8” ?> <!DOCTYPE html PUBLIC “-//w3c//DTD XHTML 1.1//EN” http://www.w3.org/TR/xhtml11/DTD/xhtml11.dtd> <html xmlns=http://www.w3.org/1999/xhtml> <head> …….. </head> <body> content of the document…….. …….. </body> </html>	<!DOCTYPE HTML> <html> <head> <title>Document Name</title> <link href="name_of_cssFile " rel="stylesheet" /> <script src="name of js file"></script> </head> <body> content of the document…… </body> </html>

Figure 19.0: Standard XHTML and HTML5 Document Structure

3. XHTML document must include the four main tags <html>, <head>, <title> and <body>. The <html> tag identifies the root element of the document and this element must use the xmlns attribute to declare the location of the namespace for XHTML syntax. The only allowed form is :

   <html xmlns=http://www.w3.org/1999/xhtml>

   In the same way, HTML5 document must contain <html>, <head>, <title> and <body>. Its also include <script> and <link> tag. The link tag is used to include cascading style sheet and script tag is used for java script file.

1.6 Example of HTML5 Form

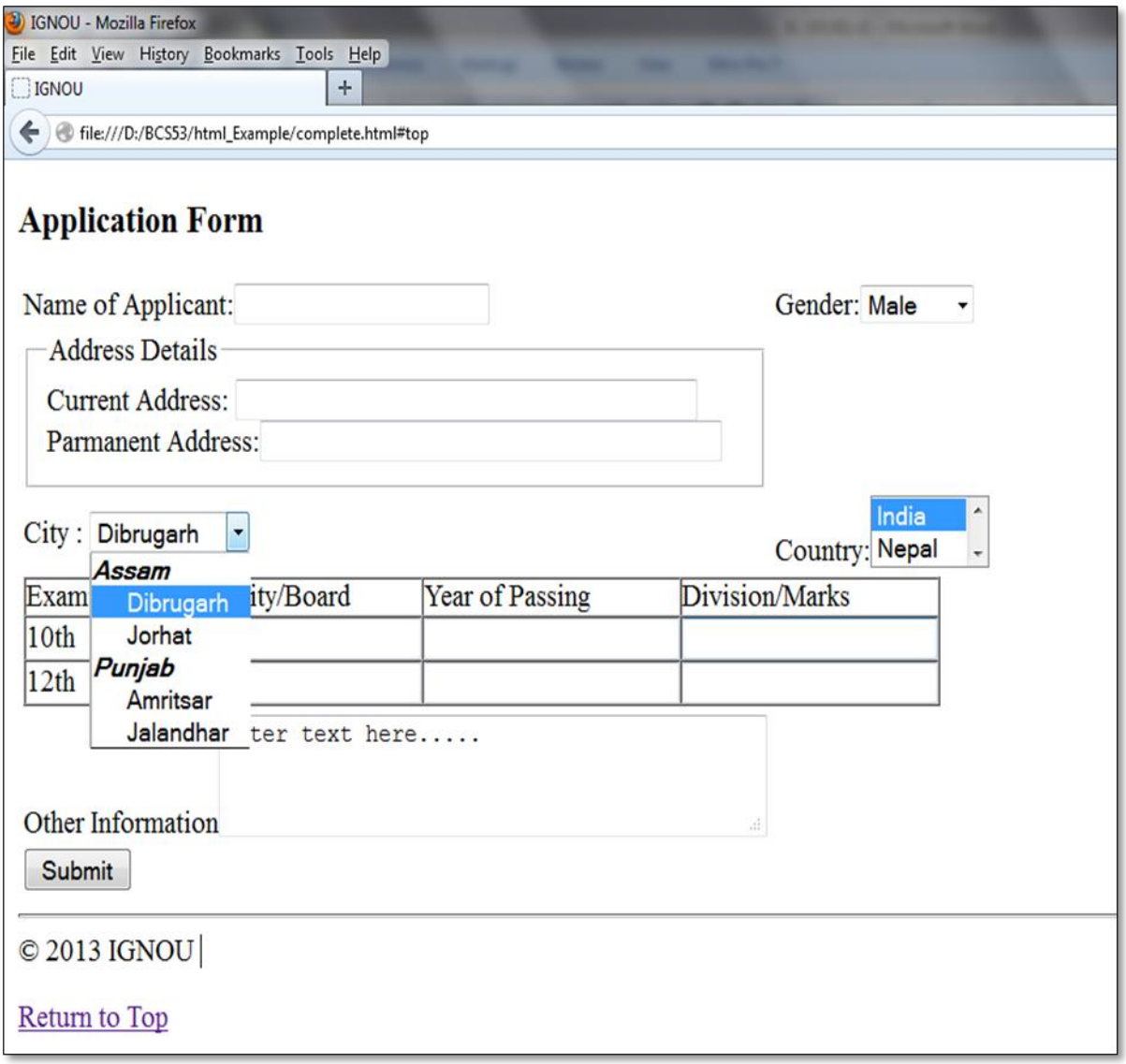
The following program creates an Application Form which includes fields such as name, gender, address, qualification and some other information.

In the example, numbers of elements are used such as title, meta, table, select, fieldset, legend, optgroup, option, input, textarea, label, footer and anchor. The title and meta elements are defined in the head portion of the HTML page and rest of the tags are defined in the body tag. The title tag tells to the users and search engine what the topic of a particular page. The meta tag is used to provide information about the page to search engine. The method, name and action attributes are defined within the form element. The name attribute is used to define a name of the form. It is used to reference form data after the form is submitted. The action attribute is used to send form data after the form submission. The get method of form element is used to get requests data from the specified resource which is defined in action attribute.

```
<!DOCTYPE  html>
<html><head> <title>IGNOU</title>
<meta name="keywords" content="HTML5, IGNOU, application">
</head><body ><h3><a name="top"> Application Form</a></h3>
<form name="HTMLForm" method="get" action="">
<table border="0">
<tr><td>Name of Applicant:<input type="text" name="FName" size="20" maxlength="50">
</td>
<td>Gender:

<select name="Gender">
<option value="">Male</option><option value="">Female</option>
</select>

</td></tr><tr><td >
<fieldset ><legend>Address Details</legend>
Current Address: <input type="text" name="caddress" size="40" maxlength="50" >
<br />
Parmanent Address :<input type="text" name="Paddress" size="40" maxlength="50">
</fieldset>
</td><td></td></tr><tr><td>City :

<select>
<optgroup label="Assam">
<option value ="">Dibrugarh</option>
<option value ="">Jorhat</option></optgroup>
<optgroup label="Punjab"><option value ="">Amritsar</option>
<option value ="">Jalandhar</option></optgroup>
</select>

</td><td>Country:
<select name="country" size="2">
<option value="">India</option><option value="">Nepal</option>
<option value="">Canada</option></select>

</td></tr>
<tr><td colspan="2"><table border="1" cellpadding="0" cellspacing="0"
width="40%"><tr><td >Examination</td><td >University/Board</td>
<td >Year of Passing</td> <td >Division/Marks</td></tr>
<tr><td >10th</td><td >
<input type="text" name="10_univ" size="20" maxlength="50"></td><td >
<input type="text" name="10_year" size="20" maxlength="50"></td><td >
<input type="text" name="10_div" size="20" maxlength="50"></td></tr>
<tr><td>12th</td><td >
<input type="text" name="12_univ" size="20" maxlength="50"></td><td >
<input type="text" name="12_year" size="20" maxlength="50"></td><td >
<input type="text" name="12_div" size="20" maxlength="50"></td></tr></table>
</td></tr><tr>
<td>Other Information<textarea  rows="3" cols="40">Enter text
here.....</textarea></td></tr><tr><td colspan="2"><input type="submit" value="Submit"
></td></tr></table></form>
<footer><hr>&copy; 2013 IGNOU </footer>
<p align="right"><a href="#top" >Return to Top</a></p></body></html>
```

The table tag is used in conjunction with <tr>, <td> tag for creating row and column. The border attribute is used to specify border of the table. The value "0" indicates the table is displayed without border. The <td> element is used to create a table cell. The table cell can span across more than one column or row by using the rowspan and colspan attributes. The <select> element is used with option group/option element to create drop down or list box. When the value of attribute type of <input> element is text, it create a text box for users input and when the value is submitted, it creates a submit button for submitting page. The <textarea> element is used for creation of multiple lines of text box for entering some other information which are not included in the form. The rows and cols attributes of <textarea> is used to create a larger section for input data.

Output of the above program is as follows:



Check Your Progress 3

1. What do you mean by HTML? Differentiate between HTML and XHTML.

---

2. Write program for header section of the page which include name of IGNOU as heading and menu bar as Unit1, Unit2, Unit3.

---

3. Write an html5 program for highlighted text "I am student of IGNOU".

---

4. Create footer for web page with copyright symbol.

---

5. Write a complete web page including header and footer.

1.7 Summary

Web 2.0 is the popular term for advanced internet technology and applications. It allow to users to actually interact with each other in the form of blogs, social networking site, social media, wikis and many more. An important part of web 2.0 is the social media, which is the way to enable people to create social networks online. This network provides online tools for sending individual messages, photo sharing and online chat. The most famous social networking site is Facebook. Related to social media is social bookmarking site. Wikis are website that allows users to add and modify content. Wiki is the multi-lingual, web-based encyclopaedia Wikipedia.

You have learned more elements and attributes about HTML5. Now, you can able to create a new webpage using this technology.

1.8 Solutions/Answers

Check Your Progress 1

Ans1: Web 2.0 is online communication platforms that facilitate online sharing and interaction. Tools like blogs, podcasts and message boards are common Web 2.0 platforms.

Ans2: Search engines are programs that search web page for given keywords and returns a list of the web pages where the keywords were found. It enables users to search for web pages on the Internet. The search engines are Google, Yahoo, Bing and many more.

Ans3: Social media is type of online media where it provides online conversations between users. It also delivers content but does not allow users to participate in creation or development of the content. It provides a platform where users are interact by sharing photos and videos and commenting on them. For example, YouTube, Flickr.

Ans4: Mashups is a web application that retrieved data from two or more external sources to create entirely new and innovative services. This is a new breed of web based data integration application

Ans5: Web widget is a component of web and it require web browser. On the other side, desktop widget is a small application that resides on computer desktop and does not require web browser.

Check Your Progress 2

Ans1: Every HTML5 program must begins with <!doctype> declaration. It is an instruction to browser about what version of HTML page is written in.

Ans2: SVG is used to create scalable vector graphics. SVG is container element that can have other element to describe the shape within itself.

Ans3:
```
<!DOCTYPE html><html><head><title>BCA:BCS053</title><head><body>
<details open="open"><summary>Name</summary><p>Dr. A.P.J. Kalam</p>
<p>If your browser supports this element, it should allow you to expand and collapse these details.</p></details>
```

Ans4: Canvas is used to create a raster graphics whereas SVG is used to create vector graphics. As you know that the raster graphics is loses quality image when enlarged and vector graphics retains it. Canvas is rectangular area on which you can create something using JavaScript, on the other hand, SVG is container element that can have other element to describe the shape within itself. SVG can have CSS control over it.

Ans5: The aside tag is used to represent text aside from main article. It is appears in bold typeface in box or as a quotation text on the page.

Check Your Progress 3

Ans1: Hypertext Markup Language (HTML) is a language. It consists of a variety of elements called tags, which is used for everything from defining a title to including audio/video clip, from creating a heading to inserting a background image in a web page.

Both languages HTML/XHTML are used for displaying web pages. XHTML is an extended version of HTML. XHTML contains all the html tags that follow the rules of XML because it is a family of XML. The main differences between XHTML and HTML are as follows:

1. XHTML provides a shorthand notation for empty elements. For example, you could use <br/> instead of <br> or </br> which HTML does not.
2. XHTML elements must always be closed whereas closing tags are often optional in HTML.
3. Other differences between XHTML and HTML are case sensitivity. In XHTML, all tags must be lowercase. In HTML, it does not matter whether tags are lowercase, uppercase or a mixture of both.
4. XHTML documents must have one root element.
5. XHTML elements must be properly nested**.**

Ans2:
```
<!DOCTYPE html><html><head><title>BCA:BCS053</title></head><body>
 <header><hgroup><h1>Indira Gandhi National Open University</h2>
 <h2>SOCIS </h2><nav>
<a href="">Unit 1</a>| <a href="">Unit 2</a>| <a href="">Unit 3</a></nav>
</hgroup></header></body></html>
```

Ans3:
```
<!DOCTYPE html><html><head><title>BCA:BCS053</title></head>
<body><p><mark>I am student of IGNOU</mark></p></body></html>
```

Ans4:
```
<!DOCTYPE html><html><head><title>BCA:BCS053</title></head>
<body><footer><hr> &copy; 2013 IGNOU</footer></body></html>
```

Ans5:
```
<!DOCTYPE  html><html><head><title>BCA:BCS053</title></head><body>
 <header><hgroup><h1>Indira Gandhi National Open University</h2>
  <h2>SOCIS </h2><nav>
 <a href="">Unit 1</a>| <a href="">Unit 2</a>| <a href="">Unit 3</a></nav>
 </hgroup></header>
 <p><mark>I am student of IGNOU</mark></p>
 <footer><hr> &copy; 2013 IGNOU</footer>
 </body></html>
```

1.9 Further Readings

1) Beginning Web Programming with HTML, XHTML and CSS by Jon Duckett. Publisher: Wrox.
2) Internet and the World Wide Web by Harvey M. Deitel, Paul J. Deitel
3) Programming the World Wide Web by Robert W. Sebesta. Publisher:Pearson
4) HTML 4 Unleashed by Rick Darnell. Publisher: Techmedia
5) XHTML 1.0 by S. Graham. Publisher: Wiley
6) http://www.w3schools.com

UNIT 2 USING STYLE SHEETS

Structure

2.0 Introduction

In the previous Unit, you were introduced to some of the tags of HTML5. In each tag of HTML, you can define a number of attributes that may define the display characteristics, such as font, color, etc. of the content in the tag. However, this model of putting the display characteristics inside the tags makes a web site inflexible, inconsistent and difficult to change. There was a need of separating content of a web page from its presentation (display in browser). This was made possible by Cascading Style Sheets (CSS). CSS allows separation of content of web pages from their presentation. The content can be part of an HTML page, whereas the presentation related information can be moved to CSS. In fact, a CSS can be used to control the style and layout of multiple html pages all at once. Cascading Style Sheet is a mechanism for adding style such as background color, font color to web pages or documents. The W3C, an organization that oversees the development of web technologies, has released three versions of CSS, namely CSS1 in 1996, CSS2 in 1998 and the latest version CSS3.

This unit introduces you to CSS and their types. It also explains how style sheet can be created and used to control the display of web pages on a browser. An external style sheet is a file that contains only CSS code and it will allow you to change the formatting style in multiple pages at once. This unit provides a complete example to demonstrate this concept. You must use CSS while designing web pages as they allow the web pages - to be portable

across browsers; to have a uniform look and feel; to have simpler design. The Websites that uses CSS are also easier to maintain. Please note that a complete discussion on CSS is beyond the scope of this Unit, you may refer to further readings and the site http://www.w3schools.com for more details on CSS.

2.1 Objectives

At the end of this Unit, you will be able to:

- write CSS rule for different elements of a web page
- link an external CSS to a web page
- control the presentation of text using CSS
- define a box model and how you set different properties for this model
- show how simply changing the CSS can alter the display of a web page

2.2 Cascading Style Sheet

Cascading Style Sheets (CSS) are used to control the presentation of a single or many web pages. In the earlier web pages, the display attributes were put in the particular tags. One of the major problems of such a situation was that if you have to insert same style to number of occurrences of that tag in same or different pages, you have to enter that style in every tag. Not only this was tedious and time consuming but also are difficult to change. But, if you use Cascading style sheet, you can set same formatting style to all such tags or elements using a single rule. This rule can then be applied to all the occurrences of that element.

A style sheet consists of *rules* that specify how formatting should be applied to particular elements in a document. In general, a style sheet contains many such rules. Each CSS rule contains two parts. The first part is *selector* and the other part is *declaration*. The selector indicates which element or elements the declaration applies. In the selector part, the elements can be separated by commas. The declaration specifies formatting properties for the element.

Figure-1 shows you how to use CSS rule within your document:

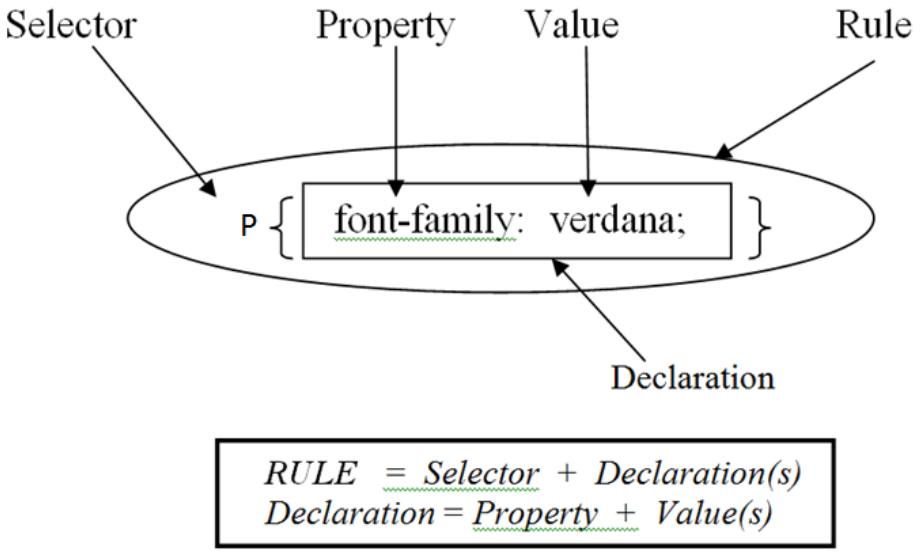


Figure 1: Format of CSS rules

In above example, the rule says that all the paragraphs, that is, <p> elements should appear in Verdana font. Notice that the declaration part is split into two parts namely property and value separated by colon. The declaration part is always written inside the curly brackets { }. Semicolon marks the end of a declaration.

A property defines the property of the selected element(s); in this example the property that is defined is *font-family* property, which is used for defining a set of fonts that may be used for display of an element. A value which specifies the value of this property, in this example, it is *Verdana* fontface is the value.

The CSS rule given in Figure-2 applies to several elements such as <h1>, <h2> and <h3>elements. Note that in the example, selector is h1, h2, h3 (separated by comma). The declaration of the rule specifies several properties for these elements with each property-value pair separated by a semicolon and all properties are kept inside the curly brackets.

```
h1, h2, h3{ font-family: verdana, tahoma, arial; font-weight: bold; font-style:italic;}
```

Figure 2: A CSS rule applicable to several elements

In Figure 2, the font-family property specifies the font for a heading element. The font-family property can hold several fonts. This rule specified that the content of each heading element <h1>, <h2> and <h3> of the related web page will be displayed in bold, italic and Verdana font. If the Veranda font is not installed on the computer then it will look for Tahoma and even if Tahoma is not installed then Arial font will be used.

CSS can be attached to a web page in three different ways as discussed in the next section. More details on CSS properties will be provided in the latter sections.

2.3 Style Sheet Types

In previous section, we have discussed about the CSS rule. A style sheet contains a number of such rules. In this section, you will learn how to use a style sheet for your documents.

There are three different types of style sheets namely Inline Style, Embedded Style and Linked External Style Sheets. The inline style sheet is used to control a single element; embedded style sheet is used to control a single page, while the linked external style sheet is used to control the entire site. This is discussed in more details in the following sub-sections.

2.3.1 Inline Style

Inline style sheet provide the finest level of control. This style sheet is written only for the single element. These style specifications appear within the opening tag of the element.

The style specification format for Inline style sheet are as follows:

```
Style = "property_1: value_1; property_2: value_2; ……;property_n:  value_n;"
```

The above syntax appears as a value of the style attribute of any opening tag. Figure 3 shows an example of an inline style.

```
<!DOCTYPE html>
<html><head></head><body>
<table border="2"><tr><td>Normal TD Cell</td>
<td style="font-family: arial; border-style: solid; background-color: red">
IGNOU:BCS053</td>
</tr></table></body></html>
```

Figure 3: An Inline style

The style given in Figure 3 is application for td tag. It will display cell data in Arial font with background color red and solid border. The output of Figure3 is as follows:

The following Inline Style Sheet of Figure 4 sets the background color of a paragraph. Please note that text color and paragraph elements background color have been specified using hexadecimal numbers.

```
<!DOCTYPE html>
<html>
<head></head>
<body>
<p style="text-transform: capitalize; background-color:#00FFFF; color:#3300CC;">
css examples for inline style sheet</p>
</body></html>
```

Figure 4: Example of Inline style for a paragraph

Output of HTML code of Figure 4:

Using Inline definition, paragraph's data is converted from lowercase to sentence case form style with cyan background and blue text color.

2.3.2 Embedded Style Sheets

This style is placed within the document. For this style sheet, CSS rule can appear inside the <head> element or between the <body> tag contained with a <style> element. The format for this embedded style is as follows:

```
<style type="text/css">…..  rule list ……..</style>
```

The *type* attribute of the <style> element tell the browser the type of style specification which is always *text/css* and rule is written in the following form:

```
Selector {property_1:value_1; property_2:value_2;……;property_n:value_n;}
```

Figure 5 shows an HTML program using Embedded style sheet.

```
<!DOCTYPE html><html><head>
<style type="text/css">
body { background-color: #FF0000; color: #000000;}
 h2, h3 {font-family:  arial, sans-serif; color: #ffffff;}
p { color: #3300FF; font-size:20px;}
</style>
</head><body>
<header> HTML: Version 5.0
<hr><hgroup>
<h2>New features should be based on HTML, CSS and JavaScript</h2>
<h3>Reduce the need for external plugins (like Flash) </h3>
</hgroup></header>
<article>
<p>HTML5 should be device independent</p>
<p>The development process should be visible to the public</p>
</article>
<footer><hr>&copy; 2013 IGNOU</footer>
</body></html>
```

Figure 5: HTML with Embedded stylesheet

Output of the program of Figure 5:

The program in Figure 5 demonstrates how you can override the color of one element by other elements. The color property is defined for body, heading and paragraph elements. The heading is defined within the section heading element named <header> in white color, content of paragraph element is displayed in blue color and footer is in black color. The color of heading and paragraph element overrides the body color. If it is not defined then whole body text is displayed in black color. The <h2> and <h3> are defined within the <hgroup> tag. The <hgroup> tag is used to group heading elements when the heading has multiple levels. The paragraph element is defined within <article> tag. The article tag is used to write text in article form like newspaper and blog. The <hr> element is used to write a horizontal row or line as a separator. The copyright symbol is defined using ampersand sign (‘&’) and copy.

2.3.3 Linking External Style Sheets

As discussed earlier the Inline style are applied within the tag and embedded style apply at document level. In those cases, when style specifications is required in more than one documents then it must be copied in each document. This is not a good practice. Instead, for such cases Linked External Style Sheet can be used. Linked External style exists as a separate file that is linked to a page with the <link> element inside the <head> tag. This file has .css extension and is referenced with URL. Inside the .css file, all style specifications are written which are applicable for the document(s). For linking an external style sheet in a web page, the following command is included:

```
<link rel=”stylesheet”  href=”name_of_file.css”  type=”text/css” >
```

The <*link*> element is used to create a link to css style sheets. The *rel* attribute specifies the relationship between the document containing link and the document being linked to. The *href* attribute specify the URL of the css file.

How to Create an External Style Sheet

External style sheets are created with a similar syntax as document level style sheet.

```
Selector {property_1:value_1; property_2:value_2;…….;property_n:value_n;}
```

Figure 6 contains an external style sheet which can be linked to an HTML document.

```
body { color: #333333;
        background-color: #FFFFFF;  //it indicate white background
        background-image: url(innovation_files/innovation_bg.gif);
      }
  h1 { font-size: 17px;
        color: #ff0000; // red color
        font-family: "Times New Roman", Times, serif;
        font-weight: bold; }
```

Figure 6: An example of External Style Sheet

Save these rules into a text file with the extension .css. In this way, you can write many more elements in .css file. Now, you need to link it to your Web pages.

In example given above, there are defined style sheet rule for only two elements i.e. body and h1. You can define in .css file as many rule as per your requirements. When you include this external sheet in your web page, the heading text is displayed in red bold color and times new roman font with size in 17 pixels. The background-color property is used to display the body color of the web page, in this example, it is white color. The background-image property is used to display an image in background of the body of the page. For this, you can define a path with name of image as a URL of the background-image property.

Precedence of styles

There are several rules that apply to determine the precedence of style sheets. The level of priority depends on the style definition which is closer to the tag. For this order, linked external style sheets have lower priority than embedded style sheets, which are of lower priority than inline style sheets. If the browser did not find any style specification then it uses default property values of its own.

Figure 7 shows a CSS file and related HTML code as well as display of HTML file in a browser window.

CSS File name: ignou.css

```
p{color:blue;}
```

HTML file

```
<!DOCTYPE html>
<html><head>
<link rel="stylesheet"  href="ignou.css"  type="text/css" >
<style>p{ color:green;}</style>
</head><body>
<p style="color:red;">BCA:BCS053</p>
</body></html>
```

Figure 7: An example to show precedence of style sheet

In the above code, style definition is given at inline, embedded and external level for <p> element. The paragraph data 'BCA:BCS053' is displayed in red color. Inline styles override the embedded and external style.

In the above code, if you delete the style attribute from paragraph <p> element, then paragraph data will be display in green color. If you will delete both the styles from inline and embedded level then color of paragraph will be displayed in blue color.

Style Sheet for more specific tags has priority over general tags. For example, if a page has <body> tag with a certain style definition and an <h1> tag with the same properties and different value then the style defined in <h1> tag will have the priority, even though it is also part of the body.

Consider the following example for the above definition. In this case, content of heading will be display in red with light grey background.

```
body{color: #000000; background-color: #FFFFFF; }
h1{color: #FF0000; background-color: #D3D3D3;}
```

For more rules, you may please refer to the website http://www.w3schools.com

Check Your Progress 1

1. Explain the term CSS.

---
2. Define the term ‘Rule’ in respect of CSS.

---
3. What are different ways to apply styles to a Web page?

---
4. What is embedded style sheet? Explain with example.

---
5. What is external Style Sheet? How to link?

2.4 Some Basic Properties in CSS

In the previous sections, you have gone through the basics of style sheet and how to use them along with the web document. This section and next section provides details on some of the properties relating to font, lists, color and alignment of text. A detailed discussion on all the properties is beyond the scope of this Unit. However, you may refer to http://www.w3schools.com for more details on various properties.

2.4.1 Font Properties

The font properties are most commonly used style sheet property. It allows you to control the appearance of text in a web document.

font-family Property:

The font-family property allows you to specify typefaces that should be used for the text. The typeface is the name of font.

For example:

```
font-family: arial, verdana, sans-serif
```

In this case, the browser will use *arial* if it support that font. If not, it will use *verdana* if it supports it. If the browser supports neither arial nor verdana, it will use *sans-serif*. If the browser does not support any of the specified fonts then it will use a default font of its own. If font name has more than one word like Times New Roman, the whole name should be delimited by single quotes as ‘Times New Roman’.

font-size Property:

The font-size property is used to specify a size of the text. You can specify a size value for this property in several ways:

- Absolute Size: xx-small, x-small, small, medium, large, x-large, xx-large
- Length: px, pt, em, cm, mm

- Relative Size: smaller, larger
- Percentage: 2%, 10%, 25%, 50%

You can use any of the above value for this property. The most common unit is px for pixels. The pt (points) may also be used. For other ways you may refer to further readings.

The following example shows font-size property using different units for heading <h1> to <h4>.

```
h1 { font-size: medium; }
h2 { font-size: 18px; }
h3 { font-size: 14pt; }
h4 { font-size: 10%; }
```

font-weight Property:

This property is used to define a degree of boldness of text. Some value for this property is normal, bold, bolder, lighter, 100 and 200.

For example: The following example shows font-weight property using normal and bold as an value for heading element <h4> and <h5>.

```
h4{font-weight: normal ;}
h5{font-weight: bold ;}
```

font-style Property:

The font-style property is used to specify a normal and italic font for the text.

In following example, normal font style is defined for heading 5 and italic font style for heading 6.

```
h5{ font-style: normal; }
h6{ font-style: italic; }
```

font Property:

This font property is used as shorthand to declare all of the font properties at once. Consider the following specifications:

```
<p style="font: bold  italic 12pt verdana">BCS053</p>
```

This specifies that the font weight should be *bold*, font style should be *italic*, font size should be *12 points* in *verdana* typeface.

2.4.2 List Properties

As you know, there are two types of lists namely ordered lists and unordered lists. In ordered lists, the list items are marked with bullets and in unordered lists, list items are marked with numbers or letters.

Using CSS rules, the lists can be more styled and images can be used in place of bullets and numbers as the list item marker. The list properties allow you to control the presentation of list item markers. The different list properties are:

list-style-type Property:

The list-style-type property is used for specifying the 'list style type'. Using this property, you can set different list item marker for ordered and unordered lists.

For example: In the following example, there are two classes are defined i.e. 'a' and 'b' which is used with ordered list and another two classes 'c' and 'd' is used with <li> element of unordered list. When you are used class 'a', the list item of ordered list is displayed in lower-roman form. Using class 'b', list item are marked as upper-alpha. For unordered list, using class c and d, list markers are displayed in square and circle form.

```
<!DOCTYPE html><html><head><style type="text/css">
ol.a {list-style-type: lower-roman ;}
ol.b {list-style-type: upper-alpha ;}
li.c {list-style-type: square ;}
li.d {list-style-type: circle ;}
</style></head>
<body><h3>List style type property for ordered list : lower roman</h3>
<ol class="a"><li>Maruti Zen</li>
<li>Maruti Wagan R</li></ol>
<h3>List style type property for ordered list : upper alpha</h3>
<ol class="b"><li>Maruti Dezire</li>
<li>Maruti Alto</li></ol>
<h3>List style type property for Unordered list : square & circle</h3>
<ul><li  class="c">Honda Activa</li>
<li  class="d">Honda DIO</li></ol></body></html>
```

Figure 8: Example for unordered lists using classes

Output of the above program is Figure 8:

List style type property for ordered list : lower roman

i. Maruti Zen
ii. Maruti Wagan R

List style type property for ordered list : upper alpha

A. Maruti Dezire
B. Maruti Alto

List style type property for Unordered list : square & circle

- Honda Activa
- Honda DIO

list-style-position Property:

The list-style-position property indicates position of the list item marker. This property contains two values: inside and outside. The inside value places the marker inside the display

box and outside places them outside the box. By default, the value of list-style-position property is outside.

The following example shows that the list style positions for ordered and unordered list. For unordered list, list style position of item marker are placed inside the box and for ordered list, position of item marker are outside the box.

```
ul {list-style-position: inside ;}
ol {list-style-position: outside ;}
```

list-style-image Property:

Using this property, you can specify an image as list item marker for unordered list. This property takes precedence over the type of marker specified by the *list-style-type* property.

For example: When you are applied the following rule in your page, list item marker are displayed as an image for unordered list.

```
ul { list-style-image: url("Img.gif"); }
```

list-style Property:

This property is used to set all the properties of list in one declaration.

For example:

```
ul { list-style: circle  inside  url("Img.gif"); }
ol { list-style: upper-roman  outside ; }
```

2.4.3 Color Property Value Forms

The style definition includes different property values in different categories such as colors, fonts, list, alignments of text and many more. The complete property values for all the categories are beyond the scope of this Unit. You can refer to http://www.w3schools.com for complete details. In this section, you will be introduced to one of the most used property value – color value. You can specify a color property as color names such as Red, Yellow etc or a six-digit hexadecimal number with 2 hex digits each for Red Green Blue (RGB) or using RGB form.

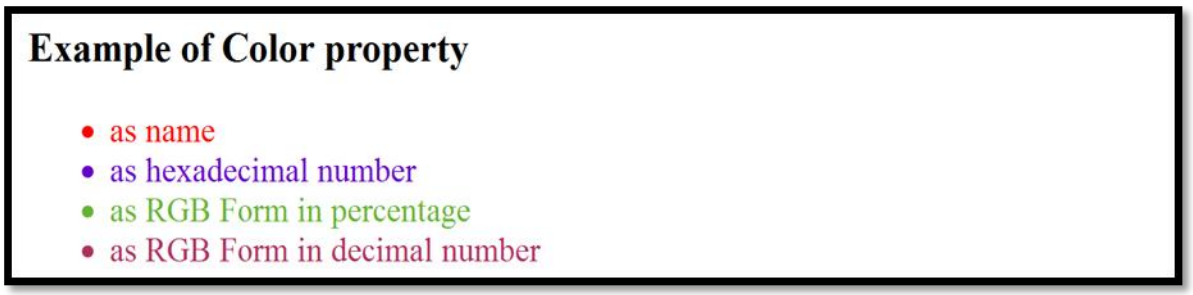
Besides the standard color names, there are a wide variety of names used for colors. For example, Blue color has many shades with different names i.e. light blue, dark blue. Some web browsers may not recognize these names. The most reliable way to specify a color in style sheets is hexadecimal code. This is because any Web browser, even an old one, recognises the hexadecimal notation as a color code. The hexadecimal notation is preceded by hash character '#'. As the base of hexadecimal is 16, you could use any one of 16^6 = 16,777,216 values for a color. In RGB form, you can write *rgb* followed by decimal number between 0 to 255 or as percentages within parenthesis. Here are the depictions of different form of color notation:

```
<!DOCTYPE html>
<html><head><title>BCA:BCS-053</title>
</head><body>
<h3> Example of Color property</h3>
<ul><li style="color:red"> as name</li>
<li style="color:#6600CC"> as hexadecimal number</li>
<li  style="color:rgb(40%,70%,20%)"> as RGB Form in percentage</li>
<li  style="color:rgb(176,48,96)"> as RGB Form in decimal number</li>
</ul></body></html>
```

Figure 9: HTML code specifying colors

Output:

Figure 9 uses the color property using inline style sheet for unordered list. The color code is defined in different forms such as simple color name, hexadecimal number and RGB form.



2.4.4 Alignment of Text

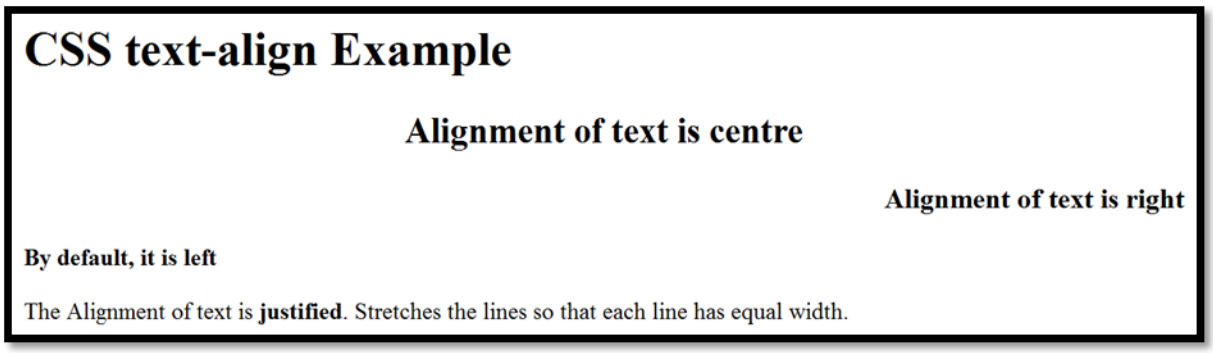
The ***text-align*** property specifies the horizontal alignment of text in an element. By default, it is left. You can define the alignment of the text by the following manner:

For example: The following program contains the different form of text alignment.

```
<!DOCTYPE html>
<html><head><title>BCA:BCS-053</title><style>
h2 {text-align:center}
h3 {text-align:right}
p {text-align:justify}
</style></head><body>
<h1>CSS text-align Example</h1>
<h2> Alignment of text is centre</h2>
<h3>Alignment of text is right</h3>
<b>By default, it is left</b>
<p>The Alignment of text is <span style="font-weight:bold;"> justified</span>.
stretches the lines so that each line has equal width. </p>
</body></html>
```

Figure 10: Styles of Text Alignment

Output of the above program:



The above CSS text-align property example shows the all forms of text alignment such as left, right, centre and justify.

2.5 Selector Forms

As the names indicate that the selectors are used to 'select' element or group of elements on an HTML page. In other words, you can say that selector is a pattern which can apply to different element(s). By using the selector, you can select elements in several ways. The general form of selector is as follows:

```
Selector{property: value;}
```

Here are depictions of the different types of selectors:

2.5.1 Simple Selector

The simple selector form is used for a single element, such as <p> element. It is a normal form of writing CSS rule. In this case, rule is applied to all the occurrences of named element. For example,

```
p {font-weight: bold; color:#336633}
```

In the above case, rule is written for all the <p> elements in a page. The text is displayed in a bold and green color. The following rule is described for grouped selectors in which rule is written once but it apply to more than one selector. This is way of shorthand writing of CSS rule. The rule is applied to both the heading elements.

```
h1, h2 {font-family: arial, book old style, book antiqua;}
```

2.5.2 Class Selector

Class selector is used to apply same style specifications to the content of more than one kind of elements with HTML class attribute. In style specification definition, the class attribute is defined with a name which is preceded with a period. Then, in the body of pages, you refer to these attribute name to activate the element tag. The general syntax for a Class selector is:

```
.ClassSelectorName {Property:Value;}
```

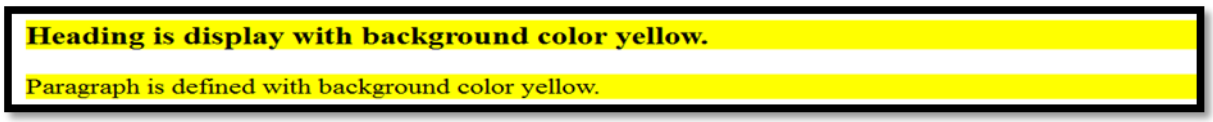
For example shows a simple class selector namely *bgcolor_tag*:

Source code for class selector:

```
<!DOCTYPE  html>
<HTML><HEAD><title>IGNOU:BCS-053</title>
<style type="text/css">
.bgcolor_tag{background-color:yellow;}
</style>
</HEAD><BODY>
<h3 class="bgcolor_tag">Heading is display with background color yellow.</h3>
<p class="bgcolor_tag">Paragraph is defined with background color yellow.</p>
</BODY></HTML>
```

Figure 11: Use of Class selector

Result:



In Figure 11, same class selector is used for heading and paragraph element. You have seen both the elements <h3> and <p> have background-color in yellow. Class selector is also used when you want to specify the style definition to a specific element then you can use element name followed by dot and class selector name. Consider the following example,

```
<!DOCTYPE  html>
<HTML><HEAD><title>IGNOU:BCS-053</title>
<style type="text/css">
p.format {color:red; text-decoration:underline;font-size:20px; font-family:algerian; }
</style></HEAD>
<BODY>
<p>This is normal paragraph</p>
<p class="format">This paragraph is defined with style specification</p>
</BODY></HTML>
```

Figure 12: Use of Class selector for a specific element

The output of the above program is:

2.5.3 id Selector

The id selector is used to select any element in an html page with specific or unique id. In style definition, id attribute is defined with hash character "#". ID selectors are similar to class selectors. The difference between an ID and a class is that an ID can be used to identify one element, whereas a class can be used to identify more than one element. The general syntax for an ID selector is:

```
#idSelectorName{Property:Value;}
```

For example:

Source code for id selector:

```
<!DOCTYPE html>
<html><head><style>
#para1
{
background-color:yellow;
color:red; font-weight:bold;
text-transform:uppercase;
}
</style></head>
<body><p id="para1">This is an example of id selector.</p>
</body></html>
```

Figure 13: Use of ID Selector

Result: The paragraph text is displayed in red color with yellow background and text-transform property is converted the lowercase letter to uppercase.

Check Your Progress 2

1. What are the different possible values in text-align property?

---

2. What is font-family? How you can define font-family property for the <p> element in Inline style definition?

---

3. Create an HTML document to display the text in the title bar of the browser. "Welcome to 5th semester".

---

4. Create a page using BOLD, ITALICS, SMALL, SUPERSCRIPT, SUBSCRIPT, UNDERLINE element.

---
5. Explain different forms of color notation in External Style Sheet definition.

2.6 The Box Model

In a document, each element is represented as a rectangular box. In CSS, each of these rectangular boxes is described using the box model. Each box has four edges: the **margin** edge, **border** edge, **padding** edge, and **content** edge. Each edge may be broken down into a top, right, bottom, and left edge. This model is shown in the Figure 14.

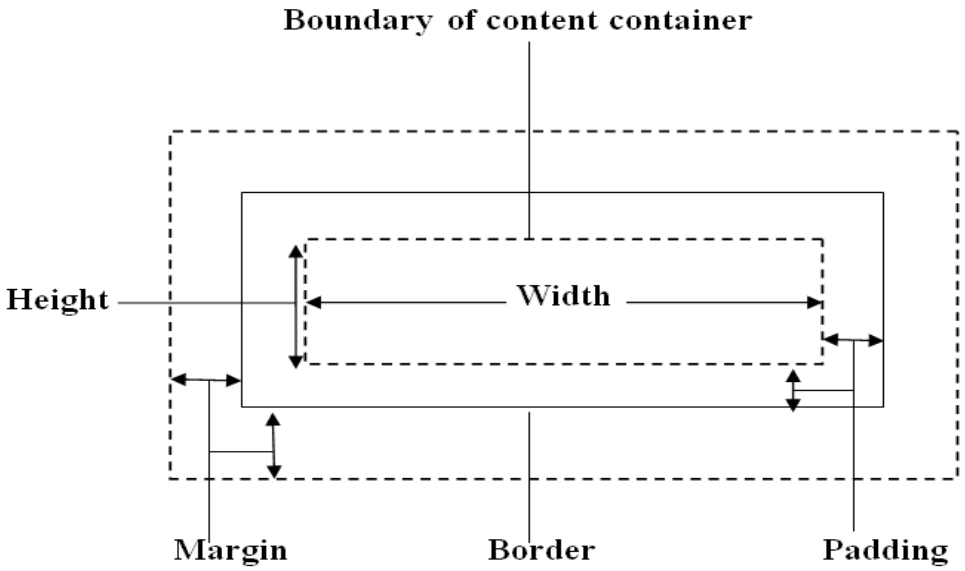


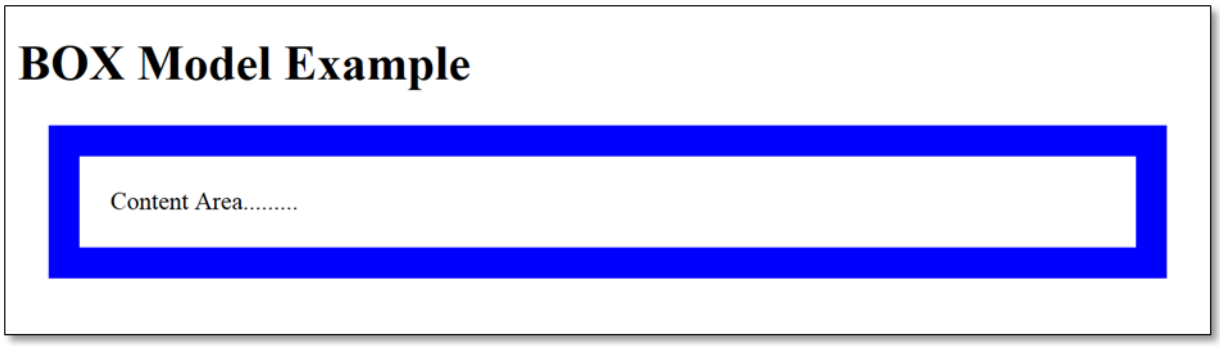
Figure 14: The Box Model of HTML

The innermost area of box model is content area where the text and images appears. The content area is measured by width and height in terms of pixel and percentages. The padding is the space between the content area of the box and its border which is affected by the background color of the box. The border is surrounding area of padding and content. The border is affected by the background color of the box. Every element has a property, ***border-style***. You can set the four sides of element with ***border-left-style***, ***border-right-style***, ***border-top-style*** and ***border-bottom-style***. The outermost area of box model is margin which is completely invisible. It has no background color. Like border edge, margin edge has the properties ***margin-top***, ***margin-bottom***, ***margin-left***, ***margin-right*** and padding have ***padding-left, padding-right***, ***padding-top*** and ***padding-bottom*** which is applies to all four sides of an element.You can set these properties in following manner for any element:

```
<!DOCTYPE html>
<html><head><title>BCA:BCS-053</title>
<style>
p { background: white;      border: 20px solid blue;
margin-top: 20px;          margin-right: 20px;
margin-bottom: 20px;     margin-left: 20px;
padding-top: 20px;          padding-right: 20px;
padding-bottom: 20px;   padding-left: 20px; }
</style></head><body>
<h1>BOX Model Example</h1>
<p> Content Area.....</p>
</body></html>
```

Figure 14: An example of text style specification using Box Model

Output:



You can set all four values using the following shorthand:

padding: [top] [right] [bottom] [left]

For example :

padding: 0 0 0 0;

p{padding:15px 5px 15px 10px;}

The above style code indicate top padding is 15px, right padding is 5px, bottom padding is 15px and left padding is 10px.

p{padding:10px 5px 15px;}

It shows padding from top(10px), right and left(5px), bottom(15px).

p{padding:20px 15px;} means top and bottom padding are 20px, right and left padding are 15px. In shorthand, you can write p**{padding:15px;}** means all four paddings are 15px.

In the similar way, you can define the margin property also.

2.7 Background Image

Background image, as the name implies, are part of the BACKGROUND of a web page. In HTML page, the most common place to add a background image is the body tag.

The ***background-image*** property is used to place an image in the background of an element. You can set the background image for a page in CSS like this:

```
body {background-image:url('logo.gif');}
```

By default, the image is repeated so it covers the entire element. This repetition is called tiling. Tiling is controlled by the **background-repeat property** which take the value ***repeat***(by default), ***repeat-x***, ***repeat-y*** *and* ***no-repeat***. The repeat-x value means that the

image is to be repeated only horizontally, repeat-y means to be repeating vertically and no-repeat specifies that only one copy of the image is to be displayed. You can also set the position for an image by using the **background-position property** which includes values top, center, left, right and bottom. You can set these values in different combinations i.e. right top, top left, bottom right and top center.

Example Source Code for background image:

```
<!DOCTYPE html>
<html><head><title>BCA:BCS-053</title>
<style>
body
{
background-image:url('logo.jpg');
background-repeat:no-repeat;
background-position: top left;
}
h1{text-align:center}
</style></head><body>
<h1>CSS Background Example</h1></body></html>
```

Figure 15: Specifying Background Image

Output:

In the above example, only one copy of image named 'logo.jpg' will be display in top left corner of the screen. You can also use the shorthand property for the above CSS code:

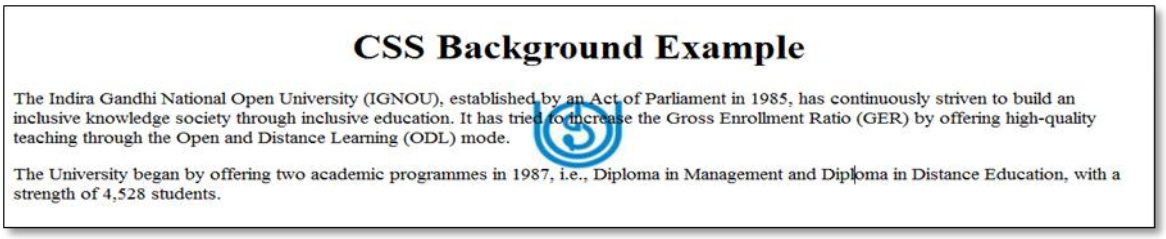
```
body {background: url('logo.gif') no-repeat top left;}
```

Consider the following example for background image:

```
<!DOCTYPE html>
<html><head><title>BCA:BCS-053</title>
<style>
body
{
background-image:url('logo.jpg');
background-repeat:no-repeat;
background-attachment:fixed;
background-position:center;
}
h1{text-align:center}
</style>
</head><body>
<h1>CSS Background Example</h1>
<p> The Indira Gandhi National Open University (IGNOU), established by an Act of Parliament in 1985, has continuously striven to build an inclusive knowledge society through inclusive education. It has tried to increase the Gross Enrollment Ratio (GER) by offering high-quality teaching through the Open and Distance Learning (ODL) mode.
</p>
<p>The University began by offering two academic programmes in 1987, i.e., Diploma in Management and Diploma in Distance Education, with strength of 4,528 students
```

Figure 16: Using Background Image

Output of the above program:



In the above example of background, only one copy of image will be display in the centre of the page. The background-attachment property is used to fix the position of the image. If the length of content is large, then page will be scroll but the image position is fixed in the centre.

2.8 The and Tags

Both the elements and are used to group and structure an HTML page and will often be used together with the selector attributes *class* and *id.*

The **div** (short for Division) elements define logical divisions in a web page. The tag is used as a container for a group of elements. It is not seen on a webpage, but works behind the scene to organize the layout of a webpage a certain way. It acts a lot like a <p> element, by placing new lines before and after the division. A division can have multiple paragraphs in it.

The **span** element has very similar properties to the element, in that it changes the style of the text it encloses. But without any style attributes, the element will not change the enclosed items at all. To use the element, simply surround the text that you want to add styles to with the and tags.

The element is used to define the style of whole sections of the HTML page whereas the element is used to style a part of a text. Div is a block-level element, while span is an inline element. Just to remind you that a block level html element is displayed from a new line like <p>, whereas an inline element is appended to the same line.

For example:

```
<!DOCTYPE html><html><head><title>BCA:BCS-053</title>
<style>
  .format{color:#FF0000; background-color:#99FFCC;}
   #edit{background-color:#9966CC; color:#FFD700;}
</style>
</head><body>
<h2>Div& Span Tags Example</h2>
<div id="edit">
<ul><li><span class="format">Republic Day </span>
of India which is celebrated on 26<sup>th</sup> January. </li>
<li> India gained its independence on
<span class="format">15<sup>th</sup> August 1947</span>. </li>
```

Figure 17: Example of use of and tags

Output of the above example is as follows:

In the above program, the highlighted text '*Republic Day*' and '*15th August 1947'* are displayed in red text color and cyan background by element and rest of the yellow text with purple background by element. Div tags can be used for organising different sections of a web page using different position attributes. A detailed discussion on this is beyond the scope of this Unit. However, we explain the essence of this with the help of example in the next section.

Check Your Progress 3

1. How do you include comments in CSS?

---
2. Explain the box model and its utility with figure.

---
3. Write CSS code for including a background image without repeating in a page?

---
4. What is the difference between and tag?

---
5. Define the CSS padding property.

2.9 USE OF CSS - A Complete Example

In earlier websites, frames and tables were used to organise contents of different web pages. However, div tag and float property provides an alternative to such web page design. The

following example explains such a design in more details. Sometimes it is referred to as table less web layout. It is a method of web design and development without the use of HTML tables for page layout control purposes. Using the DIV-based layout, you can change the entire look of the website by just changing the definitions in the CSS file. The CSS float property is a very important property for layout. You cannot float every element on a Web page. It can be used only for block-level elements such as images (<img>), paragraphs (<p>), divisions ( ) and lists (<ul>).

The float property is used to specify an element to float either left or right in a web page. It has different property values such as left - the element floats to the left and right - the element floats to the right. Another CSS property, clear is used to clear the floated elements. It has three options such as left – clears all left-floated elements, right – clears all right–floated elements and both - clears all floated elements.

In the given example, the web page contains five sections i.e. Header - display a heading, Left – used for menu like navigation, Content - text of the web page, Right – display events details and Footer - for copyright information. The external style sheet is created for this example named CSSLayout.css. Another file main.html is also created for the web page. The CSSLayout.css file is included in main document using link element. Inside the CSSLayout.css file, all style specifications are written which applicable for the main document.

Source Code for CSSLayout.css

```
body{color:#000; font-size:18pt; margin:0; padding: 0; }

.container{width:100%; }

.left{float:left; background:#ffcc00; width:300px; height:500px; padding-left:
20px;}

.right{float:right; background:#ff00cc; width:300px; height:500px; padding-left:
20px;}

.header{background:#ff0000; text-align:center;font-size:30pt; height:100px;}

.content{ float:left;width:600px; text-align:justify;}

.footer{clear:both; background:lightblue; font-size:15pt;}
```

Figure 18: A CSS file to be used with main.html

Please note that .container, .left, .header, .content and .footer are all classes. The property of these classes has been defined in the CSS given above. Please also note how are they refered in the main.html file.

Source Code for main.html

```
<!DOCTYPE html><html><head>
<link type="text/css" rel="stylesheet" href="CSSLayout.css" /></head><body>
<div class="container">
<div class="header">Indira Gandhi National Open University<br>SOCIS</div>
<div class="container">
<div class="left"><menu>
<li><a href="About.html">About Us</a></li>
<li>Programme</li>
<li>Results</li>
<li>Contact Us</li>
</menu></div>
<div class="content"><h3>Table Less DIV Based Layout using Float</h3>
Content within a div tag will take up as much space as it can, namely 100% of
the width of the current location, or the page. So, to affect the location of a
section without forcing it to a fixed width, you can change the padding or the
margin elements. </div>
<div class="right">Event<br>
<details><summary>BCS:053</summary>
<p>Unit 1: Web 2.0 and HTML5<br>
Unit 2: Style Sheets<br>Unit 3:  XML<br>
Unit 4: JavaScript<br>Unit 5: WAP & WML</p></details>
<details><summary>Datesheet</summary>
<p>Datesheet for BCA students</p></details>
<details><summary>Prospectus</summary>
<p>Prospectus for BCA students</p></details>
</div></div>
<div class="footer"><footer><hr>&copy; 2013 SOCIS, IGNOU. Design&
developed by PoonamTrikha</footer></div>
</div></body></html>
```

Figure 19 : HTML File - main.html

The output screen-1 for the above program is as follows:

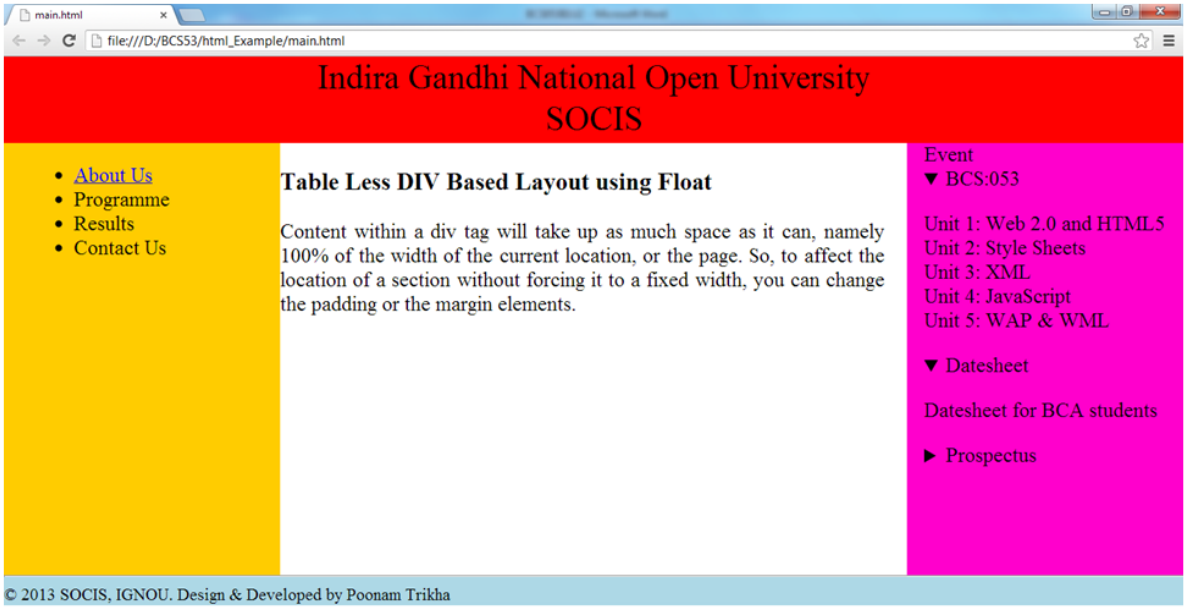


Figure 20: Output of Figure 19 HTML file using CSS of Figure 18

In the above output screen-1, header part shows the heading of the page and left column show the navigation item names such as About Us, Programme, Results and Contact Us. The navigation names are displayed by using the menu element. (You can remove the dots in this list using a CSS property; it is left as an exercise for you.) Please note that each of these navigation elements is pointing to another html file. The centre part is for writing the text of the web page and right column is displayed the events & schedule for the students by using details and summary tags. The <summary> tag defines a visible heading for the <details> element. You can click on the heading to view/hide the details. In this example program, the heading BCS053 and Date sheet is displaying the summary information and prospectus heading hide the details. The second output screen shows the same information regardless the position of the left and right column. For the second program, you can write the same program and just exchange the position of left and right column.

The difference between the following program and the above program is that the position of left column is replaced with the right column and vice versa. You can run the above and following program to see differences. Please note that the program is run only in Google Chrome due to the <summary> and <details> tags.

```
<!DOCTYPE html><html><head>
<link type="text/css" rel="stylesheet" href="CSSLayout.css" />
</head><body>
<div class="container">
<div class="header">Indira Gandhi National Open University<br>
SOCIS</div>
<div class="container">
<div class="left">Event<br>
<details><summary>BCS:053</summary>
<p>Unit 1: Web 2.0 and HTML5<br>Unit 2: Style Sheets
<br>Unit 3:  XML<br>Unit 4: JavaScript
<br>Unit 5: WAP & WML</p></details>

<details><summary>Datesheet</summary>
<p>Datesheet for BCA students</p></details>

<details><summary>Prospectus</summary>
<p>Prospectus for BCA students</p></details>

</div>
```

Figure 21: An HTML program

The output screen-2 for the above program is as follows:

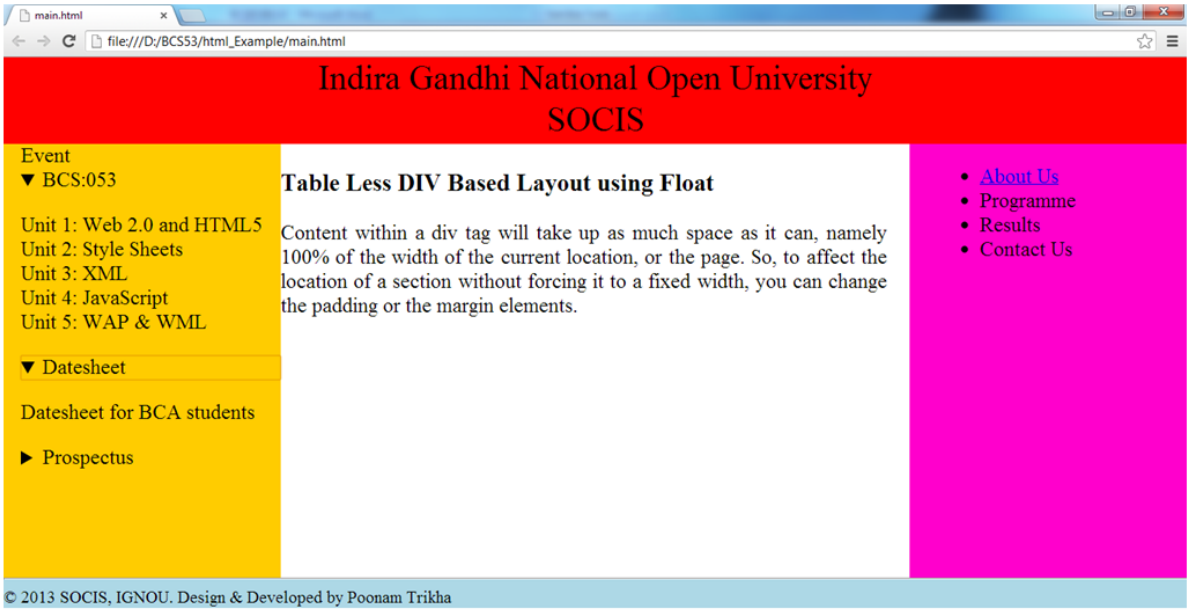


Figure 22: Display of HTML code of Figure 21

2.10 Summary

You have learned more about the Cascading Style Sheet. It is a mechanism for adding styles such as font, color, images in background to web pages. The CSS specifications are maintained by the World Wide Web Consortium (W3C). There are three ways to include CSS code in your web pages viz., inline, embedded and external. In inline style definition, you can include the style definition within the tag. Inline styles are easy and quick to add.

You do not need to create a whole new document as with external style sheets. The inline style sheet has high precedence over the other embedded and external style sheet. But, Inline style is not the best way to design a web page because it can be more difficult to find out where a style definition or rule is being set. Instead of using Inline style, you can use embedded style definition in your page. It is placed within the head section of the page. But the best way to include style in your web pages is external style sheet. In external style sheet, you can write style rules once and it is reflected in all the web pages in your site. You have also learned about the font, list, color property and box model. In CSS, box model is used for the layout of the web page. The div is most of the important element in html because in combination with CSS properties, it can give more effect in web pages. You can use any element in div tag. By using div tag, you can create a block level section in the web page. Each section can have its own formatting. Span is similar to div element. Both divide the content into individual sections. The difference is that span goes into a finer level, so you can span to format a single character if needed. In this unit, there is more exercise for you in form of questions.

You have learned HTML5 (in previous unit) and CSS rules. Now, you can design simple web page using CSS. Try to develop web sites by linking various web pages.

2.11 Solutions/Answers

Check Your Progress 1

Ans.1:
CSS is a web standard that describes style for XML/HTML documents. Cascading style sheet is used to control the layout of multiple pages at once. The CSS code is written in a separate file with extension .css. It is a mechanism to write and modify style definition in css file, and the changes will be reflected in all the web pages in which the css file is linked with link element.

Ans.2:
The CSS rule is a way of writing a code that allows web designers to define styles definition easily and effectively for HTML pages. For example, <p style=”font-weight: bold”>some text</p>.

Ans.3:
There are three ways to insert CSS into web pages by using inline, document or embedded level and external style sheet. In inline style definition, you can include the style definition within the tag. In document level, it is placed within the head section of the page. But the best way to include style in your web pages is external style sheet. In external style sheet, you can write style rules once and it is reflected in all the web pages in your site.

Ans.4: body {background: url('logo.gif’) no-repeat top left;}

Ans.5:
External style sheet is a file containing only style definition code which can be linked with any number of HTML documents. This is the way of formatting the entire site. External style sheet must have extension .css i.e. style.css. The file is linked with HTML documents using the LINK element inside the HEAD element. The following is the way to use external style sheet in a page. <link rel=”stylesheet” href=”name_of_file.css” type=”text/css” >

Check Your Progress 2

Ans.1:
The text-align property is used for horizontal alignment of the text. By default, it is left. Text can either be aligned to the left, right, centred and justify.

Ans.2:
The font-family property specifies the font for an element. The font-family property can hold several font names such as arial, Tahoma and many more. If the browser does not support the first font, it tries the next font and so on.

Ans.3:
<!DOCTYPE html><html><head><title>Welcome to 5th Semester</title>
</head><body></body></html>

Ans.4:<!DOCTYPE html><html><head><title>BCA:BCS053</title></head><body>
This line is BOLD
<u>This line is UNDELINED</u>
This line is ITALICS
<small>The font of this line is small </Small>
H₂o 2³=8 </body></html>

Ans.5:
You can use different color notation for the web page such as color name, hexadecimal form and RGB form. You can use the following program for the color notation. You can write external style sheet for the program as the following named style.css:

```
p.a{color:blue;}
p.b{color:#ff0000;}
p.c{color:rgb(40%,60%,40%);}
p.d{color:rgb(120,60,96);}
```

Now, you can include the above style.css file in the following program:

```
<!DOCTYPE html>
<html><head><title>BCA:BCS-053</title>
<link rel="stylesheet"  href="style.css"  type="text/css" >
</head><body><h3> Example of Color property</h3>
<b><p class="a">Color property as name</p>
<p class="b">Color property as hexadecimal number</p>
<p class="c">Color property as RGB Form in decimal number</p>
<p class="d">Color property as RGB Form in percentage</p></b>
</body></html>
```

Check Your Progress 3

Ans.1:
You can placed anything between /* and */ in CSS is considered as a comment. Comments are ignored by the web browser.

Ans.2:
The term 'box model' is used in CSS-based layout and design. Every element in HTML can be considered as a box, so the box model applies to all html and xhtml elements. Each box has four edges: the margin edge, border edge, padding edge, and content edge. Each edge may be broken down into a top, right, bottom, and left edge.

Ans.3:
body { background-image:url('logo.jpg'); background-repeat:no-repeat;
background-attachment:fixed; background-position:center; }

Ans.4:
The element is used to define the style of whole sections of the HTML page whereas the element is used to style a part of a text. Div is a block-level element, while span is an inline element.

Ans.5:
The CSS padding properties define the space between the element border and the element content. In CSS, it is used to specify different padding to all four sides of an element. For example :

```
padding-top:25px;
padding-bottom:25px;
padding-right:50px;
padding-left:50px;
```

2.12 Further Reading

1) Beginning Web Programming with HTML, XHTML and CSS by Jon Duckett. Publisher: Wrox.
2) HTML & CSS :design and build website by Jon Duckett.
3) Programming the World Wide Web by Robert W. Sebesta. Publisher:Pearson
4) HTML 4 Unleashed by Rick Darnell. Publisher: Techmedia
5) http://www.w3schools.com

Unit 3: Introduction to XML

Structure

3.0 Introduction

XML is widely used for the definition of platform-independent method of storing and processing texts in electronic form. It is also the interchange and communication format used by many applications on the Internet. In this Unit we introduce its basic concepts and attempt to make you independent to use its various applications.

In the first two Units of this Block you have gone through the concepts of HTML and Stylesheets. HTML is a Markup Language that uses standard tags, XML extends those tags to the domain of user defined tags. Therefore, this Unit will help you to go deeper into the aspects of topics covered in Unit1 and Unit 2. To design a cleaner HTML pages, knowledge of XML is useful. This unit will help you to write the valid xml, with formatting features using style sheets, that you have studied in the Unit 2.

3.1 Objectives

- Define the use of XML
- Define the basic terminology used in XML
- Create an XML document
- Create XML Schema and DTD
- Verify XML documents
- Create a simple display style for XML document

3.2 What is XML?

XML stands for eXtensible Markup Language. Very much like HTML, XML is also a markup language. The essence of XML is in its name:

Extensible

It lets you define your own tags. Tags are displayed in the same order as they are defined in your xml document.

Markup

The basic building block of any xml document is its tags, also called as elements. These are very much similar to the ones which are being used at html.

Language

XML is a language similar to HTML, though more flexible giving you option to create your own custom tags. Basically we can call it as meta-language also as it allows us to define or create other languages.

3.2.1 Need for XML

As you know that, HTML is designed to display documents in a web browser. It becomes cumbersome if you want to display the documents in some other language or upgrade the document for dynamic data display. XML is just suited for this purpose. It can be used in a variety of contexts. XML is used to store data in plain text format using various Unicode formats. XML data can be used by various other programming languages. This makes it easy to carry data irrespective of any platform. XML is also used as the base

language for the communication protocols such as XMPP (eXtensible Messaging and Presence Protocol). XMPP protocol, called as Jabber protocol also sometimes, functions with servers to facilitate near real-life operation, and may even allow the internet users to send instant messages (IM) to anyone else on the internet irrespective of their operating systems and browsers.

XML provides users the flexibility to define their own tags. Using meaningful tags you can structure the data, which makes it easier to transport later on and define their document structure

XML, as a document, does not do anything. It is the software which uses this document to connect with the Database and does the processing of data. XML is recommended by W3C as well, in Feb'98 for the purpose of storing and transporting data. XML is so flexible and powerful that it was used for creating other Internet Languages such as XHTML(Extensible HyperText Markup Language), WML(Wireless Markup Language), SMIL(Synchronized Multimedia Integration Language) etc. In HTML, users are supposed to use pre-defined tags only such as <p>, <table>, <b>, <i> etc. thus providing limited flexibility to the users.

Precisely we can say that HTML is a presentation language, and XML is a data-description language.Let's have a look at the sample program below:

```
<?xml version="1.0"?>

<test>

    <text1>My First XML</text1>

    <text2>Let's have coffee after dinner!</text2>

</test>
```

Figure 1: A Simple XML program

Write this text in simple notepad and save it with the extension ".xml". Now, open this file using Internet Explorer (or any other browser) and you will see the output as:

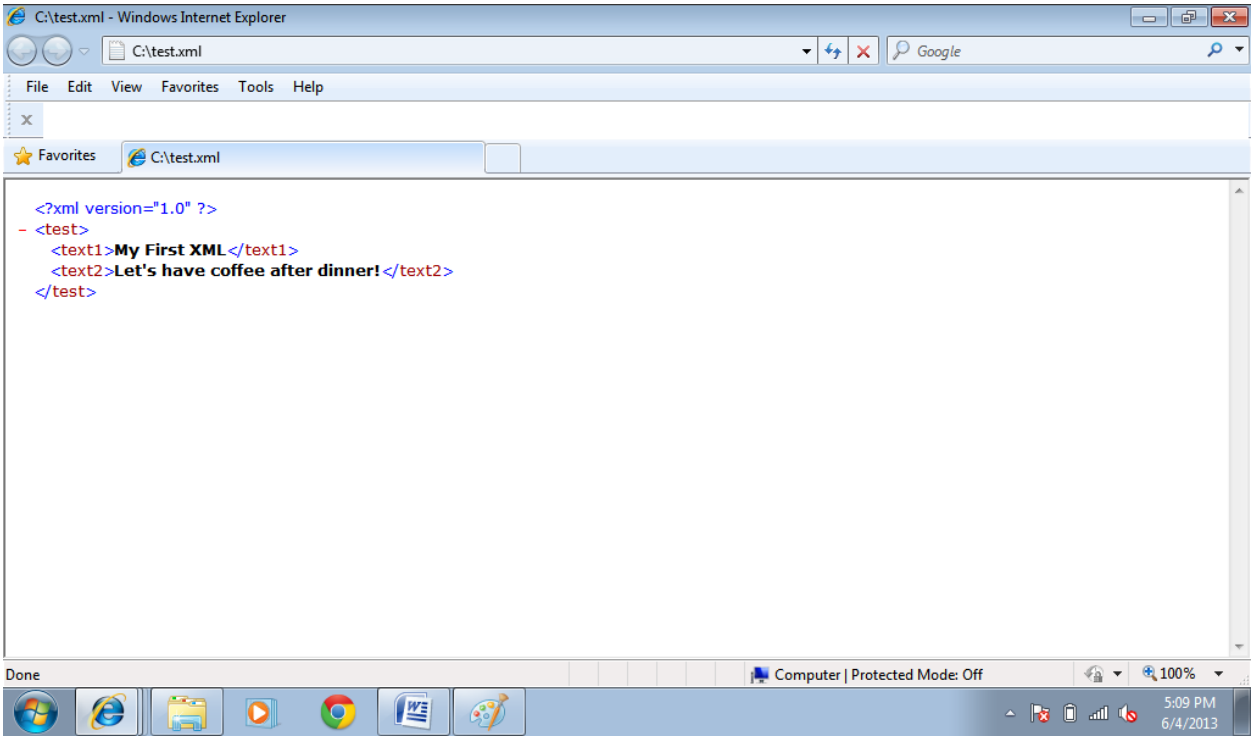


Figure 2: Display of XML program of Figure 1 in a Browser

Unlike in HTML, in XML you have to put an end tag to close open element tag, use similar capitalization in opening and closing tags, and don't use improperly nested tags. Please note that XML tags are case sensitive, that is.<text1> tag is different from <Text1> or <TEXT1> tag. If opening tag is <text1> and closing tag is </Text1>, document will be incorrect.

3.2.2 Various Terms of XML

Let us define various terms used in XML

Tags

A markup construct begins with < and ends with >. Tags are defined as:

- Start tags ; e.g. <test> in Figure 1
- End tags ; e.g. </test> in Figure 1
- Empty-element tags; for example: <line-break /> or
- <car attribute = "value" />

An element with no content is said to be empty. The representation of an empty element is either a start-tag immediately followed by an end-tag, or

an empty-element tag which is place a forward slash before the greater than symbol before the end of the tag i.e. <car />.**Element**

An element is logical part of a document that begins with start tag and ends with a matching end-tag. It can also contain an empty- element tag. The characters between start-tag and end-tag are the element's content, and may also contain other elements which are called as child elements.

For Example:

```
<document>
    <para1>sample text1</para1>
    <para2>sample text2</para2>
</document>
```

Figure 3: An XML tag with child elements

Here, <document> is the element and <para1>, <para2> are the child elements.

Attribute

An attribute is a markup which contains a name-value pair between start-tag and end-tag. For example <car type="SUV">, where type = "SUV" is the name-value pair.

Now, as we discussed earlier that XML is extensible , if we update the XML by adding or removing some tags, it immediately reflects the same on the click of refresh button on the browser. For example, if we update the example of Figure 3 as:

```
<?xml version="1.0"?>
<test>
    <text1>My First extensible XML</text1>
    <text2>Let's have coffee after dinner!</text2>
    <text3>After that, let's go for a long drive.</text3>
</test>
```

Figure 4: Modified version of Figure 3

And it will look like this, upon refresh:

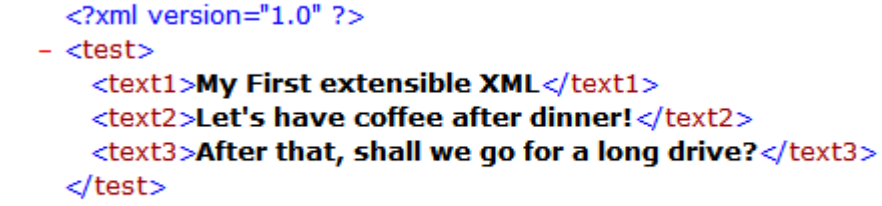


Figure 5: Display of Figure 4.

3.2.3 XML Document Structure

This section explains the document structure of an XML document. XML documents form a tree-like structure that has root and various branches. The following example shows various parts of XML document:

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

<test>

<text1>My First XML</text1>

<text2>Let's have coffee after dinner!</text2>

</test>

Figure 6: Components of XML document

- The First line is the XML declaration. This line identifies the XML version and the encoding used. In Figure 6, XML version is 1.0 and the encoding is ISO-8859-1, a standard coding close to ASCII.
- The next line is the root element of the document. It describes that this document defines a document structure named test.
- Next 2 lines contain the 2 child elements of the root element test.
- The last line describes the end of the root element.
- Comments can be written in XML document in the same way as are written in an HTML document. For example, <!—This is a comment-->

XML ELEMENTS

All the XML documents must have the ROOT Element. An XML document can be described as a tree. The ROOT element marks the beginning and end of the document tree. Each XML document may have the nested level of the sub-elements, attributes, text. For Example:

```
<Root>
<Parent>
    <Node1>
        <subNode1></subNode1>
        <subNode2></subNode2>
    </ Node1>
    <Node2>
        <subNode1></subNode1>
            <subNode1.1>Text Here!!!<subNode1.1>
        <subNode2></subNode2>
    </ Node2>
</Parent>
</Root>
```

Figure 7: Tree Structure of XML document

Here < subNode1> and < subNode2> are the sub-elements of <Node1>.

< subNode1.1> is the 2nd level of nesting for <Node2> and,

<subNode1> and <subNode2> are the 1st level of nesting for <Node2>.

Attributes

Attributes are used for storing additional information required to be displayed for any element. Attributes do not store any data as data is

dynamic in nature and it becomes difficult to maintain as a part of the attribute. Elements are the best option for storing data in an XML document.

Another important point is that Attribute values shall always be quoted. For Example:

<Student name=”Ved Prakash Sharma”>

</Student>Here “Ved Prakash Sharma” is the attribute value for the element <Student>. Like this many more attribute values can be added to this element such as age, address, qualifications etc. Adding too much attributes to an element makes it difficult to maintain later on.

Empty-Element tag

Some elements are said to be empty like <br>, <img>. In <img> all information is contained in its attributes.
 doesn’t signify any value or attributes, it just means a line break. For empty elements, we need not specify their closing tags. For example,

<emptyElementTag/>

The / at the end signifies that the element starts and ends here. It is an efficient shortcut method to mark up empty elements.

The following example demonstrates use of elements and attributes:

If we take Automobile as Parent, we may have various elements like cars, trucks, bikes etc.

<Automobile>

<car type = “SUV”>

<name>Scorpio</name>

<make>2010</make>

<price>11,000,00<price>

<car>

<car type=”MUV”>

<name>Xylo</name>

```
        <make>2011</make>
        <price>9,000,00<price>
    </car>
    <car type="SEDAN">
        <name>Honda City</name>
        <make>2010</make>
        <price>9,500,00<price>
    </car>
</Automobile>
```

Figure 8: XML elements having *type* attribute

In this example,

<automobile> is the Root Element.

<car> is the root Element, because it contains other elements.

<car> also has one attribute - "type" having various values such as "SUV", "MUV" & "SEDAN". Based on their attribute values, text contents for the following sub-elements are mentioned:

<name>,<make>, and <price> .

Rules

While designing the XMLs, you shall follow certain rules as mentioned below:

XML Document Syntax Rules:

- XML Tags are case sensitive.
- All XML elements shall have closing tags.
- XML Elements shall be properly nested.
- XML Attribute values must be in quotes.
- Some Special characters have entity reference. It means that few special characters are already used as HTML pre-defined tags. So, if we need to

use those characters, we shall write them in a different way as mentioned below:

&lt;	<	less than
&gt;	>	greater than
&amp;	&	ampersand
&apos;	'	Apostrophe
&quot;	"	quotation mark

Now, while naming the XML documents also, you shall follow certain rules such as:

XML Document Naming Rules:

- Names can contain letters, numbers, and other characters.
- Names cannot start with a number or punctuation character.
- Names cannot start with the letters xml (or XML, or Xml, etc.).
- Names cannot contain spaces.

Other than these, any name can be used, as no words are reserved.

3.2.4 XML Namespaces

XML allows you to define your own documents freely thus providing flexibility and open scope. But it is a strong possibility that, when combining XML contents from different sources, there could be inconsistencies between codes in which the **same element name** may serve very different purposes. For example, if you are creating xml document for a bookstore, your use of <title> tag may be used for book's title. A doctor may use the <title> to track patient's formal titles (like Mr., Mrs., Dr., Ms. etc.) on the medical records. While trying to combine these xmls in one system, problem will arise.

XML namespaces provide a method to avoid element and attribute name conflicts in any XML document. XML namespaces attempt to keep different

semantic usages of the same XML elements separate and unambiguous. In this example, each person could define their own namespace and then prefix the name of their namespace to specific tags:<book:title> is different from <patientrecords:title>.

An XML namespace is declared using the reserved XML pseudo-attribute xmlns or xmlns:prefix, the value of which must be a valid namespace name. You can also use a default namespace, which will be implicit in all the child elements. It has the syntax as follows:

xmlns:prefix=”namespaceURI”

A namespace is named as Uniform Resource identifier (URI), identifying an internet resource uniquely, though it does not point to an actual location of the resource. Uniform Resource Locator (URL) is the most common form of URI used.

Any namespace declaration that is placed in a document’s root element becomes available to all the elements in that document. Please note that namespaces have scope. Namespaces affect the element in which they are declared, as well as all the child elements of that document.

For Example:

```
<root xmlns:h=”http://www.w3.org/ “ xmlns:f="http://www.w3schools.com/">

<h:title>
 <h:name>
  <h:first>Vedant</h:first>
  <h:last>Babu</h:last>
  <h:age>16</h:age>
 </h:name>
</h:title>

<f:title>
 <f:bookname>You can Win!!!</f:bookname>
 <f:price>150</f:price>
 <f:author>Shiv Kheda</f:author>
</f:title>
</root>
```

eference : http://www.w3schools.com

Figure 9: XML document with Namespaces

In this example, the xmlns attribute in the <title> tag give the h: and f: prefixes a qualified namespace. So there will not be any name conflict due to same <title> - element name, both having different contents and meanings.

When a namespace is defined for an element, all child elements with the same prefix are associated with the same namespace. Namespaces can be declared in the elements where they are used or in the XML root element. You can also define default namespaces, which will help you in not prefixing any element in the xml document, e.g.:

<root xmlns=http://www.w3.org/TR/html4/

Reference : http://www.w3schools.com

Check Your Progress 1

1. What is a well-formed XML document?

2. What is a valid XML document?

3. What are the rules for naming XML?

3.3 Validating XML Documents

An XML document can be created by you using your own tags. Therefore, there should be a way by which you can find if the created document is valid that is uses correct tags as defined by you. XML provides two major ways of validating XML documents - Document Type Definitions and XML Schema. For validations or any other processing an in-built XML parser is used. Parser is used for "reading" the xml file, analyzing the markup and getting its contents according to the structure, in a program. Let us explain this by the following example:

Here is the structure of an XML file:

<food>

<soup>tomato</soup>

<vegetable>cabbage</vegetable>

<food>

The data structure is a class, having 2 string variables (soup, vegetable) and you parse the xml with tag values such as :

menuFood obj = new menuFood()

Parse(xml, obj)

It will be interpreted as :

Obj[soup:'tomato'; vegetable:'cabbage']

Let us discuss validations in more details in the next sub sections.

4.3.1 Document Type Definitions(DTD)

A Document Type Definition (DTD) defines the legal building blocks of an XML document. It defines the document structure with a list of elements and attributes. If DTD is supplied with the XML file, then the XML parser will compare the contents of the document with the rules that are set in the DTD. If the document does not conform to the rules specified by the DTD, the parser raises an error and indicates where the processing failed.

A DTD can be declared inline inside an XML document, or as an external reference.

Internal DTD Declaration

If the DTD is declared inside the XML file, it should be wrapped in a DOCTYPE definition with the following syntax:

<!DOCTYPE root-element [element-declarations]>

OR

External DTD Declaration

If the DTD is declared in an external file, it should be wrapped in a DOCTYPE definition with the following syntax:

```
<!DOCTYPE root-element SYSTEM "filename">
```

Example DTD with Internal declaration:

```
<?xml version="1.0"?>
<!DOCTYPE test [
<!ELEMENT test (text1,text2,text3)>
<!ELEMENT text1  (#PCDATA)>
<!ELEMENT text2  (#PCDATA)>
<!ELEMENT text3  (#PCDATA)>
] >
<test>
        <text1>My First extensible XML</text1>
        <text2>Let's have coffee after dinner!</text2>
        <text3>After that, shall we go for a long drive?</text3>
</test>
```

Figure 10: Example of Internal DTD

Now, run this XML in the browser and the result would be displayed like this:

```
<?xml version="1.0" ?>
<!DOCTYPE test (View Source for full doctype...)>
- <test>
    <text1>My First extensible XML</text1>
    <text2>Let's have coffee after dinner!</text2>
    <text3>After that, shall we go for a long drive?</text3>
  </test>
```

Figure 11: Display of XML file of Figure 10

You can see the source for the doctype definition. The DTD shown in Figure 10 can be interpreted as:

•*!DOCTYPE test* defines that the root element of this document is *test*

•*!ELEMENT test (test1,test2,test3)* defines that the test element contains three elements: "text1,text2,text3"

•*!ELEMENT text1*, *!ELEMENT text2* and *ELEMENT text3* define that text1, text2 and text3 elements are of the type "#PCDATA" (explained later)

The following example demonstrates the use of external DTD: <?xml version="1.0"?>

```
<!DOCTYPE test SYSTEM "test.dtd">

<test>

    <text1>My First extensible XML</text1>

    <text2>Let's have coffee after dinner!</text2>

    <text3>After that, shall we go for a long drive?</text3>

</test>
```

The test.dtd is :

```
<!ELEMENT test (text1,text2,text3)>

<!ELEMENT text1  (#PCDATA)>
```

<!ELEMENT text2 (#PCDATA)>

<!ELEMENT text3 (#PCDATA)>

Figure 12: XML document with External DTD

DTD defines the main building block of any XML document.

Please note the use of term PCDATA in Figure 10 and 12. It means **parsed character data**. PCDATA is text that WILL be parsed by a parser. The text will be examined by the parser for entities and markup. Tags inside the text will be treated as markup and entities will be expanded.

However, parsed character data should not contain any &, <, or > characters; these need to be represented by the & < and > entities, respectively.

Some time you will find the term CDATA. It means character data. Think of character data as the text found between the start tag and the end tag of an XML element. CDATA is text that will NOT be parsed by a parser. Tags inside the text will NOT be treated as markup and entities will not be expanded.

Attribute Declaration in DTD

Attributes are declared with an ATTLIST declaration.

Syntax:

<**!ATTLIST element-name attribute-name attribute-type default-value**>

For Example, in DTD :

<!ATTLIST car type CDATA “SUV” >

In XML,

<car type= “SUV”></car>

The default value of an attribute can be:

REQUIRED

IMPLIED

EMPTY

DTD:

```
<!ELEMENT car EMPTY>
<!ATTLIST car price CDATA "100000">
```

Valid XML:

```
<car price ="1000000" />
```

In this example, the ”car” element is defined to be empty element with price attribute of TYPE CDATA . If no price is specified, it has default value of 1 L.

#REQUIRED

DTD:

```
<!ELEMENT car >
<!ATTLIST car price CDATA #REQUIRED>
```

Valid XML:

```
<car price ="1000000" />
```

Here “car’ element is defined WITH REQUIRED attribute value. If no price is specified, XML parser will throw an error. So, user is forced to specify the value.

#IMPLIED

DTD:

```
<!ELEMENT car >
<!ATTLIST car price CDATA #IMPLIED>
```

Valid XML:

```
<car price ="1000000" />
```

Here “car’ element is defined with IMPLIED attribute value. It means user is not forced to specify any price value nor any default value is available for this.

You can also used FIXED keyword in the attributes. The following is the syntax of this element.

Syntax

```
<!ATTLIST element-name attribute-name attribute-type #FIXED "value">
```

Example

DTD:

```
<!ATTLIST car manufacturer CDATA #FIXED "Mahindra">
```

Valid XML:

```
< car manufacturer ="Mahindra" />
```

Invalid XML:

```
< car manufacturer ="Hyundai" />
```

Use the #FIXED keyword when you want an attribute to have a fixed value without allowing the author to change it. If an author includes another value, the XML parser will return an error.

Benefits of using DTD:

1. DTDs allow the declaration of standard data types for publishing characters.
2. DTD support is ubiquitous due to its inclusion in XML 1.0
3. DTDs are concise compared to element-based schema and thus present more information in a single screen.
4. DTDs define a document type rather than those defined by the namespaces. It helps in grouping all document constraints in a single collection.

Limitations of DTDs:

1. They have no explicit support for namespaces. All DTD declarations are global, so you cannot define two different elements with the same name, even if they appear in different contexts.

2. DTDs have support only for simple data types.
3. DTDs are not easy to read.
4. DTDs use *regular expression syntax* to describe schema. It means DTD notations are not in XML syntax, so these are not parsed or validated the way an XML document is being treated.

3.3.2 XML Schemas

XML Schema is described as successor to DTD. It also describes the structure of an XML document, and so is also referred to as XML schema definition (XSD). XSDs are more powerful than DTDs in describing XML language. They use a rich data typing system and allow for more detailed constraints on an XML document‘s logical structure. The great strength about schemas is that they are written in XML. So, if you know XML, you may be able to write XML schemas.

The XML schema defines:

- Elements and attributes of an XML document.
- Data types for elements and attributes
- Default or fixed values for elements and attributes
- the child elements
- the number and order of child elements
- empty or non-empty elements

XML Schemas are eXtensible, because they are written in XML. So they can be used in:

- reusing schemas in other schemas
- creating your own data type derived from the standard type
- reference multiple schemas from the same document.

XMLs schemas also support data types, so with this support it is simple to:

- describe document content
- validate data correctness
- work with databases
- define data facets

- define data pattern
- convert data between different data types

With XML schemas, it is easier to send or receive data using defined convention. For example, a date is always misinterpreted in different countries based on the date format they follow. For example, sender country may follow mm/dd/yyyy for date, whereas the receiver country is using dd/mm/yyyy. In such a case a date like 06th August, 2013 may be sent as 08/06/2013 and may be interpreted at receiver as 08th June, 2013. In XML, you can define date as :

<Date type = "date">2013-08-06</date>

Here XML date data type requires the format as "yyyy-mm-dd", thus avoid any chances of confusion.

XML Schema has a lot of built-in data types. The most common types are:

- xs:string
- xs:decimal
- xs:integer
- xs:Boolean
- xs:date
- xs:time

Here are some examples of XML elements:

```
<name>Charlie</name>

<age>36</age>

<dob>1977-08-06</dob>
```

And here are the corresponding simple element definitions:

```
<xs:element name="name" type="xs:string"/>

<xs:element name="age" type="xs:integer"/>

<xs:element name="dob" type="xs:date"/>
```

Example of use of XSD:

XML documents can refer to a DTD or an XML schema, as per example below:

```
<?xml version="1.0"?>

<test>

    <text1>My First extensible XML</text1>

    <text2>Let's have coffee after dinner!</text2>

    <text3>After that, shall we go for a long drive?</text3>

</test>
```

DTD File is as follows: **test.dtd**

```
<!ELEMENT test (text1,text2,text3)>

<!ELEMENT text1  (#PCDATA)>

<!ELEMENT text2  (#PCDATA)>

<!ELEMENT text3  (#PCDATA)>
```

Now XML Schema file is as follows: test.xsd

```
<?xml version="1.0"?>
<xs:schema xmlns:xs="http://www.w3.org/2001/XMLSchema"
targetNamespace="http://www.w3schools.com"
xmlns="http://www.w3schools.com"
elementFormDefault="qualified">

<xs:element name="test">
  <xs:complexType>
    <xs:sequence>
      <xs:element name="text1" type="xs:string"/>
      <xs:element name="text2" type="xs:string"/>
      <xs:element name="text3" type="xs:string"/>
    </xs:sequence>
  </xs:complexType>
</xs:element>

</xs:schema>
```

In this XSD file, <schema> element is the root element of every XML schema It has following attributes.

```
xmlns:xs="http://www.w3.org/2001/XMLSchema"
```

it says that the data types and elements are from this default namespace.

```
targetNamespace="http://www.w3schools.com"
```

it indicates that the elements defined by this schema (test,text1,text2,text3) come from the "http://www.w3schools.com" namespace.

```
xmlns="http://www.w3schools.com"
```

it indicates that the default namespace is "http://www.w3schools.com"

```
elementFormDefault="qualified"
```

it says that any element declared in this schema, shall be used by only those XML instance document which use the same namespace i.e. "http://www.w3schools.com"

A reference to this XML schema file is in the following XML:

```
<?xml  version="1.0"?>

<test xmlns="http://www.w3schools.com"

    xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"

    xsi:schemaLocation="http://www.w3schools.com test.xsd">

      <text1>My First extensible XML</text1>

      <text2>Let's have coffee after dinner!</text2>

      <text3>After that, shall we go for a long drive?</text3>

</test>
```

Here following code fragment means:

```
<test xmlns="http://www.w3schools.com">
```

the default namespace is “http://www.w3schools.com”.

This fragment means :

xmlns:xsi=http://www.w3.org/2001/XMLSchema-instance

the elements(test, text1, text2, text3) and data types used in the schema are from the “http://www.w3.org/2001/XMLSchema-instance” namespace. It also specifies that elements and attributes that come from the “http://www.w3.org/2001/XMLSchema-instance” namespace shall be prefixed with xsi:

This fragment means:

xsi:schemaLocation="http://www.w3schools.com test.xsd">

First value is the namespace used for all the elements in the xml file and second value is the location of the xml schema used for that namespace.

XML elements can contain values for various data types available.

Reference : http://www.w3schools.com and http://en.wikipedia.org/

Check Your Progress 2

1. **Which are 2 methods to validate XML files?**
2. **What are the limitations of DTD?**
3. **Write down the default built-in data types for XML schema.**
4. **Use the following XML, and write down DTD and XSD for it:**

```
<?xml version="1.0"?>

    <toyFactory>
        <toyType>Cartoon Characters</toyType>
```

```
        <toyName>McQueen</toyName>
</toyFactory>
```

3.4 Displaying XML files

In the previous section, you have gone through the methods of validating XML document. You must have noticed that an XML document is plain text file just like HTML files and is displayed in a browser, in a tree-like structure. Browser does not contain any information about the way content inside a tag may be displayed. Therefore, to enhance the readability, you can add some style to it. This can be done using css i.e. Cascading Style Sheets. CSS files are applied to HTML as well to enhance the readability. An XML document can be displayed in a web browser using a CSS and a XSLT. The following sections describe them in details:

4.4.1 XML CSS

If a browser supports css and xml, you can use css and the formatted example xml document may be displayed as:

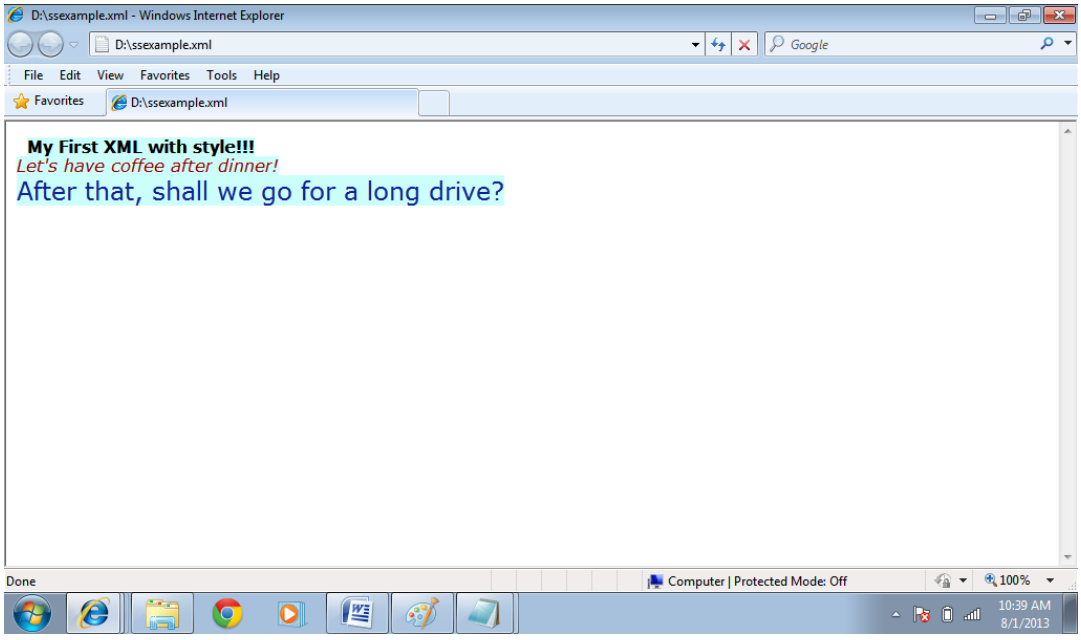


Figure 13: Display of a sample XML page

In this example, please ensure that the xml and css files are stored in the same location on the drive.

Code for the XML file:

```
<?xml version="1.0"?>
<?xml-stylesheet type="text/css" href="ss.css"?>

<test>
   <text1>My First XML with style!!!</text1>
   <text2>Let's have coffee after dinner!</text2>
   <text3>After that, shall we go for a long drive?</text3>
</test>
```

Code for the CSS file:

```
test
{
margin:10px;
background-color:#ccfffc;
font-family:verdana,sans-serif;
}

text1
{
display:block;
font-weight:bold;
}

text2
{
display:block;
color:#990000;
font-size:small;
font-style:italic;
}
```

```
text3
{
display:block;
color:#112299;
font-size:large;
}
```

You can enhance the css by adding more formatting features, and that shall reflect on the xml document. Similarly you can also try code using embedded or inline style sheets like you do in HTML. A detailed discussion of this topic is beyond the scope of this Unit. You may refer to further readings for more details on this topic.

3.4.2 XML XSLT

XSLT (eXtensible Stylesheet language Transformations) is the most recommended style sheet language for the XML documents. Using XSLT, XML document can be transformed as:

- another XML document, or
- other web objects such as HTML, plain text etc.
- This way it looks more presentable and it can be converted into PDF, PostScript and PNG files, if required. Original document is never changed, only a new document is created based on the contents of the existing ones.

An XSLT document is a valid XML document and consists of a number of elements/tags/attributes. A transformation can take place in one of the three locations:

- On the server
- On the client (for example, web browser)
- With a standalone program

The following example explains how the transformation takes place on the client, this time instead of css, you will link xml document with the xsl file. The code for the xml file is as follows:

```
<?xml version="1.0" encoding="UTF-8"
standalone="yes"?>
<?xml-stylesheet type="text/xsl" href="transform.xsl"?>

<test>
   <text1>My First XML with style using XSLT!!!</text1>
   <text2>Let's have coffee after dinner!</text2>
   <text3>After that, shall we go for a long drive?</text3>
</test>
```

Now create the xsl file, with the following code:

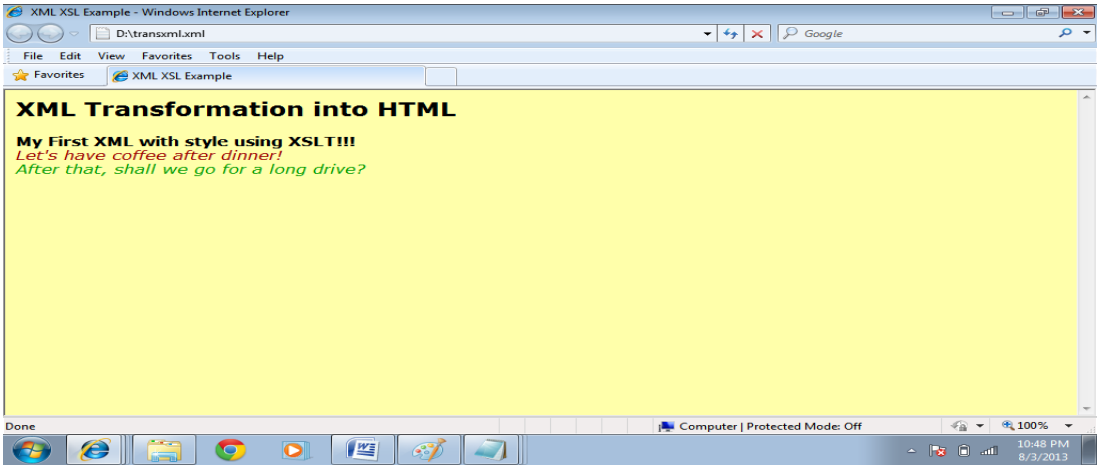
```
<?xml version="1.0"?>
<xsl:stylesheet version="1.0"

xmlns:xsl="http://www.w3.org/1999/XSL/Transform">

<xsl:template match="/">
<html>
<head>
<title>XML XSL Example</title>
<style type="text/css">
body
{
margin:10px;
background-color:#ffffaa;
font-family:verdana,helvetica,sans-serif;
}

.test-text1
{
display:block;
font-weight:bold;
}

.test-text2
{
display:block;
```

```
color:#990000;
font-size:small;
font-style:italic;
}
.test-text3
{
display:block;
color:#009900;
font-size:small;
font-style:italic;
}
</style>
</head>
<body>
<h2>XML Transformation into HTML</h2>
 <xsl:apply-templates/>
</body>
</html>
</xsl:template>

<xsl:template match="test">
  <span class="test-text1"><xsl:value-of select="text1"/></span>
  <span class="test-text2"><xsl:value-of select="text2"/></span>
  <span class="test-text3"><xsl:value-of select="text3"/></span>
</xsl:template>

</xsl:stylesheet>
```

Here <xsl:template> contain rules to apply when specific node is matched. The match attribute is used to associate the template with an XML element. Or to define a template for a whole branch of the XML document (i.e. match="/" defines the whole document). please note that <xsl:template> is a top-level element.

Please note that using style: display:block; makes text display in a newline.

The result shall be displayed like this:



References: 1. http://sitepoint.com

i. 2. http://www.w3.org

Check Your Progress 3

1 Why is style sheet or XSLT is needed?

2 Modify the XML below, as per er given specifications:

Back ground color – RED
Text Color – White
Font – Arial
Add <p> tag with the content as - A very Interesting example!!!
Color for the 3rd tag is blue.

```
<?xml version="1.0" encoding="UTF-8"
standalone="yes"?>
<?xml-stylesheet type="text/xsl" href="transform.xsl"?>

<test>
   <text1>XML formatting with XSLT!!!</text1>
   <text2>Let's have coffee after dinner!</text2>
   <text3>After that, shall we go for a long drive?</text3>
</test>
```

3.5 Summary

In this unit, you have studied a basic introduction of XML and its document structure. XML is a useful language that has immense potential in storing and transmitting data. An XML document needs to be checked, if it is as per some defined tagging format. You have seen how to validate and display any XML document and how are namespaces being used in these. Finally you have gone through the concept of conversion of XML document to a simple HTML document for the purpose of display. Please note that this Unit only introduces you to XML, however, if you want more details on XML, you must refer to some of the web sites specified in the further readings.

3.6 Answers to Check Your Progress

Check Your Progress 1

1. A well-formed document is syntactically correct. It conforms to XML's basic syntax rules:

- Every open tag must be closed.
- The opening and closing tag must exactly match. These tags are case-sensitive.
- All elements must be embedded within a single root element.
- Child tags must be closed before parent tags.

2. A structurally correct document is a valid XML documents. A valid XML document is implicitly well-formed, but well-formed document may not be valid.

3. XML naming rules:

- Names can contain letters, numbers, and other characters
- Names cannot start with a number or punctuation character
- Names cannot start with the letters xml (or XML, or Xml, etc)
- Names cannot contain spaces

Check Your Progress 2

1. DTD and Schema

2. Limitations of DTDs:

   - They have no explicit support for namespaces. All DTD declarations are global, so you can't define two different elements with the same name, even if they appear in different contexts.
   - DTDs have support only for rudimentary data types.
   - DTDs lack readability.
   - DTDs use regular expression syntax to describe schema. This is less accessible to programmers than an element-based syntax.

3. Common built-in data types are as follows:
   - xs:string
   - xs:decimal
   - xs:integer
   - xs:Boolean
   - xs:date
   - xs:time

4. Including XSD, XML file is updated as :

```
<?xml version="1.0"?>

        <toyFactory
xmlns="http://www.w3schools.com/2001/XMLSchema"
           xmlns:xsi="http://www.w3.org/2001/XMLSchema-
instance"

xsi:noNamespaceSchemaLocation="toyXSDExample.xsd">


        <toyType>Cartoon Characters</toyType>
```

```
        <toyName>McQueen</toyName>

        </toyFactory>
```

And the code for XSD is :

```
<?xml version="1.0" encoding="ISO-8859-1" ?>
<xs:schema xmlns:xs="http://www.w3.org/2001/XMLSchema"
targetNamespace="http://www.w3schools.com"
xmlns="http://www.w3schools.com"
elementFormDefault="qualified">

<xs:element name="toyFactory">
  <xs:complexType>
    <xs:sequence>
      <xs:element name="toyType" type="xs:string"/>
      <xs:element name="toyName" type="xs:string"/>
    </xs:sequence>
  </xs:complexType>
</xs:element>

</xs:schema>
```

Now, including DTD, same XML file is updated as:

```
<?xml version="1.0"?>
<!DOCTYPE toyFactory SYSTEM "toyDTDExample.dtd">

        <toyFactory>

        <toyType>Cartoon Characters</toyType>
        <toyName>McQueen</toyName>

        </toyFactory>
```

And code for DTD file(toyDTDExample.dtd) is :

```
<!ELEMENT toyFactory (toyType,toyName)>
<!ELEMENT toyType (#PCDATA)>
<!ELEMENT toyName  (#PCDATA)>
```

Check Your Progress 3

1. When we want to display the XML document in a presentable and more readable manner, we prefer to use formatting, which is achieved either by css or XSLT. CSS (Cascading Style Sheet) is used to enhances, formatting features of an XML document, in terms of making few words/lines bold, adding para, newline, spaces etc. XSLT is used to transform the entire XML document itself into a presentable format in the form of another XML or HTML/XHTML document, **2. Code for the XSL file is :**

```
<?xml version="1.0"?>
<xsl:stylesheet version="1.0"
xmlns:xsl="http://www.w3.org/1999/XSL/Transform">

<xsl:template match="/">
<html>
<head>
<title>XML XSL Example</title>
<style type="text/css">
body
{
margin:10px;
background-color:#990000;
font-family:arial,helvetica,sans-serif;
color:#999999;
}

.test-text1
{
color:#999999;
display:block;
font-weight:bold;
}
```

```
.test-text2
{
display:block;
}
.test-text3
{
display:block;
color:#000099;
font-size:small;
}
</style>
</head>
<body>

<xsl:apply-templates/>
<p>-  A very Interesting example!!!</p>
</body>
</html>
</xsl:template>

<xsl:template match="test">
  <span class="test-text1"><xsl:value-of
select="text1"/></span>
  <span class="test-text2"><xsl:value-of
select="text2"/></span>
  <span class="test-text3"><xsl:value-of
select="text3"/></span>
</xsl:template>

</xsl:stylesheet>
```

Code for the XML file is :

```
<?xml version="1.0" encoding="UTF-8" standalone="yes"?>
<?xml-stylesheet type="text/xsl" href="testTransform.xsl"?>

<test>
```

```
    <text1>XML formatting with XSLT!!!</text1>
    <text2>Let's have coffee after dinner!</text2>
    <text3>After that, shall we go for a long drive?</text3>
</test>
```

3.7 References

2. http://www.w3schools.com
3. http://en.wikipedia.org
4. http://sitepoint.com
5. http://www.w3.org

http://searchdomino.techtarget.com

UNIT 4 DOCUMENT OBJECT MODEL

Structure

4.0 INTRODUCTION

In the first two Units of this block you have gone through the concepts of Web 2.0, HTML and CSS. Every web browser window displays a HTML document. The window object represents a window. This window has a document property which refers to a document object. The document object has objects that represent the content of the document. The HTML documents can contain text, hyperlinks, images, forms etc. All this content of the document can be directly accessed and manipulated by JavaScript code. A DOM is an API that defines how to access the objects that compose a document.

"Dynamic HTML" was the immediate ancestor of the Document Object Model. DHTML was thought of largely in terms of browsers. The DOM originated as a specification to allow JavaScript scripts and Java programs to be portable among Web browsers.

The Document Object Model (DOM) is an application programming interface (API) for valid/ well-formed HTML and XML documents. DOM defines the logical structure of documents. It also defines the way to access and manipulate a document.

This Unit explains the Document Object Model in details. It also explains the concepts of events and how JavaScript can be used to handle DOM and events.

4.1 OBJECTIVES

After going through this unit, you should be able to:

- define the Document Object Model
- write JavaScript code to handle HTML DOM
- create documents and navigate through their structures
- handle events using JavaScript
- add, modify and delete elements and content;

4.2 DOM LEVELS

There are three DOM levels:

- The Level 0 DOM – these are by all browsers which are Netscape 2 and onwards.
- The two Intermediate DOMs- these are supported by NS 4 and IE 4 and 5.
- The Level 1 DOM (W3C DOM) – these are supported by Mozilla, IE 5 and above.

"DOM is language and platform independent interface which permits programs and scripts to dynamically access/ update the content, structure, and style of a document."

There are 3 different parts of W3C DOM standard:

- Core DOM
- XML DOM
- HTML DOM

In this unit, we will be discussing about HTML DOM only.

4.2.1 HTML DOM

The HTML DOM is defined as:

- A standard object model for HTML
- A standard programming interface for HTML
- A W3C standard

The HTML DOM defines the **objects** and **properties** of all HTML elements. It also defines the methods required to access HTML elements. In other words "*The HTML DOM is a standard for how to fetch, modify, add, or delete HTML elements.*"

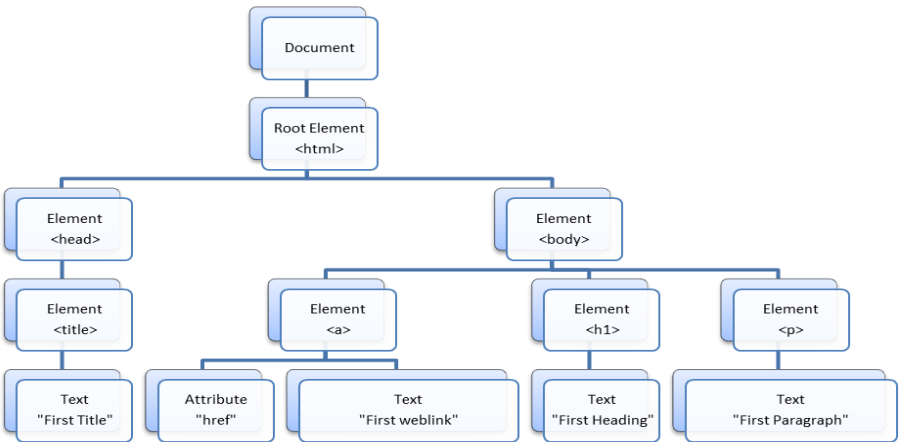
4.2.2 HTML DOM Nodes

According to the W3C HTML DOM standard, everything in an HTML document is a node:

- **document node:** The document node comprises of the whole document.
- **element node :**All HTML element are known as element nodes.
- **text nodes :** The text inside HTML elements is known as the text node.
- **attribute node :** Every HTML attribute is an attribute node.
- **comment nodes :** Every comment in the document is a comment node.

4.2.3 HTML DOM Node Tree

HTML documents are viewed as tree structures by the HTML DOM. The structure is called a **Node Tree.**



With the HTML DOM, all nodes in the tree can be accessed, modified, deleted and created by JavaScript.

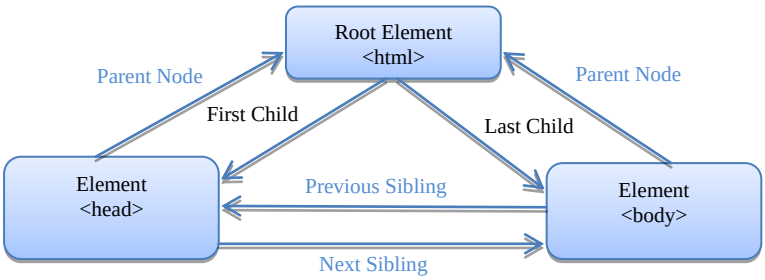
4.2.4 Node Parents, Children and Siblings

The nodes in the node tree have a hierarchical relationship with each other. The node directly above a node is the parent node of that node. The nodes at the same level and same parent are sibling nodes. The nodes that are one level directly below another node are the children of that node. So, to summarize

- The topmost node is called the root node in a node tree.

- Except the root, each node has one parent.
- There is no limit on the number of children, a node can have.
- Sibling nodes are the nodes with the same parent.

The following image illustrates a part of the node tree and the relationship between the nodes:



Look at the following HTML fragment:

```
<html>
        <head>
                <title>Welcome to  IGNOU</title>
        </head>
        <body>
                <h1>Courses Offered</h1>
                <p>Computer Science</p>
        </body>
</html>
```

From the HTML above:

- the root node: The <html> It has no parent node.
- the parent node of the <head> and <body> : <html> node
- The parent node of the "Computer Science" text node : <p> node
- The child nodes of <html> : <head> and <body>
- The child node of <head> : the <title> node.
- The child node of <title> node : the text node "Welcome to IGNOU"
- The siblings and child nodes of <body> : <h1> and <p> nodes
- The first child of the <html> element : <head> element
- The last child of the <html> element : <body> element
- The child of the <body> element : <h1> element
- The last child of the <body> element : <p> element

Check Your Progress 1

1. What is DOM and what are the objectives of DOM?

   ……

   ……

2. What are different levels of DOM?

   ……

   ……

3. Why was the name Document Object Model chosen?

   ……

   ……

4. Describe the HTML DOM with an example?

……

……

4.3 ACCESSING ELEMENT IN JAVASCRIPT

Every HTML element is defined as object. The programming interface comprises of the object methods and object properties.

4.3.1 Method

A **method** is an action, we can take. The action can be to add or modify an element. Refer to table given below for methods used to access an HTML element in different ways:

Method	Purpose
getElementById()	Returns the element with the specified Id
Example: Get the element with id as “university” from the given document. *document.getElementById("university");*	
getElementsByTagName()	Returns all elements with a specified tag name
Example 1: Get a list of all <p> elements in the given document. *document.getElementsByTagName("p");* Example 2: Retrieve a list of all <p> elements that are descendants (children, grand-children, etc.) of the element with id="university" from the given document. *document.getElementById("university").getElementsByTagName("p");*	
getElementByClassName()	returns a list of all elements with a specified class name
Example : Fetch a list of all elements with class="university" from the given document. *document.getElementsByClassName("university");*	

4.3.2 Property

A **property** is a value that we can fetch or set , e.g. it can be the name or content of a node.

Property	Description

innerHTML	• To fetch the content of an element • Useful for getting or replacing the content of HTML element

Following code gets the innerHTML from the <p> element with id="university":

```
< html>
< body>

< p id="university"> Welcome to IGNOU</p>

< script>
var txt=document.getElementById("university").innerHTML;
document.write(txt);
< /script>

< /body>
< /html>
```

nodeName	The nodeName property specifies the name of a node. • nodeName is read-only • nodeName of an element node is the same as the tag name • nodeName of an attribute node is the attribute name • nodeName of a text node is always #text • nodeName of the document node is always #document Note: nodeName always contains the uppercase tag name of an HTML element.

Example: To get the node name of the body element from a given document.

Include the following statement in the script
document.body.nodeName;

The result will be:
BODY

nodeValue	The nodeValue property specifies the value of a node. • nodeValue for element nodes is undefined • nodeValue for text nodes is the text itself • nodeValue for attribute nodes is the attribute value

Following example retrieves the text node value of the <p id="university"> tag from the given document.

```
< html>
< body>
< p id="university"> Welcome to IGNOU </p>
< script type="text/javascript">
```

```
        x=document.getElementById("university");
        document.write(x.firstChild.nodeValue);
< /script>
< /body>
< /html>
```

nodeType	The nodeType property returns the type of node. nodeType is read only. The most important node types are: Element type — NodeType Element — 1 Attribute — 2 Text — 3 Comment — 8 Document — 9

Example: To converts all Text node (descendants excluded) data to uppercase:

```
if(n.nodeType == 3  /*Node.TEXT_NODE*/
   n.data = n.data.toUpperCase();
```

4.4 TRAVERSING A DOM TREE

We can traverse the DOM tree using node relationships in HTML DOM.

4.4.1 Node List

The getElementsByTagName() method returns a **node list**. A node list is an array of nodes.

Example: Select all <p> element nodes in a document and access the second <p>

```
var x=document.getElementsByTagName("p");
y= x[1];          //as the index starts at 0.
```

4.4.2 Node List Length

The “length” property defines the number of nodes in a node-list. We can loop through a node-list by using the “length” property.

Example: Get all <p> element nodes. For each <p> element, output the value of its text node

```
var x=document.getElementsByTagName("p");
for (i=0;i<x.length;i++)  // loop through <p> elements, no. of <p> nodes =x.length
{
        document.write(x[i].innerHTML);    // output the value of text node
        document.write("<br />");
}
```

4.4.3 Node Relationship

We can use the three node properties namely parentNode, firstChild and lastChild to navigate in the document structure. Let us have a look at the following HTML fragment:

```
< html>
< body>

< p>Welcome to IGNOU</p>
< div>
< p>The courses offered by IGNOU</p>
< p>This example demonstrates node relationships.</p>
< /div>

< /body>
< /html>
```

- The first <p> element is the firstChild of the <body> element
- The element is the lastChild of the <body> element
- The <body> element is the parentNode of the first <p> element and the element

Example: This example demonstrates the use of "firstChild" property to access the text of an element. The output of this script will be Welcome to IGNOU, which is the text of the <p> element (the firstChild of the <body> element).

```
< html>
< body>
< p id="university">Welcome to IGNOU</p>
< script>
x=document.getElementById("university");
document.write(x.firstChild.nodeValue);
< /script>
< /body>
< /html>
```

4.4.4 Root Nodes

We can access the full document by using these two special properties :

- document.documentElement - The full document
- document.body - The body of the document

Example

```
< html>
< body>

< p>Welcome to IGNOU</p>
< div>
< p>The Courses offered</p>
< p>This example demonstrates the <b>document.body</b> property.</p>
< /div>

< script>
alert(document.body.innerHTML);
< /script>

< /body>
< /html>
```

4.4.5 childNodes and nodeValue

childNodes and nodeValue properties can also be used to get the content of an element, in addition to the innerHTML property.

The following code gets the value of the <p> element with id="university":

Example

```
< html>
< body>

< p id="university"> Welcome to IGNOU </p>

< script>
var txt=document.getElementById("university").childNodes[0].nodeValue;
document.write(txt);
< /script>

< /body>
< /html>
```

In the example above, getElementById is a method, while childNodes and nodeValue are properties.

4.5 MODIFYING A DOM TREE

The HTML DOM can be modified in following different ways

- By modifying the HTML content
- By modifying the HTML style
- By creating new elements
- By deleting existing elements
- By replacing elements

4.5.1 Modifying HTML Content

We can modify/change the content of an element is by using the **innerHTML** property. It is the easiest way to do so.

Example: This example demonstrates how to change the HTML content of a <p> element. Here the content *Welcome to IGNOU* has been changed to *IGNOU provides innovative Learning!*

```
< html>
< body>
< p id="university">Welcome to IGNOU</p>
< script>
document.getElementById("university").innerHTML="IGNOU provides innovative
Learning!";
< /script>
< /body>
< /html>
```

4.5.2 Modifying HTML Style

With the HTML DOM we can access the style object of HTML elements. In the following example the HTML style of a paragraph has been changed.

```
< html>
< body>
<p id="university">Welcome to IGNOU</p>
<script>
document.getElementById("university").style.color="blue";
< /script>
</body>
< /html>
```

4.5.3 Creating New Elements

To add a new element to the HTML DOM, we must create the element (element node) first, and then append it to an existing element.

Below HTML document contains a element with two child nodes (two <p> elements):

```
< div id="div1">
< p id="p1">This is first paragraph.</p>
< p id="p2">This is second paragraph.</p>
< /div>

<script>
var para=document.createElement("p");  //creates a new <p> element
var node=document.createTextNode("This is new paragraph.");  //create a text node
para.appendChild(node);  //append text node to <p> element

var element=document.getElementById("div1"); // finds an existing element
element.appendChild(para);  // appends new element to existing element
< /script>
```

The appendChild() method in the above example, appended the new element as the last child of the parent.

If we want that the child should be inserted before a specific node and not as the last child, we can use the insertBefore() method:

```
<script>
var para=document.createElement("p");
var node=document.createTextNode("This is new paragraph.");
para.appendChild(node);

var element=document.getElementById("div1");
var child=document.getElementById("p1");
element.insertBefore(para,child);
< /script>
```

4.5.4 Deleting Existing Elements

To delete/ remove an HTML element, we must know the parent of the element. In this example below HTML document contains a element with three child nodes (three<p> elements).

In this script the child node with id as p1 (*This is first paragraph.)* is removed from the parent i.e. element.

```
< div id="div1">
< p id="p1">This is first paragraph.</p>
< p id="p2">This is second paragraph.</p>
<p id="p3">This is third paragraph.</p>
```

```
< /div>
<script>
var parent=document.getElementById("div1"); //find the element with id “div1”
var child=document.getElementById("p1");    //find the <p> element with id “p1”
parent.removeChild(child);                  //remove the child from the parent
< /script>
```

OR

Find the child that is to be removed and use its parentNode property to find the parent. The following code lines also achieve the same.

```
var child=document.getElementById("p1");
child.parentNode.removeChild(child);
```

4.5.5 Replacing Elements

To replace an element to the HTML DOM, we use the replaceChild() method.

In the script below HTML document contains a element with three child nodes (three <p> elements). Here we replace the first child with id as p1 (*This is first paragraph*) with the newly created <p> element *para* having a text node *node* as a child (*This is new paragraph.*).

```
< div id="div1">
< p id="p1">This is first paragraph.</p>
< p id="p2">This is second paragraph.</p>
<p id="p3">This is third paragraph.</p>

< /div>

<script>
var para=document.createElement("p");
var node=document.createTextNode("This is new paragraph.");
para.appendChild(node);

var parent=document.getElementById("div1");
var child=document.getElementById("p1");
parent.replaceChild(para,child); // p1 gets replaced by para.
< /script>
```

4.6 DOM COLLECTIONS & STYLES

The groups of related objects on a page are known as Collections in the Document Object Model. DOM collections are accessed as properties of DOM objects such as the document object or a DOM node. The document object has properties containing the collections of images, links, forms and anchors. These collections comprise of all the elements of the corresponding type on the page. To find the number of elements in the collection, the length property is used. The variable currentLink (a DOM node

representing an a element) has a specialized href property to refer to the link's href attribute. An easy access to all elements of a single type in a page is provided by DOM collections. This is useful for gathering elements into one place and for applying changes in entire page. For example, the forms collection could be used to disable all form inputs after a submit button has been pressed to avoid multiple submissions while the next page loads.

An individual style statement is represented by the Style object. We can access the Style object from the document or from the elements on which that style is applied.

The syntax for using the Style object property is*:*
document.getElementById("id").style.property="value"

Example : The following example changes the background color of the <body> element using style object's *backgroundColor* property when a button is clicked

```
< input type="button" onclick="document.body.style.backgroundColor='yellow';"
value="Change background color" />
```

OR

```
< script>
 function ChangeBackground()
 {
   document.body.style.backgroundColor="yellow";
 }
< /script>

< input type="button" onclick="ChangeBackground()"
value="Change background color" />
```

The Style object property has various categories like: Background, Border/Outline, Generated Content, Text, List, Positioning/Layout Printing, Margin/Padding , Table Misc etc.
For a detailed description on the style object property you can visit http://www.w3schools.com/

An element's style can be changed dynamically. Such a change is often made in response to user events. Such style changes can create many effects, including mouse over effects, interactive menus, and animations. In general, CSS properties are accessed in the format node.style.styleproperty. DOM Style Sheets allow us to step through the rules of each stylesheet, change the selectors, read and write styles, and add new rules. This allows us to create or change CSS that affects several elements at the same time, instead of just one element as with traditional DHTML. It also allows us to take advantage of CSS selectors to target the desired elements, and enter rules into the CSS cascade. DOM stylesheet does not provide an exact copy of what we put in our stylesheet. It produces what the browser sees, and what it interprets. Rules that the browser does not understand are not included . Styles that are not understood are ignored. Comments are not included.

The document.styleSheets collection has all stylesheets available. An easy way to check if a browser supports some amount of DOM Style Sheets is by checking for the existence of the document.styleSheets collection. It can be checked simply by

```
if( document.styleSheets ) {
  // If the browser supports styleSheets,DOM stylesheets will be available.
}
```

Each stylesheet has a number of properties that give details of the stylesheet. These properties can be URL (href), title (title), type (type, usually 'text/css'), the media types it applies to (media), and if the property is disabled or not (disabled). The disabled property can be set to true or false. All other properties are read-only. Only the properties that are applicable to the stylesheet in question are available. For example, if a link element does not have the title attribute set, then its associated StyleSheet object will not have a title.

Check Your Progress 2

1. Write a function that converts all the Text node data of a node and its descendants to uppercase?

   ……

   ……

2. Write a function to find all the tables in a document.

   ……

   ……

3. Explain How to change HTML Attribute using HTML DOM?

   ……

   ……

4. Write a function for searching a specific table in a document and count its rows?

   ……

   ……

5. Write a function to return all name/value pairs of cookies in a document?

   ……

   ……

6. Write a script to toggle the visibility of a para element on the click of a button.

   ……

   ……

4.7 EVENTS

Events are generated by the browser when "things happen" to HTML elements. The HTML DOM allows you to execute code when an event occurs. For example clicking of the mouse, loading of the web page / image, moving the mouse over an element or submission of a HTML form etc. are HTML events.

4.7.1 How Events Work

When events happen to an HTML element in a web page, it checks to see if any event handlers are attached to it. If the answer is yes, it calls them in respective order, while sending along references and further information for each event that occurred. The event handlers then act upon the event. DOM elements can be nested inside each

other. And somehow, the event handler of the parent works even if we click on its child. The reason for this is *event bubbling*. There are two types of event order:

- Event bubbling
- Event capturing

Event bubbling: It begins by checking the target of the event for any attached event handlers, and then bubbles up through each respective parent element until it reaches the HTML element. The main principle of bubbling states that after an event triggers on the deepest possible element, it then triggers on parent s in nesting order.

Event capturing starts with the outer most element in the DOM and works inwards to the HTML element the event took place on and then out again. For example, a click in a web page would first check the HTML element for onclick event handlers, then the body element, and so on, until it reaches the target of the event.

We can choose whether to register an event handler in the capturing or in the bubbling phase. This is done through the addEventListener() method . If its last argument is true the event handler is set for the capturing phase, if it is false the event handler is set for the bubbling phase. Bubbling or capturing can be stopped by event.cancelBubble=true for (IE < 9) and event.stopPropagation() for other browsers. In all browsers, except (IE < 9), there are two stages of event processing .The event first goes down - that's called *capturing*, and then *bubbles* up. This behavior is standardized in W3C specification.

4.7.2 Reacting to Events

A JavaScript can be executed when an event occurs.

Example 1: Content of the <h1> element is changed when a user clicks on it

```
<html>
< body>
< h1 onclick="this.innerHTML='IGNOU'">Click here!</h1>
< /body>
< /html>
```

Example 2: In the following example the javascript is executed on onblur event. When the user leaves an input field the onblur event is triggered and the handler for this event (*changeToUpper()*) gets executed. This function changes the text of the input field to upper case.

```
<html>
<head>
<script>
function changeToUpper(){
var x=document.getElementById("fname");
x.value=x.value.toUpperCase();
}
</script>
</head>
<body>
Enter your name: <input type="text" id="fname" onblur=" changeToUpper()">
<p>When you leave the input field,  the input text will  change  to upper case.</p>
</body>
</html>
```

Example 3: In the following example we change the text of the <p> element from “Let us learn Event Handling” to “I have learnt Event Handling” when a button is clicked.

```
< html>
< body>
<p id="p1">Let us learn Event Handling.</p>
< script>
function ChangeText() {
document.getElementById("p1").innerHTML="I have learnt Event Handling.";
}
< /script>
< input type="button" onclick="ChangeText()" value="Change text">
< /body></html>
```

4.7.3 HTML Event Attributes

To assign events to HTML events we can use event attributes.

Example: Assigning an “onclick” event to a button element

```
<button onclick="displayMonth()">Check it yourself</button>
```

In the example above, a function named *displayMonth* will be executed when the button is clicked.

4.7.4 Assign Events using the HTML DOM

HTML DOM allows us to assign events to HTML elements using JavaScript.

Example: Assigning an “onclick” event to a button element

```
<script>
document.getElementById("myBtn").onclick=function(){displayMonth()};
</script>
```

In the example above, a function named *displayMonth* is assigned to an HTML element with the id=myBtn".

Event	Description
onload onunload	• These events are triggered when the user enter or leaves the page • onload event can be used check browser type/ version and load the proper version of web page • onload and onunload can be used to deal with cookies Example: *<body onload=”checkCookies()”*
Onchange	• often used in combination with validation of input fields Example: *< input type="text" id="fname" onchange="upperCase()">*

onmouseover onmouseout	• These events can be used to trigger a function when the user mouse over, or out of, an HTML element Example: *<html> <body> <h1 onmouseover="style.color='red'" onmouseout="style.color='blue'"> Mouse over this text</h1> </body> </html>*
onmousedown onmouseup onclick	• onmousedown, onmouseup, and onclick events are all parts of a mouse-click • First when a mouse-button is clicked, the onmousedown event is triggered, then, when the mouse-button is released, the onmouseup event is triggered, finally, when the mouse-click is completed, the onclick event is triggered.

For more information on the events you can visit http://www.w3schools.com/

Check Your Progress 3

1. Write a program to change the HTML element using events?

   ……

   ……

2. What are the functionalities performed by onload() and onUpload()?

   ……

   ……

3. Execute a javascript before the browser closes the document.

   ……

   ……

4. Write a script to alert the keycode of the key pressed.

   ……

   ……

5. Write a function to execute a script that changes the color of an image when moving the mouse over / out of the image?

   ……

   ……

6. Write a function to return the type of event that occurred?

   ……

   ……

4.8 DYNAMIC DOCUMENTS USING JAVASCRIPT

Dynamic Document Creation is the creation of a Web document from within the JavaScript. It may be created while an HTML document is being displayed, and may

be influenced by features of the current Web page. As a technique, it is very useful for displaying information from Web pages and creating new HTML documents.

Let us create dynamic documents with **document.write()**. This method can

- insert text into the current web page
- create an entirely new document

Let us look at this example that uses write to display today's date to an otherwise static HTML document.

```
<script type="text/javascript">
 var today = new Date()
 var mon = today.getMonth() + 1
 document.write(
  "<html><head><title>Dynamic Document</title></head>\n"
  + "<body bgcolor=yellow>\n  <h1 align=center>Today is "
  + mon + "/"  + today.getDate() + "/" + today.getYear()
  + "</h1>\n</body></html>")
</script>
```

We can also use the write method in conjunction with the open() and close() methods of the Document object, to create entirely new documents in other windows or frames. The function given below opens a pop up widow to display the date the document is accessed on. Invoke this function from an event handler.

```
Function recent( ) {
      var w = window.open( );     // Create a new window with no content
      var d = w.document( );      // Get its Document object
      var today = new Date( );
      d.open( );                  //Start a new document
      d.write("<p> Document recently accessed on:  " + today.tostring( ));
      d.close( );                 // Close the document
 }
```

4.9 AJAX

AJAX stands for **Asynchronous JavaScript and XML**. AJAX is a new technique for creating better, faster, and more interactive web applications with the help of XML, HTML, CSS and Java Script. It uses XHTML for content and CSS for presentation, as well as the Document Object Model and JavaScript for dynamic content display.

In standard Web applications, the interaction between the customer and the server is synchronous. This means that one has to happen after the other. If a customer clicks a link, the request is sent to the server, which then sends the results back.

With Ajax, the JavaScript that is loaded when the page loads handles most of the basic tasks such as data validation and manipulation, as well as display rendering the Ajax engine handles without a trip to the server. At the same time that it is making display changes for the customer, it is sending data back and forth to the server. But the data transfer is not dependent upon actions of the customer.

The Ajax engine works within the Web browser through JavaScript and the DOM. It renders the Web application and handles any requests of web server's client. While the Ajax engine is handling the requests, it can hold most information in the engine itself. At the same time Ajax engine allows the interaction with the application and the customer to happen **asynchronously** and independently of any interaction with the server. The key feature of Ajax application is that it uses scripted HTTP to communicate with a web server without causing pages to reload. Since the amount of data exchanged is often small and the browser does not have to parse and render a document. As a result, the response time is greatly improved and this results in making web applications feel more like desktop applications.

Here is the list of famous web applications which are using AJAX

Google Maps (http://maps.google.com/)
A user can drag the entire map by using the mouse instead of clicking on a button or something

Google Suggest (http://www.google.com/)
As you type, Google will offer suggestions. Use the arrow keys to navigate the results

Gmail (http://gmail.com/)
Gmail is a new kind of webmail, built on the idea that email can be more intuitive, efficient and useful.

Check Your Progress 4

1. What is AJAX? List out the differences between AJAX and JavaScript.

   ……

   ……

2. What are the advantages of AJAX?

   ……

   ……

3. Name the browsers that support AJAX?

   ……

   ……

4. What are the limitations of Ajax?

   ……

   ……..

4.10 SUMMARY

In this unit we have learnt how to use the HTML DOM to make our web site more dynamic and interactive. We have also learnt the ways to manipulate HTML elements in response of different scenarios and created dynamic web pages by using scripts on the client (in the browser). We got to know about AJAX which is a new technique for creating better, faster, and more interactive web applications with the help of XML, HTML, CSS and Java Script.

4.11 ANSWERS TO CHECK YOUR PROGRESS

Check your progress 1

1. The Document Object Model (DOM) is a cross-platform and language-independent convention for representing and interacting with objects in HTML, XHTML and XML documents. With the Document Object Model, programmers can build documents, navigate their structure, and add, modify, or delete elements and content.

One important objective for the Document Object Model is to provide a standard programming interface that can be used in a wide variety of environments and applications.

2. There are three DOM levels:

- The Level 0 DOM, supported from Netscape 2 onwards by all browsers.
- The two Intermediate DOMs, supported by Netscape 4 and Explorer 4 and 5.Note that the use of these DOMs is not necessary any more
- The Level 1 DOM, or W3C DOM, supported by Mozilla and Explorer 5

3. The name "Document Object Model" was chosen because it is an "object model" is used in the traditional object oriented design sense: documents are modeled using objects, and the model encompasses not only the structure of a document, but also the behavior of a document and the objects of which it is composed.

4. A standard way to access and manipulate HTML documents is defined in HTML DOM. HTML document is represented as a tree-structure in DOM.

Check your progress 2

1.
```
function uppercase(n) {
  if (n.nodeType == 3)  /* Text Node */
        n.data = n.data.toUpperCase( );
  else{
        var children = n.childNodes;
        /* loop through children, recursively call
        for ( var  i=0; i<children.length; i++)
              uppercase(children[i] );
        }
  }
```

2.
```
var tables = document.getElementByTagname( “table” ) ;
 alert( “ This document contains ( + tables.length + “tables” );
```

3. Example to change HTML Attribute by using HTML DOM

```
<html>
<body>
```

```
<img id =”image” src =”oldclip.jpg”>
<script type = “ javascript”>
document.getElementById(“image”).src = “newclip.jpg”
</script>
</body>
</html>
```

In the above example we load an image on HTML document by using id="image". Using DOM we get the element with id="image". This script will change the src attribute from oldclip.gif to newclip.jpg

4.
```
var table secondtable  = document.getElementById ( “ COURSES” );
   var rows = secondtable.getElementByTagname( “ tr “ );
var totalrows = rows.length;
```

5.
```
<html>
 <body>
   Cookies associated with this document:
 <script>
   document.write(document.cookie);
  </script>
 </body>
 </html>
```

6.
```
<html>
  <body>
<p id="p1"> Welcome to IGNOU Welcome to IGNOU Welcome to IGNOU.
Welcome to IGNOU </p>
<input type="button" value="Hide text"
onclick="document.getElementById('p1').style.visibility='hidden'" />
<input type="button" value="Show text"
onclick="document.getElementById('p1').style.visibility='visible'" />
</body>
</html>
```

Check your progress 3

1. Events are usually generated by the browser, when an event on some object takes place like user clicks an element. Event handlers are used to handle the events and execute the code . The example is shown below that is used to change the HTML element values:

```
<html>
<body>
<input type="button" onclick="document.body.bgColor='green';"
value="Change background color" />
</body>
</html>
```

2. onload() and onUpload() are two functions that get activated or the event gets triggered when the user enters or leaves the page. The onload() event is used to verify and check the user’s visit according to the browser’s type and it loads a version of the

event. It provides the web page information that allows easy access to the website and consists of the information regarding the event that is triggered. Onload() and onUpload() events use the cookies to hold down the values given by the users when it enters or leaves the page.

```
3. <html>
<head>
<script>
function beforeclose()
{
alert("Welcome to IGNOU!");
}
</script>
</head>

<body onunload="beforeclose ()">

<h1>Welcome to IGNOU Home Page</h1>
<p>Press F5 to reload the page OR close this window.</p>

</body>
</html>

4. <html>
<head>
<script>
function codeKey(event)
{
alert(event.keyCode);
}

</script>
</head>

<body onkeyup=" codeKey (event)">
<p>Press a key on your keyboard. An alert box will show the keycode of the key
pressed.</p>
</body>

</html>

5.<html>
<head>
<script>
function bgChange(bg)
{
document.body.style.background=bg;
}
</script>
</head>
<body>
<b>Mouse over the squares and the background color will change!</b>
<table width="200" height="100">
 <tr>
  <td onmouseover="bgChange('red')"
     onmouseout="bgChange('transparent')"
     bgcolor="red">
```

```
  </td>
  <td onmouseover="bgChange('blue')"
     onmouseout="bgChange('transparent')"
     bgcolor="blue">
  </td>
  <td onmouseover="bgChange('green')"
     onmouseout="bgChange('transparent')"
     bgcolor="green">
  </td> </tr>
</table>
</body>
</html>
```

```
6.function getTypeOfEvt(event)
{
alert(event.type);
}
</script>
</head>

<body onmousedown=" getTypeOfEvt (event)">

<p>Click in the document.
 The type of event triggered will be shown in an alert box .</p>

</body>
</html>
```

Check your progress 4

1. Ajax is abbreviated as Asynchronous Javascript and XML. It is new technique used to create better, faster and more interactive web systems or applications. Ajax uses asynchronous data transfer between the Browser and the web server. Here on sending request to the server, one needn't wait for the response. Other operations on the page can be carried out Hence, Asynchronous. On the other hand, Java script sends an HTTPRequest to the server and waits for the XML response e.g. populating State field. Using JavaScript we need to use the "Onchange" event where as using ajax, the request is just sent to populate the state list. Other operations can be carried out on the page. Ajax is a part of Java Script programming. Java Script is used to manage and control a web page once downloaded. Ajax does not need to wait for the whole page to download.

Use of Ajax can reduce connections to the server since the script has to be requested once.

2. Following are the advantages of Ajax:

- It saves memory when the data is fetched from the same page. So, bandwidth utilization is better.
- It provides more interactivity.
- Using Ajax data retrieval takes less time.

3. Following browsers support AJAX:

- Internet Explorer 5.0 and above
- Opera 7.6 and above

- Netscape 7.1 and above
- Safari 1.2 and above

4. Limitations of AJAX:

- Back functionality cannot work because the dynamic pages don't register themselves to the browsers history engine
- The page cannot be bookmarked if implemented using Ajax.
- If java script is disabled, Ajax will not work.
- Because different components of the pages are loaded at different times it may create confusion for the user.

4.12 REFERENCES & FURTHER READINGS

http://www.w3schools.com
http://www.w3schools.com/htmldom
http://www.w3.org/
http://www.w3.org/DOM/
http://www.w3.org/TR/
http://www.w3.org/wiki/Handling_events_with_JavaScript
http://simplehtmldom.sourceforge.net/
http://stackoverflow.com/
https://developer.mozilla.org/en/docs/DOM

Deitel, H. M., & J., D. a. (2008). Internet & World Wide Web How to Program, 4/e. *Pearson Education*

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Unit 5: Introduction to WAP and WML

Contents

5.0 Introduction to WAP

Internet's penetration and expansion into fields such as finance, research, medicine, education, business etc. has initiated new ways of providing services to customers and conducting business. **WAP (Wireless Application Protocol)** is simply acommunication protocol by which a wireless device talks to a server installed in a wireless network. It is an open, global specification, which gives mobile users with access to wireless devices the opportunity to easily access the Internet or other computer applications, defined by the WAP forum.

WAP Forum, founded in 1997, is the industry association of carriers, handset manufacturers, infrastructure providers, software developers etc. dedicated to make internet other information services available to handheld wireless devices.

WAP is an emerging industry standard which aims at providing wireless internet services and information access using handheld devices having limited display capabilities and over limited bandwidth wireless channels. How successful this effort has been can be seen by the fact today more than 95% of the global hand set makers are members of the WAP Forum.

5.1WAP Protocol Stack

WAP stack has inherited most of the characteristics of the ISO OSI reference model

It consists of five layers, namely: application layer, session layer, transaction layer, security layer and datagram layer

Application Layer (Wireless Application Environment, WAE)

WAE provides an application environment intended for the development and execution of portable applications and services. WAE User Agents are designed to understand text in encoded WML (Wireless Markup Language) and compiled WMLScript. WAE consists of WML and WMLScript as the two main building blocks of the user agents located on the client side

Session Layer (Wireless Session Protocol, WSP)

WSP supplies methods for the organized exchange of content between client/ server applications.

Transport Layer (Wireless Transport Protocol WTP)

WTP is responsible for providing reliable transmission of WSP data packets between the client and the server over a wireless medium.

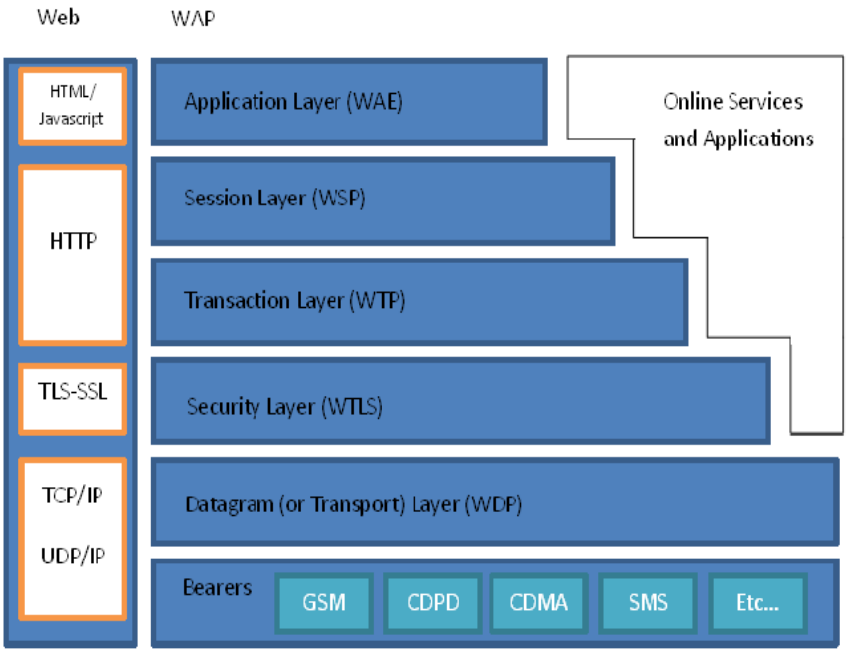
Security Layer (Wireless Transaction Layer Security WTLS)

WTLS is an optional layer and is the solution to the security issue, provided by the WAP Forum. WTLS is based on SSL(Secure Socket Layer)and when present provides services that ensure privacy, server authentication, client authentication and data integrity.

Network Layer (Wireless Datagram Protocol WDP)

WDP is the bottom most layer of the WAP stack. It is modelled after User Datagram Protocol (UDP) and is a datagram oriented protocol.WDP shields the upper layers from the bearer services like SMS, CMD etc. provided by the network and hence allows applications a transparent transmission of data

over different bearers. WDP must have bearer specific implementation since it is the only layer that has to interface various bearer networks.

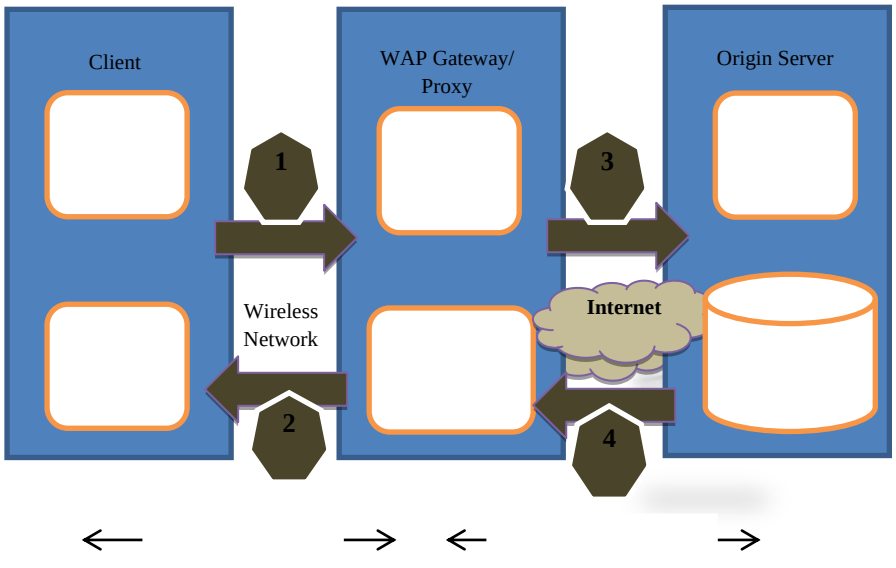


5.1.1 Objectives of WAP

Standard HTML content cannot be effectively displayed on the small-size screens of pocket-sized mobile phones and pagers.WAP utilizes binary transmission for greater compression of data and is optimized for long latency and low bandwidth. The lightweight WAP protocol stack is designed to minimize the required bandwidth and maximize the number of wireless network types that can deliver WAP content.

5.1.2 The WAP Model

Below figure shows the WAP programming model. You can clearly see the similarities with the Internet model i.e. the two models would have been practically identical without the WAP Gateway/Proxy.



WAP Gateway/Proxy is the entity that connects the wireless domain with the Internet. We should make a note that the request that is sent from the wireless client to the WAP Gateway/Proxy uses the Wireless Session Protocol (WSP). In its essence, WSP is a binary version of HTTP.

A markup language - the Wireless Markup Language (WML) has been adapted to develop optimized WAP applications. In order to save valuable bandwidth in the wireless network, WML can be encoded into a compact binary format. Encoding WML is one of the tasks performed by the WAP Gateway/Proxy.

5.1.3 Working of WAP Model

When it comes to actual use, WAP works like this:

1. The user selects an option on their mobile device that has a URL with Wireless Markup language (WML) content assigned to it.
2. The mobile device uses phone network to send the URL request to a WAP gateway, using the binary encoded WAP protocol.
3. This WAP request is translated into a conventional HTTP request for the specified URL, and sent to the Internet by the WAP gateway.
4. This HTTP request is now picked up by the appropriate Web server.
5. The request is processed by the server. If the URL refers to a static WML file, the server delivers it. If a CGI script is requested, it is processed and the content is returned as usual.
6. The HTTP header is added to the WML content and returned to the gateway by the Web server.
7. The WML is compiled intobinary form by WAP gateway.
8. The WML response is sent back to the phone by WAP gateway.
9. The WML is received by the mobile device via the WAP protocol.
10. The WML is processed and the content is displayed on the screen by micro-browser.

5.1.4 Benefits of WAP

- Wireless network operators can decrease churn, cut costs and increasesubscriber base.
- Content providers can have access to customers who seek enhanced services.
- End users can have more value and functionality from their mobile devices.

5.1.5 Limitations of WAP

- Device limitations that arise from limitations of power and formfactor.
- Bearer limitations that arise from limitations of bandwidth andmobility.
- Use case limitations that arise from the consumer nature of mobiledevices.

Check Your Progress 1

1. What is the WAP? Why do we need WAP?

   ……

   ……

2. Name the various layers of WAP stack.

   ……

   ……

3. Which layer of the WAP stack should have a bearer specific implementation and why?

   ……

……

4. What are the advantagesand limitations of WAP ? Give some example of WAP.

……

……

5.2 WML - Overview

The topmost layer in the WAP (Wireless Application Protocol) architecture is made up of WAE (Wireless Application Environment), which consists of WML and WML scripting language. WML is the markup language defined in the WAP specification. WML is an application of XML, which is defined in a document-type definition. WAP sites are written in WML, while web sites are written in HTML. WML is based on HDML and is modified so that it can be compared with HTML. WML is very similar to HTML. Both of them use tags and are written in plain text format. WML takes care of the small screen and the low bandwidth of transmission.

5.2.1 WML Versions:

WAP Forum has released a latest version WAP 2.0. Most of the new mobile phone models released are WAP 2.0-enabled. The markup language defined in WAP 2.0 is XHTML Mobile Profile (MP). The WML MP is a subset of the XHTML. A style sheet called WCSS (WAP CSS) has been introduced along with XHTML MP. The WCSS is a subset of the CSS2.WML 1.x is an earlier technology and a lot of wireless devices that only supports WML 1.x are still using it. Latest version of WML is 2.0 and it is created for backward compatibility purposes.

5.2.2 WML Components(WML Decks and Cards):

Developing in WML is slightly different from developing for the web. As far as the development for the web is concerned, each HTML file constitutes one HTML page. In WML, since each page or screen is very small, it does not make much sense for each page to constitute a separate file. WML pages – content viewed on separate screens – are *cards* and the cards are all placed within a *deck* of related pages that constitute one single file. So, a main difference between HTML and WML is that the basic unit of navigation in HTML is a page, while that in WML is a card. A WML file can contain multiple cards and they form a deck.

When a WML page is accessed from a mobile phone, all the cards in the page are downloaded from the WAP server. So if the user goes to another card of the same deck, the mobile browser does not have to send any requests to the server since the file that contains the deck is already stored in the wireless device.Logically, a user navigates through a set of cards. WML decks can be stored in ‘static’ files on an origin server, or the content generator that is running on an origin server can dynamically generate them. Each card, in a deck, contains a specification for a particular user interaction. We can put links, text, images, input fields, option boxes and many other elements in a card. WML comments use the same format as HTML comments.

Note that comments are not compiled or sent to the user agent, and thus have no effect on the size of the compiled deck.

5.2.3 WML Program Structure:

A WML program is typically divided into two parts: the documentprolog and the body. Consider the following code:

```
<?xml version="1.0"?>
<!DOCTYPE wml PUBLIC "-//WAPFORUM//DTD WML 1.2//EN"
"http://www.wapforum.org/DTD/wml12.dtd">

<wml>
<card id="one" title=" My First Card">
<p> Welcome to IGNOU!</p>
</card>
<card id="two" title=" My Second Card">
<p>Let us learn to make a Wireless World...</p>
</card>
</wml>
```

The first line of this text says that this is an XML document and the version is 1.0. The second line selects the document type and gives the URL of the document type definition (DTD).One WML deck (i.e. page) can have one or more cards as shown above.

WML Document Prolog:

The first line of this text says that this is an XML document and the version is 1.0. The second line selects the document type and gives the URL of the document type definition (DTD). The DTD referenced is defined in WAP 1.2, but this header changes with the versions of the WML. The header must be copied exactly so that the tool kits automatically generate this prolog.

The prolog components are not WML elements and they should not be closed, i.e. we should not give them an end tag or finish them with />

WML Document Body:

The body is enclosed within a <wml></wml> tag pair. The body of a WML document can consist of one or more of these, namely Deck,Card,Content to be shown and Navigation instructions.

5.2.4Testing Program

Firstly the above code is put in a file called test.wml file, and then this WML file is put locally on the hard disk. Now it can be viewed using an emulator.

This is by far the most efficient way of developing and testing WML files. If our aim is, however, to develop a service that is going to be available to WAP phone users, we should upload our WML files onto a server once WML files have been developed locally and test them over a real Internet connection. Before accessing any URL, we should make sure WAP Gateway Simulator is running on the PC.

When WAP program is downloaded then only the first card is seen at the mobile. Following is the output of the above example on Nokia Mobile Browser 4.0. This mobile supports horizontal scrolling. The text can be seen off the screen by pressing the "Left" or "Right" button.

First Card
Welcome to IGNOU!
OptionsBack

When the right button is pressed then second card will be visible as follows:

Second Card
Let us learn to make a Wireless World...
Options Back

Check Your Progress 2

1. Short Note on WML Component?

……
……

2. In what aspects is the WML development different from web development?

---

3. What are the Characteristic Features of WML?

5.3 WML Elements - formatting and links

WML has a set of *elements* that specify all markup and structural information for a WML deck. Elements are identified by tags, which are each enclosed in a pair of angle brackets. Unlike HTML, WML strictly adheres to the XML hierarchical structure and hence elements must contain a start tag and an end tag. WML is a case sensitive language. The Card and card are different things. Elements have one of the following two structures:

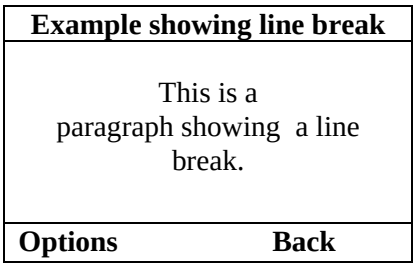
> **<tag> content </tag>** : This form is identical to HTML.
> **<tag />:** This is used when an element cannot contain visible content or is empty, such as a line break. WML document's prolog part does not have any element which has closing element.

5.3.1Line Break:

The <br /> element defines a line break and almost all WAP browsers support a line break tag. Following is the example showing usage of <br /> element.

```
<?xml version="1.0"?>
<!DOCTYPE wml PUBLIC "-//WAPFORUM//DTD WML 1.2//EN"
"http://www.wapforum.org/DTD/wml12.dtd">

<wml>
<card title="Example showing line break">
<p align="center">This is a <br /> aparagraph showing a line break.
</p>
</card>
</wml>
```

This will produce following result:



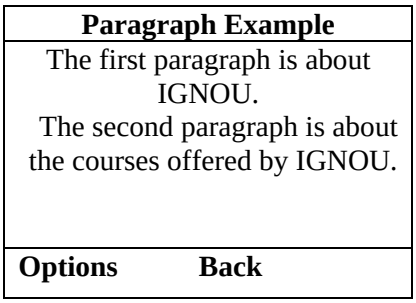
5.3.2Text Paragraphs:

The element defines a paragraph of text and WAP browsers always render a paragraph in a new line.In WML, all text to be displayed on the main part of the screen must be inside a paragraph element.A element is required to define any text, image or a table in WML.

Following is the example showing usage of element.

```
<?xml version="1.0"?>
<!DOCTYPE wml PUBLIC "-//WAPFORUM//DTD WML 1.2//EN"
"http://www.wapforum.org/DTD/wml12.dtd">

<wml>
<card title="Paragraph Example">
<p align="center">The first paragraph is about IGNOU.</p>
<p align="right">The second paragraphis about the courses offered by IGNOU.</p>
</card>
</wml>
```

This will produce following result:



5.3.3 WML Tables:

The <table> element alongwith<tr> and <td> is used to create a table in WML. WML does not allow the nesting of tables.A <table> element should be put with-in ... elements.

Following is the example showing usage of <table> element.

```
<?xml version="1.0"?>
<!DOCTYPE wml PUBLIC "-//WAPFORUM//DTD WML 1.2//EN"
```

```
"http://www.wapforum.org/DTD/wml12.dtd">

<wml>
<card title="WML Tables">
<p><table columns="3" align="LCR">
            <tr>
            <td>Col 1</td><td>Col 2</td><td>Col 3</td>
            </tr>
            <tr>
            <td>Course1</td><td>Course2</td><td>Course3</td>
            </tr>
            <tr>
            <td>Course4</td><td>Course5</td><td>Course6</td>
            </tr>
</table></p>
</card>
</wml>
```

This will produce following result:

WML Tables

Col 1	Col 2	Col 3
Course1	Course2	Course3
Course4	Course5	Course6

Options **Back**

5.3.4 Preformatted Text:

The <pre> element is used to specify preformatted text in WML. Preformatted text is text of which the format follows the way it is typed in the WML document. This tag preserves all the white spaces enclosed inside this tag. We have to make sure that we are not putting this tag inside ...

Following is the example showing usage of <pre> element.

```
<?xml version="1.0"?>
<!DOCTYPE wml PUBLIC "-//WAPFORUM//DTD WML 1.2//EN"
"http://www.wapforum.org/DTD/wml12.dtd">

<wml>
<card title="Preformatted Text">
<pre>
  This preformatted
Text<b>Welcome to IGNOU</b>will appear
as it is.
</pre>
</card>
</wml>
```

This will produce following result:

Preformatted Text
This preformatted Text **Welcome to IGNOU** will appearas it is.
OptionsBack

5.3.5 WML Fonts - <b>, <big>,,<italic>

WML Elements	Purpose
<b>	Defines bold text
<big>	Defines big text
	Defines emphasized text
<i>	Defines italic text
<small>	Defines small text
	Defines strong text
<u>	Defines underlined text

5.3.6 WML – Images

'A picture is worth a thousand words'. With such small screens, small images instead of text can be very useful, allowing us to get more information across to the user in the small space available. Images can be particularly useful when used as links. For example an application could be navigated using small icons instead of lots of text.The <img> element is used to include an image in a WAP card.WAP-enabled wireless devices only supported the Wireless Bitmap (WBMP) image format.The file extension of WBMP is ".wbmp" and the MIME type of WBMP is "image/vnd.wap.wbmp".

Following is the example showing usage of <img> element.

```
<?xml version="1.0"?>
<!DOCTYPE wml PUBLIC "-//WAPFORUM//DTD WML 1.1//EN"
"http://www.wapforum.org/DTD/wml_1.1.xml">
<wml>
<card id="main" title="Image">
<p>
What a beautiful image of the<br/>
<imgsrc="rainbow.wbmp" alt="rainbow"/><br/>
on a rainy day
</p>
</card>
</wml>
```

This will produce following result:

Image
What a beautiful image of the  on a rainy day
Options **Back**

5.3.7 WML Navigational Elements - <do>, <a>, <anchor>and <go>

Implementing good navigation around a WAP application is important since very little can be displayed on the small screen that the device has. In WML the elements that are used for navigation between WML cards are <do>, <a>, <anchor>and <go>. These are discussed below.

The do Element

The do element gives the user a general mechanism for performing navigation between cards. The do element establishes a soft key which gives the user the ability to alter the path or jump to a different card without having to navigate a full list of options.The do element may appear at both the card-level and deck level.

Card-Level

The do element may appear inside a card and may be located anywhere in the text flow. If the user agent intends to render the do element inline, it should use the element's anchor point as the rendering point.

Deck-Level

The do element may appear inside a template, indicating a deck level do element. A deck level do element applies to all the cards in the deck. It is equivalent to specifying the do element with in each card.

A card level do element overrides a deck-level do element if they have the same name. For a single card, the active do element are defined as the do elements specified in the card, plus any do elements specified in the deck's template and not overridden in the card.

Syntax

<do type="type" label="label" name="name">

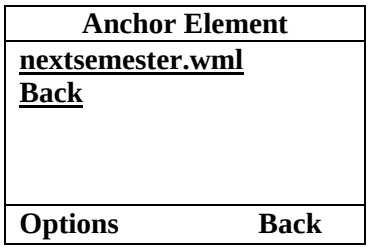
WML <anchor> Element:

The <anchor>...</anchor> tag pair is used to create an anchor link. It is used together with other WML elements called <go/>, <refresh> or <prev/>. These elements are called task elements and tell WAP browsers what to do when a user selects the anchor link. We can enclose Text or image along with a task tag inside <anchor>...</anchor> tag pair.

Following is the example showing usage of <anchor> element.

```
<?xml version="1.0"?>
<!DOCTYPE wml PUBLIC "-//WAPFORUM//DTD WML 1.2//EN"
"http://www.wapforum.org/DTD/wml12.dtd">

<wml>
<card title="Anchor Element">
<p><anchor>
<go href="nextsemester.wml"/>
</anchor></p>
<p><anchor>
<prev/>
</anchor></p>
</card>
</wml>
```

This will produce following result:

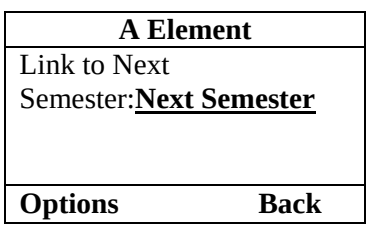


WML <a> Element:

The <a>... tag pair can also be used to create an anchor link and always a preferred way of creating links.We can enclose Text or image inside <a>... tags.Following is the example showing usage of <a> element.

```
<?xml version="1.0"?>
<!DOCTYPE wml PUBLIC "-//WAPFORUM//DTD WML 1.2//EN"
"http://www.wapforum.org/DTD/wml12.dtd">

<wml>
<card title="A Element">
<p> Link to Next Semester:
<a href="nextsemester.wml">Next Semester</a>
</p>
</card>
</wml>
```

This will produce following result:



The go element is discussed later in WML Tasks.

Check Your Progress 3

1 List the various WML navigational elements.

2.Explain how Images are linked in WML?

5.4 WML - Inputs

WML provides various options to let a user enter information through WAP application.

First of all, let us look at the different options for allowing the user to make straight choices between items. These are usually in the form of menus and submenus, allowing users to drill down to the exact data that they want.

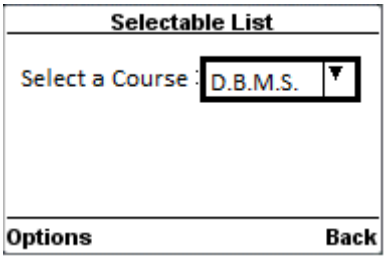
5.4.1 WML <select> Element:

The <select>...</select> WML elements are used to define a selection list and the <option>...</option> tags are used to define an item in a selection list. Items are presented as radio buttons in some WAP browsers. The <option>...</option> tag pair should be enclosed within the <select>...</select> tags.

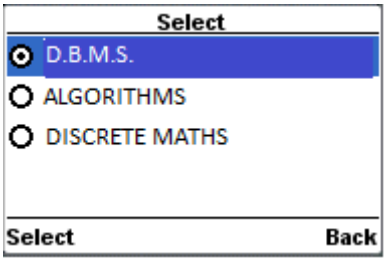
Following is the example showing usage of these two elements.

```
<?xml version="1.0"?>
<!DOCTYPE wml PUBLIC "-//WAPFORUM//DTD WML 1.2//EN"
"http://www.wapforum.org/DTD/wml12.dtd">

<wml>

<card title="Selectable List">
<p> Select a Course :
<select>
<option value="dbms">D.B.M.S</option>
<option value="algo">ALGORITHMS </option>
<option value="dm">DISCRETE MATHS </option>

</select>
</p>
</card>

</wml>
```

When we will load this program it will show us following screen:



Once we highlight and enter on the options it will display following screen:



We want to provide option to select multiple options then set *multiple* attribute to *true* as follows:

```
<?xml version="1.0"?>
<!DOCTYPE wml PUBLIC "-//WAPFORUM
//DTD WML 1.2//EN"
"http://www.wapforum.org/DTD/wml12.dtd">

<wml>

<card title="Selectable List">
<p> Select a Subject :
<select multiple="true">
<option value="dbms">D.B.M.S</option>
<option value="algo">ALGORITHMS </option>
<option value="dm">DISCRETE MATHS </option>
</select>
</p>
</card>

</wml>
```

This will give us a screen to select multiple options.

5.4.2 WML <input> Element:

The <input/> element is used to create input fields and input fields are used to obtain alphanumeric data from users. This element supports the following attributes:

Attribute	Value	Description
Name	Text	The name of the variable that is set with the result of the user's input

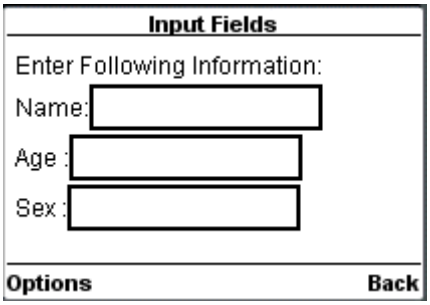
maxlength	Number	Sets the maximum number of characters the user can enter in the field
emptyok	true false	Sets whether the user can leave the input field blank or not. Default is "false"
format	A a N X x M m *f *nf*	Sets the data format for the input field. Default is "*M". A = uppercase alphabetic or punctuation characters a = lowercase alphabetic or punctuation characters N = numeric characters X = uppercase characters x = lowercase characters M = all characters m = all characters **f* = Any number of characters. Replace the *f* with one of the letters above to specify what characters the user can enter *nf* = Replace the *n* with a number from 1 to 9 to specify the number of characters the user can enter. Replace the *f* with one of the letters above to specify what characters the user can enter
Size	Number	Sets the width of the input field
tabindex	Number	Sets the tabbing position for the select element
Title	Text	Sets a title for the list
Type	text password	Indicates the type of the input field. The default value is "text". Password field is used to take password for authentication purpose.
Value	Text	Sets the default value of the variable in the "name" attribute
xml:lang	language_code	Sets the language used in the element
Class	class data	Sets a class name for the element.
Id	element ID	A unique ID for the element.

Following is the example showing usage of this element.

```
<?xml version="1.0"?>
<!DOCTYPE wml PUBLIC "-//WAPFORUM//DTD WML 1.2//EN"
"http://www.wapforum.org/DTD/wml12.dtd">

<wml>

<card title="Input Fields">
```

```
<p> Enter Following Information:<br/>
 Name: <input name="name" size="12"/>
 Age :  <input name="age" size="12" format="*N"/>
 Sex :  <input name="sex" size="12"/>
</p>
</card>

</wml>
```

This will provide us following screen to enter required information:



5.4.3 Setvar Element

The setvar element specifies the variable to be set in the current browser context as a side effect of executing a task. The element is ignored if the name attribute does not evaluate to a legal variable name at runtime.

Syntax

<setvar name=”vname” value=”value”>

Name specifies the variable name and Value specifies the value to be assigned to the variable. Both the attributes are required.The following element would create a variable named *a* with a value of 1000:

```
<setvar name="a" value="1000"/>
```

5.4.4 WML <fieldset> Element:

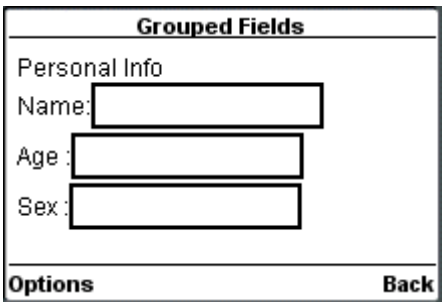
The <fieldset/> element is used to group various input fields or selectable lists.

Following is the example showing usage of this element.

```
<?xml version="1.0"?>
<!DOCTYPE wml PUBLIC "-//WAPFORUM//DTD WML 1.2//EN"
"http://www.wapforum.org/DTD/wml12.dtd">

<wml>

<card title="Grouped Fields">
<p>
```

```
<fieldset title="Student Info">
 Name: <input name="name" size="12"/>
 Age :  <input name="age" size="12" format="*N"/>
 Sex :  <input name="sex" size="12"/>
</fieldset>
</p>
</card>

</wml>
```

This will provide us following screen to enter required information. This result may differ browser to browser.



5.4.5 WML <optgroup> Element

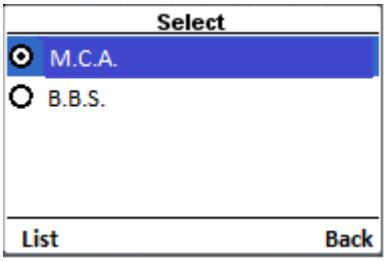
The <optgroup/> element is used to group various options together inside a selectable list.

Following is the example showing usage of this element.

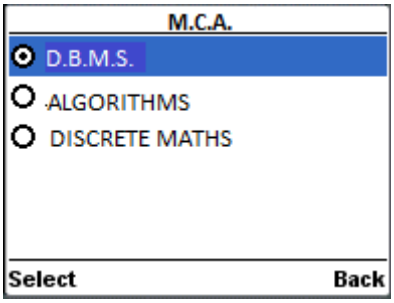
```
<?xml version="1.0"?>
<!DOCTYPE wml PUBLIC "-//WAPFORUM//DTD WML 1.2//EN"
"http://www.wapforum.org/DTD/wml12.dtd">

<wml>

<card title="Selectable List">
<p> Select a Course :
<select>
<optgroup title="M.C.A">

<option value="dbms">D.B.M.S</option>
<option value="algo">ALGORITHMS </option>
<option value="dm">DISCRETE MATHS </option>
</optgroup>
<optgroup title="B.B.S">
<option value="marketing">Marketing</option>
<option value="ob">Organizational Behaviour</option>
<option value="hrm">Human Resource Management</option>
</optgroup>

</select>
```

```
</p>
</card>

</wml>
```

When a user loads above code then it will give two options to be selected:



When a user selects any of the options then only it will give final options to be selected. So if user selects India then it will show us following options to be selected:



5.4.6 WML - Submit Data to Server

Similar to *HTML Form* WML also provide a mechanism to submit user data to web server. To submit data to the server in WML, we need the <go>...</go> along with <postfield/> tags. The <postfield/> tag should be enclosed in the <go>...</go> tag pair. To submit data to a server, we collect all the set WML variables and use <postfield> elements to send them to the server. The <go>...</go> elements are used to set posting method to either POST or GET and to specify a server side script to handle uploaded data.

CHECK YOUR PROGRESS 4

1. What are Input Elements? Explain briefly.

---

2. Discuss about Select Element?

---

3. What is the use of DO Element?

---

4. Define setvar element?

5.5 WML – Tasks

A WML task is an element that specifies an action to be performed by the browser, rather than something to be displayed. For example, the action of changing to a new card is represented by a <go> task element and the action of returning to the previous card visited is represented by a <prev> task element. Task elements encapsulate all the information required to perform the action. WML provides four elements to handle four WML tasks called go task, pre task, refresh task and noop tasks.

5.5.1 go task

A go executes a push operation on the history stack. As the name suggests, the <go> task represents the action of going to a new card.Following is the example showing usage of <go> element.

```
<!DOCTYPE wml PUBLIC "-//WAPFORUM//DTD WML 1.2//EN"
"http://www.wapforum.org/DTD/wml12.dtd">

<wml>
<card title="GO Element">
<p>
<anchor>
      Semester 1 : <go href=semester1.wml"/>
</anchor>
</p>
</card>
</wml>
```

5.5.2 The <prev> Task:

The <prev> task represents the action of returning to the previously visited card on the history stack. When this action is performed, the top entry is removed from the history stack, and that card is displayed again, after any <setvar> variable assignments in the<prev> task have taken effect.If no previous URL exists, specifying <prev> has no effect. Following is the example showing usage of <prev> element.

```
<?xml version="1.0"?>
<!DOCTYPE wml PUBLIC "-//WAPFORUM//DTD WML 1.2//EN"
"http://www.wapforum.org/DTD/wml12.dtd">

<wml>
<card title="Prev Element">
<p>
<anchor> Previous Page :<prev/></anchor>
</p>
</card>
</wml>
```

5.5.3 The <refresh> Task:

The <refresh> task performs the variable assignments specified by its <setvar> elements and then redisplays the current card with the new values. It is most often used to perform some sort of "reset" action on the card. The <go> and <prev> tasks perform the same action just before displaying the new card. Following is the example showing usage of <refresh> element.

```
<?xml version="1.0"?>
<!DOCTYPE wml PUBLIC "-//WAPFORUM//DTD WML 1.2//EN"
"http://www.wapforum.org/DTD/wml12.dtd">

<wml>
<card title="Referesh Element">
<p>
<anchor> Refresh this page:
<go href="test.wml"/>
<refresh>
<setvar name="x" value="100"/>
</refresh>
</anchor>
</p>
</card>
</wml>
```

5.5.4 The <noop> Task:

The purpose of the <noop> task is to do nothing (no operation). This attribute is useful for overriding deck-level do elements.The only real use for this task is in connection with templatesFollowing is the example showing usage of <noop> element.

```
<?xml version="1.0"?>
<!DOCTYPE wml PUBLIC "-//WAPFORUM//DTD WML 1.2//EN"
"http://www.wapforum.org/DTD/wml12.dtd">

<wml>
<card title="Noop Element">
<p>
<do type="prev" label="Back">
<noop/>
</do>
</p>
</card>
</wml>
```

Check Your Progress 5

1. Write a WML application to navigate between cards.

---

2. Discuss one situation where it can be useful to include variables in a <prev> task.

5.6 WML - Events

Events can be used to make WAP applications dynamic. Event in ordinary language as the name suggests, is simply the happening of something notable.In programming **event** is identical in meaning, but with one major difference. When something happens in a computer system, the system itself has to **(1)** detect that something has happened and **(2)** know what to do about it.WML language also supports events and we can specify an action to be taken whenever an event occurs. This action could be in terms of WMLScript or simply in terms of WML. WML supports following four event types:

- onenterbackward: This event occurs when the user hits a card by normal backward navigational means. That is, user presses the Back key on a later card and arrives back at this card in the history stack.
- onenterforward: This event occurs when the user hits a card by normal forward navigational means.
- onpick: This is more like an attribute but it is being used like an event. This event occurs when an item of a selection list is selected or deselected.
- ontimer: This event is used to trigger an event after a given time period.

These event names are case sensitive and they must be lowercase.

5.6.1**WML – Timer**

WML provides us**ontimer** event to handle if user wants something to happen without the user explicitly having to activate a control.

We can bind a task to this event with the <onevent> element. Here is the syntax:

```
<onevent type="ontimer">
  A task to be performed.
</onevent>
```

Here a task could be <go>, <prev> or <refresh>.

5.6.2 WML <timer> Element:

A timer is declared inside a WML card with the <timer> element. It must follow the <onevent> elements if they are present. (If there are no <onevent> elements, the <timer> must be the first element inside the <card>.) No more than one <timer> may be present in a card.

Following is the example showing usage of <timer> element.

```
<<?xml version="1.0"?>
<!DOCTYPE wml PUBLIC "-//WAPFORUM//DTD WML 1.1//EN"
"http://www.wapforum.org/DTD/wml_1.1.xml">
<wml>
<card id="card1" title="First card"
ontimer="#card2">
<timer value="10"/>
<p>
Welcome to IGNOU...<br/>
This is First Card
<do type = "accept" label="Next">
```

```
<go href="#card2"/>
</do>
</p>
</card>
<card id="card2" title="Second card"
ontimer="#card1">
<timer value = "20"/>
<p>
Let us learn to make a Wireless World <br/>
This is the Second Card
<do type = "prev" label="Back">
<prev/>
</do>
</p>
</card>
</wml>
```

The first card Welcome to IGNOU... would be visible on the screen for 10 seconds. Automatically, the second card comes on view as soon as thetimer expires. The second card,Let us learn to make a Wireless World would be displayed for 20 seconds. At the expiry of the timer, the user is taken back to the first card.

5.7 WML Variables

When a user switch from card to card in a deck, we need to store data.This mechanism is provided via WML variables.WML variables arecase sensitive.

5.7.1 Naming the Variable

Specify a Variable with the Setvar Command

When someone executes a task (like go, prev, and refresh), the setvar element can be used to set a variable with a specified value.

The following example will create a variable named k with a value of 345:
<setvar name=”k” value =”345”/>
The name and value attributes are required.

Specify a Variable through an Input Element

Variables can also be set through an input element (like input, select, option, etc.). A variable is automatically created that corresponds with the named attribute of an input element.

```
<?xml version="1.0"?>
<!DOCTYPE wml PUBLIC "-//WAPFORUM//DTD WML 1.1//EN"
"http://www.wapforum.org/DTD/wml_1.1.xml">

<wml>
<card id="first" title="First Card">
<p align="center">
Select Any one... <br/>
<select name="coursename">
```

```
<option value="no">Select </option>
<option value="MCA">MCA Course</option>
<option value="MBA">MBA Course</option>
</select>
<do type="access" label="next">
<go href="#card2"/>
</do>
</p>
</card>
<card id="card2" title="Second Card">
<p>You selected: $(coursename)</p>
</card>
</wml>
```

The use of variable that we created in the example above:

You selected: $(coursename)

5.8 WML Examples

A WML deck with two cards - one for user input and one for displaying the result - can be set up, like demonstrated in this example:

```
<?xml version="1.0"?>
<!DOCTYPE wml PUBLIC "-//WAPFORUM//DTD WML 1.1//EN"
"http://www.wapforum.org/DTD/wml_1.1.xml">

<wml>
<card id="card1" title="Course">
<do type="accept" label="Answer">
<go href="#card2"/>
</do>
<p>
<select name="name">
<option value="MCA">MCA Course</option>
<option value="BBS">BBSCourse</option>
<option value="BFIA">BFIA Course</option>
</select>
</p>
</card>
<card id="card2" title="Answer">
<p>
You selected: $(name)
</p>
</card>
</wml>
```

Example Explained

The Prolog <?xml version="1.0"?>

<!DOCTYPEwml PUBLIC "-//WAPFORUM//DTD WML 1.1//EN"
"http://www.wapforum.org/DTD/wml_1.1.xml">

The first lines in the WML document is called the prolog: The prolog defines that this is an XML document. It defines the XML version, and the DTD to be referenced.

The Deck <wml> .....</wml>

The deck is the WML document itself. It is embedded within <wml> tags

The Cards

<card> ..... </card>

Card are always displayed one at the time. The two cards named "card1" and "card2" are defined between <card> tags

The <do> element

<do> ... </do>

The first card has a <do> element that defines an event to be triggered. The type="accept" attribute of the do element causes the label="Answer" to be displayed in the lower left corner of the display.

The Event

The go element triggers when the user clicks the do label. The href="#card2" attribute of the go element causes card2 to be displayed on the screen.

The Variable

Card2 displays the $(name) variable from card1, because variables are valid across cards.

Check Your Progress 6

1. Discuss briefly about WML Event?

---

2. How to use Timer in WML?

---

3. What are the WML variables? How to use them?

5.9 Summary

WAP is simply aprotocol – a standardised way by which a wireless device talks to a server installed in a wireless network.WAP provides a method to communicate across wireless networks quickly, securely and efficiently. WAPprovides the opportunity to integrate databases, dynamic content, e-commerce and secure information trafficking through an WAP-enabled device. It takes a client sever

approach. It incorporates a relatively simple microbrowser into a mobile phone requiring only limited resources on the mobile phone. This makes WAP suitable for thin clients and early smart phones. It is aimed at turning a mass- market mobile phone into a "network based smart phone". The philosophy behind the WAP approach is to utilise as few resources as possible on the handheld device and compensate for the constraint of the device by enriching the functionality of the network. WML is a markup language, which is used to interface with the WAP browser. It allows a programmer to simultaneously develop web-based applications that can be viewed both within a traditional web browser and within a hand held device. WML supports several elements to solicit user input. The elements can be combined into one or more cards. All requests for user input are made in abstract terms, allowing the user agent the freedom to optimize features for the particular device. WML includes a small set of input controls. For example, WML includes a text entry control that supports text and password entry. Text entry fields can be masked preventing the end user from entering incorrect character types. WML also supports client-side validation by allowing the author to invoke scripts at appropriate times to check the user's input. It includes an option selection control that allows the author to present the user with a list of options that can set data, navigate among cards, or invoke scripts. WML supports both single and multiple option selections. WMLalso includes task invocation controls. When activated, these controls initiate navigation or a historymanagement task such as traversing a link to another card (or script) or popping the current card off of thehistory stack. The user agent is free to choose how to present these controls. It may for example, bindthem to physical keys on the device, render button controls in a particular region of the screen (or inlinewithin the text), bind them to voice commands, etc.WML allows several navigation mechanisms using URLs. It also exposes a first –class history mechanism.Navigation includes HTML-style hyperlinks, inter-card navigation elements, as well as history navigationelements.

5.10 Answers to Check Your Progress

Check Your Progress 1

Ans.1 WAP (Wireless Application Protocol) is simply a communication protocol by which a wireless device talks to a server installed in a wireless network. It is an open, global specification, which gives mobile users with access to wireless devices the opportunity to easily access the Internet or other computer applications, defined by the WAP forum. Standard HTML content cannot be effectively displayed on the small-size screens of pocket-sized mobile phones and pagers. WAP utilizes binary transmission for greater compression of data and is optimized for long latency and low bandwidth. The lightweight WAP protocol stack is designed to minimize the required bandwidth and maximize the number of wireless network types that can deliver WAP content.

Ans.2 It consists of five layers, namely: application layer, session layer, transaction layer, security layer and datagram layer.

Ans.3 Network layer of WAP i.e. WDP(Wireless Datagram Protocol) shields the upper layers from the bearer services like SMS, CMD etc. provided by the network and hence allows applications a transparent transmission of data over different bearers. WDP must have bearer specific implementation since it is the only layer that has to interface various bearer networks.

Ans.4 Increase in subscriber base, enhanced services, low cost, more value and functionality from mobile devices are some of the advantages of WAP. Limitations of WAP areimposed by device limitations and by the bandwidth and mobility limitations. Some basic examples of WAP are given below:

1. Using WAP we can get information of train time-table.
2. Using WAP can purchase tickets like: movie,journey ticket etc.
3. Using WAP we perform task like flight check in
4.We can also view traffic information.
5.We can get information about current weather condition.
6.Using WAP we can also do trading of shares.
7.We can also display sport results on our small wireless devices.

Check Your Progress 2

Ans.1: WML Components consists of WML Decks and Cards. WML pages – content viewed on separate screens – are *cards* and the cards are all placed within a *deck* of related pages that constitute one single file.

Ans.2: In WML, since each page or screen is very small, it does not make much sense for each page to constitute a separate file.So, a main difference between HTML and WML is that the basic unit of navigation in HTML is a page, while that in WML is a card..

Check Your Progress 3

Ans.1: In WML the elements that are used for navigation between WML cards are <do>, <a>, <anchor>and <go>.

Ans.2: The do element gives the user a general mechanism for performing navigation between cards. These buttons give the user the ability to alter the path or jump to a different card without having to navigate a full list of options.The do element may appear at both the card-level and deck level.

Ans.3: The <img> element is used to include an image in a WAP card.WAP-enabled wireless devices only supported the Wireless Bitmap (WBMP) image format.The file extension of WBMP is ".wbmp" and the MIME type of WBMP is "image/vnd.wap.wbmp".

Following is the example showing usage of <img> element.

```
<?xml version="1.0"?>
<!DOCTYPE wml PUBLIC "-//WAPFORUM//DTD WML 1.1//EN"
"http://www.wapforum.org/DTD/wml_1.1.xml">
<wml>
<card id="main" title="Image">
<p>
What a beautiful image of the <br/>
<imgsrc="rainbow.wbmp" alt="rainbow"/><br/>
on a rainy day
</p>
</card>
</wml>
```

Check your progress 4

Ans.1: The <input/> element is used to create input fields and input fields are used to obtain alphanumeric data from users.

Ans.2: The <select>...</select> WML elements are used to define a selection list and the <option>...</option> tags are used to define an item in a selection list. Items are presented as radio buttons in some WAP browsers. The <option>...</option> tag pair should be enclosed within the <select>...</select> tags.

Ans.3: The setvar element specifies the variable to be set in the current browser context as a side effect of executing a task. The element is ignored if the name attribute does not evaluate to a legal variable name at runtime.

Syntax

<setvar name=”vname” value=”value”>

Check Your Progress 5

Ans.1:

```
<wml>
<card id="main">
<do type="accept" label="Enter">
<go href="#inbox"/>
</do>

<p><b>Messages</b>
</p>
</card>
<card id="inbox">
<do type="prev"><prev/></do>
<p><anchor><go href="#c1"/>1) Inbox</anchor><br/>
<anchor><go href="#c2"/>2) Outbox</anchor><br/>
</p>
</card>
<card id="c1">
<do type="prev"><prev/></do>
<p>
NO SPACE.
</p>
</card>
<card id="c2">
<do type="prev"><prev/></do>
<p>
NO MESSAGES.
</p>
</card>
</wml>
```

Ans.2: One situation where it can be useful to include variables in a <prev> task is a login page, which prompts for a username and password. In some situations, we may want to clear out the password field when returning to the login card, forcing the user to reenter it. This can be done with a construct such as:

```
<?xml version="1.0"?>
<!DOCTYPE wml PUBLIC "-//WAPFORUM//DTD WML 1.2//EN"
```

```
"http://www.wapforum.org/DTD/wml12.dtd">

<wml>
<card title="Prev Element">
<p>
<anchor>
<prev>
<setvar name="password" value=""/>
</prev>
</anchor>
</p>
</card>
</wml>
```

Check Your Progress 6

Ans.1:WML language supports events and we can specify an action to be taken whenever an event occurs. WML supports following four event types:

- **onenterbackward:** This event occurs when user presses the Back key on a later card and arrives back at this card in the history stack.
- onenteforward: This event occurs when the user hits a card by normal forward navigational means.
- onpick: This event occurs when an item of a selection list is selected or deselected.
- ontimer: This event is used to trigger an event after a given time period.

Ans.2: We can set Timer in WML.We express time unit of timer as 1/10 of a second.

Below given is the example which will display text on WML page for 6 seconds.

Example:

```
<?xml version="1.0"?>
<!DOCTYPEwml PUBLIC "-//WAPFORUM//DTD WML 1.1//EN"
"http://www.wapforum.org/DTD/wml_1.1.xml">
<wml>
<card ontimer="timetest.wml"><timer value="60"/>
<p>Write some text here</p>
</card>
</wml>
```

Ans.3: Use of variables in WML is that when client wants to switch over card to card in a deck, then client stores the data into variables.

We can use variables in WML in two ways.

1. Can set a variable using setvar Command: Suppose that if client want to execute go,prev and refresh type task than they can use setvar command and create a variable with a specific value.

Example:

```
<setvar name="x" value="9888"/>
```

2. Can set a variable with an input element: If we want to set variable with an input,select, option etc input element.

Example:

```
<card id="card1">
<select name="course">
<option value="DBMS">DBMS </option>
<option value="CSA">CSA</option>
<option value="DISCRETE">DISCRETE MATHS</option>
</select>
</card>
```

We can use this created variable course into the card2.

```
<card id="card2">
<p>You have selected: $(course)</p>
</card>
```

In the above example we create a variable course in card1 and passed the selected course into card2 by variable course.

5.11 References

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http://www.w3schools.com/xml/xml_usedfor.asp

BLOCK INTRODUCTION

In the previous Block you have gone through the concepts related to web programming languages such as markup languages like HTML5, XML and scripting languages like JavaScript etc. One common point about these languages is that these languages are interpreted and executed by the browser which results in display of web pages. When you access a web page the client side script files are transferred from the web site which is hosted on a web server to the client side through hypertext transfer protocol. But are these files stored as similar files at the web server or they are generated with the help of a programming language? Simply, if a web site displays standard HTML pages to a client browser, the web server will either have those web pages as standard HTML pages or these HTML pages will be created using a programming language. The web sites where all the pages are in standard HTML are sometimes referred to as static web sites. However, in practice static web sites has limited uses and Web 2.0 web sites are more dynamic and interactive. This means that the pages that may be created for a client may change as per the need of the client, thus, you need some dynamism at the web server level too. The languages that are used to create client pages at the server, based on clients requirements may be categorized as the Server Side Scripting Languages. Some of the common server side scripting languages are PHP, JSP, SERVLET, ASP.NET, PYTHON and many more. In this Block, we have used JSP as the server side scripting language.

This Block discusses about the server side scripting. It consists of four Units:
Unit 1 discusses the basic concepts relating to server side scripting. It explains various enterprise level architectures, HTTP methods and the concept of web container.
Unit 2 explains the basic directives and elements of JSP. It also explains the concepts of expressions, and some basic JSP objects.
Unit 3 focuses on exception handling using JSP and use of cookies and sessions in the content of JSP. It also introduces the concept of managing emails using JSP.
Unit 4 presents an example of JSP that uses JDBC and database drivers. It also explains how you can connect to databases and develop applications involving databases.

Unit Continues from Next Page

UNIT 1: THE SERVER SIDE SCRIPTING

Structure **Page Nos.**

1.0 INTRODUCTION

In the last Block you have gone through the concepts of client side scripting. A client side script is executed by a browser and displayed as per the stated format. Such code however, in general is static in nature. In order to create dynamic web sites you need to use server side scripting.

This unit explains the concepts of server side scripting. It first defines the need of server side scripting. It explains various types of client server architectural model that are being used to develop flexible dynamic applications. This Unit also describes the role of various HTTP methods which help in transfer of data from the client side to the server side. It also explains the concept of request and response primitives that may be needed in a client server system. Finally the unit explains the concept of a web container with the help of an example.

This Unit thus, provides the basic information about the server side scripting. The remaining three Units of this Block are devoted to one server side scripting language JSP. Please remember that this block only introduces you to the server side scripting. This is one area where tools and technologies are changing at a very rapid rate, therefore, you must keep learning about web programming through suggested further readings on the WWW.

1.1 OBJECTIVES

After going through this Unit you should be able to:

- Define the need and the purpose of server side scripting
- Explain the purpose of tiers of architecture
- Identify several languages for server side scripting

- Work with some of the HTTP methods.
- define request and response primitives and their uses.
- List the features of a web container

1.2 SERVER SIDE SCRIPTING AND ITS NEED

Internet and specially World Wide Web is a major phenomenon of the last two decades. It was first proposed in a paper written by Sir Tim Berner-Lee in the year 1989. The WWW proposal by him was aimed at better communication and was based on the concept of hypertext – a text that can be linked (called hyperlink) to other text document. What should the basic requirements of WWW?

You must have visited WWW and would have visited many web sites. So just try to identify what are the very basic requirements that might be needed for WWW. The first and the foremost is the web address which is a unique address of a resource at a website on WWW. This resource address is also called the Uniform Resource Locator (URL). The second in this context would be a set of rules that allows transfer of the resources (mostly files) from a website to the user. This set of rules was documented as HyperText Transfer Protocol (HTTP). Thirdly, you must agree on some common but simple computer language that allows consistent publishing of the contents (may be in any spoken language). This common computer language is HyperText Markup Language (HTML) which uses standard tags. Now, the question is how does a user reach to a website and where does the website reside?

You as a user of WWW you need an Internet connection which should be running the HTTP and TCP/IP protocols (recollect HTTP is the application layer protocol of TCP/IP). You on your computer use a browser, type a website address which happens to be a URL of a starting page(may be the default index page index.html) of the website. The website responds by sending this page over the Internet and browser interprets and displays this page for you. In the whole process, the browser at your computer acts as a *Client.* The website obviously has to take the responsibility to make sure that client gets the requested page, thus, serves the client. Thus, websites are hosted on a *Server.* Since this server is of WWW commonly called web, the server is called the Web Server. In effect, the basic architecture is the *Client-Server* architecture. Figure 1 shows this architecture. Please note in the figure that there may be many clients for a website.

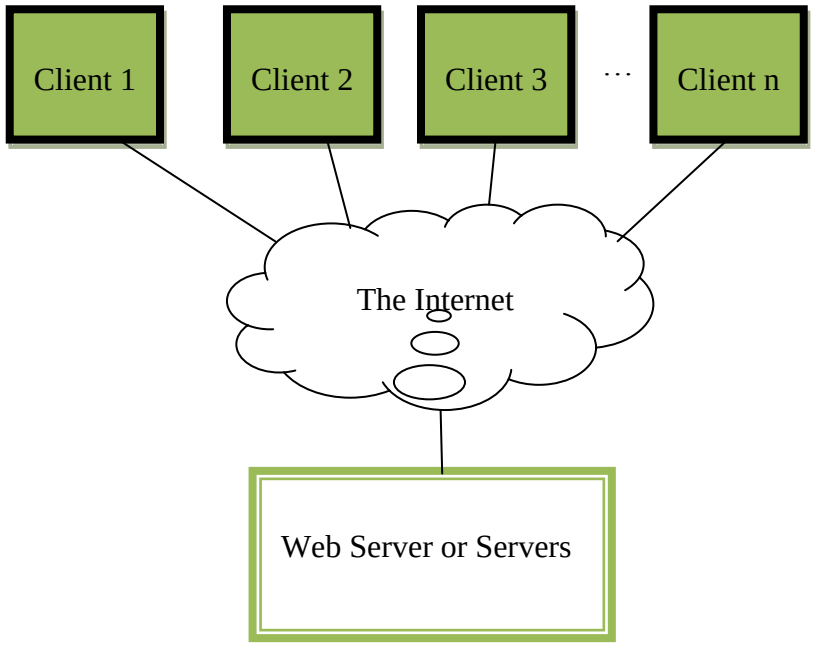


Figure 1: The Client-Server Model

The implication of this architecture is that you can clearly identify three basic components viz. the Client, the Internet cloud and the Server. The technologies of all these three components can be enhanced separately as long as they follow the three basic tenets, those are, the resources should be named using a standard (URL), a standard communication protocol is used (HTTP) and the contents are transferred to the client using a standard tagging language (HTML). Even all these standards over the period of time can be enhanced, but for this purposes newer client and server software needs to be created. You can relate these facts to development of newer secure protocols like HTTPS, creation and enhancement of client side scripting languages and CSS, and server side scripting technologies. The tremendous growth of WWW in terms of technologies can, thus, be attributed to the simple, flexible architecture and basic technologies.

Static Web pages: As discussed earlier a web page is accessed by the browser of a client computer from the web server using the Internet. For the discussion here let us ignore other client side scripting languages and just assume that web page has just HTML and CSS. The question here is: Does the server stores the web page seen by you exactly that is as HTML and CSS page? If the answer is YES, then the web site designed by you is Static. Please note that a static web site in addition to HTML, CSS can include images, audio, video content etc. You cannot interact with these static web sites as the content is fixed (static). Every user of the web site will see the same information on the web site. The web sites that were created in early stages of WWW were Static. These web sites were useful in showing brochure like fixed content about an organisation. Any changes or corrections in the content were made by the web administrator that too occasionally. For editing, the web designer/administrator may edit the static HTML pages or change images and their links on the HTML pages and reload them on the web server. Some of early tools used for such editing included Notepad which you can find in the accessories Menu of windows. You also needed tools for editing images, audio and video etc. Some of the major task of these designers was creating a web site layout, page linkages and creation of content and presentation format for each web page. Even today some of the pages of your web sites may be static in nature and may be designed using just HTML and CSS. A elementary example of a static web page may be – a static result page that displays the result of all the student in one page.

Dynamic Web pages: With the popularity of WWW, it was felt that the static web sites were not flexible and lacked user interaction. User wanted that a web page should display information as per his requirements. For example, you just need to be shown only your result. This would require that a web page is created that asks for your enrolment number and a password and displays your result to your browser only. There can be many other forms of user interactions that were possible (please refer to section on Web 2.0 in Block 1 Unit 1 of this Course). Thus, your web pages may consist of JavaScript or Java Applet at the client side, as well as they may be created at the server as per your interaction using rich set of server side languages and database tools. However, all these programming activities must be completed in quick time, such that you as a client do not have to unduly wait for information.

Today WWW consists of dynamic and interactive websites. A website can be made dynamic using both the client-side and server-side scripting. On the client side many technologies, like HTML5, CSS3, JavaScript, JSON, AJAX and many others, have been developed. Some of these technologies have been studied by you in Block 1. You must keep studying about these technologies form the WWW and keep updating yourself. The client side scripting can be used to perform activities at the client site that does not require information from the server. Some such activities may include creating effects such as animations, simple games, changing display, and even checking of information in forms that does not require checking at the server etc. The

client-side scripting not only helps in creating some visual effect on the client but also reduces unnecessary communication between the client and server.

However, it is the Server-Side Scripting that has lead to major advances in website design. The basic tenet of server side scripting is that to send a HTML file to a client (browser), you need not store these files on the server as HTML files. Rather, information can be collected from many sources including databases and HTML document can be created and sent to the browser. This makes the websites very dynamic as they can collect information and display formats as per the choices of the clients. The input to server side script is the input obtained from the client. The server-side script is executed at server using the resources of the servers. The final output is created for a client and sent to it for display on the browser. Please note that server-side scripting may generate different output for different browsers, if required. It makes the process of creating web pages simple and programmable. Server side scripting had helped in creating big e-commence based portals simpler to create and deploy. Can you think of some basic usage of server-side scripting?

Some basic uses of server-side scripting include applications that require users to login to system using a password. However, for such applications you also face problems due to stateless nature of HTTP protocol. What does this stateless protocol means?

It simply means that your current request to a server cannot be related to previous request as in HTTP server is not required to retain information about your previous requests. Therefore, if you are performing a transaction that requires multiple requests, you need to make sure that the information of previous requests is duly recorded. Thus, you need to make special provisions such as creating cookies or sessions that help in performing such tasks. Unit 3 of this Block explains these concepts in more details. However, you should know that the concept of stateless protocol is extremely useful for Internet as storing states take space and time, and given the size of internet and its users it would have made Internet very slow.

Server-side scripting is also very useful in extracting information from the user, may be with the help of a form or otherwise, and processing the information for some useful purpose. Suppose, you are interested in opening a web based email account, then you may fill up an account opening request form of an e-mail service provider like gmail, yahoo mail, rediffmail, etc. When you are filling up the form and commit some catchable mistake, client side JavaScript caches the error. However, once you submit the form and still an error is encountered, like duplicate user name, it can only be caught by the server-side script. As another example, consider that you are buying some product on an e-commerce based website, the client side is expected to keep track of your login information and present selections and sever need to maintain detailed list of your selections during a session. Please note that in general, client side scripts are less secure and are browser dependent. For secure applications, you should use server-side scripting languages.

Server-side scripting is also useful when you want to use a database as a backend to a web based application. Databases are normally stored on a database server which can be directly connected to the web server. Such kind of application has been discussed in the Unit 4 of this Block.

Finally, just some basic advice on when to use client-side scripting and when to use server-side scripting? The answer is very simple – if a user interaction element of a page can be processed without the need of any information from the web server, then you use client-side scripts. It reduces the load on network traffic, but the client hardware should be sufficiently fast to execute the client side script.

1.3 WEB APPLICATION ARCHITECTURES

In the previous section, you have gone through the concept of client-server model of computing. The model discussed in Figure 1, defines two simple portion where computing is performed. The first one is the client, which performs the tasks such as displaying a web page of an HTML document using CSS, running JavaScript, performing data conversion on the client side, dealing with client side Graphical User Interface display, communicating the data of the clients over the Internet to the server. While on the server side data may be stored, updated, or retrieved from database, the data may also be processed and a response may be sent to the client. Thus, the model clearly identifies a Client and a Server.

The objective of such a model is to clearly the division of work providing a flexible and scalable model of computing. This model provides flexibility in the sense that a new client can be added to whole system without much effort. The client only needs to know what server to access through the network and how. Now, consider a client-server environment in which you initially had only single digit number of clients, therefore, one single server was able to serve all the clients. However, the application became popular and hundreds of clients joined. In order to serve these clients you may need to deploy more servers. The important point here is that you can scale the number of servers based on the requirements. Thus, client-server model is a scalable model of computing.

1.3.1 N-Tier Architecture

In order to develop client-server based, you need an application development architecture. One such architecture that can be considered is 2-tier architecture. Obviously, in the 2-tier architecture, the first tier belonging to the client, which may be called a client tier, client tier or frontend, and the second tier may be called the server tier or backend. A developer needs to design the basic interactivity for the application, rules of data access and business rules in the client tier. In present day applications interactivity is provided through GUIs. Thus, all the information pages, forms, etc. designed by you are part of the client tier. Thus, web pages of a web application accessed by you using your computer system and browser are part of the client tier of the web application. The following is an illustration of use of 2-tier architecture.

You (client Computer) using a Browser	**Web Server running a Web Application**	
	Client Tier/Layer	**Server Tier/Layer**
Requests index page of a web site by typing the address of the web site		Receives the request and processes it to collect relevant files.
	The presentation tier will use server tier files to create the web page HTML+CSS+JavaScript for communication to client computer.	
The index page is displayed on the browser. Suppose the web site requests you to login. You will enter the user Id and password and press		The server will receive the data. It will connect to database to determine if
	The failure message will be converted to the	

Submit. The message page will be displayed. You can try again and the process continues…	required web page in HTML format along with CSS and the page will be communicated to the client computer. Please note this layer may also check the number of login attempts.	the user ID and Password are correct. Suppose it is not then it will create the failure message.

Figure 2: An Illustration of 2-Tier Architecture

As a client, you use the client tier to submit your request for a web page or some data. The client tier also checks, if you have permission to access the requested data. In case, user has the access permission, the requested information details are passed to the server, where the server-tier programs services the request sent by you (as a client). Once the requested data is available, then it is sent back to the client. Please note that display of data on your client computer is processed by the client tier of the web application.

The 2-tier client-server applications are useful for distribution of work, however, they require complex client implementations and number of communications between the client and servers. With the popularity of Internet new web application architecture was developed called n-Tier architecture. One of the most common n-tier architecture is 3-tier architecture. Figure 3 shows 3-tier architecture.

The layers and their basic functions are:

Presentation Layer/Tier: The presentation tier of the three tier architecture interfaces with the client. The presentation tier is responsible for displaying the information to the client as well as extracting information from the client. Technically, for a web based application the presentation tier resides on the web server on request the presentation layer displays interactive web pages in the browser of client computers.

Application Logic Layer/ Tier: This is also called the middle ware. This layer is primarily responsible to provide business rules, sharable components of a web application, access control etc. This layer shields the data layer from direct use of the clients. This layer provides an interface between the presentation and data layer.

Data Layer/Tier: The data for a web application may be hosted on a database management system or a file system. The data layer controls the integrity of data residing on some data storage system. The application logic sends queries to data layer which sends back the query results to the application logic layer.

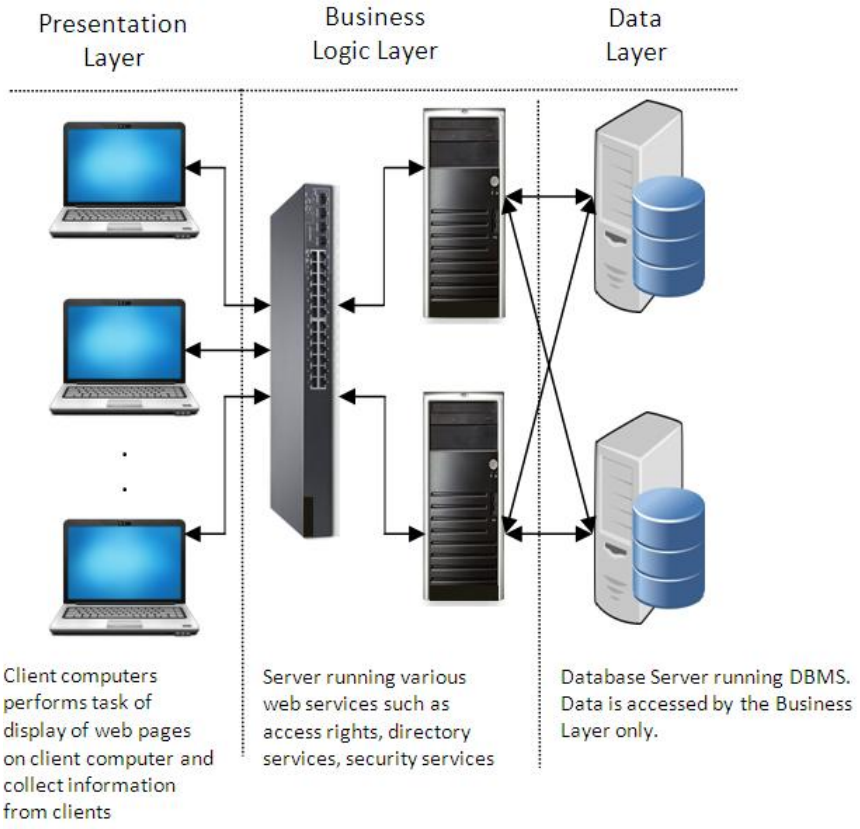


Figure 3: An n-Tier Architecture

Figure 4 shows an illustration of 3-tier Architecture.

Layer / Executed at	Example
Presentation Layer/client computer and web server	User logs in and on Successful login requests the list of students for BCA programme using a GUI based interface created by the web server.
Business Layer/Web Server	On user request the business layer verifies the access constraints of the user, suppose he is only authorized to see a group of students of BCA, then the query to database is suitably modified.
Data Layer/Web Server and Database Server	The query is executed using a connection with the database, and the results are returned to the web server.
Business Layer/Web Server	The web server checks if the returned data set is empty or not. If not passes the data set to the Presentation Layer, else returns an error message.
Presentation Layer/ web server and client computer	The presentation layer converts the data into a HTML table or error message to an error page. This page then is sent to client computer and displayed in the browser.

Figure 4: An illustration of 3-Tier Architecture

An n-tier architecture in addition to the above three layers may have many more application layers such as client presentation layer, entity class layer, persistence layer etc. The more are the number of layers the more complex the system is, however, more layers may bring better application flexibility.

In general, n-tier architectures results in more scalable, more secure (database access is hidden) and better integrity based applications. However, they are more complex in nature.

1.3.2 MVC Architecture

In the previous sub-section, you have gone through the concept of n-tier architecture. In this section, we discuss an important architecture that is used by Java for web application development. This architecture is known as Model-View-Controller (MVC). This architecture can also be used for the development of a web application. Figure 6 shows the component of web applications as per this architecture.

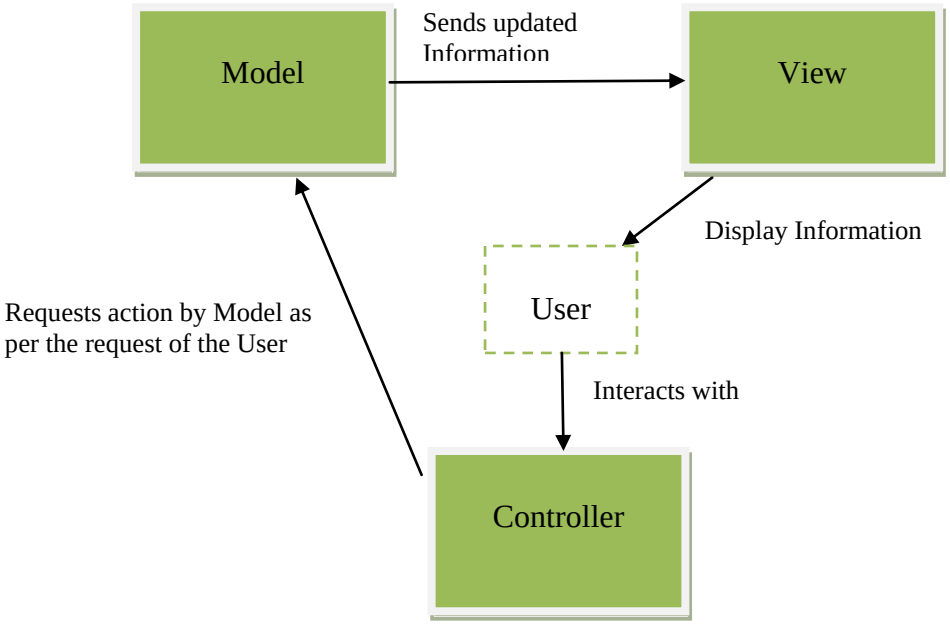


Figure 6: MVC Architecture

The MVC architecture has three functional component of a web application that communicates through a user as well as among them. The following are the basic components of MVC architecture:

Model: In the context of MVC a Model defines the data model and its access controls. The main role of this component is to represent data and perform updates on it as per the defined rules. The main responsibility of this component is to accept user requests and the data entered by the user and perform the necessary data related function.

View: The function of the view will be to accept the data from the Model and convert it to form that can be seen be a user in a user friendly way. Thus, view is responsible for displaying web pages for the user. Any change in the model should also change the view. This can be achieved using two processes -

> Push processes allows views to register with a model and change in the data of the model result in pushing the current data to view.
>
> Pull process requires the view to get data current data from the model when needed.

Controller: A user may be allowed to interact with the web pages created by the View component. This interaction may be in the form of selection of options of Menu, pull down lists, check boxes etc., filling up data in text boxes etc. It is the controller which accepts this data from the user and initiates suitable actions that should be carried out by the models.

Let us explain the MVC with the help of an illustration as shown in figure 7.

Model	You decided to create a website for storing information of registered students for various courses on an e-learning website. The model may be the student registration database.
View	As a first time user, you want to register into the website, one of the view would be the registration page. Another view may be the list of courses on offer. Please note that in the view pages the course list will be created from the model. In case a new course is added, this list needs to be updated. How? Not manually, but by a program. You will learn about this in the subsequent Units.
Controller	You may register to a course by submitting the online registration form, the data of this form will be accepted by the controller and sent to model for necessary actions.

Figure 7: An Illustration of MVC

☞ Check Your Progress 1

1) Differentiate between Static and Dynamic Web pages?

……
……

2) What is the need of Server side scripting? How is it different to client side Scripting?

.....
.....
.....

3) What are the various components of 3-Tier architecture? Why is it needed?

.....
.....

4) Compare 3-Tier Architecture with MVC?

.....
.....

1.4 TOOLS FOR SERVER SIDE SCRIPTING

In this section we will explain about the basic features needed for the server side scripting languages. As discussed in section1.2, purpose of server-side scripting is program the response of a server to the client side requests. Therefore, the input to server side scripting would be the interactive data input sent by the client using a web browser, and the output is the displayable web page which are displayed at the client's browser.

The question that you need an answer is: What should be the elements of a server side programming language? In order to answer this question, you need to first look at the functions that may be performed by the server side scripting. These are:

- Some mechanism for accessing the data that has been transferred from the client.
- Creation of dynamic web pages in which server side scripting may change the contents of a specific portion of a webpage
- Processing of form data obtained from the client side, this data sometimes may be used to store, update, and retrieve information from the database. All these activities are performed by the server-side scripting
- Handling errors that may occur due to several reasons, such as database access errors, data related errors, or other events.
- Enforcing the data security and integrity and handling constraints.
- Handling creation of sessions between client and server despite HTTP is stateless protocol.
- Creating output pages in a HTML or other client side language form.

Thus, a server side scripting language support following constructs:

- The basic programming constructs like variables, data types, assignment statements, if statement, looping statements, arrays, etc.
- Most of the web programming languages are object oriented programming languages, therefore, they uses classes, objects, inheritance hierarchy, containers, collections of classes, error handling etc.
- To communicate with the clients, they support some predefined methods, primitives and protocols. This ensures that data entered by a user is duly sent to a program that handles it. Most of the server side programming languages call these data items as parameters and have various ways to refer to these parameters.
- A good website requires access to a database system to store, update and retrieve data based on user's request. A database is maintained under the control of a DBMS. You are required to use a database driver that makes possible the exchange between the web server and the database server. These drivers must be connected through some connection protocols (some of these protocols are Open DataBase Connectivity (ODBC) and Java DataBase Connectivity (JDBC)). Thus, a server side script must have classes for driver specification and connection establishment. In addition, server-side scripting support constructs to create and execute SQL commands through these connections and obtain the resulting data tables. But how to access individual data records and attributes? Thus, every server-side scripting must support tools to access data records or rows and attributes or columns.
- Since HTTP is a stateless protocol, therefore, you need to establish sessions or create cookies (These will be discussed in Unit 3 of this Block). Thus, server side scripting must have classes/mechanisms to deal with sessions and cookies.
- Server side script produces output for the browser, therefore, such classes or commands must exist in such languages.

Thus, server-side scripting requires extensive features on part of its tools. Some of the most popular server-side scripting languages include – ASP.NET, PHP, JSP and SERVLETS, Perl and many more. There are a number of tools that integrate complete web development environment including web servers. Some such IDEs are Eclipse, NetBeans, and Visual Studio Express etc. A detailed discussion on these tools is beyond the scope of this Unit. You will be learning more about JSP in this Block. However, you may learn and use other languages also as many of the concepts are of similar nature.

1.5 HTTP PRIMITIVES

In the previous sections, you have been explained about the client-server architectures and the features of the language required for web application development. In these sections, you have been told that data from the client is passed to the server using a protocol. In this section, we define some of the basic methods that make this communication possible.

HyperText Transfer Protocol (HTTP) is the protocol that is used for WWW. HTTP is an application level protocol. What is an application level protocol? Please find out answer to this question from BCS041: Fundamentals of Computer Networks. Present version that is in use is HTTP/1.1.

An interesting related work that has helped WWW immensely is the concept of MIME (Multipurpose Internet Mail Extensions). MIME is a standard that was designed by an Internet Engineering Task Force Working Group. It was designed so that you can include or attach multimedia contents such as pictures, audio, video etc. and non-ASCII texts in your emails. The standard defines the way to represent and encode such contents. MIME standard became very popular and now it is used to describe content type for the Internet also. In the context of HTTP it defines the format of data for transmission. Internet Media Types, also called MIME type, defines the content type that is being transmitted over the Internet using HTTP or some other protocols. Some of the examples of theses Internet Media Types are:

File Type	Description
audio/mp4	The audio file containing audio data as per mp4 standard
image/png	Image file containing picture in Portable Network Graphics format.
text/css	Human readable text data containing style sheet content
...	...

There is long list of all such types. You can refer to further readings for more details.

1.5.1 Request and Response

HTTP uses a request-response method of communication. As a client, you type in the URL of a website, for example, http://www.ignou.ac.in/student/results.jsp, you are initiating a request for the web server. This process would involve TCP to set up a connection between the client and the host computer hosting www.ignou.ac.in at port 80 which is the default port for HTTP. But, how will it identity to which web server this request has been uninitiated, so that the connection can be established? First nearest Domain Name System (DNS) server to the client tries to translate the www.ignou.ac.in portion of the URL into the equivalent IP. If it fails it takes the help of other name servers to do so. Thus, if a web site exists, its IP address is returned. Please note that the IP address is of the web server hosting www.ignou.ac.in. However, please note that the URL also has path and name of the file which you wish to access. In this case the path is */student/* and the file name that you wish to access is *results.jsp*. Please note that due to security issues path may be a virtual path. Please

refer to further readings for more details on path. In any case the web server must be told about the path and file (resource) that a client needs to access.

Now, the client computer knows the IP address of the web server, the path and the resource name. It initiates the request using the HTTP methods such as GET (this is explained in the next subsection). A request is initiated with the help of a message. This message contains a head and a body. The format of the message is defined in the RFC 2616. A detailed discussion on RFC 2616 is beyond the scope of this Unit. You can read more about this document from one of the websites of RFC 2616 - http://www.hjp.at/doc/rfc/rfc2616.html.

For example, for the requested IGNOU page, the request may look like the following for the host www.ignou.ac.in:

GET /student/results.jsp HTTP/1.1

The message means that the request method is GET, the resource is results.jsp and the path for that resource is student folder of the root directory. HTTP/1.1 informs the host about the version of protocol.

Please note that a request for a resource should specify the host name, path, resource name and the protocol version.

As far as response of the sent request is concerned the response will include several messages that are sent in a sequence:

First the status code of the failure or success of the request along with the protocol version is sent. For example, the response line that indicates success of the request is: HTTP/1.1 200 ok. There are a number of status codes (with small description). For more details on response code, you may refer to RFC 2616.

As a second step a number of *HTTP headers* are sent to the clients. The purpose of HTTP headers is to inform the client about the type of document being sent such as text, graphics, etc. For more details, please refer to the RFC 2616 document.

Finally the resources requested by the client are sent. Please note that even a single request may result in sending multiple resources to the client.

The process of request-response is shown in Figure 7.

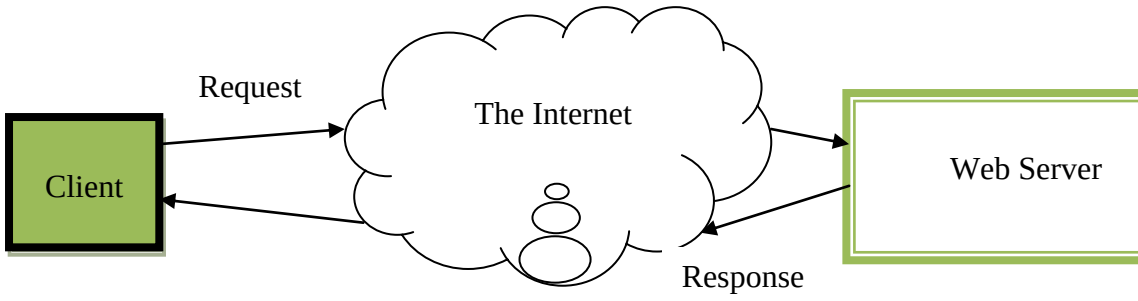


Figure 7: Request and response primitives

1.5.2 HTTP Methods

In the previous subsection, you read the term method in the context of request message. There are several methods defined in the RFC 2616, however, we will discuss the ones that you use most often for getting specific response from

the server. These methods are - GET, POST, HEAD, etc. But before we discuss, about the specific methods let us identify some basic characteristics of these methods.
Safe Methods: The methods that are only meant to retrieve information and not make any change in the server of any kind are considered as safe methods. GET and HEAD methods are safe methods.

GET method: The purpose of GET method is to retrieve the required sources from the server. GET can also be used to communicate information to the server as part of URL. For example, the in the practical lab manual of course BCSL057, we have used the GET method to access the list of the students of a course through a form. The following is the display of web page:

Figure 8: Display of form that initiates a GET request

Please note that the form is stored in the webpage
http://localhost:8080/DatabaseApplcation/CourseStudentList.jsp
Here, the localhost:8080 indicates that you are referring to the local web server on this machine at a port number 8080. The webpage uses the path /DatabaseApplcation/ and access the resource CourseStudentList.jsp. This results in display as shown in Figure 8. This jsp file contains the HTML code line:
`<form name="InputProgramme" action="CourseStudentListProcess.jsp" method="GET">`

Thus, when you select Bachelor of Computer Application and press Submit button on the form displayed in Figure 8, the action will be taken by the resource file CourseStudentListProcess.jsp. The method that will be used will be GET method as stated in the HTMLcode (…method="GET">). This will result in display of the web page that displays the student list. From the point of view of our discussion, the actual display of the student list is not important but the address line which is:
http://localhost:8080/DatabaseApplcation/CourseStudentListProcess.jsp?ProgCode=BCA

Please notice that after the resource name there is text *?ProgCode=BCA*. This text is passing additional information to the server that about a parameter called ProgCode having the value BCA for Bachelor of Computer Applications. Thus, GET not only passes the resource name but also several parameters that can be used by server to refine information. For example, in the case above server may use the jsp file and ProgCode information to find the information of BCA students only and send it back to the client.

HEAD method: HEAD method is like the GET method only, the only difference being that the only the headers are sent by the response and not the requested resources.

POST method: POST is another important method used for passing data to the server. However, in POST method data is passed inside a message and not as part of the URL being sent. Consider the following filled in HTML form from the URL http://localhost:8080/DatabaseApplcation/StudentInformationForm.jsp and displayed in Figure 9.

Figure 9: An HTML form for Student Information.

The form contains the following HTML code:

```
<form name="InputStudentData" action="StudentDataInput.jsp"
method="POST">
```

When you submit the form by pressing Submit Information Button, the information must be sent to the server. In this case parameters like student ID, name, phone, programme etc will be put inside the request message as the method used is POST. Thus, the URL of the page processing this information will be http://localhost:8080/DatabaseApplcation/StudentDataInput.jsp

There are several other request Methods, however, a detailed discussion on those methods ares beyond the scope of this Unit. You may refer about them in the further readings.

Mostly you would be using GET or POST methods while doing simple web programming. You must be wondering which of the two would be better? GET has an advantage that it is simple and safe, however, the maximum length of the string that you can pass through a URL is fixed. POST on the other hand has an advantage that it hides information as it is not displayed. Sometimes several hidden parameters are also passed along with basic parameters, in such case you may like to use POST method. In general, whenever you want that data should not be visible on URL you use POST method. GET method is very useful when you are testing your applications, as you clearly know the values of different parameters.

☞ Check Your Progress 2

1) Differentiate between the client side and server side scripting languages. Name at least four server side scripting languages

.....

.....

2) What is a request and response in the context of HTTP? What are its methods in the context of a request?

.....

.....

.....

3) How is GET different to POST?

.....

.....

.....

1.6 WEB CONTAINERS

In the last section we have discussed about the examples of GET and POST methods of HTTP request. A HTTP request is for specific web resource form a web server, generally, the HTML page, which should be sent as part of the response to the client. Notice that in the example of GET and POST we have asked for a web resource which have .jsp as a file extension which is a JSP file and not HTML file. How, does this JSP file along with the parameters is converted to a desired dynamic response from the web server to the client? This is the responsibility of the web container part of the web server.

A web container is part of Java Enterprise Architecture. We will discuss only generic information about Web Container. You can refer to more details from WWW or any reference book on JSP and Servlets. A web container is part of a web server. It relates a client request to a servlet that is to be executed in order to give a response to a request. A Servlet is a Java Class that is executed on the server. Figure 10 shows the basic functioning of a web container.

Client	Web Server	
	HTTP Server	Web Container
Requests for a JSP Page	Accepts the parameters from the client and checks if the request is for a jsp file or servlet. If so pass the parameter and requested resource information to the Web Container	Accepts the request and checks if the latest version of JSP file is translated to the Servlet, if not then 1. Translates JSP file to servlet 2. Uses Java Compiler to convert the Servlet to Java (.class) file. Once the .class file is available, it is executed using Java Runtime Environment at the Server. The output may be in the form of HTML. This is sent back to HTTP server.
The Requested Page is displayed.	Checks for error conditions, if everything is ok, HTML code is sent back to the client or else error message is sent.	

Figure 10: Role of Web Container

Some of the most common Web containers are Apache Tomcat, GlassFish, Eclipse Virgo, JBOSS, WebLogic, WebSphere and so on.

☞ **Check Your Progress 3**

1) Explain the role of web container.
.....
.....

2) Name any three web containers
.....

1.7 SUMMARY

This Unit introduces you to the concepts of server side scripting. The unit first defines the server-side scripting and explains the basic terms used in this context. Client-server architecture specifically n-tier architectures were explained. MVC architecture is an important architecture for web application development. Model-View-Controller defines the three important aspects of server side programming. The model defines the data model, view defines the user view, and controller establishes the necessary interaction between the two. In order to perform web programming you need to use a language. This Unit list some of the basic features required in the server side scripting languages. You may find the trends in server side scripting technologies from the WWW or further readings. HTTP is the protocol that is used for WWW. The Unit also discusses the request-response primitive of HTTP. It explains GET and POST methods of client to server communication. Finally, the Unit defines the web container and explains its need.

1.8 ANSWERS TO CHECK YOUR PROGRESS

Check Your Progress 1:

1

Static Web pages	*Dynamic Web pages*
The web pages on server use HTML and CSS, they can include images, audio, video etc.	Web pages use a server side language and/or database. They can also include images, audio, video etc.
You cannot interact with static web pages	You can interact with these pages
Every user of the web site will see the same information	User may see the information of his/her choice
web sites were useful in showing brochure like fixed content	Web based applications such as Web 2.0 based applications
Changes or corrections in the content were made by the web administrator that too occasionally	Changes can be made in program, if needed.
Editing would require reload of content to web site.	Changed program may be reloaded
Designing and maintenance of web site was very tedious	Designing and maintenance and security or web site is better

2 Server side scripting is required for dynamic web page environment. This script can help you in designing flexible, maintainable and dynamic websites involving databases. The client-side scripting is used when an interaction can be replied to without any server interaction. Client side scripting is less secure than server side scripting. Client side scripting cannot connect to a server database

3 Three-tier web software architecture involves Presentation layer which is displayed on the client computer, Business Logic layer which controls access of data which is stored in the Data layer. This architecture helps in making scalable, secure, flexible web applications.

4 In MVC architecture the view can directly be updated by the Model, however, in the 3-tier architecture, the Data layer never interacts directly with the Presentation Layer. The information is passed through the Application Logic layer.

Check Your Progress 2:

1 The client side scripting languages are used for implementing functions that can provide basic interactivity at client side. These functions do not need any support of the server. For example, checking whether information in a form has been filled up, format of data entered is correct, while server side scripting is used to provide features from the server, for example, client side scripting cannot check the availability of a user name, it has to be checked using server side scripting. Server side scripting is safer and very useful when dynamic web pages are to be designed using database. Client-side scripting is browser dependent whereas serve scripts are run at web server and are generally independent of the browser. Server side scripting is very useful in making maintainable websites. Server side scripting languages include PHP, ASP.NET, Ruby on Rails, Java Server Pages etc.

2 Request and response are messages send in HTTP protocol. Request primarily is used by client to ask for resource specified using the URL. Response is given by the web server on receiving a request. Response may include either the resource requested or the error messages. The methods are used as part of request to include additional information or parameters for the server.

3 GET passes the parameters by appending them with the URL, whereas, POST puts them in the message body. POST is preferred over GET, when you want that information should not be seen along URL. GET is preferred when testing an application.

Check Your Progress 3:

1 A web container is used for translation, if needed, of the server side script like JSP into a servlet. In addition, the web container also decides which servlets are to be invoked in order to respond to user request passed to it.

2 Some of the web containers are Apache Tomcat, GlassFish, Eclipse Virgo, JBOSS, WebLogic, WebSphere etc.

1.9 FURTHER READINGS

http://www.wikipedia.org
http://www.w3Schools.com
http://www.oracle.com

http://www.microsoft.com
http://www.eclipse.org
http://www.java2s.com
"MIME: Multimedia Internet Mail Extensions" written by "Nathaniel S. Borenstein"

UNIT 2 JSP - Basics

Structure

2.0 Introduction

In the previous block, you have learned that how to create HTML web pages. The simple HTML pages are static pages. Java Server Pages are simple but powerful technology used to generate dynamic web pages. Dynamic web pages are different from static web pages in that web server will create a web page when it is requested by a client or user. For example, your online results on IGNOU website, the page for every student instead IGNOU web server dynamically creates a page depending on your enrolment number.

JSP was released in 1999 by SUN Microsystems. JSP is a technology for developing web pages. JSP is similar to PHP and ASP, but it uses the Java programming language. It follows the characteristics of Java ‘write once and run anywhere'. JSP enables you to add dynamically generated content with static html. In addition to html, JSP page are built using different components viz., directives, scripting elements, standard actions and implicit objects. This unit covers how to create a JSP page. It also provides a basic understanding of Java Bean, custom tag and life cycle of Java Server Page.

2.1 Objectives

After going through this Unit, you will be able to

- use JSP to create simple dynamic web pages
- define the JSP page life cycle
- use directives, scripting tags and JSP action elements in a JSP page
- access Java Bean within JSP page
- create a custom tag
- forward request from JSP page to other resource
- use JSP implicit objects

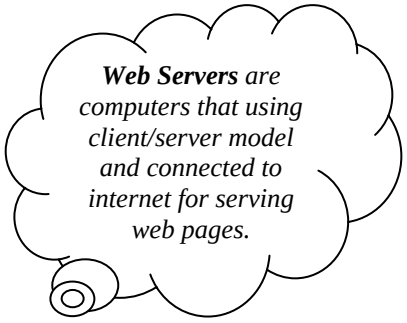
2.2 JSP: An Introduction

Java Server Pages (JSP) is a web technology that helps software developers to create dynamic content based web pages. Unlike a plain HTML page, which contains static content that always remains the same but in JSP; you can change content dynamically with the help of Java Bean and JSP elements. JSP is an extension of Java Servlet because it provides more functionality than servlet.

Servlet are server side components that services requests from a web server. It is basically a Java class that runs on a server. Servlet technology is used to create web application. It uses the Java language. It is runs inside the Java Virtual Machine. Two packages such as javax.servlet and javax.servlet.http are required for writing a servlet. These two packages make up the servlet architecture. The javax.servlet package contains the classes and interfaces that are implemented and extended by all the servlets. Other package javax.servlet.http contains classes that are required when creating a HTTP specific servlet. All servlets must implement the Servlet interface, which defines life-cycle methods. The Servlet interface defines the three most important methods such as init(), service() and destroy() method. Servlet also possesses all the Java features such as platform independence, high portability, security and Java database connectivity.

Servlet is very useful for writing server side code but it suffer from some disadvantages. In particular, writing HTML code with plenty of out.println() statements (println() is a method of system.out object to display string which is passed to it), it is very tedious and error prone and also software developers has to take on dual roles of developing application logic and designing web pages. JSP is designed to address these disadvantages.

A Java Server Page contains HTML tags as well as JSP elements. The JSP elements are basic building blocks of the page. The JSP elements are easier to maintain than the servlet. A JSP page contains a very simple structure that makes it easy for developers to write JSP code and also easy for servlet engine to translate the page into a corresponding servlet. In addition to html tags, a JSP page consists of directives, scripting elements, scriptlets and action elements. Each of these elements can use either JSP syntax or they can be expressed in XML syntax but you cannot intermix the two. For this problem, you can use the include mechanism to insert file that may use different syntax.



The Java Server Pages has more advantages over the servlet which are as follows:

- It allows programmers to insert the Java code directly into the JSP file that makes the development process easier.
- JSP support element based dynamic content that allows programmers to develop custom tags libraries to satisfy application needs.
- Content and display logic are separated
- JSP pages can be used in conjunction with servlet that handle business logic.

The file extension for the source file of a JSP page is .jsp. The following code contains a simple example of a JSP page:

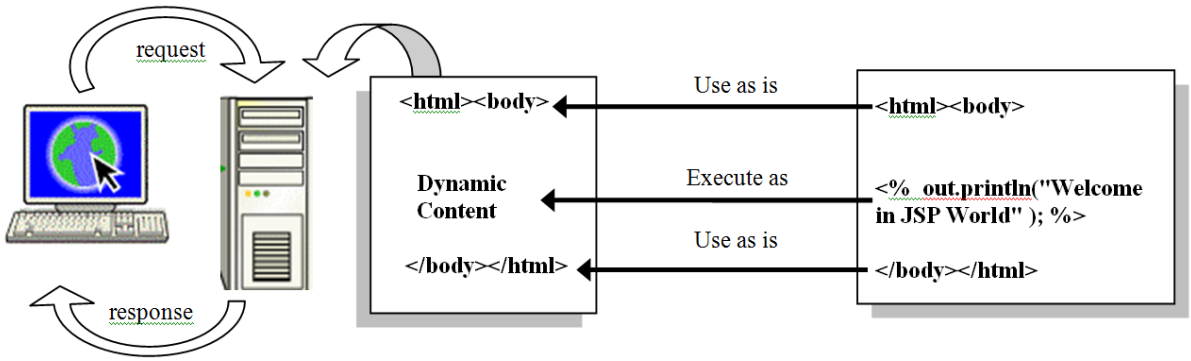


Figure 1: Generating dynamic content with JSP page.

The output of the above program is as follows:

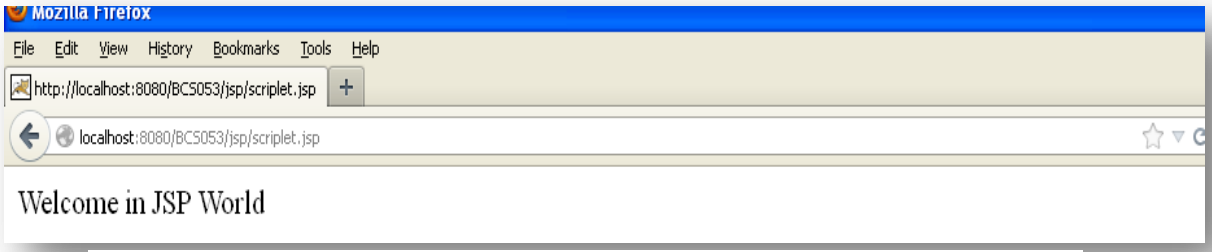


Figure 2: JSP Page

You can see the above program which looks like any other HTML page with some added JSP elements that allow the server to insert dynamic content in the page. When client send a request for a JSP page, the server executes a JSP page elements merges with static contents and sends the dynamically page back to the client browser, as illustrated in Figure-1.

The JSP technology is based on JSP API (Application Programming Interface) that consists of two packages i.e. javax.servlet.jsp and javax.servlet.jsp.tagext packages. In addition to these two packages, JSP also needs two packages of servlet such as javax.servlet and javax.servlet.http. Apart from these interfaces and classes, the two exception classes: JspException and JspError are also defined in JSP API. The javax.servlet.jsp package has two interfaces such as HttpJspPage and JspPage and four classes: JspEngineInfo, JspFactory,JspWriter and PageContext. The jspInit() and jspDestroy() methods are defined in

JspPage interface and _jspService() method is in HttpJspPage interface. The javax.servlet.jsp.tagext contains classes and interfaces for the definition of Java Server Pages Tag Libraries.

2.3 JSP Life Cycle

In this section, you will go through the life cycle of JSP and see how a JSP page is displayed. When the JSP is first accessed, it is translated into corresponding servlet (i.e. java class) and compiled, then JSP page services request as a servlet. The translation of JSP page is done by the JSP engine of the underlying web container/servlet container (e.g. Tomcat). Figure-3 shows that how a JSP page is processed.

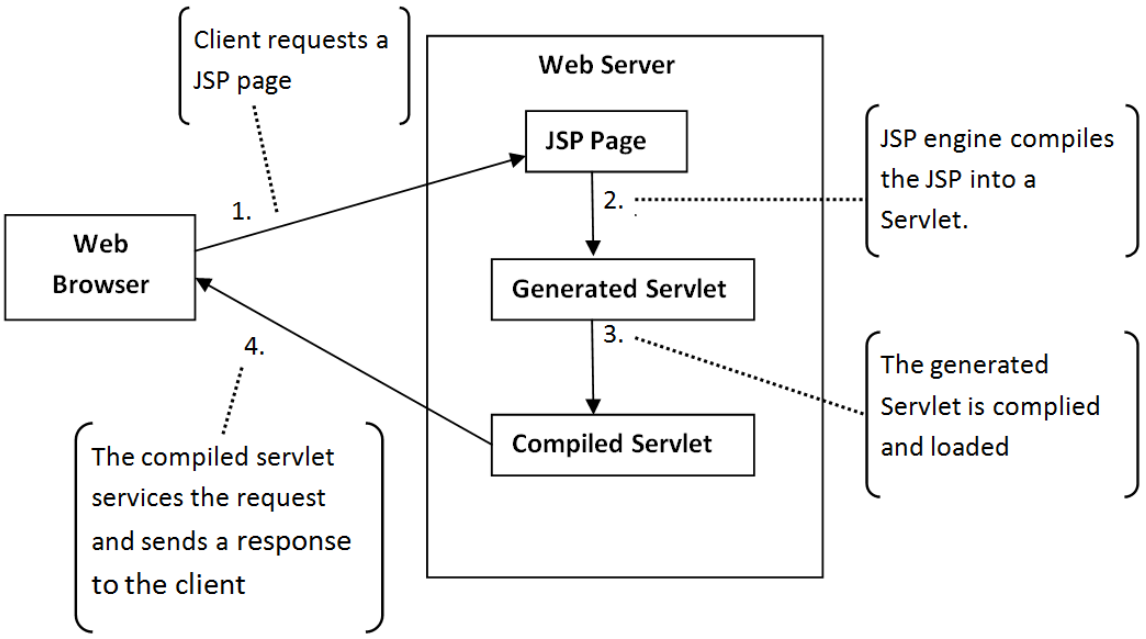


Figure 3: The steps of a JSP Page processing.

The life cycle of JSP page is controlled by three methods i.e. jspInit(), _jspService() and jspDestroy().

jspInit() - The jspInit() method is called only once during life cycle of a JSP, similarly, servlet also have an init() method whose purpose is same as that of jspInit(). jspInit() method is used to initialize objects and variables that are used throughout the life cycle of JSP. This method is defined in JspPage interface. This method is invoked when the JSP page is initialized. It has no parameters, return no value and thrown no exceptions. The signature of the method is as follows:

```
public void jspInit()  {    // Initialization code   }
```

_jspService() – _jspService() is the method which is called every time the JSP page is requested to serve a request. This method is defined in the javax.servlet.jsp.HttpJspPage

interface. This method takes HttpServletRequest and HttpServletResponse objects as an arguments. The _jspService() method corresponds to the body of the JSP page. It is defined automatically by the processor and should never be redefined by you. It returns no value. The underscore ('_') signifies that you cannot override this method. The signature of the method is as follows:

```
public void _jspService(
                    javax.servlet.http.HttpServletRequest request,
                    javax.servlet.http.HttpServletResponse response)
                    throws javax.servlet.ServletException, java.io.IOException
{
  // services handling code
}
```

jspDestroy()- The jspDestroy() is invoked when the JSP page is to be terminated. It is synonymous with the destroy() method of a servlet. It has no parameters, return no value and thrown no exceptions. Override jspDestroy() when you need to perform any cleanup, such as releasing database connections or closing open files. The signature of the method is as follows:

```
public void jspDestroy(){    //  cleanup code    }
```

The following Figure-4 shows the life cycle of JSP page.

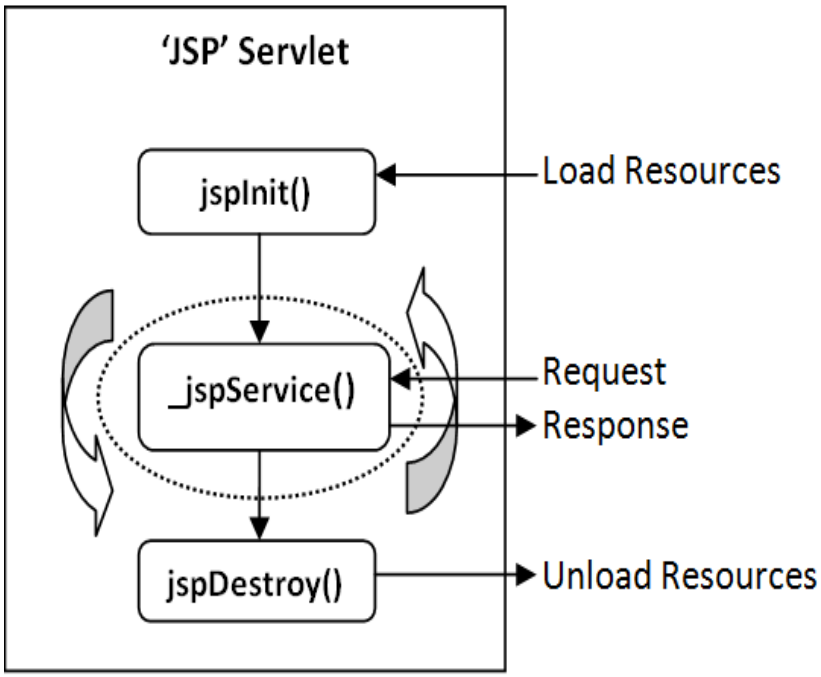


Figure 4: Life Cycle of JSP Page

Check Your Progress 1

1. Explain the term JSP.

---

2. What are the advantages of JSP over Servlet?

---

3. Describe the _jspService() method.

---

4. Write the basic steps for processing JSP request.

---

5. Explain the life cycle of JSP.

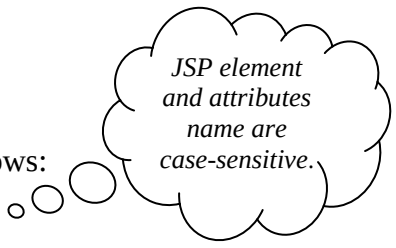
2.4 Elements of JSP

In this section, we are going to introduce the elements of JSP that make up a JSP page. There are three types of JSP components such as directives, expressions and scriptlets. A directive affects the overall structure of the JSP page. They are discussed in detail in the following sections:

2.4.1 Directives

Directives are used as guiding the JSP container for translating and compilation of JSP page. It appears at the top of the page. Using directives, the container translate a JSP page into corresponding servlet. They do not directly produce any output. A directive contains one or more attribute name/value pairs. Directives are defined by using <%@ and %> tags. Directives have the following syntax:

```
<%@  directive  attribute = "value" %>
```



You can write XML equivalent of the above syntax as follows:

```
<jsp:directive. directivename attribute = "value" />
```

There are three types of directives currently used in JSP document: *page*, *include* and *taglib*. Each one of these directives and their attributes are defined in following sections:

page Directive

The page Directive is used to specify the attributes of JSP page such as declaration of other resources i.e. classes and packages, page buffering requirements and name of page that should be used to report run time errors, if any. The page Directive is a JSP element that

provides global information about an entire JSP page. This information will directly affect the compilation of the JSP document. Following is the syntax of page directive:

```
<%@  page  attribute = “value” %>
```

The page directive contains many attributes, you can set these attributes. The attribute may be one or more of the following:

Attribute	**Description**
language=”scripting language”	This attribute define the language that will be used to compile the JSP document. By default, it is java language.
import=”import list”	This attribute defines the names of packages.
session=”true|false”	It specifies whether or not the JSP document participate in HTTP session. The default is *true*.
extends=”classname”	This attribute define the name of parent class that will be inherited by generated servlet. It is rarely used.
buffer=”none|size in kb”	The default value is 8kb. It specifies the size of *out* buffer.
autoFlush=”true|false”	The default is *true*. It means that the *out* buffer will be automatically flushed when full. If it is *false*, it will be raised an exception when buffer is full.
Info=’text”	If this attribute is used, the servlets will override the getServletInfo() method.
errorPage=”error_page_url”	This attribute defined the relative URL to JSP document that will handle exception.
isErrorPage=”true|false”	This attribute indicates whether the current page can act as an error page for another JSP page. The default is *false*.
isThreadSafe=”true|false”	The default value is *true*. It indicates that the page can service more than request at a time. When it is *false*, the SingleThreadModel is used.

An example of the use of page directive is as follows:

```
<%@ page import=”java.io.*, java.util.Date”  buffer=”16k”  autoFlush=”false” % >
```

This page directive instructs the web container to import java.io package and java.util.Date class. It also instructs the web container to set buffer size to 16k and turn off autoflushing.

You can specify multiple page directives in your JSP document, such as the following:

```
<%@ page import=”java.util.Date”  info=”Example Page”  %>
<%@ page errorPage=”MyErrorPage.jsp”  buffer=”16kb”%>
```

In the above examples of page directives, the first directive statement tells the web container to import java.util.Date class and to set information about the JSP page which is retrieved by getServletInfo() method. The value of the info attribute will be a text string. The second page directive statement define a name of error page which is used for handling errors and set the buffer size in 16 kb.

include Directive

Include directive is an important JSP directive. This is used to insert text and code in the form of file such as html, JSP into a current JSP document at the translation time. It means that it enables you to import the content of another static file into a current JSP page. This directive can appear anywhere in a JSP document. The syntax of include directive is as follows:

```
<%@ include file = "relative URL" %>
```

***Relative URL** only specifies the filename or resource name; while **Absolute** URL specifies the protocol, host, path, and name of the resource name.*

For example: The following example will demonstrate the physical inclusion of header file. In this way, you can create a single header file only once and use it many times for your website.

Source code for main.html:

```
<html><body>
<h2>Example of include directive</h2>
<%@ include file='header.html' %>
</body></html>
```

Source code for header.html:

```
<html><body>
<h2>This is from Header File</h2>
</body></html>
```

The output of the above program is as follows:

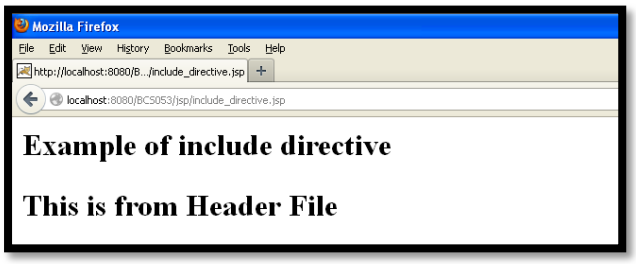


Figure 5: Example of include directive

Uniform Resource Identifier (URI) identifies a resource either by location or name. For e.g. http://www.ignou.ac.in /ignou/aboutignou

taglib Directive

As yet, you have learned the basic elements of JSP. In this section, you will learn about the creation of custom tag libraries in Java Server Pages.

A custom tag is user defined tag. It is a reusable code in a JSP page and tag library is a collection of custom tags.

Custom Tag Syntax **-**

To use the customs tags in a JSP page, JSP technology provide a taglib directive to make use of the tag. The taglib directive has the following syntax:

```
<%@ taglib uri="tagLibraryURI" prefix="tagPrefix" %>
```

The uri attribute defines an absolute or relative uri of tag library descriptor (TLD) file and the prefix attribute defines the string that will identify a custom tag instance.

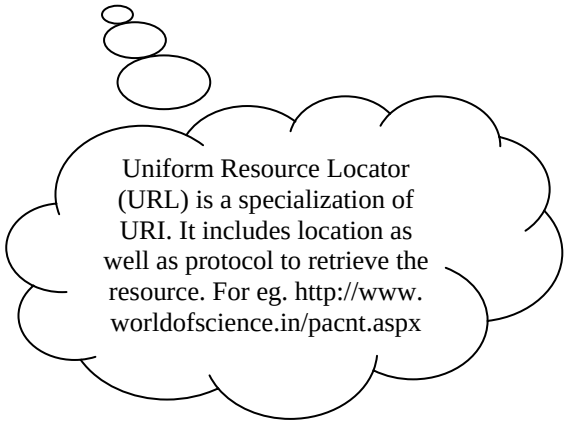
To use customs tags in a JSP page, you need to know four components that make use of the custom tags. These are:

1) Tag handler class

2) Tag library descriptor file

3) JSP file

4) Deployment descriptor file (web.xml)



Tag Handler Class -

It is a java class that defines the behaviour of the tags. This class must implement the javax.servlet.jsp.tagext package.

Tag Library Descriptor (TLD) file -

A tag library descriptor file is an xml document. It defines a tag library and its tags. The file extension of this file is .tld. It contains one <taglib> root element and <tlibversion>, <jspversion>, <shortname> tag are sub elements of the taglib element. The tag is the most important element in TLD file because it specifies the name of the tag and class name of the tag. You can define more than one tag element in the same TLD file.

Deployment Descriptor file (web.xml) -

The deployment descriptor is an xml file that specifies the configuration details of the tag. The most important element for custom tag in web.xml file is <taglib-location>. Using the web.xml, the JSP container can find the name and location of the TLD file.

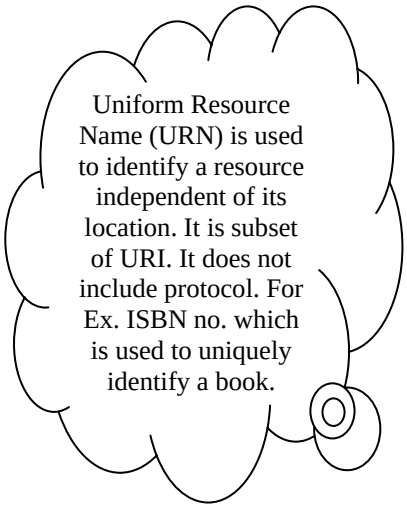
A JSP file -

Once, you have created tag handler java class, a tag descriptor file and define configuration details in deployment descriptor file and then you have to write a JSP file that makes use of the custom tag.

Here are some steps for generating a simple custom tag. Now, follows the following five easy steps:

Step-1: write and compile a java class called MyCustomTag.java which is given in following program source. The class file must be placed in the directory say 'customTag' under the WEB-INF/classes directory.

```
package customTag;
import javax.servlet.jsp.*;
import javax.servlet.jsp.tagext.*;
public class MyCustomTag extends TagSupport {
public int doEndTag() throws JspException {
JspWriter out = pageContext.getOut();
try { out.println("Hello from custom tag"); }
catch(Exception e) {}
return super.doEndTag();
 }//doEndTag()
} //main class
```



Step-2: Create a TLD file named taglib.tld as shown in following program source and save it in WEB-INF directory.

```
<!DOCTYPE taglib  PUBLIC "-//Sun Microsystems, Inc.//DTD JSP Tag Library
1.2//EN"  "http://java.sun.com/j2ee/dtd/web-jsptaglibrary_1_2.dtd">
<taglib><tlib-version>1.0</tlib-version><jsp-version>1.2</jsp-version>
  <short-name></short-name>  <tag>  <name>myTag</name>
   <tagclass>customTag.MyCustomTag</tagclass></tag> </taglib>
```

Step-3: Create a JSP file named CustomTag.jsp that contains the following code:

```
<html><body><%@ taglib uri="/myTLD" prefix="easy"  %>
<easy:myTag /></body></html>
```

Step-4: Place the following code in web.xml under the <web-app> root element.

```
<taglib> <taglib-uri> /myTLD  </taglib-uri>
            <taglib-location>/WEB-INF/taglib.tld  </taglib-location>
</taglib>
```

Step-5: Start server say Tomcat (if you are using this). Open web browser and run the JSP page. The following screen comes as an output for a simple custom tag.

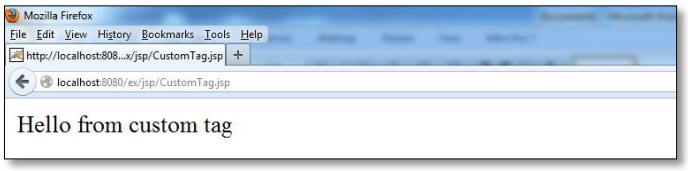


Figure 6: A simple JSP Custom Tag page

When the user requests the JSP page, the JSP container first sees the taglib directive and gets the taglib uri. On the basis of this, JSP container looks into the web.xml file to find taglib location and continues the processing and get the name of tag. After getting the name and location of TLD file, it obtains the java class. Now, the JSP container loads the class for custom tag and continues the processing.

2.4.2 Scripting Elements

Scripting elements allow you to insert java code fragments directly into an HTML page. You can specify three ways to include java code into your JSP document, such as declarations, expression and scriptlets. Each of these scripting elements has an appropriate location in the generated servlet. These are discussed in more detail in following sections:

Declarations

As its name implies, declarations are used to declare the variables and methods that can be used in the JSP document. The declaration part is initialized when the JSP document is initialized. After the initialization, they are available to other expressions, declaration and scriptlets. A declaration is start with a <%! and end with a %>. The syntax of the declaration is as follows:

```
<%!  declaration  %>
```

You can write XML equivalent of the above syntax as follows:

```
<jsp:declaration> code fragment </jsp:declaration>
```

For example: simple declaration of variables

```
<%! int i = 0; %>       // i is an integer type variable
<%! int a, b, c; %>    // a, b, c is an integer type variable
<%! Square a = new Square (4.0); %>
```

Following is a variable and method declaration:

```
<%!  String name = new String("SOCIS");  %>
<%! public String getName() { return name; }  %>
```

When the above code is automatically compiled and converted from JSP code to servlet, the declaration part of JSP page is included in the declaration section of the generated servlet. The first declaration statement is used to defined a variable as string type with initial value 'SOCIS' and second statement is defined a string type method named 'getName()'.

Expressions

An Expression is an instruction to the web container to execute the code within the expression and to display the resulting data at the expression's referenced position in the JSP document. Expressions are evaluated at request time i.e. run time. The syntax of the expression is as follows:

```
<%= expression  %>
```

You can write XML equivalent of the above syntax as follows:

```
<jsp: expression > code fragment </jsp: expression >
```

For example, to show the current date and time:

```
<%= new java.util.Date() %>
```

Consider another example:

```
<html><body>
<%!  String name = new String("SOCIS");  %>
<%! public String getName() { return name; }  %>
Hello  <b><%= getName()%></b><br/><%= new java.util.Date() %>
</body></html>
```

Translation time is the portion of time when the JSP engine is translating & compiling the JSP file.

The output of the above program is as follows:

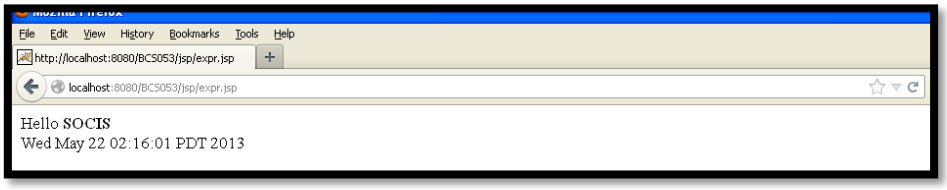


Figure 7: Expression example

When the above code is complied and converted to servlet code and then expression part is placed in its referenced position of the generated servlets' _jspService() method.

Scriptlets

In scriptlets, all the scripting elements are brings together. It is executed at the request time and makes use of declaration, expressions and JavaBeans. You can write scriptlets anywhere in a page. It contains a valid java statements within the <% and %> tag and get inserted into the _jspService() method of generated servlet.

The syntax of the scriptlet is as follows:

```
<%  scriptlet code  %>
```

You can write XML equivalent of the above syntax as follows:

```
<jsp:scriptlet > code fragment </jsp:scriptlet >
```

Request time is the portion of time when the JSP-Servlet is handling the request.

For example: The following example will demonstrate the number series from 1 to 3.

```
<html><body><p>Counting to 1- 3 :</p>
<% for (int i=1; i<=3; i++) {%><p>This number is <%= i %>.</p>
<% } %></body></html>
```

Output of the above program is as follows:

Figure 8: scriptlets Example

2.4.3 Actions Elements

Action elements (or standard actions) are tags that can be embedded in a JSP document. At the compile time, they are replaced by java code.

Before going to start learning about how you can add Java Bean in JSP page, you must take a look at what a bean is. A Java Bean is nothing more than a java class. It is reusable component that work on any Java Virtual Machine. For the creation of Java Bean, you must create a java class that implements java.io.Serializable interface and uses public get/set methods to show its properties.

<jsp:useBean>

The first JSP standard action (identified by *jsp* prefix) is <jsp:useBean>. This action is used to include an instance of java bean within java server pages. The syntax of the <jsp:useBean> action is as follows:

```
<jsp:useBean    id=”name”
                scope=”page | request | session | application”
                typeSpecification>
                body
 </jsp:useBean>

typeSpecification can be represented in the following syntax:

typeSpecification ::= class=”className” |
                      class=”className” type=”typeName” |
                      type=”typeName”  beanName=”bean_name” |
                      type=”typeName”
```

Following table contains the attributes of the <jsp:useBean> action:

Attribute	Description
id	It represents name of the object. This attribute is required.
scope	It defined the scope of the object. It may be *page, request, session* or *application*. This attribute is optional. By default, it is *page*.
Class	This attribute represents the fully qualified class name of the object. The class name is case sensitive.
type	It specifies the type of object. The value of this attribute is equal to *class*, a super class of *class* or an interface implemented by the *class*. If it is not specified then same as class attribute.
beanName	It is the name of bean.

The **scope** attribute of Java Bean means how long the object is available and if it is available than only for a single user or all application users JSP provides different scope for sharing data between web pages. These are:

- **Page** - 'page' scope means, the JSP object can be accessed only from within the same page where it is created. By default, it is page. JSP implicit objects out, exception, response, pageContext, config and page have 'page' scope.
- **Request –** The object is available to current JSP and to any JSP or Servlet that control is forward to and included from. Only Implicit object request has the 'request' scope.
- **Session –** JSP object is accessible from any JSP within the same session. Implicit object session has the 'session' scope.
- **Application -** JSP object is accessible from any JSP within the same web application. Implicit object application has the 'application' scope.

<jsp:setProperty>

This action is used to sets the Java Beans property value. The syntax for this action is as follows:

<jsp:setProperty name="beanName" property_expression />

property_expression can be represented in the following syntax:

property="*" |
property="propertyName" |
property="propertyName" param="parameterName" |
property="propertyName" value="propertyValue"

Following table contains the attributes of the <jsp: setProperty > action:

Attribute	Description
name	It represents name of the bean instance defined in <jsp:useBean> action.
property	It specifies the name of property being set. This attribute is required. If it is an asterisk ('*') then it is used to set all properties of bean. You can also specify the specific bean property.
param	This attribute represents the name of parameter.
value	It specifies the value assigned to the named bean's property.

<jsp:getProperty>

Once you have defined a bean and given it a name using the <jsp:useBean> action. Now, you can get the beans property values with another standard action <jsp:getProperty>. This action is used to get the property value from a Java Beans and add to the response body. The syntax for this action is as follows:

```
<jsp:getProperty  name=”beanName”  property=”propertyName”  />
```

Following table contains the attributes of the <jsp: getProperty > action:

Attribute	Description
name	It represents name of the bean instance defined in <jsp:useBean> action.
property	This attributes represents the specific property within bean.

Following is the simple Java Bean example that store student name.

Let’s create a Java Bean named student.java and place class file under WEB-INF/classes/bean1 directory.

```
package bean1;
public class student {
private String name;
public String getName() { return name;}
public void setName(String name) { this.name=name;}}
```

Now, you can access the properties of the Java Bean from a JSP.

```
<html><body>
<jsp:useBean id="myBean" class="bean1.student" scope ="session" />
<jsp:setProperty name="myBean" property="name" value="Poonam" />
Welcome to this Unit, <jsp:getProperty name="myBean" property="name" />
 , Please visit egyankosh.ignou.ac.in to get more.
</body></html>
```

The following output screen is as follows for the above program.

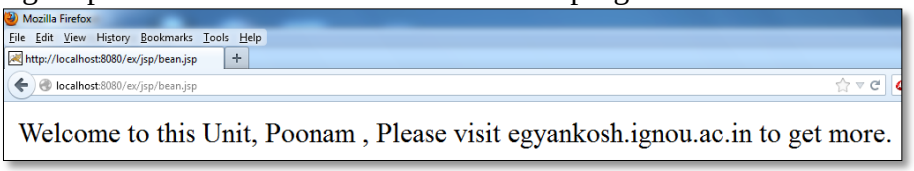


Figure 9: A simple Java Bean Example

You have learned the standard actions specific to a Java Bean. The remaining actions are defined in the following sections. Using the following standard actions, you can dynamically insert a resource into a current JSP page, forward the current request to another page or add bean/applet in a page.

<jsp:param>

The <jsp:param> action tag defines the name/value pair of parameter to be passed to an included or forwarded JSP document or a page that uses the <jsp:plugin> tag.

Following is the syntax of the above action tag:

```
<jsp:param  name=”paramName” value=”paramValue” />
```

In the above syntax, name attribute defines the name of parameter being referenced and value represents the value of named parameter.

<jsp:include>

JSP supports two types of include: static and dynamic. In the previous section, you have already been studied the static include i.e. include directive. In static include, the content of included JSP code is inserted into the including JSP (or current JSP Document) at the translation time. After the content of included JSP is processed, the content included in JSP file does not change until the included file is changed and server is restarted. While in dynamic include, the content is included at the request time. This means that it is a mechanism for including static as well as dynamic content in the current JSP document such as static HTML, JSP or Servlet. This is done by <jsp:include> action element.

Dynamic includes are performed using the following syntax:

```
<jsp:include page=”relativeURLSpecification” flush=”true” />
                                or
<jsp:include page=”relativeURLSpecification” flush=”true” >
        <jsp:param ……/>
</jsp:include>
```

In the above syntax, page attribute defines the path of the resource to be included and flush attribute indicates whether the buffer is flushed. It is an optional parameter. The first syntax is used when <jsp:include> does not have a parameter name/value pair. If you want to pass the parameter to the included resource, use the second syntax.

For example:

```
<html><head><title>Student Information</title></head><body>
<h2>JSP Include Example</h2><table><tr><td>
<jsp:include page="head.jsp" flush="true">
<jsp:param  name="student" value="Poonam"/>
<jsp:param  name="prg" value="BCA"/>
</jsp:include>
</td></tr><tr><td>Course Name:BCS-053</td></tr></table>
</body></html>
```

Source code for **head.jsp** file:

```
<% // Get the Student Name from the request
        out.println("<b>Student Name:</b>" + request.getParameter("student"));
       out.println("<br>");
   //  Get the Course Name from the request
       out.println("<b>Programme Name:</b>" + request.getParameter("prg")); %>
```

Output screen for the above program:

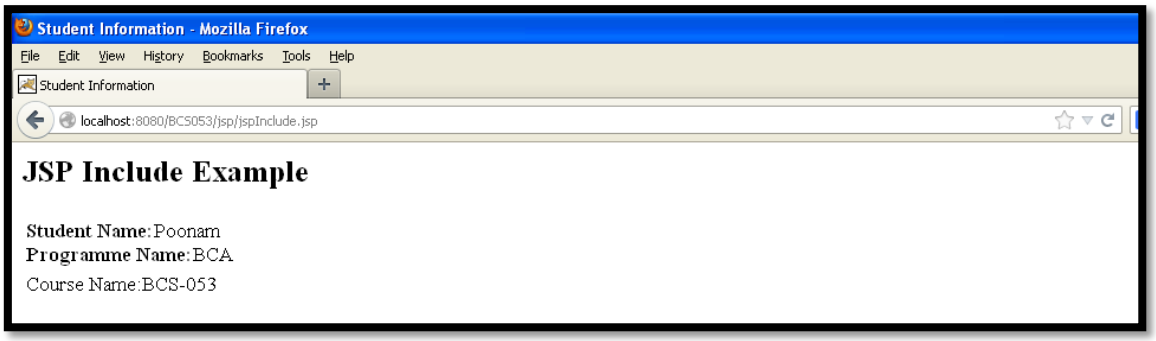


Figure 10: JSP Include Example

<jsp:forward>

The <jsp:forward> action is used to terminates the current execution of JSP page and transfer the control to the another JSP page within the same application. It may be static or dynamic page or resource. It can be used with <jsp:param> tag. The <jsp:param> is used for providing the values for parameters in the request to be used for forwarding.

The syntax for <jsp:forward> action tag is as follows:

```
<jsp: forward page=”relativeurlSpecification” flush=”true” />
                                    or
<jsp: forward page=”relativeurlSpecification” flush=”true” >
          <jsp:param ……/>
</jsp: forward >
```

For example:

```
<html><head><title>Example: JSP Forward</title></head><body>

<%  if((request.getParameter("city")).equals("delhi"))   {  %>
      <jsp:forward page="head.jsp" >
      <jsp:param  name="student" value="Poonam"/>
     <jsp:param  name="prg" value="BCA"/></jsp:forward>

<%  } else   { out.println("Your value is incorrect"); }   %>

</body></html>
```

Source code for head.jsp file is same as in the above <jsp:include> example. Enter the following URL into your browser to see the result.
http://localhost:8080/BCS053/jsp/jspForward.jsp?city=delhi

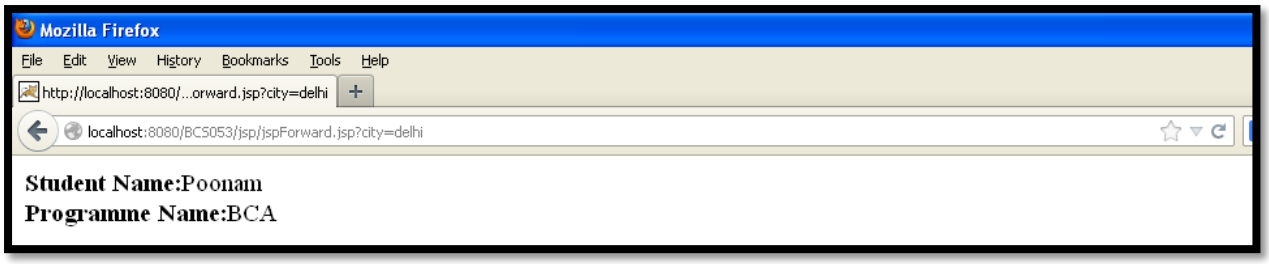


Figure 11: JSP forward example

<jsp:plugin>

The <jsp:plugin> action element is used to insert java component such as Applets and JavaBean in JSP page. The <jsp:param> is also used with action element to send parameters to Applet or Bean. Following is the syntax of <jsp:plugin> action:

```
<jsp:plugin type=”pluginType” code=”classFile” codebase=”relativeURLpath>
<jsp:param ……/>
</jsp: plugin >
```

In the above syntax, type attribute indicates the type of plugin to include in JSP page, code attribute represent the name of class file and codebase attribute is the path of where the code attribute can be found.

For example: An Applet program named JavaApplet.java

```
import java.applet.*;
import java.awt.*;
public class JavaApplet extends Applet{
  public void paint(Graphics g){
    g.drawString("Welcome in Java Applet.",40,20);
  } }
```

Plugin source code:

```
<html><body><p>Plugin Example :</p>
<jsp:plugin type="applet" code="JavaApplet.class"  width = "200" height = "200">
          <jsp:fallback>
                    <p>Unable to load applet</p>
          </jsp:fallback>
         </jsp:plugin>
</body></html>
```

The output of the above plugin program is as follows:

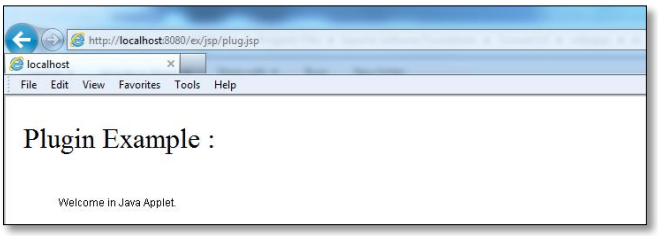


Figure 12:plugin example

<jsp:fallback>

The <jsp:fallback> action is used only with the <jsp:plugin> action element. It provides alternative text to the browser.

For example: <jsp:fallback> Unable to see plugin </jsp:fallback>

Check Your Progress 2

1. Explain the directive element of JSP with their syntax.

---

2. What are Standard actions in JSP? Explain the standard action specific to Java Bean.

---

3. What is difference between JSP include and include directive?

---

4. What is declaration scripting element? Explain with example.

---

5. Write a program which will demonstrate the use of <jsp:include> with <jsp:param> action.

2.5 Comments and Template Data

In this section, you will learn about the comments which is very necessary for developers to understand the flow of program for further reference. It is explanatory information about the function of code. Comments are very useful for any other developers also to maintaining or enhancing the code. You will also learn how to use template data within your JSP page.

JSP Comments

Commenting is a part of good programming practice. Comments help in understanding what is actually code doing. You can write comments in JSP like the following way:

JSP comment syntax:
<%--jsp comment text --% >

This comments tag is used within a Java Server Page for documentation purpose. It tells the JSP container to ignore the comment part from compilation, so it does not appear in the resulting java code.

<!-- **HTML comment** --> This HTML comment is treated by JSP container as just like another html tag. It is not a JSP comment. It can be viewed through the web browser's "view source" option.

`/*` **java comment** `*/` or `//` used inside the scriptlets tag is also not a JSP comment. This is a java comment. This comments are not translated by JSP container and therefore do not appear on the client side web document.

For example:

```
<html><body>
<%-- This is JSP comment – not visible in the page source --%>
<!-- This HTML Comment - visible only in the page source
 <% out.println("Welcome in JSP World" ); %>    -->
<% //This is single line comment under the scriptlet %>
<% /* out.println("This comment is used for multiple lines."); */ %>
```

Program output:

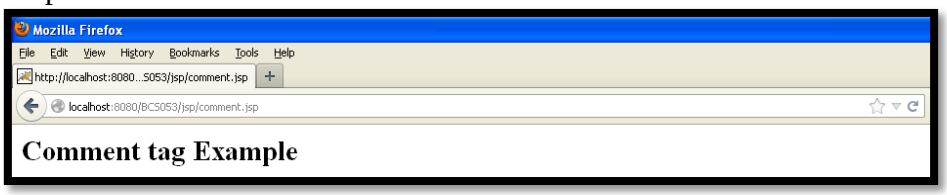


Figure 13: JSP comment example

Program output is visible only in page source code of web browser.

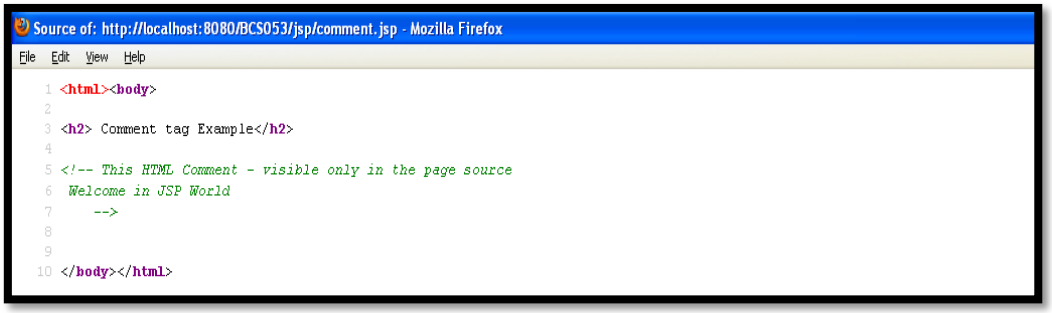


Figure 14: HTML comment's view in web browser

JSP XML Text Element

The <jsp:text> is an XML tag. It is used to enclose template data in JSP document. Template(static) data consists of any text that is not interpreted by the JSP translator. You cannot intermix JSP data with XML data in single file even you can include directive. The XML syntax for text element is as follows:

```
<jsp:text> text </jsp:text>
```

2.6 JSP Implicit Object

JSP Implicit objects are the java objects that are available for the use in JSP document to developers and they can call them directly without being declared first. These objects are also called predefined variables. These variables are parsed by JSP engine and inserted into generated servlet as if you defined them yourself. These objects are used within the scriptlets and expressions of the JSP page. These implicit objects are defined in the servlet specification's javax.servlet.http package, two are part of the JSP javax.servlet.jsp package and some is in Java core API.

JSP supports implicit objects which are listed below:

Implicit Object	Type	Scope
request	javax.servlet.HttpServletRequest	Request
response	javax.servlet.HttpServletResponse	Page
session	javax.servlet.http.HttpSession	Session
application	javax.servlet.ServletContext	Application
page	javax.servlet . jsp.HttpJspPage	Page
pageContext	javax.servlet.jsp.pageContext	Page
out	javax.servlet.jsp.JspWriter	Page
config	javax.servlet.http.servletConfig	Page
exception	java.lang.throwable	Page

2.6.1 request Object

The request object is an instance of HttpServletRequest interface. This object is used to retrieves the values that the client browser passed to the server during HTTP request such as cookies, headers or parameters associated with the request. The most common use of request object is to access query string values. You can do this by calling the getParameter() method. You have already seen the example of request.getParamater() method in <jsp:include> and <jsp:forward>.

For example:

```
<html><body><h2>Example of request Object</h2>
<%  // Get the Programme Name from the request Query
        String name=request.getQueryString();
        out.println("Hello:   "+name); %>
</body></html>
```

When you run this program, it looks for your name in the query and returns the value, if it is found. Enter the following URL into your browser to see the result.

http://localhost:8080/BCS053/jsp/reqObject.jsp?poonam

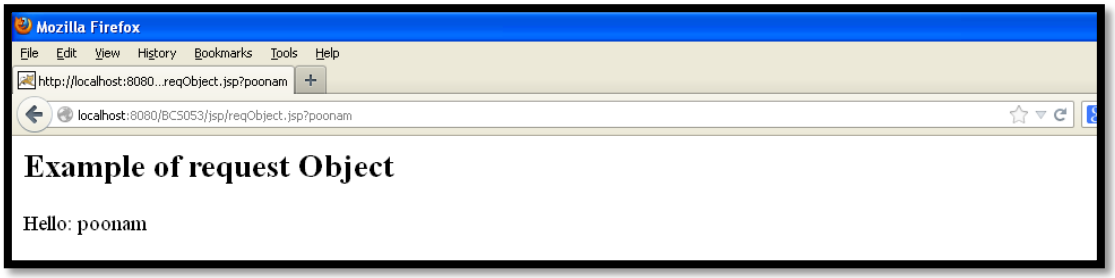


Figure 15: Example of Request Object

In the above program, getQueryString() method of request object is used to return the query string from the request.

2.6.2 response Object

As you know, response is a process to responding against it request. Using response object, reply is sent back to the client browser. Through this object, response parameter can be modified or set. This object is used to handles the output of client. The response object is an instance of *HttpServletResponse* interface.

<% response.sendRedirect("http://www.ignou.ac.in");%>

When the above code is run in Tomcat server, the *sendRedirect()* method of the *javax.servlet.HttpServletResponse* to redirect the user to a different URL. In this case, control transfer to IGNOU website.

2.6.3 session Object

The session object is represented by the *javax.servlet.http.HttpSession* interface. This object is behaves in same way as under the java servlet. For each user, servlet can create an *HttpSession* object that is associated with a particular single user. This object is used to track the user information in a same session. Session tracking allows servlet to maintain information about a series of request from the same user. This can be done by URL rewriting, cookies, hidden form fields and session.

2.6.4 application Object

The application object is an instance of javax.servlet.ServletContext. This object has application scope which means that it is available to all JSP pages until the JSP engine shut down. The ServletContext is the environment where the servlet run. The servlet container creates a servletContext object that we can use to access the servlet environment. There is one ServletContext object for each web application per Java Virtual Machine.

2.6.5 page Object

It represents the javax.servlet.jsp.HttpJspPage interface. This object is reference to the current instance of the JSP page. The page object is a synonym for *this* object and is not useful for programming language.

2.6.6 pageContext Object

The pageContext object is an instance of javax.servlet.jsp.PageContext. It is used to represent the entire JSP page. The pageContext object is used to set, get and remove attribute of the JSP page.

It provides a single point of access to many of the page attribute such as directives information, buffering information, errorPageURL and page scope. It is also provides a convenient place to store shared data. This object stores references to the request and response objects for each request. The PageContext class defines several fields, including PAGE_SCOPE, REQUEST_SCOPE, SESSION_SCOPE, and APPLICATION_SCOPE, which identify the four scopes.

2.6.7 out Object

Out is a very simple and frequently used implicit object in scriptlet. JSP expression is automatically placed in output stream. So, out object is rarely needed to refer in expression. It is an instance of javax.servlet.jsp.JspWriter class which extends java.io.writer. You call either print() or println() method to send output to the client.

For example: <% out.println(" Hello! Out Object"); %>

2.6.8 config Object

The config object is an instance of javax.servlet.http.servletConfig. This object is used to get the configuration information of the particular JSP page.

2.6.9 exception Object

This object is available only on pages that are marked as an error page using the page directive *isErrorPage* attribute. This object is assigned to the Throwable class which is the super class of all errors and exceptions in the java language. It contains reference to uncaught exception that caused the error page to be invoked.

Check Your Progress 3

1. What are the implicit objects?

---

2. What is request object? Explain with example.

---

3. Which implicit object allows the storage of values in an associated hash table?

---

4. Write Java code using JSP component for generating odd numbers.

---

5. Write a JSP program for displaying a Remote address using scriptlets.

2.7 Complete Example

The following program displays a JSP login page which accepted login information from the user and counts the number of times user visit the page.

Source code for header.html

```
<html><head><title>BCA:BCS-053</title>
<style>h1{text-align:center}</style>
</head><body><table><tr><td><img src="logo.jpg" /></td><td>
<h1>Indira Gandhi National Open
University</h1></td></tr></table></body></html>
```

Source code for visitCount.java

```
package bean1;
public class visitCount {
int count=0;
public visitCount(){}
public int getCount(){ count++;
return this.count;}
public void setCount(int count)
{this.count=count;}}
```

Source code for footer.jsp

```
<html><head><title>BCA:BCS-053</title></head><body>
<%@ page language="java" %>
<jsp:useBean id="counter" scope="session" class="bean1.visitCount" />
<jsp:setProperty name="counter" property="count" param="count" />
<footer><hr> &copy; 2013 IGNOU</footer>
Visitor Count:
<jsp:getProperty name="counter" property="count" />
</body></html>
```

Source code for main.jsp

```
<html><head><title>BCA:BCS-053</title></head><body>
<%@ include file="header.html" %>
<form action="actionJsp.jsp">
<fieldset ><legend>Login Details</legend>
 Username <input type="text" name="uname"/><br>
 Password <input type="password" name="pwd"/> <br></fieldset>
<input type="submit" value="submit"> </form><br>
<jsp:include page="footer.jsp" />
 </body></html>
```

Source code for actionJsp.jsp

```
<html><head><title>BCA:BCS-053</title></head><body>
<%@ include file="header.html" %>
<% // Get the User Name from the request
        out.println("<b>User Name:</b>" + request.getParameter("uname"));
       out.println("<br>");
    //  Get the Password from the request
       out.println("<b>Password:</b>" + request.getParameter("pwd")); %>
</body></html>
```

For storing and running the above programs, you can use the following steps. The following steps are based on windows operating system. In lab manual block (BCSL057), the detailed description of Netbeans with Web Server - Apache and Glassfish are given for creation and deployment of JSP program. It is best practice to use IDE for web development. In this section, you can go through the simple steps for running your JSP program using Apache Tomcat without any IDE. You can use Notepad to write your program.

Step 1 - Download and install Java development Kit.

Step 2 - Download and install Tomcat

Step 3 - After successfully installation of Java and Tomcat, you can set the environment variables using environment variables. For this right click on System icon → properties →Advanced System Setting → environment variables and ok. Now, click on New tab and enter variable name as JAVA_HOME and in variable value, write the path of Java installation directory and click on ok then the following screen comes after the selection of the step3.

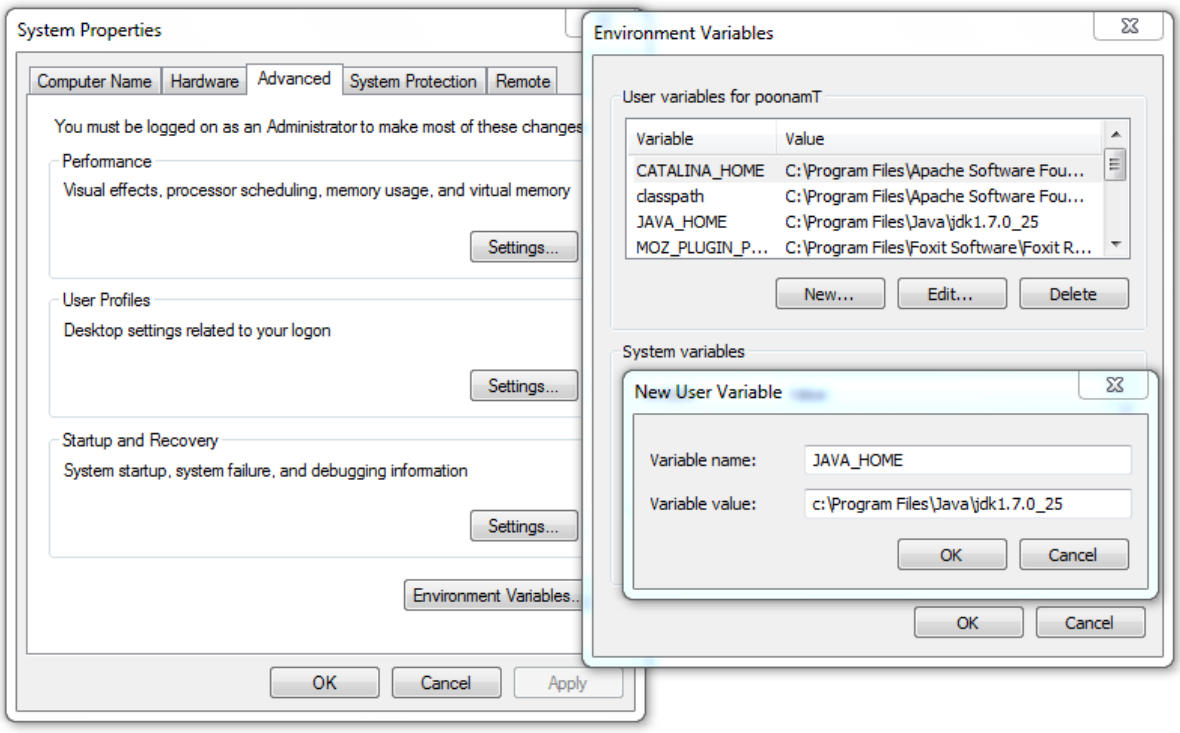


Figure 16: Screen for setting Environment variable.

In similar way, you can set the variable name and variable value for the following environment variable using step 3:

variable name	variable value:
classpath	C:\Program Files\Apache Software Foundation\Tomcat 6.0\lib\Servlet-api.jar;C:\Program Files\Apache Software Foundation\Tomcat 6.0\lib\jsp-api.jar;
path	C:\ProgramFiles\Java\jdk1.7.0_25\bin;C:\ProgramFiles\Java\jdk1.7.0_25\lib;
CATALINA_HOME	C:\Program Files\Apache Software Foundation\Tomcat 6.0

Step 4 - After installation, the tomcat folder has the following folders are bin (binary files for Tomcat and friends), conf (configuration files), lib (library JAR files), logs (server log files), temp (temporary files), webapps (area Tomcat looks for web application, it contains JSP files, Servlets and other content) and work (working space for holding translated JSP files). You can see these folders in following figure 17.

Step 5 - Create directory "ex" under the webapps as per the following figure 17:

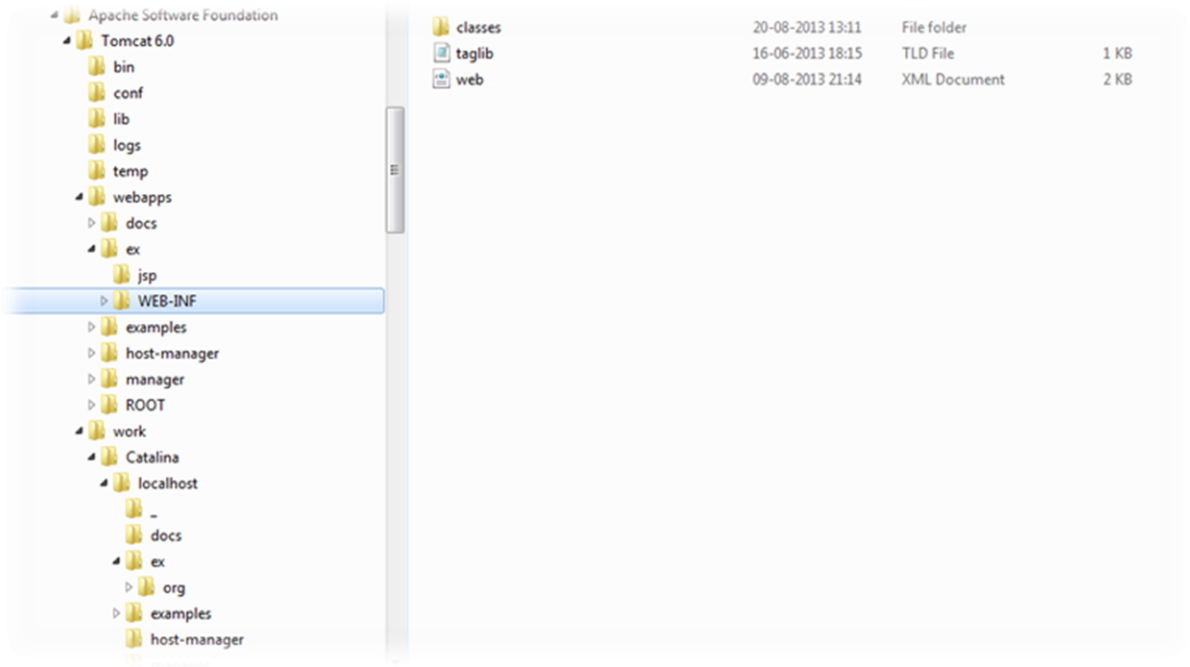


Figure 17: Directory Structure for Tomcat

Step 6 - Create directory "WEB-INF" and "JSP" folder under the "ex" folder. Create another folder named "classes" in WEB-INF folder. All your java classes used in your web application should be placed in classes folder.

Step 7 - Copy web.xml file from ROOT directory and paste into "WEB-INF" folder under the "ex" folder.

Step 8 - Save the files header.html, footer.jsp, main.jsp, actionJSP.jsp in the following location: C:/ Program Files/…/…/webapps/ex/JSP folder.

Step 9- Compile visitCount.java file and place the visitCount.class file in the following location: C:/ Program Files/…/…/webapps/ex/Web-INF/classes folder as you can see in following figure:

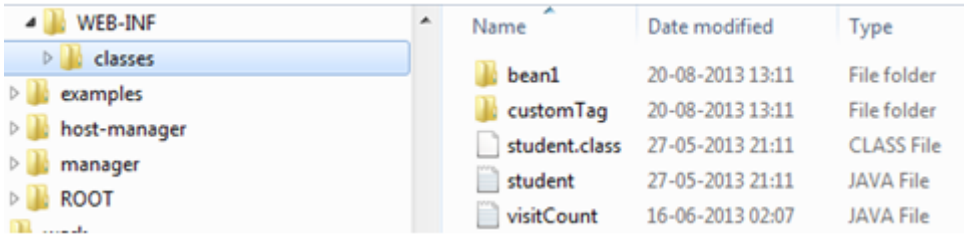


Figure 18: Screen shows classes Directory

Step 10- Start Tomcat server. Open new tab in browser or open new window : http://localhost:8080/ex/jsp/main.jsp

The outputs of the above programs are as follows:

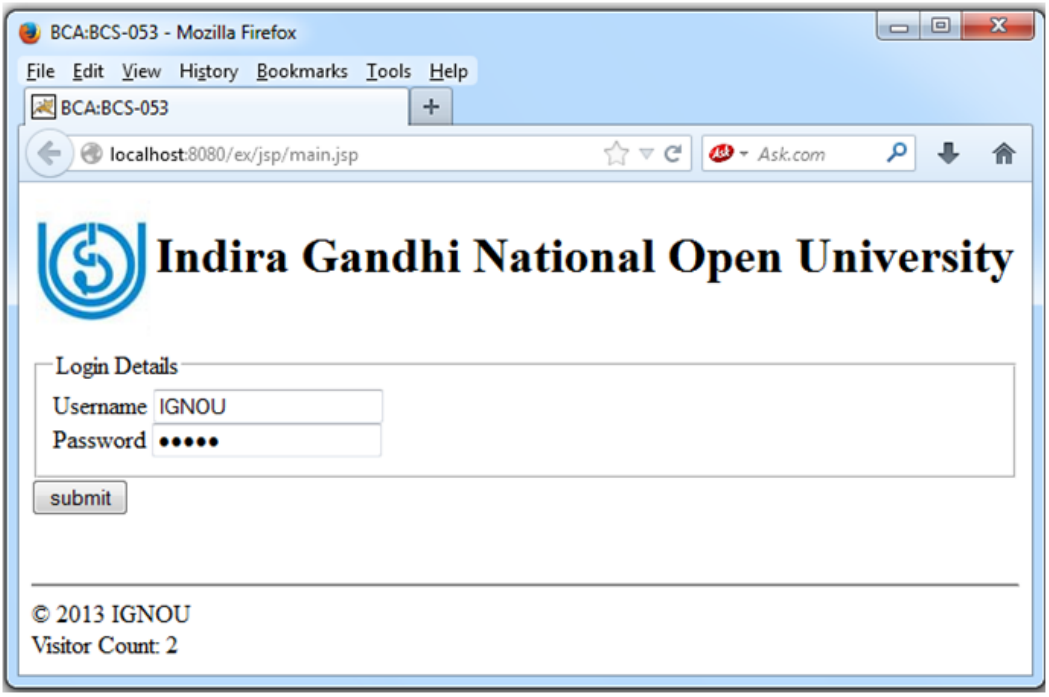


Figure 19: Login Screen

When you will click on the submit button of the above form, the following screen will be displayed with the login information.

Figure 20: Output screen for above program

The above example contains many small program files such as header.html, visitCount.java, footer.jsp, main.jsp and actionJsp.jsp. The header file is used for displaying a heading for the program page. In visitCount.java, visitCount is a Java Bean class that acts as a visitor counter. It has a single int type property count that holds the current number of times the beans property has been accessed. This program also contains the methods for getting and setting the count property. In footer.jsp, the visitCount bean is integrate with JSP page using the <jsp:useBean> standard action. Other two action elements <jsp:setProperty> and <jsp:getProperty> are also defined for the count property. In main.jsp file, header and footer files are included by using the include directive and include action. Two input form control is defined for accepting the user's login information. Another file actionJsp.jsp is also included in main program. When you will run main program named main.jsp, it will show you a form, in which you fill information and submit the form and result will appear on the screen.

2.8 Summary

In this unit, you gone through the basics of Java Server Pages. Now, you can explain the JSP technology and how is used to create web application. It is an extension of the servlet because it provides more functionality than servlets. Aside from the regular HTML, there are three types of JSP components that you embed in your document i.e. directives, scripting elements and actions. Directives are used to control overall structure of the JSP page. You have learned three types of scripting elements such as declaration, expression, and scriptlets. Some Standard actions are specific to Java Bean and other actions are used to include or forward request, add applets or plugin within JSP page. You have also learned about the objects that are available for use in scriptlet or expression without being declared. Now, you have able to create a web page in JSP and also able to create/access a Java Bean within the JSP.

2.9 Solutions/Answers

Check Your Progress 1

Ans1:

JSP stands for Java Server Pages. It was developed by Sun Microsystems in 1999. JSP page or document is normal html page with embedded Java code. A JSP page contains static data

as well as dynamic data. The static data is written in normal html form and dynamic content is constructed JSP elements. The file extension for the source file of a JSP page is .jsp. JSP is a technology used to develop interactive Web pages.

Ans2:

Both Servlet and JSP are server side technology but the development process of JSP page is easier than Servlet. The content and display logic is separated in a JSP page and you can insert directly java code inside the JSP page while in servlet, you can write java code with plain html using plenty of out.println() statement for front end display of the page which is very tedious work. Another advantage of JSP page over the Servlet is that the JSP page can use custom tags while in Servlet, it is not possible. The power of JSP is to provide a framework for Web application development.

Ans3:

The _jspService() method is defined in javax.servlet.jsp.HttpJspPage interface and it is invoked every time a new request comes to a JSP page. This method takes HttpServletRequest and HttpServletResponse objects as an arguments. It returns no value. A page author cannot override this method. It is defined automatically by the processor.

Ans4:

When a client requests a JSP page, the browser sends a request to web server which is forwarded to the JSP engine. If it is a new request from the client then it translated and compiled by the JSP engine into a servlet. Now, servlet is ready for servicing the client request and generates response which returns back to the browser via web server. For the second time same request from the client including browser and web server request to JSP engine, the JSP engine determines the request that the JSP-Servlet is up to date, if yes then it immediately passes control to the respective JSP-Servlet.

Ans5:

The life cycle of JSP document contains three phases from initialization to destruction. These phases is controlled by three methods i.e. jspInit(), _jspService() and jspDestroy().

The initialization phase include jspInit() method which is called only once during life cycle of a JSP. The jspInit() method is used to initialize objects and variables that are used throughout the life cycle of JSP. Another method of JSP life cycle is _jspService() method. It is called every time the JSP page is requested to serve a request. The destruction phase of the JSP life cycle starts when a JSP is being removed from use by a container. It has no parameters, return no value and thrown no exceptions. Override jspDestroy() when you need to perform any cleanup, such as releasing database connections or closing open files.

Check Your Progress 2

Ans1:

The directives are JSP component that provide global information about the page. It has further three elements such as page Directive, include Directive and taglib Directive.

The syntax of the directive is as follows:
<%@ directive {attribute = “value” %>

Ans2:

The standard actions are tags that are embedded in a JSP page such as forward, include and many more. It is also called as action elements. You can dynamically insert a file, reuse a Java Bean, forward or include a request to/from the other page. There are three action elements specific to Java Bean i.e. <jsp:useBean>, <jsp:setProperty> and <jsp:getProperty>.

Ans3:

This include directive is used to insert text and code at the translation time. You can not pass the parameter in this directive. The syntax is: <%@ include file=”relativeURL” %>

The include action is used to include static as well as dynamic content in the current JSP page at the request or run time. You can pass the parameter using param action. The syntax is :

<jsp:include page =”relativeURL”/> or
<jsp:include page =”relativeURL”/> <jsp:param ../></jsp:include>

Ans4:

The declaration tag is used to declare variables and methods which are placed inside the declaration part of the generated servlet. In JSP page, the declaration tag is start with <%! and end with %>. The code inside this tag must end with semicolon. For example:

```
<html><head><title>JSP Example</title></head>
<body><p>Example of declaration tag </p>
<%! private int i = 4; %>
<%! private int squre(int i)
{  i = i * i ;  return i; }%>
<%= squre(i) %> </body></html>
```

Ans5: Source code for <jsp:include> action :

```
<html> <head><title>JSP:Include example</title></head><body>
  <jsp:include page="faculty.jsp">
    <jsp:param name="name1" value="Sh. Shashi " />
    <jsp:param value="Director" name="desig1"/>
    <jsp:param name="name2" value="Sh. Ram Kumar" />
    <jsp:param value="Associate Professor" name="desig2"/>
  </jsp:include>
 </body></html>
```

Source code for faculty.jsp file

```
<html><head><title>faculty.jsp</title></head><body>
  <b><i>
  <% out.print("Name : "+request.getParameter("name1")); %></i></b>  <br>
   <% out.print("He is a "+request.getParameter("desig1")+" Dept.: SOCIS"); %> <br>

   <b><i><% out.print("Name : "+request.getParameter("name2"));%></i></b><br>
   <% out.print("He is a "+request.getParameter("desig2")+" Dept.: SOCIS "); %>
 </body></html>
```

Check Your Progress 3

Ans1:

In Java Server Pages, there are certain objects such as request, response, session and application are automatically available for JSP documents. These are called implicit objects and are summarized in the following table:

Implicit Object	Type
request	javax.servlet.HttpServletRequest
response	javax.servlet.HttpServletResponse
session	javax.servlet.http.HttpSession
application	javax.servlet.ServletContext
page	javax.servlet . jsp.HttpJspPage
pageContext	javax.servlet.jsp.pageContext
out	javax.servlet.jsp.JspWriter
config	javax.servlet.http.servletConfig
exception	java.lang.throwable

Ans2:

The request object is used to access request parameters. You can do this by calling the gerParameter() method of request object. For example,

```
<html><head><title>A request example</title></head>
<body>
<% String UserName = request.getParameter("UserName");
out.println("User Name = " + UserName);
%>
</body></html>
```

Ans3:

The pageContext object is an instance of javax.servlet.jsp.PageContext. It is used to represent the entire JSP page. The pageContext object is used to set, get and remove attribute of the JSP page. It provides a single point of access to many of the page attribute such as directives information, buffering information, errorPageURL and page scope. It is also provides a convenient place to store shared data.

Ans4:

```
<%@ page language="java"%>
<html><head><title>Odd number example written in JSP</title></head>
 <body><p>Odd number are:</p>

        <%   for(int i=0;i<=100;i++)  {
          if((i%2)!=0)
         {    out.println(i);   out.println(""); } }
        %>
  </body></html>
```

Ans5:

```
<html><body>
<% out.println("Remote Address is :" +  request.getRemoteAddr());%>
</body></html>
```

2.10 Further Reading

- Professional JSP….. Brown-Burdick, Apress, SPD.
- Java for the web with Servlets, JSP…Budi Kurniawan, Techmedia
- Pure JSP….Java Server Pages, James Goodwill, Sams, Techmedia
- JavaServer Pages, Hans Bergsten, O'Reilly
- http://tomcat.apache.org
- http://www.ibm.com/developerworks/java/tutorials/j-introjsp/section2.html

UNIT 3 JSP - Applications

Structure

3.0 Introduction

In the previous unit, you have learned how to create JSP web pages. When you include java code inside the html page, it becomes Java Server Pages (or JSP). Java Server Pages are simple but powerful technology used to generate dynamic web pages. Dynamic web pages are different from static web pages in which web server creates a web page when it is requested by a client or user. For example, when you see your online results on IGNOU website, different pages are generated for different students. It is not the same static page for all; rather IGNOU web server dynamically creates different pages depending on your roll number. You might have seen that when you enter your roll number in the input field, it shows you some roll number for your selection, do you know how the web server maintains or remembers such data. In fact, it is all possible because of cookie. You will study more about how web server maintains session management through cookie, session object, hidden form field and URL rewriting.

You have been introduced to operate a JSP page but without debugging and handling error, the development process is not complete. This unit will also introduce you about exception handling and managing email using JSP.

3.1 Objectives

After going through this unit, you will be able to:

- define and implement JSP error page
- write program for handling exception at page and application level in JSP
- explain the use of deployment descriptor
- define the session management
- use different techniques to achieve session management i.e. cookie, session objects
- sending email using JSP

3.2 Exception and exception handling using JSP

Web applications can sometimes generate a numbers of errors that you do not want to see. You can only expect an information rich page is display instead with an ugly and unexpected HTTP status code such as “404 Not Found” and “408 Request Timeout” in web browser. You can handle these error codes and runtime exception with an informative error messages. You can do this by creating an error page. You can write program codes for handling exception after going through this unit.

An exception is an abnormal condition that arises in a program code at run time. The exception can appear any time in web application, so it is necessary to write code for exception handling. Exception is a run time error or you can say that the exception is an object that is thrown at run time and exception handling is a process to handle the runtime errors. An exception can occur if you trying to connect to a database which does not exists or the database server is down, it may be thrown if you are requesting for a file which is unavailable, then the exception will be thrown to you.

In Java Server Pages (JSP), there are two types of errors i.e. translation time or compilation time error and run time or request time error. These errors can occur in JSP in two different phases of its life.

JSP Compilation Time Error

The first type of error comes at translation or compilation time when JSP page is translated from JSP source file to Java Servlet class file. These errors are usually the result of compilation failures due to some syntax error or spelling mistakes. These errors are known as translation time errors and are reported to the client browser with some error status code 500. The compilation time error is handled by JSP engine.

For example: In following scriptlet code, tag is improperly terminated.

```
<% out.println("Hello Students in JSP World"); >
```

When you will run the above code, it shows the following error description. The syntax error is in the one line scriptlet code. In following figure, you will see the error “unterminated % tag” in first.jsp named file. It means that the program code line is not terminated properly with %>; the percentage sign is missing.

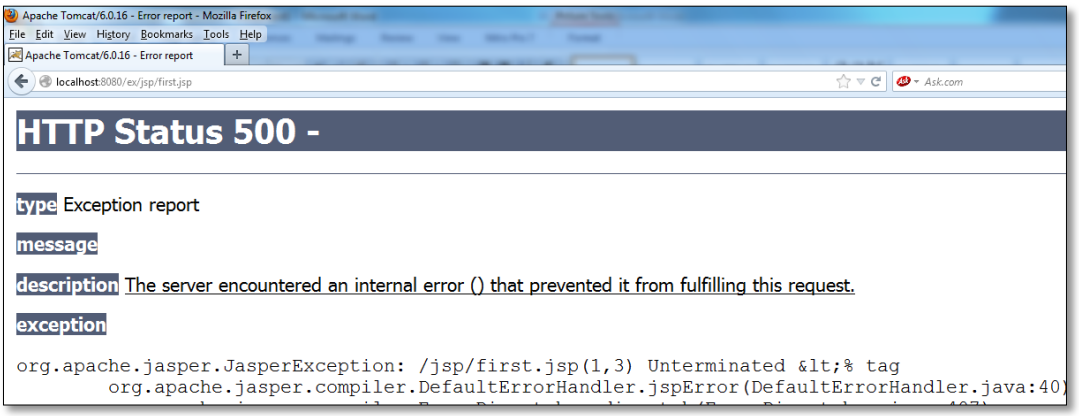


Figure 1: JSP Compilation time error

When you will run the following proper scriptlets code line terminating with % sign, it will display the correct result of program code.

```
<% out.println("Hello Students in JSP World");%>
```

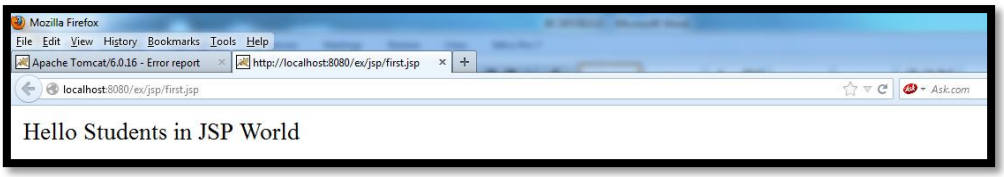


Figure 2: Simple JSP page

JSP Request Time Error

The second type of JSP error which is called as request time error occurs during run time or request time. These run time errors results in a form of exception. These run time exception can be caught and handled by the calling JSP. These exceptions occur in the body of the JSP Page. In following section, you will find more examples for the run time exception.

For exception handling, you need to create and define JSP error page. You can define an error page in two ways i.e. page level and application level. In page level, an error page contains the exception handling code description for a particular page. It means that the exception handling code is defined on each page and if there is an unhandled exception thrown from that page, the corresponding error page will be displayed. The page wise error page is defined when dealing with exception using page directive. In application level, error page contain source code for not any specific web page rather it is defined for all pages by describing in deployment descriptor i.e. web.xml file.

The following sections describe in detail how to define and implement the error pages. Also, exception can be handled in Java server pages in the following way:

3.2.1 Error handling at the page level

In this approach, you can write the code for exception handling only for the particular JSP page using page directive and Java standard exception mechanism. In the page directive, there are two attribute for exception handling i.e. errorPage and isErrorPage. You can create an error page using errorPage attribute of page directive element of JSP. In standard Java mechanism, you can use try and catch clause to capture the exception which is thrown within scriptlets element of the current JSP page.

3.2.1.1 Using page Directive

You have already been learned about the page directive in the previous unit. The page directive is used to specify the properties of the JSP page. The two attributes of the page directive such as errorPage and isErrorPage are useful for in JSP exception handling and also, one implicit object “exception” is used in handling JSP errors.

The errorPage attribute

The errorPage attribute of page directive is used to specify the name of error page that handles the exception. You can handle the exceptions in JSP by specifying errorPage in the page directive. It is used as follows:

```
<%@ page errorPage=”relative URL” %>
```

The isErrorPage attribute

The isErrorPage attribute of page directive indicates whether or not the JSP page is an errorPage. The default value of this attribute is false.

```
<%@ page isErrorPage=”true” %>
```

Here is the example for exception handling at page level or within current JSP page using errorPage and isErrorPage attributes of page directive. In this case, you must create an error.jsp named file which contains source code for handling exception and the other page named main.jsp file, where may exception occur, define the errorPage attribute of page directive. The third file input.jsp is used for input values. This example is for dividing two values and displays the result.

Source code for input.jsp:

```
<html> <head> <title>Input.jsp</title> </head> <body>
<form action="main.jsp">Enter Number 1<input type="text" name="num1">
<br>Enter Number 2 <input type="text" name="num2"> <br>
<input type="submit" value="submit"> </form> </body></html>
```

Source code for main.jsp

```
<%@ page errorPage="error.jsp" %>
<html> <head> <title> main.jsp </title> </head> <body>
 <% String n1 = request.getParameter("num1");
String n2 = request.getParameter("num2");
int Var1 = Integer.parseInt(n1);
int Var2 = Integer.parseInt(n2);
int Var3 = Var1 / Var2;
out.println("First number = "+ Var1);
out.println("Second number = "+ Var2);
out.println("Division of two numbers are  "+ Var3);  %>
</body></html>
```

Source code for error.jsp

```
<%@ page isErrorPage="true" %><html> <head>
 <title>error.jsp</title></head> <body>
Your page generate an Exception : <br>
<%= exception.getMessage() %>  </body></html>
```

Output of the above programs:

When you will run the above program code, it shows the following two screens one after another. In the first screen, there are two input box where you will input two integer value and click on submit button. In the second screen, the browser displays the result after the division of two numbers.

Figure 3: JSP page for division of two numbers

Now, you will run the above same program again and input an integer value in first text box and zero in second text box and click on submit button. Now, the program will generate an Arithmetic exception: division by zero. When you will input any float value in any text box, then also it will generate exception.

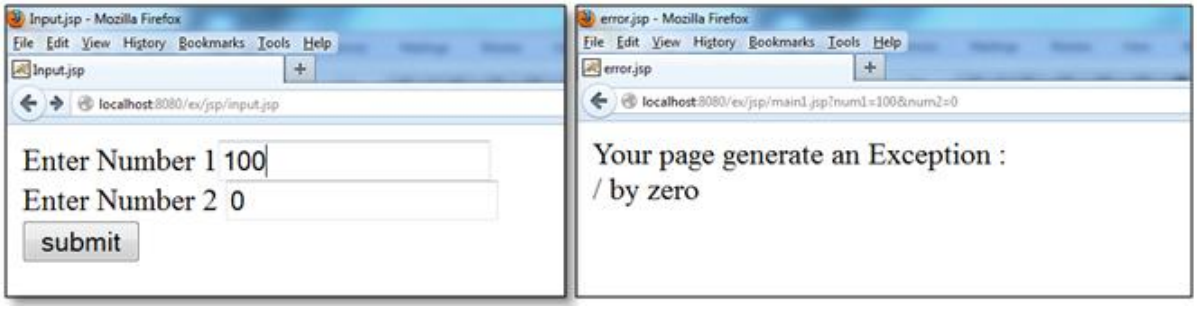


Figure 4: JSP page for handling exception

3.2.1.2 Using Java Mechanism

If you want to handle exception within the current JSP page, then you can also use standard java exception handling mechanism. For this, you can use try and catch clause. In try block, you can write the normal code that might throw an exception. The catch block is used to handle the exception. Both the try and catch clause are written inside the scriptlets component of the JSP page. Unlike page directive, there is no need to be written an error page for this mechanism.

You can use the try and catch block like the following:

```
<%    try {   // code that thrown an exception   }
      catch (exception e) {  // exception handler for exception occur in try block}
%>
```

The following program code is for handling exception using try and catch block clause of Java. In this program, normal coding is defined in try clause and exception handling code is in catch block. In try block, there are three integer variable x, y and z are defined. The variable x contains a value zero and y contains value 18. When the program tries to divide the value of y by x then exception is occurred. The program control flow is preceded and display only those statement which are included in catch block.

```
<html><head><title>Using standard Java mechanism</title></head>
<body><h3>Exception handling through try and catch clause</h3>
<%      int x, y, z;
        try { // monitor a block of code.
                x = 0; y = 18; z = y / x;
                out.println("This will not be printed.");
            }
        catch (ArithmeticException e) { // catch divide-by-zero error
        out.println("Division by zero."); }
        out.println("After catch statement."); %>
</body></html>
```

Output of the program:

Figure 5: Exception handling through standard Java mechanism

3.2.2 Error handling at the Application level

In previous section, you have learned about the exception handling at page level using page directive and standard java mechanism. The following section describes the exception handling at the application level.

3.2.2.1 Using Deployment Descriptor

You can also handle exception in JSP page at application level by specifying the error page using <error-page> element in the deployment descriptor. The deployment descriptor is a file named web.xml. It is resides in the web applications under the WEB-INF/ directory. This approach is better if you want to handle any exception in any JSP page. Under the <error-page> element, you can specify either an <exception-type> element with the class name of the expected exception such as java.lang.ArithmeticException or <error-code> element with an HTTP error code value such as 500 with <location> element. The <location> element tell JSP container for URL path of the resource to show when the error occurs. Unlike page directive, you do not need to specify the isErrorPage attribute in each JSP page. You can specify only one time the name of error page in the <location> element.

To include a generic error page for all exceptions at application level in the following way in web.xml file:

```
<error-page>
  <exception-type>Exception</exception-type>
  <location>/error.jsp</location>
</error-page>
```

If you want to handle exception using any specific error status code such as File not found error 404, Server error 500, then you can specify <error-code> element instead of <exception-type>. This is the best way to declare error page using error-code element in web.xml file. It is used as follows:

```
<error-page>
  <error-code>500</error-code>
  <location>/jsp/error.jsp</location>
</error-page>
```

Here is the example for exception handling at application level using <error-page> element. The example code is very similar to the above used example in page directive option. For this example, four files are needed to run the program:

- input.jsp file for input values (It is same as the above example in page directive section 3.2.1)
- main.jsp for dividing two numbers and displaying the result
- error.jsp file for displaying the exception (which is also same as the above example defined in page directive option)
- web.xml file for specifying the <error-page> element

Source code for main.jsp: Now, you do not need to specify errorPage attribute of page directive in each JSP page.

```
<html> <head> <title> main.jsp </title> </head>
<body>
 <% String n1 = request.getParameter("num1");
String n2 = request.getParameter("num2");
int Var1 = Integer.parseInt(n1);
int Var2 = Integer.parseInt(n2);
int Var3 = Var1 / Var2;
out.println("First number = "+ Var1);
out.println("Second number = "+ Var2);
out.println("Division of two numbers are  "+ Var3);  %>
</body></html>
```

Source code for web.xml: You can include the following code in your web application under the WEB-INF/web.xml file. The <location> element tells the web container for location of the error page. In this example, error.jsp file is placed under the jsp/error.jsp folder in web application.

```
<web-app>
……
…….
<error-page>
  <error-code>500</error-code>
  <location>/jsp/error.jsp</location>
</error-page>
……..
</web-app>
```

Output of the program:

When you run the input.jsp program file and input two integer value in the respective boxes, the program is successfully run and display the following output screens.

Figure 6: Simple program without an exception

When you run the above program code again with incorrect values such as zero or float values in input text field then program will generate an exception accoding to your input values.

Figure 7: Exception handling at application level by using deployment descriptor

Note: The page directive declaration overrides any matching error page configurations in deployment descriptor. If the JSP page throws java.lang.ArithmeticException and deployment descriptor has an exception-type attribute for that exception, the web container invokes the page directive instead of any URI specified in deployment descriptor (web.xml) configuration.

Check Your Progress 1

1. Explain the term JSP error Page.

---

2. Explain the two attributes of page directive which is included in exception handling in JSP page.

---

3. What is the purpose of <error-page> element in JSP page and where it is used?

---

4. How can you write code fragment for 'File Not Found Error 404' using deployment descriptor?

---

5. Explain the use of deployment descriptor in JSP.

3.3 Session Management

The Hypertext Transfer Protocol (HTTP) is the network protocol that web server and client machine use to communicate with each other. HTTP is a stateless protocol which means that it cannot persist the data or you can say that it does not remember a thing. When you send a request as a client to server through HTTP, HTTP treats each request as a new request. So every time you will send a request, you will be considered as a new user. It is not reliable when you are doing some kind of business transaction such as online banking or other work that are most important, where the persistence of the data is necessary. To remove this obstacle, you can use session management.

Before going in detail of session management, you should know two things that are necessary for implementing flexible business transaction across the multiple request and response. These are as follows:

- **Session:** The server should be able to identify a series of request from the same user form a single working 'session'. For example: In online banking application, each user can distinguish from another user by associating a specific request with a specific working session.
- **State:** The server should be able to remember information related to previous request and other business decisions that are made for the request. For example: In online banking application, the state contains user's account number, amount or transaction made within the particular session.

Session management also called session tracking, does not change the nature of HTTP protocol i.e. statelessness feature and it just provides a way to remember the information that has been requested or entered by the user. Session management allows JSP/Servlet to maintain information about a series of request from the same user.

Generally, there are four techniques to session tracking:

- URL rewriting
- Cookies
- Hidden fields
- Session object

Each of the above techniques are differ in their implementation but all are based on one principle that is to exchange data in the form of token or session ID between the client and server. In the following figure, client sends a request to server for the first time, a unique

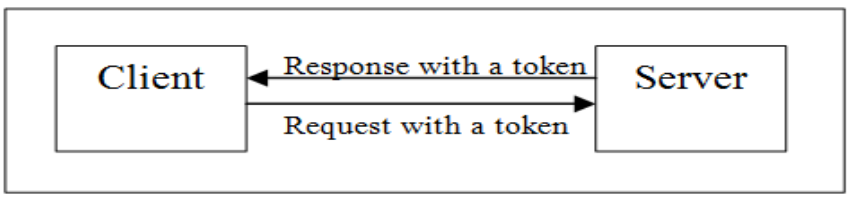


Figure 8: Client - Server model for session tracking

token is generated by the server and transmitted to the client by the response object and

stored on the client machine as a cookie. Whenever, the client visits a server again, it will send a request along with token to the server. On the server side, server can recognize client with this token. This is the way of working nature of session tracking.

The following section describes the above said four techniques and how these techniques represent the tokens:

3.2.1 Cookies

A cookie, also known as an HTTP cookie, web cookie, or browser cookie, is a small piece of data sent from a website and stored in a user's web browser while a user is browsing a website. When the user browses the same website in the future, the data stored in the cookie is sent back to the website by the browser to notify the website of the user's previous activity.

Cookies are widely used session tracking technique. A cookie is small piece of information that is sent by the server to client browser. It is stored at the client machine in the form of text file. It is basically information about the user viz., username, password, email id, date of login and identification number etc. When the next time, browser sends request along with cookies, then the server uses these cookies to identify the user.

Typically, cookies are set at the beginning of the JSP page because they are sent as a part of HTTP headers. The creation and maintenance of cookies are the same the servlet. For this, servlet API provides a javax.servlet.http.Cookies package. You can create a cookie by calling a constructor of Cookie class and passing a name /value pair of parameter. The signature of the Cookie class is defined as follows:

```
public Cookie(String name, String value)
```

For example, the following source code line creates a cookie object named cookieOne. This object cookieOne has the name “nameCookie” and value of “valueCookie”. Both the name/value pair is defined by the user.

```
// create a new cookie
Cookie cookieOne = new Cookie(“nameCookie” , “valueCookie);
```

You can add this cookie to JSP in-built response object using addCookie() method of HttpServletResponse interface:

```
response.addCookie(cookieOne);
// send the cookie to browser to be stored on client machine
```

Now, you can retrieve a cookie from the request using getCookie() method of HttpServletRequest interface:

```
request.getCookie(cookieOne); // retrieve a cookie
```

You can also set the life of the cookie using the setMaxAge() method. Look the following code:

```
public void Cookie.setMaxAge(int expiry)
```

You can specify the age of cookie using the above method in seconds. A negative value indicates the default value; it should be expired when browser exits. A zero value indicates that the cookie is immediately deleted by the browser. For example:

```
cookieOne.setMaxAge(60 * 60) // expire in 1 hour
cookieOne.setMaxAge(0) // to remove the cookie
```

Here is the complete example of the cookie:

In following example, there are three programs namely CookiePrg1.jsp, CookiePrg2.jsp and CookiePrg3.jsp. In first CookiePrg1.jsp program, there is defined only one text box where you can input university name and click on the Go button. When this form is submitted, control transfer to the second program named CookiePrg2.jsp, where the cookie is set an age using the cookie.setMaxAge() method. In the third CookiePrg3.jsp program, the cookie is retrieved using the method request.getCookies() and the value of the cookie is displayed. Normally, you can get the value of the form fields using request.getParameter() method on the second or action page but the purpose of this example using three programs is used to show you the value of cookie is displayed on the third page. In this way, you can get the value of cookie on any web page.

Source code for CookiePrg1.jsp

```
<html><body>
  <form method = "post" action="CookiePrg2.jsp">
   University Name<input type = "text" name = "name"><br>
  <input type = "submit" name = "submit" value = "Go" >
  </form></body></html>
```

Source code for CookiePrg2.jsp

```
  <%@ page language="java" import="java.util.*"%>
  <%
   String name=request.getParameter("name");
   Cookie cookie = new Cookie ("Name",name);
   response.addCookie(cookie);
   cookie.setMaxAge(60 * 60);
  %>
  <a href="CookiePrg3.jsp">Continue</a>
```

Source code for CookiePrg3.jsp

```
<p>Display the value of the Cookie</p>
 <%
   Cookie[] cookies = request.getCookies();
   for (int i=0; i<cookies.length; i++)
   {
     if(cookies[i].getName().equals("Name"))
     out.println("University Name =    "+cookies[i].getValue());
    }
 %>
```

When you will run the above programs, the following output is displayed in your browser.

Figure 9: Simple program for Cookie

3.2.2 URL Rewriting

URL rewriting is used in place of the cookies when the browser cookies are functionally turned off. It is used to maintain the session. In this approach, the token is embedded in each URL. In each dynamically generated page, the server embeds an extra query parameter or extra path information. When client submits request using such URL, the token is retransmitted to the server. You can send name/value pairs of parameter in the following format:

http://ignou.ac.in/student.jsp?name1=value1&name2=value2&.....

A name and value parameter is separated by equal (=) sign, a parameter name/value pair is separated by another parameter name/value pair using ampersand (&) sign. When you click the hyperlink, the parameter name/value pairs will be passed to the server. From JSP page,

you can use getParameter() method of HttpServletRequest interface to retrieve the parameter value. You can write the following code for retrieving parameter value.

request.getParameter(name1);

For example: In the following hit counter program, the two variable count and counter are defined. Count is integer type and counter is string type variable. For the first time, the value of counter is retrieve using request.getParameter() method and it is equals to null then set the value of count is one. The program is display value of hit counter is one. When you will click on 'click@Link' link, value of count variable is passed to counter variable like the following way:

http://localhost:8080/ex/jsp/index1.jsp?counter=1

The String.valueOf(count) method is used to convert the integer value of count in string type. For the second time, when if condition is false and control transfer to else part of the program and value of counter variable is incremented by one each time, when you click on the link.

```
<html><head></head><body>
<h3>Page Counter Example using URL Rewriting </h3>
<% int count;
if (request.getParameter("counter") == null) count=1;
else { count=Integer.parseInt(request.getParameter("counter"))+1; }%>
<p>This is Hit Counter No.:<%=count%><br>
<a href="index1.jsp?counter=<%=String.valueOf(count)%>">Click @Link</a></p>
</html>
```

Output of the above program:

Figure 10: Simple program for URL Rewriting

3.2.3 Hidden Fields

Another technique for managing user session is by passing a token as the value for an HTML hidden field. When the client submits a form, the additional field values will also be send in the request in the form of field. Unlike the URL rewriting, the value does not display in address bar but it can be read by viewing html source code. It can be retrieved by using getParameter() method.

For example, the following HTML input control of type HIDDEN:

<input type="hidden" name="userId" value="ignou">

For example: the following example is same as the above hit counter example in URL Rewriting session management techniques.

```
<% int count;
if (request.getParameter("counter") == null) count=1;
else { count=Integer.parseInt(request.getParameter("counter"))+1; }%>
<html><head></head><body>
<form action="HiddenForm.jsp" method="get">
<h3>Page Counter Example using Hidden Form Fields</h3>
<p>This is Hit Counter No.:<%=count%></p>
<input type="hidden" name="counter"
value="<%=String.valueOf(count)%>">
<input type="Submit" value="Access New Counter"></form></body>
</html>
```

When you run the above program named "HiddenForm.jsp" example, you will get the following screen. When you run the program for the first time, the value of integer type counter variable is null and hit counter takes value one and after in a subsequent manner, it is incremented by one. Whenever you click on 'Access New Counter' button in same session, the form is again submitted and the value is incremented by one. The URL of the JSP page in address bar is looks like the following:

http://localhost:8080/ex/jsp/HiddenForm.jsp?counter=2

Figure 11: Program for Hidden Form Field

3.2.4 Session Object

This is easiest to use and powerful for session management. Session and Cookies go hand in hand, the only difference between the cookies and session is that the cookie is stored in the client side and session is stored on server side which is another method to handle a session.

Any web application can use the concept of sessions and Session object is used to store data for a particular client when that client is connected to server. For example, when a client logs on to a Shopping site web application, client login name, password, and other pertinent information might be stored in a Session variable and maintained during her/his visit to the site so that it can be accessed when needed. When a session begins, the requesting browser is given unique piece of information, or "token" that is presented by the browser on subsequent visits to identify the client. The Web application can then, for example, customize the settings for that client when she/he visits, since it can find her/his personal preferences using the information stored in the Session object referenced by the token. If there are 10 simultaneous clients, then 10 Session object will be created in the server and each client can access only

own HttpSession object. The Session object is represented by the javax.servlet.http.HttpSession interface.

Java Server Pages has been provided an implicit object session. So, you do not need to create a session object explicitly as you can do in servlet. The session object is defined inside the page directive of the JSP page by the following way:

<%@ page session = “true|false” %>

In JSP, the default value of session object is true. If you do not declare the session object inside the page directive then session will be automatically available to JSP page as it is default by true. The following are the some methods that are applied for session management using session object in JSP:

setAttribute() method

This method is used to add a name/attribute pair to the HttpSession object. The setAttribute() method returns an IllegalStateException on invalidated HttpSesion object. This method has the following signature:

```
public void setAttribute(String name, Object attribute) throws IllegalStateException
```

You can add attributes to the session in the following way:

<% session.setAttribute(number, new Float(48.8)); %>

The above statement creates number as a session variable and assigns to a float value. To retrieve this object, you can use getAttribute() method.

getAttribute() method

This method is used to retrieves an attribute from the HttpSession object. Like the setAttribute() method, the getAttribute() method returns an IllegalStateException, if it is called upon an invalidated HttpSession object. The signature is as follows:

```
public Object  getAttribute(String name) throws IllegalStateException
```

To retrieve information from a session, you simply use the getAttribute() method, like this:
Number : <%=session.getAttribute(number); %>

Here is the example for session management using session object:

The example is included three program named sessionJSP1.jsp, sessionJSP2.jsp and sessionJSP3.jsp. In the first program, there is a form which includes two form text fields i.e. Name and Password. When you will enter these values in the respective text boxes and form is submitted, the control goes to the second program where set the username as a key for session variable, name and password is validated, if it is correct then control transfer to the third program. In the third program, value of the session object is retrieved using getAttribute() method and display a message for valid user. If it is not valid then shows an error message “name and password is invalid” using response.sendError() method. The

session is always managed with data that is stored on persistent storage. You will learn database handling concept in next unit of this block. This session management program is a static program. For testing purpose, you will input username 'IGNOU' and password 'socis' then program will run correctly otherwise it will show an error message.

Source code for sessionJSP1.jsp:

```
<html><head>
<title>Session Management: Using Session Object</title>
</head><body>
<h3>Session Management: Using Session Object</h3>
<form method = "post" action = "sessionJSP2.jsp">
 Name<input type = "text" name = "name"><br/>
 Password<input type="password" name = "pwd" ><br/>
<input type = "submit" name = "submit" value = "submit" >
</form></body></html>
```

Source code for sessionJSP2.jsp:

```
<%  String name = request.getParameter("name");
      String password = request.getParameter("pwd");
      if (name.equals("IGNOU") && password.equals("socis"))
      {
            session.setAttribute("UserName",name);
            response.sendRedirect("sessionJSP3.jsp");
      }
      else { response.sendError(404, "Name and Password is invalid."); } %>
```

Source code for sessionJSP3.jsp:

```
Hello! User:  <%= session.getAttribute("UserName") %>
```

Output of the program: when you will run the above program, it will display the following two screens.

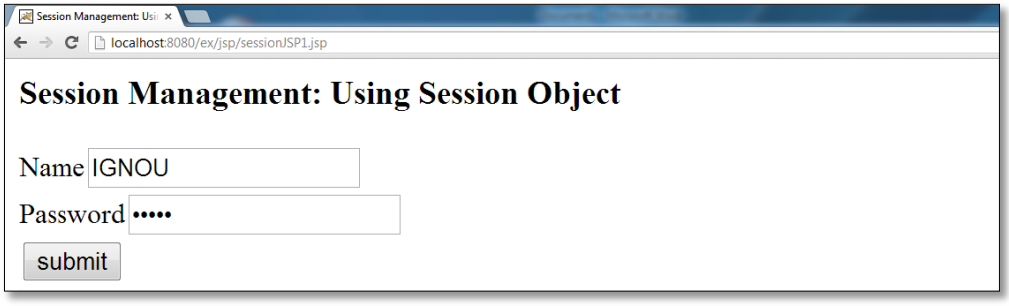


Figure 12: Session Management using Session Object

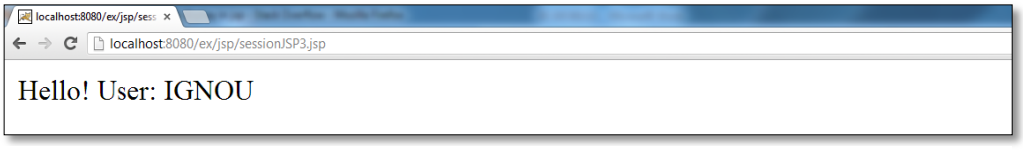


Figure 13: Validate User in Session Management

When user name and password are not validated from the program then the following screen is displayed.

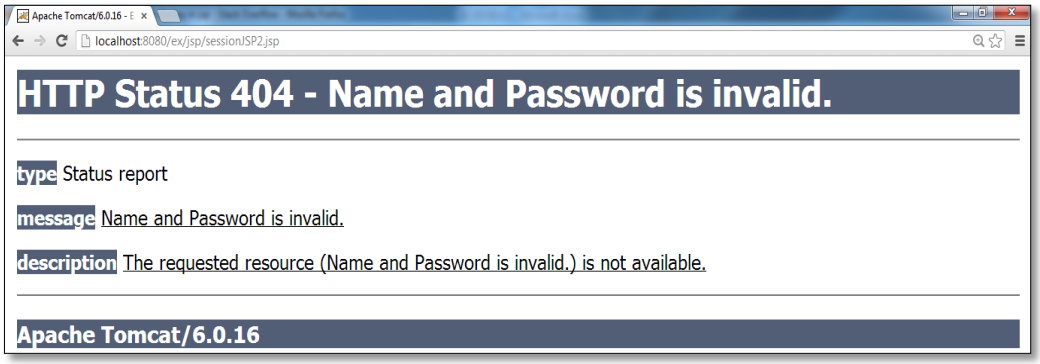


Figure 14: Error message for Invalidate user

Now that you know how session management works using the HttpSession object. The java.servlet.http.HttpSession interface has the following some additional methods for handling session:

isNew() method

This method indicates whether the session object was created with this request and if the user has joined the session, it contains true value otherwise false. The method has the following signature:

```
public boolean isNew() throws IllegalStateException
```

getCreationTime() method

The getCreationTime() method returns the time when the session was created, measured in milliseconds. The signature is as follows:

```
public long getCreationTime() throws IllegalStateException
```

getLastAccessedTime() method

The getLastAccessedTime() method returns the time when the session was last accessed by the client. The signature of method is as follows:

```
public long getLastAccessedTime()
```

getId() method

The getId() method returns the session identifier. The signature of method is as follows:

```
public String getId()
```

getMaxInactiveInterval() method

The getMaxInactiveInterval() method returns the maximum time interval, in seconds, that the container will keep the session open between client accesses. The signature of method is as follows:

```
public int getMaxInactiveInterval()
```

setMaxInactiveInterval() method

This method sets the numbers of seconds between client requests before the container will invalidate this session. The signature of method is as follows:

```
public void setMaxInactiveInterval(int  interval)
```

Consider the following example for defined above all the function related to session management. The following program uses session tracking to keep track of how many times it has been accessed by a particular user and to display some details of the current session.

```
<%@ page import ="java.util.Date" %>
<h3>Session Management through Session Object</h3>
<h5>Session Details : </h5>
<%
session = request.getSession(true);
Integer count = (Integer) session.getAttribute("count");
if (count == null)
{ count = new Integer(1);}
else { count = new Integer(count.intValue()+1);}
session.setAttribute("count", count);

out.println("You have visited this page  " +count+((count.intValue() == 1) ? " time." :
" times."));
out.println("<br/>");
out.println("Session ID :   " + session.getId());
out.println("<br/>");
out.println("New Session :   " + session.isNew());
out.println("<br/>");
out.println("Creation Time :   " + new Date(session.getCreationTime()));
out.println("<br/>");
out.println("Time Out :   " + session.getMaxInactiveInterval());
out.println("<br/>");
out.println("Last Access Time :   " + new Date(session.getLastAccessedTime()));
%>
```

When you run the above program, it shows you the following output screen:

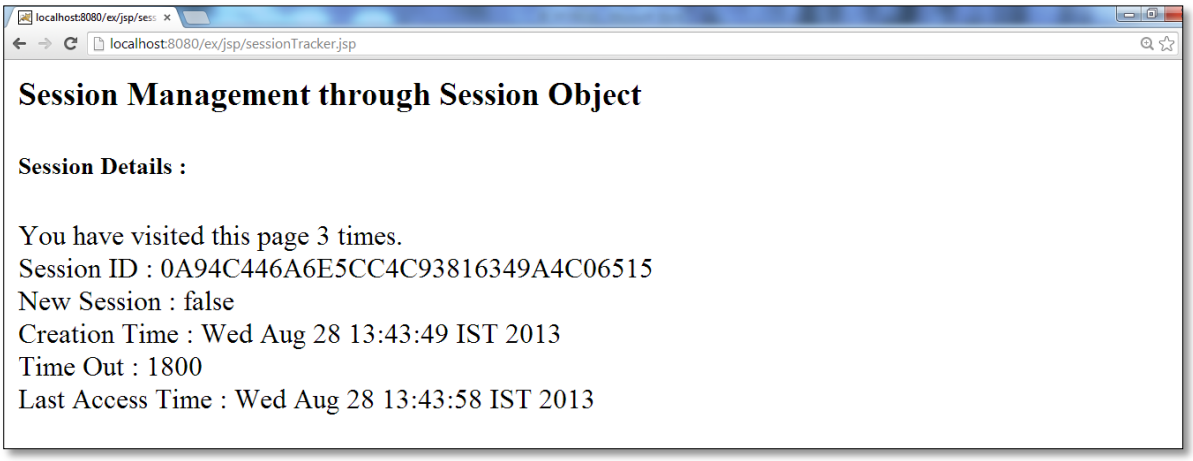


Figure 15: Session Tracking through Session Object

Check Your Progress 2

1. What are the Cookies? How do you delete Cookies within a JSP?

---

2. Explain Session Management in JSP?

---

3. What are the different session tracking methods?

---

4. Explain getSession() method.

3.4 Managing Email using JSP

JavaMail API is the standard mechanism used for sending email. The JavaMail API provides platform-independent and protocol-independent framework for sending and receiving emails. The javax.mail and javax.activation packages contain core classes of JavaMail API. These packages are comes in form of jar i.e. mail.jar and activation.jar. You can place these files under library directory of your web application. There are various ways to send email using JavaMail API. You must have SMTP server that is responsible for send mails. For this purpose, you can install any mail server such as Apache James server, Postcast server, cmail server etc.

Mailing protocols

In order to correctly send an email, client machine is used network protocol to connect the server. Basically, a protocol represents standard method used at each end of a communication channel to properly transmit information.

Generally, four protocols are used to send and receive email:

Simple Mail Transfer Protocol (SMTP):

SMTP is an Internet standard for electronic mail (e-mail) transmission across the networks. SMTP is used to deliver email to the recipient mail server. SMTP communications are transported by TCP to ensure reliable end-to-end transport.

POP (Post Office Protocol 3):

This protocol defines a single mailbox for a single user and a standardized way for users to access mailboxes and download messages to their computers as well. It provides facility to users to retrieve e-mail when connected. Once the messages are downloaded from the server, you can disconnect the Internet connection and read your mail.

IMAP (Internet Message Access Protocol):

It is a protocol by which you can read email via Internet. The email messages are stored on servers. When you check your inbox, your email client connects to the server to view your messages. When you read an email message you aren't actually downloading or storing it on your computer; instead, you are only reading it on the server, this is done by this protocol.

MAPI (Messaging Application Program Interface):

MAPI is used to send Email with in windows application and provide facility to take advantage of word processors, spreadsheets, and graphics applications.

Process of sending an email:

On the Internet, each domain has email Server, when you send an email then the following steps may be follows:

1. When you send email, your email client whether its outlook express or your JSP program connects to your SMTP Server. For example, smtp.ignou.ac.in
2. When client program communicates with SMTP Server, it sends sender and recipients' mail address along with message body.
3. The SMTP Server of the sender machine checks recipient email address especially its domain. If the domain name is same as the senders', the message is directly send to recipient domain's POP3 or IMAP server. If the domain name is different than SMTP server will have to communicate with other domain server.
4. After finding the recipient server, the SMTP server of the sender machine has to communicate with Domain Name Server (DNS). The DNS translates the recipient address into IP address.
5. The SMTP server of client machine is connected to recipient's SMTP server.
6. Now that the recipients SMTP server forwards the message to the domain's POP3 or IMAP server.

Here is a simple email program:

```
<%@ page import="java.io.*, java.util.*, javax.mail.*"%>
<%@ page import="javax.mail.internet.*, javax.activation.*"%>
<%@ page import="javax.servlet.http.*, javax.servlet.*" %>

<%
  String result;
  // Recipient's email ID needs to be mentioned here.
  String to = "abc@gmail.com";

  // Sender's email ID needs to be mentioned here.
  String from = "xyz@yahoo.com";

  // it is assumed that you are sending email from localhost
  String host = “localhost";

  // get system properties object
  Properties properties = System.getProperties();

  // set SMTP mail server
  properties.setProperty("mail.smtp.host", host);

  // get the default Session object.
  Session mailSession = Session.getDefaultInstance(properties);

  try{
    // Create a default MimeMessage object.
    MimeMessage message = new MimeMessage(mailSession);
    // Set From: header field of the header.
    message.setFrom(new InternetAddress(from));
    // Set To: header field of the header.
    message.addRecipient(Message.RecipientType.TO,   new InternetAddress(to));
    // Set Subject: header field
    message.setSubject("This is the Subject Line!");
    // Send the actual message
    message.setContent("<h1>This is actual message</h1>", "text/html" );
    // Send message
    Transport.send(message);
    result = "Sent message successfully....";
  }catch (MessagingException mex) {
    mex.printStackTrace();
    result = "Error: unable to send message....";
  }
%>
<html><head><title>Send HTML Email using JSP</title></head>
<body><center><h3>Send Email using JSP</h3>
</center><p align="center">
<%
  out.println("Result: " + result + "\n");
%>
</p></body></html>
```

When you run this program and send an email to given email ID and would display following response:

Check Your Progress 3

1. What are the important packages in JavaMail API?

---

2. Write the names of essential network protocol used in email.

---

3. Explain MIME?

---

4. Write the process of sending an email from client program to destination server.

3.5 Summary

In this unit, you have covered the exception and exception handling of Java Server Pages, session management and also managing email through JSP. Now you have known that the JSP technology is a powerful technology that is used to create web application, managing email. You can also do the exception handling in JSP pages at current and application level.

An exception is an abnormal condition that occurs at the time of program execution and it disrupts the normal flow of program code. For the exception handling, you have to create and define error page which includes the exception handling code. You can have two options for error handling at the page level and application level. At page level, you can use page directive and standard java try - catch clause for handling exception in current JSP page and also include error handler at the application level by using the deployment descriptor.

You have already known that the HTTP is a stateless protocol. When a client sends a request to server, the server sends back response to the client but does not keep information about the client request and state. The solution of this problem is session management. There are four techniques you can use to manage user sessions. In this unit, each technique has been described with examples. Additionally you learned about managing email through JSP page.

3.6 Solutions/Answers

Check Your Progress 1

Ans1:

A JSP error page is designed to handled runtime errors and display a customized view of the exception. You can include an error page in your application at page or application level. At page level, you can use page directive or standard java mechanism options. At application level, you can only use an <error page> element of deployment descriptor.

Ans2:

The errorPage and isErrorPage are two attributes of page directive which is included in exception handling in JSP at page level.

The errorPage attribute of page directive is used to define the name of error page that handles exception and display a customized an error statements. You can use the following syntax for errorPage attributes.

<%@ page errorPage=”relative URL” %>

The isErrorPage attribute of page directive indicates whether the current page can act as an error page for another JSP page. The default is *false*. It is used as follows:

<%@ page isErrorPage=”true|false” %>

Ans3:

You can handle exception in JSP page at application level by specifying the error page using <error-page> element in deployment descriptor. This is the best way to handle an exception in any JSP page. The deployment descriptor file is resides in the web applications under the WEB-INF/ directory. The <error-page> element is used to define the exception type or error code and location of the error page. Under the <error-page> element, you can specify <exception-type> or <error-code> and <location> element. You can use only either <exception-type> or <error-code>.

Ans4:

You can write code fragment for any specific error status code such as File not found error 404 using <error-code> element. This is the best way to declare error page using error-code element in web.xml file. It is used as follows:

```
<web-app>
…..
<error-page>
  <error-code>404</error-code>
  <location>/jsp/error.jsp</location>
</error-page>
…….
</web-app>
```

Ans5.

This file is an xml file whose root element is <web-app>. It is resides in the web applications under the WEB-INF/ directory. You can configure JSP tag libraries, welcome files, customizing HTTP error code or exception type. You can use the <error-page> element in deployment descriptor to specify exception type or HTTP error code and location of the error page. The JSP tag libraries can be defined using the <tag-lib> element of deployment descriptor.

Check Your Progress 2

Ans 1:

A Cookie is a small piece of data sent from a website and stored in a user's web browser while a user is browsing a website. When the user browses the same website in the future, the data stored in the cookie is sent back to the website by the browser to notify the website of the user's previous activity. You can remove cookie in the following way:

```
<%
   Cookie cookie = new Cookie( "name", "" );
   cookie.setMaxAge( 0 );
  %>
```

In the above example we have created a new instance of cookie with a "null" value and the age of the cookie is set to "0". This will remove or kill the cookie.

Ans2:

The HTTP is a stateless protocol. When a client sends a request to server, the server sends back response to the client but does not keep information about the client request and state. In a web application or website, a client has to visit number of pages for completing his task. For example, a user wants to buy some books from an online book store. User should add each book to cart and at the end and pay for them in order to complete his task. The server must maintain this type of conversation between user and the web application using different techniques i.e. Cookie, Session Object, Hidden Form field and URL Rewriting.

Ans 3:

Cookies: With this method, you can use HTTP cookies to store information. Cookies will be stored at browser side. If the browser does not support cookies, or if cookies are disabled, you can still enable session tracking using URL rewriting.

URL rewriting: The information is carried through url as request parameters.

HttpSession: Using HttpSession, you can store information at server side. HttpSession provides methods to handle session related information.

Hidden fields: By using hidden form fields, you can insert information in the web pages and this information will be sent to the server. These fields are not visible directly to the user, but can be viewed using view source option from the browsers. For example, you can create hidden form field like the following: <input type='hidden' name='courseCode' value='BCS053'/>

Ans4:

The getSession() method returns the current valid session associated with the request. This method has two overloads. They are as follows:

HttpSession getSession(boolean create) : It returns the HttpSession object associated with this request if there is a valid session identifier in the request. Otherwise it return null.

HttpSession getSession() : It returns current session associated with the request or if the request does not have a session identifier, it creates a new one.

Check Your Progress 3

Ans1:

The javax.mail and javax.activation packages contain core classes of JavaMail API.

Ans2:

For sending and receiving an email, client machine is used no. of network protocol to connect the server like SMTP, POP, IMAP and some other protocol. A protocol represents standard method used at each end of a communication channel to properly transmit information.

Ans3:

Multipurpose Internet Mail Extensions (MIME) defines mechanisms for sending other kinds of information in email like images, sounds, movies, and computer programs. MIME is an Internet standard that extends the format of email to support such as text in character sets other than ASCII, non-text attachments, message bodies with multiple parts and header information in non-ASCII character sets

Ans4:

When you send an email from source to destination server the following step are follows:

1. Email client Program sends the message to Email server.
2. Email server contact to the recipient's email server provided in the email address.
3. Email server checks that user name is valid or not.
4. If it is valid send email to the address's email server.
5. When recipient log on his mail account, gets his Email.

3.7 Further Readings

- Professional JSP….. Brown-Burdick, Apress, SPD.
- Java for the web with Servlets, JSP…Budi Kurniawan, Techmedia
- Pure JSP….Java Server Pages, James Goodwill, Sams, Techmedia
- Java Server Pages, Hans Bergsten, O'Reilly
- http://www.oracle.com/technetwork/java/javaee/jsp/index.html

UNIT 4 JSP APPLICATION DEVELOPMENT

Structure

4.0 Introduction

In the previous units, you have learnt about the importance of JSP. You have also studied the different components of JSP, exception handling, session management and managing email through JSP.

As you know that the JSP is basically used for server side programming. You have also known that the basic difference between static and dynamic pages. Whenever we discuss about the dynamic pages, it means that it is interactive pages and it is difficult to imagine the interactive pages of any web application that does not employ database interaction. Most of the web applications rely on back - end relational databases.

Therefore, database handling is the necessary feature of JSP. In this unit, you will learn about JDBC, different types of database drivers, connection steps for connecting database and insertion, manipulation through SQL statement in a database. At the end of this unit, you will go though the process of application deployment.

4.1 Objectives

After going through this unit, you should be able to:

- define the use and role of JDBC
- use different types of JDBC SQL statements
- appreciate the use of different types of database drivers and their usage
- write program using different steps to connect a database
- use JDBC to access and modify database
- develop and deploy database application

4.2 JDBC: An Introduction

Most of the web applications use database. Database accessing is played a significant role in web development. In this unit, you will learn about how data can be stored, retrieved and manipulated using databases on a web application. A Java API (Application Programming Interface) that enables JSP program to execute SQL statements is called JDBC.

JDBC is a Java enabled technology that specifically designed for database connectivity. This technology provides methods for querying and updating data in a database.

Sun Microsystems released first official JDBC API 1.0 as part of JDK 1.1 in 1997. When JDBC 2.0 comes with enhancements to the JDBC core API, it contains new features such as scrollable ResultSets (you can move record pointer both forward and backward) and batch updates (you can submit multiple DML statements at a once like insert, update). In 2001, JDBC 3.0 API has been launched with the features such as reusability of prepared statements by connection pools, passing parameter to Callable Statement and added a new data type i.e. java.sql.BOOLEAN.

The Latest version of JDBC is JDBC 4.1 and Features of JDBC 4.1 is same as JDBC 4.0. The main feature of JDBC 4.1 is to autoloading of JDBC drivers. In earlier versions of JDBC, applications had to manually register drivers before requesting Connections. With JDBC 4.0, applications no longer need to issue a Class.forName() on the driver name; instead, the DriverManager will find an appropriate JDBC driver when the application requests a Connection. JDBC 4.0 Standard Extension API is defined in the javax.sql package. It is required for applications that uses connection pooling, distributed transactions, Java Naming and Directory Interface (JNDI) and RowSet API.

JNDI is standard used for looking up distributed components across the network. A J2EE application client may use the JNDI API to look up enterprise beans resources (database) and environment entries. A RowSet object is a java bean component and extends the ResultSet interface. It has a set of JavaBeans properties and follows the JavaBeans event model. A RowSet object's properties allow it to establish its own database connection and to execute its own query in order to fill itself with data.

The core API is defined in java.sql package and it is enough for normal database applications. The following section introduces JDBC and then explores how to use it in JSP programs.

4.2.1 Need for JDBC

Today, the most widely used interface to access database is ODBC. ODBC stands for Open Database Connectivity. It is a standard in relational database connectivity published by Microsoft (though originally developed jointly by Microsoft and Sybase). ODBC cannot be used directly with Java program because it uses a Programming Language C interface and it also makes use of Pointers which have been removed from Java. JDBC comes after the ODBC but JDBC is a Java API and contains Java interface for working with SQL

4.2.2 Two- and Three-Tier Database Access Models

The JDBC provides support for two- and three-tier database access models. Please note that these access models are defined for general applications. In two-tier model, java application is directly connected to the database. This is done through the use of JDBC driver. The JDBC driver sends commands directly to the database and result of these commands are sent back directly to application. The following figure shows the two-tier model.

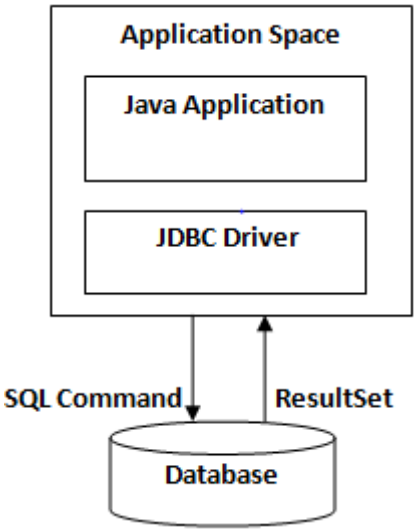


Figure 1: The two-tier Database Access Model.

In three-tier JDBC model, Java application can not connect directly to the database. A middle-tier comes between the Java application and database. When you use three-tier model, JDBC driver of Java application sends commands to middle-tier, which in turn sends commands to the database. The result of these commands is sent back from the database to middle-tier and middle-tier sent back to the application. The following figure shows the three-tier model.

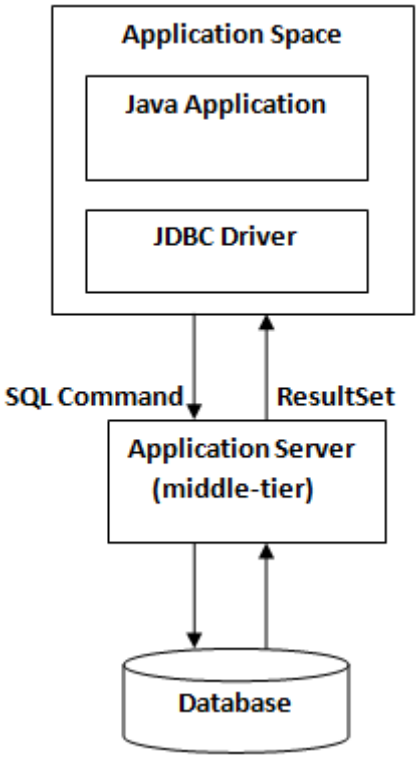


Figure 2 : The three-tier Database Access Model.

4.3 JDBC API

In this section, you will learn about the JDBC API. The JDBC provides a set of classes and interfaces that can be used to write database applications. The JDBC API (Application Programming Interface) is implemented by JDBC drivers. A JDBC driver is a software component that enables a Java application to interact with a database. The JDBC core API is found in the java.sql package and additional optional extensions for JDBC are found in javax.sql package such as connection pooling, rowsets and distributed transactions. The most important members of JDBC API are as follows:

- DriverManager class
- Connection interface
- Statement interface
- Prepared and Callable Statement Interface
- ResultSet interface

The DriverManager Class

The task of DriverManager class is to maintain a list of JDBC drivers. This list contains information about the object reference of drivers and subprotocols that it supports. When a program requests a database connection with getConection() method call, the DriverManager goes through the list and match a suitable driver. Each JDBC driver must be registered with the DriverManager. The JDBC drivers are provided by the database vendor or third party. You can use different JDBC drivers for different database servers.

The most important method of DriverManager class is getConnection() that returns a java.sql.Connection object. The signatures of this method are as follows:

```
public static Connection getConnection(String url)
public static Connection getConnection(String url, Properties info)
public static Connection getConnection(String url, String user, String password)
```

You can write connection string like the following way:

Connection con = DriverManager.getConnection(dbURL);

The dbURL is specified in the following manner:

protocol:subprotocol:other parameter

For example:

jdbc:microsoft:sqlserver://127.0.0.1:1433;user=dbusername; password=dbpwdname; DatabaseName=dbname;

The protocol should be jdbc. The subprotocol represents database type. This may be Microsoft SQL Server, Oracle, MySql, jdbdc:odbc and so forth. In the above case, it is Microsoft SQL Server. In other parameter category, IP address of the system, port number such as 1433 for Microsoft SQL Server and name, password, username of the database. The above definition is depends on the type of JDBC driver and database vendor.

The Connection Interface

This interface declares the methods that can be used to create a connection for particular database. An instance of the connection interface is obtained from getConnection() method of

the DriverManager class. After creating the connection with database, you can execute SQL statements for that particular connection and retrieve the results.

Some of the methods are listed below:

createStatement() method

The createStatement() method is used to create a statement object for sending SQL statements to the database. If you are using the same SQL statement in your application many times, it is more efficient and suitable to use a PreparedStatement object. Its signature of createStatment() method is as follows:

```
public Statement createStaement() throws SQLException
```

prepareStatement() method

This method is used to create a PreparedStatement object. Its signature is as follows:

```
public PreparedStatement prepareStatement() throws SQLExecption
```

close() method

The close() method is used to immediately close and release a Connection object. Its signature is as follows:

```
public void close() throws SQLException
```

The Statement Interface

The statement interface provides methods for executing SQL statements and obtains the results that are produced. The following is the two important method of Statement interface i.e. executeQuery() and executeUpdate(). Both are used for execution of SQL queries. The signature for both methods is as follows:

```
public int executeUpdate(String sql) throws SQLException
public ResultSet executeQuery(String sql) throws SQLException
```

executeUpdate() method

The executeUpdate() method is used to executes an insert, delete, update SQL statements and also DDL statements to create, drop and alter tables. It returns the row count for insert, update, delete statement and returns zero(0) for SQL statement that return nothing.

executeQuery() method

The executeQuery() method is used to executes an SQL select statement that returns a single ResultSet object which contains data.

execute() method

execute() method is used to execute stored procedure.

Prepared and Callable Statement Interface

Prepared Statement Interface
When you are used same SQL statements over and over again changing only parameter values, it is best way to use prepared statement i.e. java.sql.PreparedStatement. The PreparedStatement differ from simple Statement in that it specified fill-in-blanks SQL template.

For example, "insert into tablename values (?, ?)"

There is a two unknown parameter in the form of question marks which are set at the run time by your application using setXXX() method such as setString(), setInt(). The PreparedStatement is a precompiled statement and has a query plan generated for it once. It is mainly used to speed up the process of insertion, deletion and updation especially when there is a bulk processing. When the program sends SQL queries to database engine, the query is parsed, compiled and optimized, the outcome of this process is called query plan.

For example:

PreparedStatement pstmt = con.prepareStatement("update product_table set productcode = ? where product_name like ?");

pstmt.setString(1, P001);
pstmt.setString(2, "Washing Machine");
ResultSet rs = pstmt.executeUpdate();

Here, ? represents a modifiable value in SQL statement. You can set the value of unknown parameter i.e. question mark with setXXX() method which specifies a parameter number and a value.

The Callable Statement Interface
A Callable statement is used for handling stored procedure. A stored procedure is one or more SQL statement stored as a one group in a compiled form inside a database engine. You can simply call the store procedure as you call a method call. It is an extension of PreparedStatement. The CallableStatement's object is obtained from Connection.prepareCall() method and set the parameter using setXXX() methods. The execute() method is used to execute stored procedure.

For example:

CallableStatement cs = con.prepareCall("{call myProcedure}");

ResultSet rs = cs.executeQuery();

The ResultSet Interface

The ResultSet interface represents an object that contains data in the form of row and column. The ResultSet object maintains record pointer that points to its current row of data. Initially, the cursor is positioned before the first row. By default, the record pointer of ResultSet object is forward only scrollable. You can traverse through the ResultSet using next() method only. The next() method returns false when the last record is reached and no more details can than be retrieved. The java.sql.ResultSet interface provides several methods for retrieving column

values with getXXX() method such as getString(), getInt() and getLong(). Some of the methods are defined in the section 4.6 of this unit.

Check Your Progress 1

1. Explain the term JDBC.

---

2. Why ODBC can not directly be used with Java programs?

---

3. What is the use of JDBC API?

---

4. Explain different types of statements in JDBC.

---

5. What are the different methods used in Statement interface?

---

6. What is stored procedure? How to call stored procedure using JDBC API?

---

7. How can you create JDBC Statement?

---

8. Write the names of important package used in JDBC.

---

9. Explain the importance of DriverManager class in JDBC.

---

10. Explain some methods of ResultSet object.

4.4 Types of JDBC Driver

In the previous section, you have learnt JDBC API. Now, you will learn different types of JDBC drivers. To connect with database, there is a need of JDBC driver that you use for different database servers. There are four types of JDBC driver in Java for data connectivity. These drivers are categorized from Type-1 to Type-4. In other words, you can say that the each database server such as Oracle, Microsoft SQL Server used these four types of drivers. These are as follows:

1. JDBC-ODBC Bridge, plus ODBC driver
2. Native API, Partly Java Driver
3. JDBC-net, Pure Java Driver
4. Native-Protocol, Pure Java Driver

Each of these types is described below:

Type 1: JDBC-ODBC Bridge, plus ODBC Driver

The first type of JDBC driver is the JDBC-ODBC Bridge. It is also called TYPE-1 driver. It is freely distributed with the JDK. This bridge driver works with Microsoft vendor such as Microsoft Access and Microsoft SQL Server. The driver translates JDBC method calls to ODBC function calls that are then passed to ODBC driver. The ODBC driver must be configured on the client machine for bridge to work. This type of driver is used for prototyping or when there is not any alternative option for JDBC driver. The JDBC-ODBC Bridge does not support multiple concurrent open statements per connection.

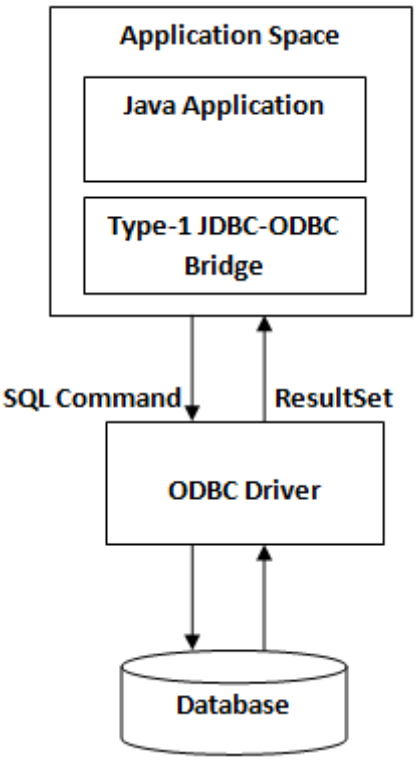


Figure 3: Type-1 JDBC-ODBC Bridge Driver

Type 2 : Native API, Partly Java Driver

The native-API driver, also known as Type-2 driver, converts JDBC commands into DBMS specific native calls. Like the Type-1 driver, this type of driver requires some binary code be loaded on each client machine that directly accesses the database.

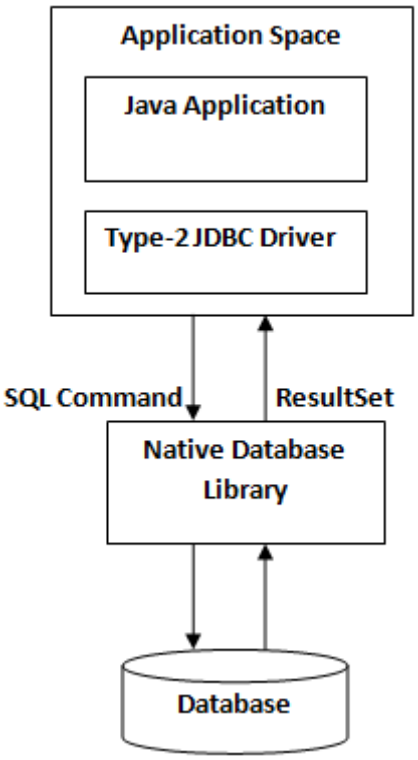


Figure 4: Type-2 Native-API Driver

Type 3 : JDBC-Net, Pure Java Driver

The JDBC Type-3 driver is a database driver which makes use of a middle-tier (application server) between the calling program and the database. It follows the three-tier communication

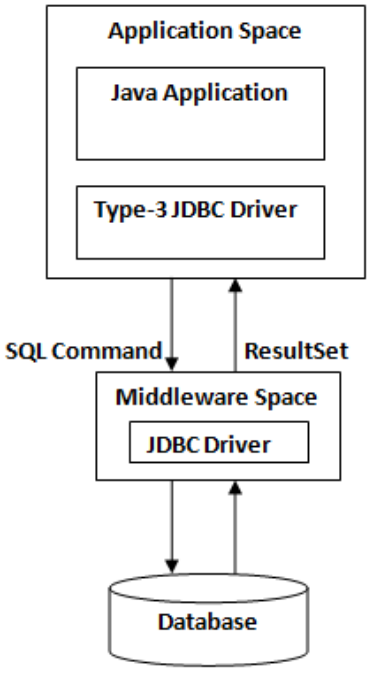


Figure 5: Type-3 JDBC-Net, Pure Java Driver

approach. This driver is ideal for Internet based applications. It translates JDBC calls on a client machine into RDBMS-independent network protocol (for example HTTP) and sends to a middle-tier server. The middle-tier server translates this RDBMS-independent network protocol into an RDBMS-specific protocol which is sent to a particular database. The results are routed through the middle-tier server and sent back to the client. This type of driver is more suitable for pure java client.

Type 4 : Native - Protocol, Pure Java Driver

The type-4 driver is also known as pure java driver. This driver's implementation is a two-tier approach because it communicates directly with a database. They do this by converting JDBC calls directly into a vendor specific database protocol. It is written completely in java and it is platform independent. This driver is install inside the JVM of the client. This type of driver has an advantage over all the other driver types because it has no additional translation or middle-tier server which improves performance of the JDBC driver. The following figure illustrates the working process of Type-4 driver:

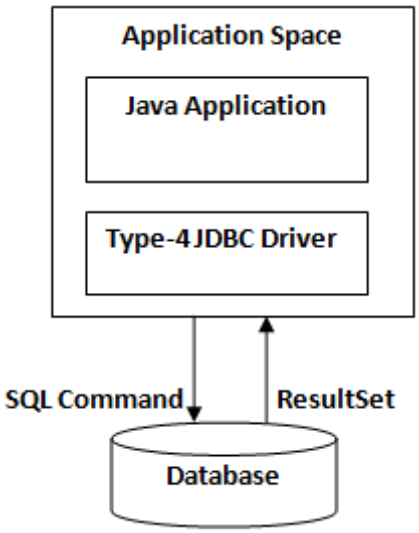


Figure 6: Type-4 Native-Protocol, Pure Java Driver

4.5 Connection steps using JDBC API

In this section, you will learn about access a database and manipulation of data. Before, you can access data from database; you need to connect to that database server. After you get the connection, you can communicate with database server using a SQL query. Once, the connection is established between client machine and database server, you can create, delete and update a table, invoke a stored procedure and you can do many more SQL query against the database.

To use JDBC, you must perform the following steps:

1. Load a JDBC database driver
2. Create a connection

3. Create a JDBC statement
4. Process the results
5. Close the connection to the database

Each of these steps will be discussed with smaller code fragment in the following sections:

Step 1 : Load a JDBC database driver

The first step is to load an appropriate JDBC driver. JDBC driver are available for most of the popular database today such as Microsoft SQL Server, Oracle and MySQL. Each database servers have their own language or syntax for communication in the form of JDBC driver. For this reason, each database server has their own jdbc driver. If you want to connect with a particular database server, you need to get the JDBC driver for that database.

As you have studied earlier, each database servers have four types of JDBC driver. Now, you can choose any one driver from the four database drivers. The JDBC-ODBC driver is more popular among the users. If you are using any other type of driver, it should be installed on your system. The JDBC driver comes in the form of jar file. If you are using Tomcat or other web server, simply copy the jar file into WEB-INF/lib directory under your web application directory and define its pathname in your classpath.

For example, In Microsoft SQL server database, there are three jar files i.e. msutil.jar, msbase.jar and mssqlserver.jar used for database handling. Like the following, if you are using type-4 driver of Microsoft SQL Server database, path should be defined under the classpath environment variable.

```
C:\Program Files\Apache Software Foundation\Tomcat 6.0\lib\msutil.jar;
C:\Program Files\Apache Software Foundation\Tomcat 6.0\lib\msbase.jar;
C:\Program Files\Apache Software Foundation\Tomcat 6.0\lib\mssqlserver.jar;
```

To load the driver, you can use the following syntax:

```
Class.forName(drivername);
```

The forName() method of the class Class is used to load the named class.

```
//load the JDBC-ODBC bridge driver
Class.forName("sun.jdbc.odbc.JdbcOdbcDriver");

//load the SQL Server Type-4 driver
Class.forName("com.microsoft.jdbc.sqlserver.SQLServerDriver");
```

Step 2 : Create a connection

When a JDBC driver is loaded onto memory, it is registered with java.sql.DriverManager class. The DriverManager class maintains a list of instances of JDBC drivers available to a given JVM at runtime. After you register a JDBC driver with DriverManager, you can use getConnection() method of this class to obtain Connection object. In JDBC, Connection is represented by java.sql.Connection interface.

The syntax is looks like the following:

```
Connection con = DriverManager.getConnection(dbURL);
```

Here are several examples for connecting to various databases:

```
//Example1: get the connection using JDBC-ODBC bridge driver
Connection con = DriverManager.getConnection("jdbc:odbc:DSN", "user", "pwd");

// Example 2: get the connection using SQL Server Type-4 driver
Connection con =
DriverManager.getConnection("jdbc:microsoft:sqlserver://127.0.0.1:1433;
user=dbusername; password=dbpwdname; DatabaseName=dbname");
```

In the example 1, the DSN stands for data source name, is the name which you gave in control panel->Administrative Tools ->ODBC while registering a database or table.

In example 2, 127.0.0.1 is an IP address, you can give IP address of your system and 1433 is port number for SQL server database.

Step 3: Create a JDBC statement

Now that a connection is established with a database, it's the time to interact with it by invoking the operation using SQL query on data contained within the database. A statement is used to send the SQL query to Database Management System. You can create a statement and execute the query. The Statement object is defined in java.sql.Statement interface. The Statement object is not instantiated directly rather it takes an instance of active connection object 'con' which is created in the earlier step. The code looks like:

```
Statement stmt = con.createStatement();
```

You can also use PreparedStatement or CallableStatement according to your requirement.

Step 4: Process the Result

In order to execute query, you have to obtain a ResultSet object and call the executeQuery() method to execute the query. You have to pass SQL query as an parameter to the executeQuery() method. The code fragment is as follows:

```
ResultSet  rs = stmt.executeQuery("select  *  from tablename");
```

A ResultSet is a collection of rows and columns corresponding to the results of the query. A row is a record which consists of one or more columns and column indicates fieldnames. The next() method is used to obtain the row of data of ResultSet. To obtain the values of each column, you can use getxxx() method where xxx refers to specific java datatype such as int, float, string and more. These methods like getString() (to retrieve String fields), getInt() (to retrieve Integer fields) and getFloat() (to retrieve Float fields) are defined in the java.sql.ResultSet.

Like the following way, you can get all the data from the ResultSet.

```
while (rs.next())
 {

// get the type_id, which is an int
out.println("Type Id=" + rs.getInt("type_id"));
//get type_name which is a string
out.println("Type Name ="  + rs.getString("type_name"));

}
```

You can retrieve the values of columns by passing its column index or column name.

Step 5: Close the connection to the database

After successfully performing the above steps, you must close the Connection, Statement and Resultset object by calling the close() method on appropriate objects.

For example

```
rs.close();          // close Connection object
stmt.close();        // close Statement object
con.close();         // close connection object
```

Check Your Progress 2

1. How can you load the drivers?

---

2. How can you retrieve data from the ResultSet?

---

3. How can you make a connection using JDBC?

---

4. Which type of JDBC driver is the fastest one?

---

5. What are the main steps to make JDBC connection?

---

6. Assume that there is a table in MS-Access which contains field names such as Id, name, course and course_fee. Write a JSP program to display the records in mentioned table using JDBC type-1 driver.

---

7. What is ResultSet?

---

8. What is connection pooling? What is the advantage of connection pooling?

---
9. What is the latest version of JDBC and new features of it?

---
10. What is DSN?

4.6 Example Applications using JSP

This section will provide you in-depth knowledge of data access specifically insertion and retrieval of data to/from a database. Consider a table named as Student is created in MS SQL Server database with Roll No, Name and Programme. This table is used in both the following sections. This section defines example for storing/retrieving data into/from a Microsoft SQL Server using type-4 JDBC driver. You can run these programs on any web server such as Tomcat. For running these programs, you need a JDBC driver in .jar form and place them in lib directory under the your web application.

4.6.1 Using JDBC to Store data in Database

The example contains a JSP form for entering data and another program for data processing. In InputFrm.jsp program, there are three input fields such as roll no, student name and programme name. On the submission of this form, program named InsertData.jsp is called.

Source code for InputFrm.jsp :

```
<html><head><title>Using JDBC to store data in database</title>
</head><body>
 <form method="get" action="InsertData.jsp" >
<h4>Enter values in following fields</h4>
<table>
<tr><td>Roll No</td>
<td><input type="text" name="rno" value="" size=9> </td></tr>
<tr><td>Name </td>
<td><input type="text" name="sName" value="" size=15></td></tr>
<tr><td>Programme</td>
<td> <input type="text" name="prg" value="" size=15> </td></tr>
<tr><td colspan="2" align="center">
<input type="submit" value="Submit Data"></td></tr>
</table></form></body></html>
```

In the following source code, the first step to get the data from InputFrm.jsp program using request.Parameter() method. After connecting to database, an insert query is executed using executeUpdate() method. The program is written using try and catch clause of standard Java mechanism within JSP scriptlets.

Source code for InsertData.jsp :

```
<%@ page import="java.util.*" %>
<%@ page import="java.sql.*;" %>
<html>
<head><title>Insert data into database</title></head>
<body>
<h3>Using JDBC to Insert Data into Database</h3>
<table border=1>
<%
String rollNo = request.getParameter("rno");
String StuName = request.getParameter("sName");
String prgName = request.getParameter("prg");

Connection con = null;   //create connection object
Statement stmt = null;   // create statement object

// connection string using Type-4 Microsoft SQL Server driver
// you can also change the next line with your own environment
String url=
"jdbc:microsoft:sqlserver://127.0.0.1:1433;user=sa;password=bcs53;
  DatabaseName=SOCIS";

try{
// load JDBC type-4 SQL Server driver
 Class.forName("com.microsoft.jdbc.sqlserver.SQLServerDriver");
con = DriverManager.getConnection(url);

if (con != null)
{
        stmt = con.createStatement();

        //insert query
        String rsql ="insert into student
        values("+rollNo+",'"+StuName+"','"+prgName+"'"+")";

        //execute query
        stmt.executeUpdate(rsql);
        out.println("Your data is successfully stored in database");
}
if(con == null)

   { con.close();  // release connection }

} // end of try clause

catch(SQLException se){ out.print("SQL:"+se.getMessage());}
catch(Exception e){ out.print("Exception:"+e.getMessage());}
 %>
```

The following screen is display after running the above programs:

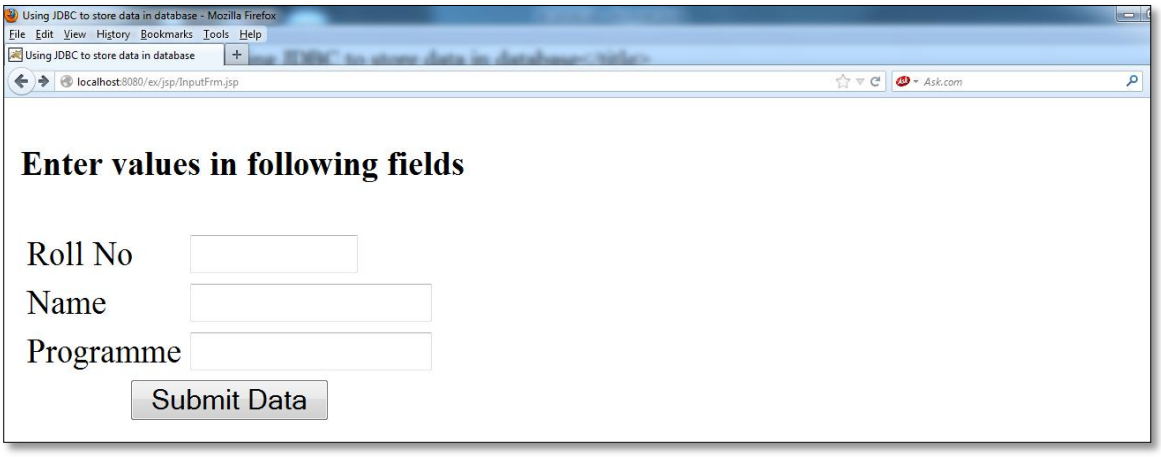


Figure 7: Input Form for storing data into database

In the above screen, when you will enter values then the following screen will show you a message for data storage.

Figure 8: Data stored in persistent storage

4.6.2 Using JDBC to Retrieve Data from Database

The following example gives you an illustration about how to query a database. After execution of the above program, you have stored sufficient data into database. Now, you will execute the following code for retrieving the data. In this program, one additional ResultSet object is used for retrieving data from select query. The data is retrieved from ResultSet object using getXXX() method such as getInt() and getString(). Note that if the column name is an integer type then you should use getInt() method instead getString() method.

```
<%@ page import="java.util.*" %>
<%@ page import="java.sql.*;" %>
<html>
<head><title>Retrieved data from database</title></head>
<body>
<h3>Using JDBC to Query a Database</h3>
<table border=1>
<%
Connection con = null;   //create connection object
Statement stmt = null;   // create statement object
ResultSet rs = null;       // create ResultSet object

// connection string using Type-4 Microsoft SQL Server driver
// you can change the next line with your own environment
String url= "jdbc:microsoft:sqlserver://127.0.0.1:1433;user=sa; password=bcs53;
                DatabaseName=SOCIS";
try{
// load sql server JDBC type-4 driver
 Class.forName("com.microsoft.jdbc.sqlserver.SQLServerDriver");

con = DriverManager.getConnection(url);

if (con != null) {
stmt = con.createStatement();

// select SQL statement
String rsql ="select * from Student";

//execute query
rs = stmt.executeQuery(rsql);
 %>
<tr><td>Roll Number</td><td>Student Name</td><td>Programme</td></tr>
<%
while( rs.next() ){
%><tr>
<td><%= rs.getInt("RollNo") %></td>
<td><%= rs.getString("Student_Name") %></td>
<td><%= rs.getString("Programme") %></td>
</tr>
<%      }}
if(con == null) {con.close();}
}
catch(SQLException se){ out.print("SQL:"+se.getMessage());}
catch(Exception e){ out.print("Exception:"+e.getMessage());}
 %>
```

After running the above program, following output screen is displayed.

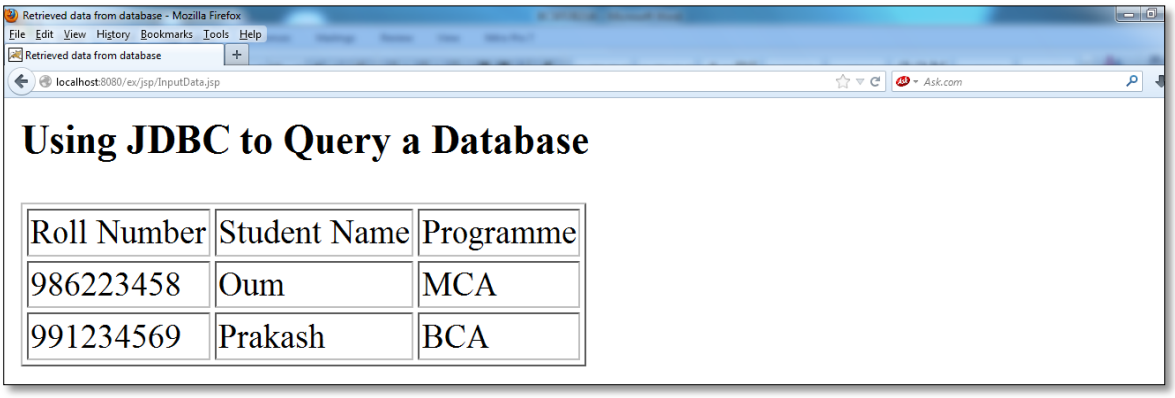


Figure 9: Display data from database

The majority of real projects are build using Oracle database as back end. For this, you can change only port no and Oracle JDBC driver name in above code. You can also refer sample JDBC Code for Connectivity with ORACLE in following link:

http://www.csc.ncsu.edu/faculty/mpsingh/local/programming/sample-JDBC-code.html.

4.7 Application Development and Deployment

Let us take an example to understand how to develop and deploy a database application using NetBeans. The detailed description of installation and creating a project in NetBeans IDE are described in lab session block BCSL057 of this course.

In Unit 3 of this block, you have seen a static session program in which user name and password is statically compared and shows the result. Now, this section gives you an illustration using the same program using database values. Let us take a tour of this program; a login page contains two input fields named user name and password. When you want to submit form without entering data values in input form fields, the program called a validate() function to display an error message otherwise it goes for normal processing On the submission of the form, a actionPage.jsp program is called which retrieved data from login page using request.getParameter() method and compared with the data stored in database. If the data is valid and found in database then set the session using session.setAttribute() method and control transfer to the nextPage.jsp program to display welcome message for user otherwise it display a error message for invalid user.

The two files are included in login page namely top.jsp and bottom.jsp using include directive and the default file is index.html which include a hyperlink as ‘Student Login’. The code for index.html, top.jsp and bottom.jsp are same as the lab session block (BCSL057) program. This example is connected with MS Access database using Type-1 JDBC driver. For creating system DSN(data source name), you go through the Control Panel\All Control Panel Items\Administrative Tools\ODBC\system DSN and follow some steps and create DSN name for your application.

Source code for LoginPage.jsp:

```
<%@page contentType="text/html" pageEncoding="UTF-8"%>
<%@include file= "top.jsp"%>
<!DOCTYPE html>
<html> <head>

<script type="text/javascript">
function validate()
{
uid=document.form1.uid.value;
pwd=document.form1.pwd.value;

if(uid=="" || uid==null)
{
alert("Please Enter Your User ID");
document.form1.uid.focus();
return false;
}
if(pwd=="" || pwd==null)
{
alert("Please Enter Your Password");
document.form1.pwd.focus();
return false;
}
return true;
}
</script>
<title>Login Page in JSP</title>
</head>
<body onload="document.form1.uid.focus()">
<h3>LOGIN PAGE IN JSP</h3>
<form  name="form1" method="post" action="actionPage.jsp"
onsubmit="return validate()">

<table><tr><td><b>User ID</b></td>
<td><input name="uid" type="text"/></td></tr>
<tr><td><b>Password</b></td>
<td><input name="pwd" type="password"/></td></tr>
<tr><td><input type="submit" value="Submit" /> </td>
<td><input type="reset" value="Reset" /></td></tr>
</table> </form><%@include file= "bottom.jsp"%>
</body></html>
```

Source code for actionPage.jsp :

```
<%@page contentType="text/html" pageEncoding="UTF-8"%>
<%@ page import="java.sql.*;" %>
<!DOCTYPE html>
<html> <head>
  <meta http-equiv="Content-Type" content="text/html; charset=UTF-8">
      <title>JSP Login Action Page</title>
   </head><body>

<%
String cid=request.getParameter("uid");
String pass=request.getParameter("pwd");

      Connection con = null;  // create connection object
      Statement stmt = null;    // create statement object
      ResultSet rs = null;        // create ResultSet object

// load JDBC-ODBC bridge Type-1
 Class.forName("sun.jdbc.odbc.JdbcOdbcDriver");

String db = "jdbc:odbc:db1";  //db1 is DSN
 con = DriverManager.getConnection (db, "","");
stmt=con.createStatement();

rs=stmt.executeQuery("select * from Login where userID="'+cid+'" and
Password="'+pass+'" ");
if(rs.next())
{
session.setAttribute("scid",cid);
con.close();
response.sendRedirect("nextPage.jsp");
}
else
{
%>
<h1>Invalid UserID or Password</h1>
<jsp:include page="LoginPage.jsp" />
<%
}
%></body></html>
```

Source code for nextPage.jsp:

```
<%@page contentType="text/html" pageEncoding="UTF-8"%>
<!DOCTYPE html>
<%@ page import="java.sql.*" %>
<%@include file= "top.jsp"%>
<%! String scid=""; %>
<head><meta http-equiv="Content-Type" content="text/html; charset=utf-8"/>
<title>Login Page</title>
</head><body>
<%
scid=(String)session.getAttribute("scid");
%>
<div id="welcome">
<h2><span>Welcome User:::<strong><font color='Blue'>
<%= scid %></font></strong></span></h2></div>
<%@include file= "bottom.jsp"%> </body></html>
```

When you will run the index page from Netbeans IDE then the following output screen will display:

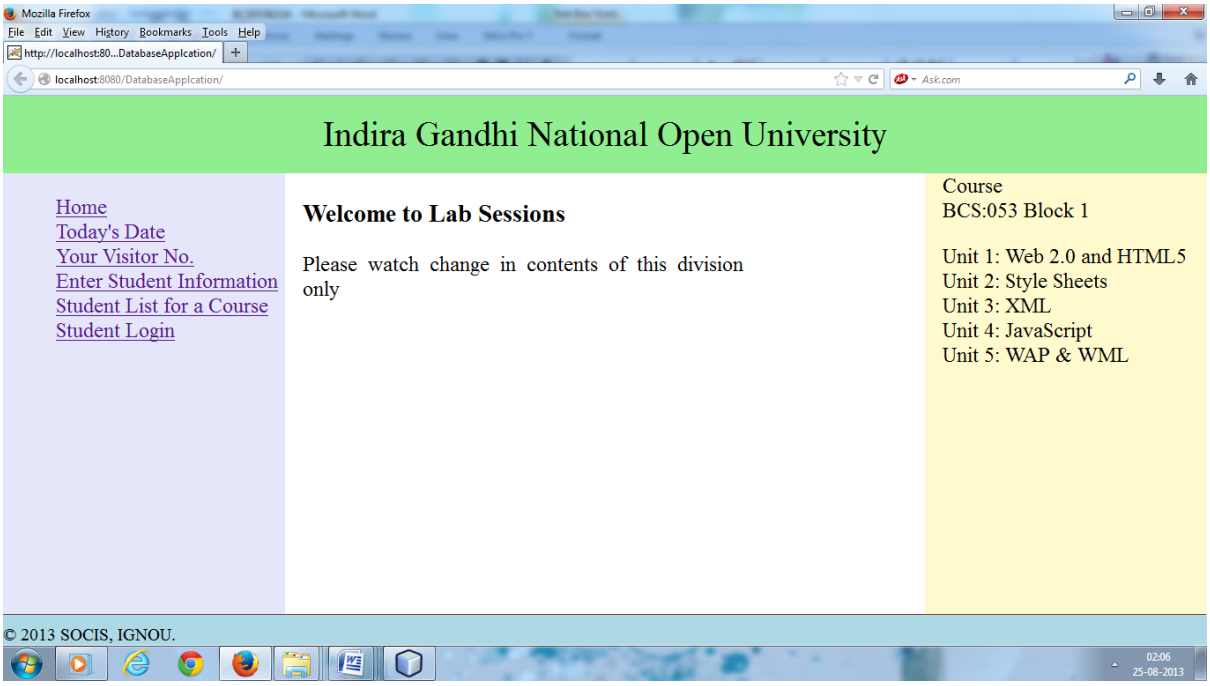


Figure 10: Display an Index page

When you will click on student Login hyperlink, the login page is display in the browser.

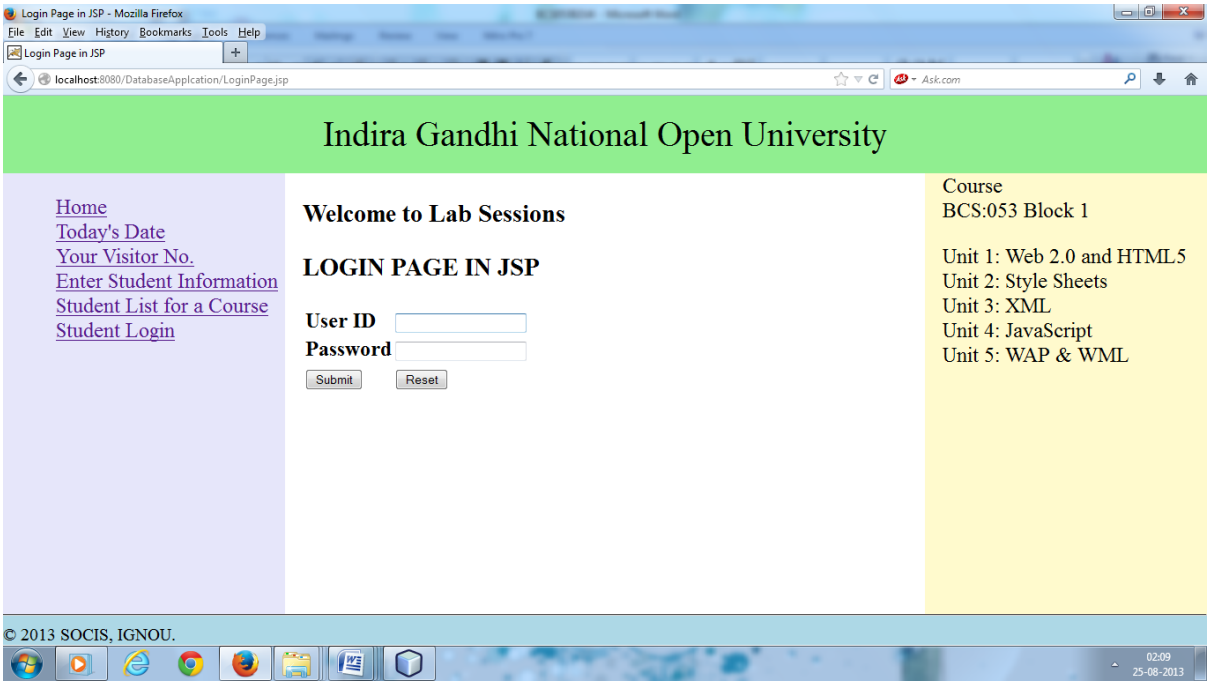


Figure 11: Display a Login page

When you submit a blank form field, it shows an error message. Looks like the following screen:

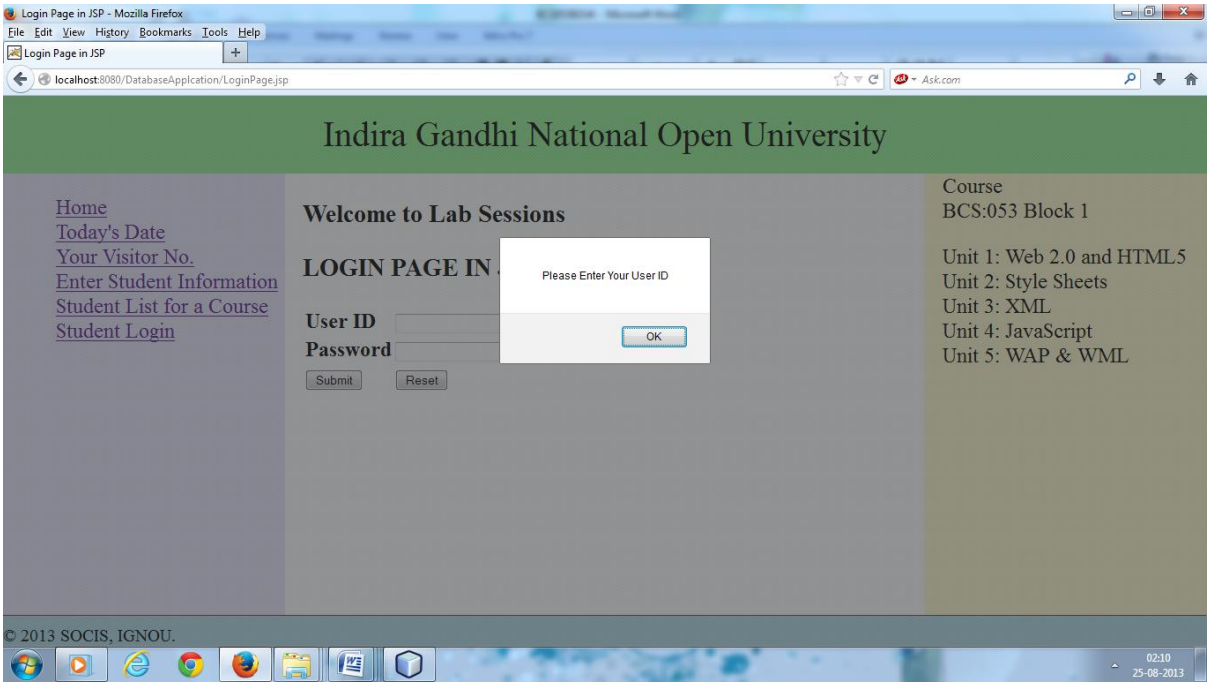


Figure 12: Display an error message

After successfully validated user, it shows welcome message for user and comes with the following screen:

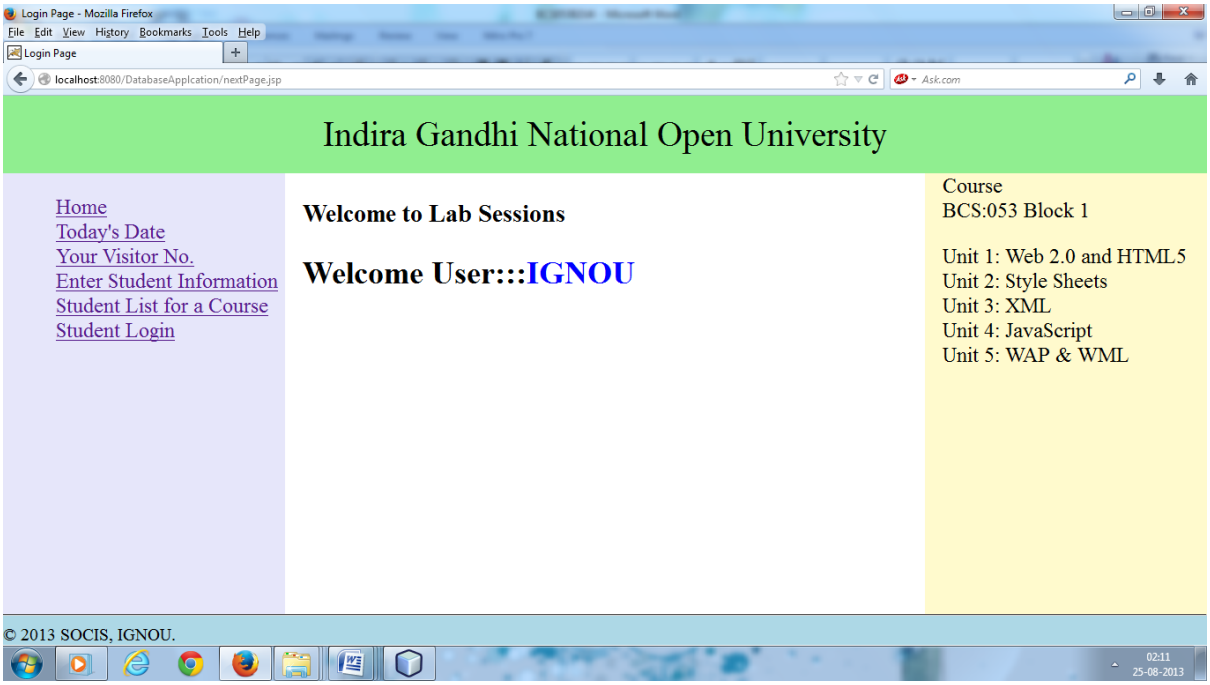


Figure 13: Display welcome message for valid user

Now, you are able to create a web application with database connectivity. Here's some introductory information related to JSP Standard Tag Library (JSTL) SQL tags which are used for data access.

JSTL SQL tag library

JSTL SQL tag library provides various tags to access the database. To use these tags in JSP, you should have used the following taglib:

<%@ taglib uri="http://java.sun.com/jsp/jstl/sql" prefix="sql" %>

There are two important JSTL SQL tag such as <sql:setDataSource> and <sql:query> which are described below:

JSTL <sql:setDataSource> tag

This tag is used for creating a DataSource configuration that may be stored into a variable which can be used as an input to another JSTL database-action. You can use this tag like the following:

```
<sql:setDataSource  var="student" driver="com.mysql.jdbc.Driver"
          url="jdbc:mysql://localhost/student"   user="netbean"
password="netbean7"/>
```

The <sql:setDataSource> tag has following attributes:

- **var :** This attribute is optional. It specifies the name of the variable which stores a value of the specified data source.
- **dataSource :** This attribute is optional that specifies the data source.
- **driver:** This optional attribute defines the JDBC driver class name.

- **url :** This optional attribute specifies the JDBC URL associated with the database.
- **user :** This is an optional attribute that specifies the JDBC database user.
- **password** : This optional attribute specifies the JDBC user password.

JSTL <sql:query> tag

This tag is used for executing the SQL query written into its body or through the sql attribute. For example:

```
<sql:query dataSource="${student}" var="ProgData">
  SELECT ProgCode, Prname from programme;
</sql:query>
```

The <sql:query> tag has following attributes:

- **var:** This is a required attribute that specifies the name of the variable to stores a value of the query result.
- **scope:** This optional attribute specifies the scope of a variable to display a result from the database. By default, it is page.
- **sql**: This attribute specifies the statement of SQL query to execute.
- **dataSource:** This is an optional attribute specifies the data source.
- **startRow:** This optional attribute that includes the specified starting index.
- **maxRows:** This optional attribute specifies the maximum number of rows.

You will find examples of the JSTL SQL tag in the lab session block (BCSL057).

4.8 Summary

Database access is one of the important features of Web application. Java has its own technology for database connectivity is called JDBC. JDBC provides a standard library for accessing wide range of relational databases like MS-Access, Oracle and Microsoft SQL Server. Using JDBC API, you can access a wide variety of different SQL databases. The core functionality of JDBC is found in java.sql package. In this unit, you have seen many members of this package and learned how to use them. This unit has also introduced to you about the different types of drivers.

To connect a database, you should follow certain steps. The first step is to load an appropriate driver from the type-1 driver to type-4 driver for specific database. The second step is to create a connection to the database using getConnection() method of DriverManager class. Third step is to create a JDBC statement by using createStatement() method of connection object. You can also use PreparedStatement and CallableStatement in place of simple JDBC Statement but all three have different role in JDBC. Statement interface provides different method used to execute query i.e executeUpdate() and executeQuery(). When a SQL query is used many times then PreparedStatement is used whereas CallableStatement is used to execute stored procedure. After creation of statement, the next step is to process result and store result in ResultSet object. To navigate the ResultSet object, you can use next() method and getxxx() method to retrieve fields values. Last step is to close all the connection, statement and ResultSet object. This is the way to query or modify a database records.

A couple of examples have been created in this unit that illustrate various database operations like storage and retrieval of records to/from database. Now, you have much more knowledge about the different JDBC drivers and database servers. This unit defines the examples for database application using Type-1 JDBC driver for MS Access database and Type-4 driver for MS SQL Server database. In the lab session block of this course, you will also get example using MySql database.

4.9 Solutions/Answers

Check Your Progress 1

Ans1.
JDBC is java database connectivity as name implies it's a JDBC API for communicating to relational database, API has java classes and interfaces using that you can easily interact with database. For this you need database specific JDBC drivers.

Ans2.

Open Database Connectivity (ODBC) cannot be used directly with java programs due to the following reasons:

- ODBC uses a C interface. This will have drawbacks in the security and robustness.
- ODBC makes of Pointers which has been not used in Java.
- ODBC driver creates a complex connecting procedure.

Ans3.
The JDBC API defines the Java interfaces and classes. It is used to connect to the database and send SQL queries. A JDBC driver implements these classes and interfaces for a specific database vendor.

Ans4.

There are three types of statements in JDBC API i.e. Statement, PreparedStatement and CallableStatement.

The Statement object is used to send SQL query to database and get result from database, and get statement object from connection object.

Statement: It is used for getting data from database useful when you are using static SQL statement at runtime. It will not accept any parameter.

```
Statement   stmt = con.createStatement( );
ResultSet rs = stmt.executeQuery();
```

PreparedStatement: when you want to use same SQL statement many times using different parameter then it is useful and it will accept parameter at runtime. It is precompiled statement.

```
String sql = "update course_table  set fee = ? where courseCode = ?";
PreparedStatement  pstmt = con.prepareStatement(sql);
pstmt.setInt(1, 5000);
```

pstmt.setString(2, “BCS053”);
ResultSet rs = pstmt.executeQuery();

CallableStatement: When you want to access stored procedures then CallableStatement is useful and they also accept runtime parameter. It is called like the following way:

CallableStatement cs = con.prepareCall("{call store_procedure_name}");
ResultSet rs = cs.executeQuery();

Ans5.
Stored procedure is a group of SQL statements that written inside the database engine. Stored Procedures are used to encapsulate a set of operations or queries to execute on database. Stored procedures can be compiled and executed with different parameters and results and may have any combination of input/output parameters. Stored procedures can be called using CallableStatement class in JDBC API. Below code snippet shows how this can be achieved.

CallableStatement cs = con.prepareCall("{call store_prodecure_name}");
ResultSet rs = cs.executeQuery();

Ans6.
The Statement interface provides different methods for execution of the SQL statements. These are as follows:

- executeUpdate() - This method is used to executes an insert, delete, update SQL statements and also DDL statements to create, drop and alter tables. It returns the row count for insert, update, delete statement and returns zero(0) for SQL statement that return nothing.
- executeQuery() - The executeQuery() method is used to executes an SQL select statement that returns a single ResultSet object which contains data.
- execute() - The execute() method is used to execute stored procedure.

Ans7.
You use the statement interface method to execute SQL queries and obtain results. You can create a statement object and then execute query. The statement interface provides some methods for executing SQL statements. For manipulation of data, executeUpdate() method is used and executeQuery() method is used for retrieval of data from persistent storage. You can send these queries using createStatement() method of Connection interface.

Statement stmt = con.createStatement();

Ans 8.
The most important package used in JDBC is java.sql package. The JDBC core API is found in the java.sql package and additional optional extensions for JDBC are found in javax.sql package such as connection pooling, rowsets and distributed transactions.

Ans 9.
The DriverManager class provides static methods for managing JDBC drivers. The most important method of this class is getConnection() that return java.sql.Connection object. The DriverManager class maintains a list of JDBC drivers. This list contains information about the object reference of drivers and subprotocols that it supports.

Ans 10.
The ResultSet interface provides some methods which are used for movement of record pointer such as isFirst(), isLast(), next() and obtain the values of each column with getXXX() method where xxx refers to specific java datatype such as int, float, String.

Check your Progress 2

Ans 1.
For loading a JDBC driver, you can use Class.forName() method. If you want to use JDBC-ODBC bridge driver, the following code will load it.

Class.forName("sin.jdbc.odbc.JdbcOdbcDriver");

Ans2.
JDBC provides ResultSet interface that contains rows you retrieved from database, so you need an instance of ResultSet to hold the results. To create ResultSet object, you use the following code fragment:

ResultSet rs = stmt.executeQuery("select emp_name, salary from emp_table");
String s = rs.getString("emp_name");

Ans3.
For establishing a connection, you need to have appropriate JDBC driver. If you use type-1 JDBC driver then create a data source name (DSN) using ODBC and use the DSN name in connection string. Like the following way, you can create a connection

Connection con = DriverManager.getConnection(jdbc:odbc:datasourcename);

Ans4.
Type-4 JDBC Native Protocol Pure Java driver is the fastest driver among the drivers because it converts the JDBC calls to vendor specific commands and directly interacts with database. It follows the two-tier database access model.

Ans5.
The main steps used to connect to database are as follows:

- **Load the Driver:** First step is to load the database specific driver which communicates with database using Class.forName() method.
- **Create Connection:** Next step is to create a connection with database using getConnection() method of Connection interface.
- **Get Statement object:** Using createStatement() method of Connection interface, you can get statement object which is used to send SQL statement to the database.
- **Process the result:** Using statement object, you execute the SQL or database query and get result set from the query.
- **Close the connection:** After getting ResultSet and all required operation performed the last step should be closing the database connection.

Ans 6.

The source code is as follows:

```
<%@ page import="java.util.*" %>
<%@ page import="java.sql.*;" %>
<html>
<head><title>Retrieved data from database</title></head>
<body>
<h3>Using JDBC to Query a Database</h3>
<table border=1>
<%
Connection con = null;  //create connection object
Statement stmt = null;   // create statement object
ResultSet rs = null;       // create resultset object

// connection string using Type-1 Microsoft Access driver

try{
// load sql server JDBC type-1 driver
 Class.forName("sun.jdbc.odbc.JdbcOdbcDriver");

String db = "jdbc:odbc:db1";
  con = DriverManager.getConnection (db, "","");

if (con != null) {stmt = con.createStatement();
String rsql ="select * from Student";
rs = stmt.executeQuery(rsql);
%>
<tr><td>ID</td><td>Student Name</td><td>Course</td><td>Course
fee</td></tr>
<%
while( rs.next() ){
%><tr>
<td><%= rs.getInt("ID") %></td>
<td><%= rs.getString("studentname") %></td>
<td><%= rs.getString("Course") %></td>
<td><%= rs.getString("CourseFee") %></td>
</tr>
<%
}}
if(con == null) {con.close();}
}
catch(SQLException se){ out.print("SQL:"+se.getMessage());}
catch(Exception e){ out.print("Exception:"+e.getMessage());}
 %>
```

Ans 7.

ResultSet object is used to store result after executing a SQL statement in the form of rows and columns. To navigate the rows of the ResultSet, the next() method is used and obtain the values of each column with a getxxx() method where xxx refers to a specific Java datatype such as Int, Float and String.

Ans 8.
The connection pooling is a technique to reuse the created connection. Connection pooling is provided the faster execution of program to reuse the connection with out making new connection. This feature is found in javax.sql package. To use the connection pooling, you need to connect to the data source using javas.sql.DataSource interface. Using the connection pooling, you can manage number of connection with your application.

Ans 9.
The Latest version of JDBC is JDBC 4.1 and Features of JDBC 4.1 is same as JDBC 4.0. The main feature of JDBC 4.1 is to autoloading of JDBC drivers. In earlier versions of JDBC, applications had to manually register drivers before requesting Connections. With JDBC 4.0, applications no longer need to issue a Class.forName() on the driver name; instead, the DriverManager will find an appropriate JDBC driver when the application requests a Connection.

Ans 10.
Data Source Name is a name given to the database to identify it in the java program. The DSN name is linked with the actual location of database. It is used with JDBC-ODBC bridge type-1 driver to connect database.

4.10 Further Readings

- Professional JSP….. Brown-Burdick, Apress.
- Java for the web with JSP…Techmedia
- Pure Java 2 …Sams, Techmedia
- Java for the web with Servlets, JSP…Budi Kurniawan, Techmedia
- Pure JSP….Sams, Techmedia
- Java Database Programming, prateek Patel, Corollis
- list of drivers is available at : http://www.devx.com/tips/Tip/28818
- http://docs.oracle.com/javase/1.3/docs/guide/jdbc/getstart/GettingStartedTOC.fm.html