Dynamic Web Technology

- ## Common Gateway Interface (CGI)

In the early 90s, the National Center for Supercomputing Applications (NCSA) developed a specification for calling scripts on their servers from the URL. It was quickly adopted by other web servers. The technique is simple. The last portion of the URL is divided into two sections.

```
<script name>?<parameter-value list>
```

The script name and parameter value list are separated by a question mark, "?." And the parameter value list is a list of parameter name and value pairs separated by an ampersand, "&."

```
<parameter-value list> = <parameter 1 name>=<value 1>&<parameter 2 name>=<value 2>
```

An advantage of CGI is that all the information for generating the webpage is contained in the URL. So, the user can save the URL and reuse it just as any other link.

- ## Java Servlet

In 1997, Pavni Diwaji specified the Servlet while working at Sun Macro-systems. Servlets are a middle layer between a request from the browser and the database or applications on the server. Java Servlets is a Java alternative to CGI. It has several advantages over CGI:

- **Performance**: because it creates a thread for each request not a process. CGI opens a new process for each request which results in more memory consumption because proccesses get their own block of memory. Threads in a process share the memory.

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Opening a new process requires more overhead and is slower then opening a new thread

- **Portability**: because it uses java language.
- **Robust**: Servlets are managed by JVM so we don't need to worry about memory leak, garbage collection etc. But this does not always work.
- **Secure**: because it can uses the Java language and Java APIs.

Java Servlets require a web ***container*** to manage the Servlets. Apache Tomcat is an open-source Java web server developed by the Apache Software Foundation (ASF). Tomcat implements several Java EE specifications including Java Servlet, Java Server Pages (JSP), and more. Tomcat has many components. The most important competent for us is the ***Catalina*** component. Catalina is the servlet container, often called "container" for short. The container packages the request, decides which servlet to should process the request and passes the request to servlet.

Servlet have life cycle which include:

- init – initializes when the servlet is instantiated.
- service – processes client's requests
- destroy – runs when the servlet is terminated

Consequently has access to scope parameters

- Web context – life of the servlet

- Session – across multiple request from a client

- Request – a single request

- Page – The JSP page that creates the object

➢ **Backend Frameworks**

After the development of backend scripting languages for web servers, backend frameworks emerged. Some of the key components of the backend frameworks are

- Model-View-Controller design pattern
- Routing or URL Mapping.
- Database including Object Relation Mapping (ORM)
- Security
- Template System and addition tags
- Scaffolding

Model-View-Controller (MVC) design pattern has become the standard for web development, although one very popular web development tool, WordPress, is not MVC based. MVC is very effective at separating programming concerns.

Routing or URL Mapping using the MVC paradigm has also become standard with frameworks. Nearly all frameworks use controller-action URL mappings.

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A template system reduces the html code duplication. Also frameworks generally provide a few simple html tags to reduce the amount of backend coding a frontend developer has to learn. They also simplify or clean up the appearance of the html code in the view.

➢ JavaScript

JavaScript was written by the Netscape in the mid-1990s for their brand of web browsers. It does not have any relations to Java.

The original role of JavaScript was to enable frontend dynamics such as button shading to indicate clicking on a button or to animate portions of the webpage.

CGI and JavaScript combined with the html "form" tag formed the original bases for dynamic webpages. The CGI enabled interaction with backend scripts that could then interface with the database while JavaScript could enhance the frontend interaction with the human.

➢ AJAX (Asynchronous JavaScript + XML)

AJAX is combination of technologies used to generate portions of webpages asynchronously (in the background). The technologies are

- HTML and CSS for the presentation
- Document Object Model (DOM) for dynamic display of the data
- XML for data transfer from the server the client although now JSON is more common.

- XMLHttpRequest object for asynchronous communication with server.
- JavaScript to tie everything together.

➢ Document Object Mode (DOM)

Is a language and platform independent standard for representing objects in the HTML coded page. The browser internally models the all the elements of the web page as nodes in a tree. This is possible because HTML is inherently hierarchical. All the page is contained between the <html> … </html> tags, which represents the "root" node. The rest of the tags, <div> etc, are nested within each other designating parent-child relation and constructing a tree.

Important DOM objects and interfaces:

- Document – is the root element of the DOM. It contains all the content of the webpage including the body tag.
- Element – represents any object in the DOM, for example the document is an element. It is one of the fundamental types.
- Node – is another base type.
- NodeList – is an array of nodes.

There are also interfaces for additional object that are not really in the DOM:

- Window – is an object representing the browser window?
- Text – is the object representing the text in a node or an attribute?
- Event – events generated by the document elements.

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➤ JavaScript Object Notation (JSON)

JSON has replaced XML for most AJAX data exchanges for two primary reasons:

- It is smaller than XML because it has very little mark up.
- It is more human readable because it has less mark up.

There are only two basic structures or mark ups

- {…} – representing an object
- […] – representing an array

Objects may contain string-value pairs

```
{"string 1": value1, "string 2": value2}
```

Arrays are ordered and can contain values which are strings, numbers, objects or other arrays (also true, false, null).

```
[value1, value2]
Or
[value1, {"string 2": value2}]
Or
{"string 1": [value1, value2]}
```

➤ XMLHttpRequest

XMLHttpRequest is a JavaScript object that was designed by Microsoft and released in 1999. It was later adopted by Mozilla in 2001. It is the primitive mechanism in JavaScript for writing a request.

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Coding for the XMLHttpRequest requires only four steps

1. Create the XMLHttpRequest object
2. Attach the callback handler for the response
3. Open the request using the XMLHttpRequest open method
4. Send the request using the XMLHttpRequest send method

The three parameters for the open methods:

1. A string representing the request method
2. A string representing the URL, which can be an absolute path or a relative path
3. A boolean representing asynchronous for true.

Another important method is setRequestHeader, which specifies a name-value pair.

➢ HTML5

HTML5 is a series of proposed JavaScript API that attempt to make HTML modern. These APIs have not become standards yet many are implement in most web browsers.

➢ Frontend Frameworks

Frontend frameworks are collections of pre-written code and tools that help developers build the UI/UX of a website or web application. These frameworks provide a structured approach to web development, offering a set of reusable components, libraries, and utilities to streamline the process.

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There are only a few more technologies left for us to talk about. These frameworks make programming the frontend easier. There are basically three types of frontend frameworks.

- Styling or CSS frameworks although these typically have some JavaScripting
- JavaScipt libraries for manipulating the DOM and making AJAX calls
- JavaScript frameworks for data binding

React and **jQuery** are the top two most commonly used frontend frameworks

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