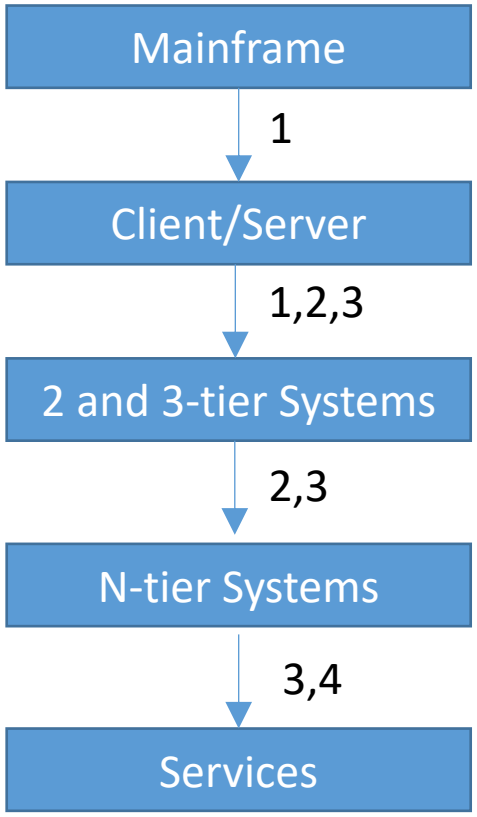
Chapter 2 Recap

- Main reasons for the evolution of distributed systems



Reasons

1. Hardware evolution
2. Finer work division (identify general functionalities)
3. Flexibility (hide heterogeneity)
4. Standardization

- Some old techniques/hardware die out: Mainframe, CORBA, etc.
- Some still in use (internally): Client/Server architecture, Synchronous, J2EE

IS 651: Distributed Systems
Chapter 3: Web Technologies

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Spring 2021

Learning Outcomes

- After learning chapter 3, you should be able to
  - Understand how web architecture works
  - Understand HTTP request and response, and the differences between HTTP GET and HTTP POST method
  - Understand and write simple HTML, CSS, JavaScript and PHP scripts

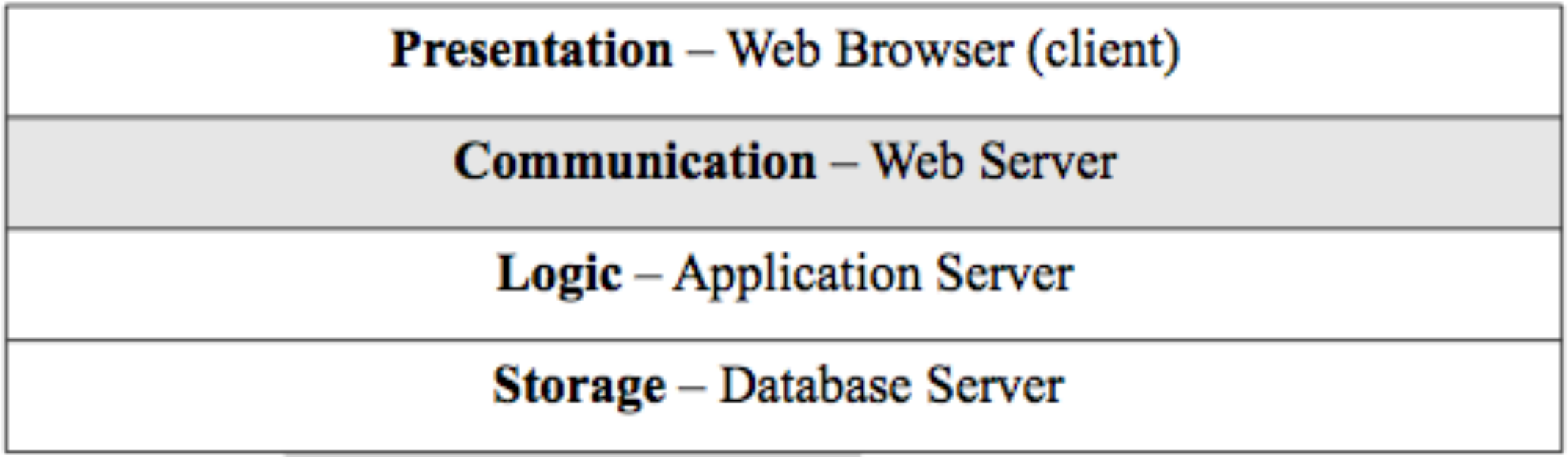
XML Encoding

- Default encoding: UTF-8, which support international characters
- Demo: http://userpages.umbc.edu/~jianwu/is651/programs/chp2/
- Right click and select “View Page Source” to check encoding and DTD

Web Technologies

- Web Architecture
- HTTP, Browsers, URLs
- Client-side Techniques
- Server-side Techniques
- Important web site for the chapter/course: http://www.w3schools.com/

Web Architecture

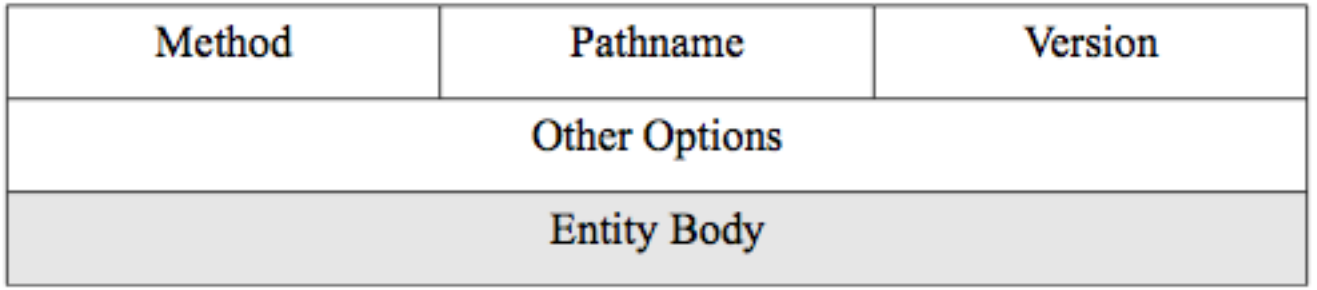


Browsers, URLs

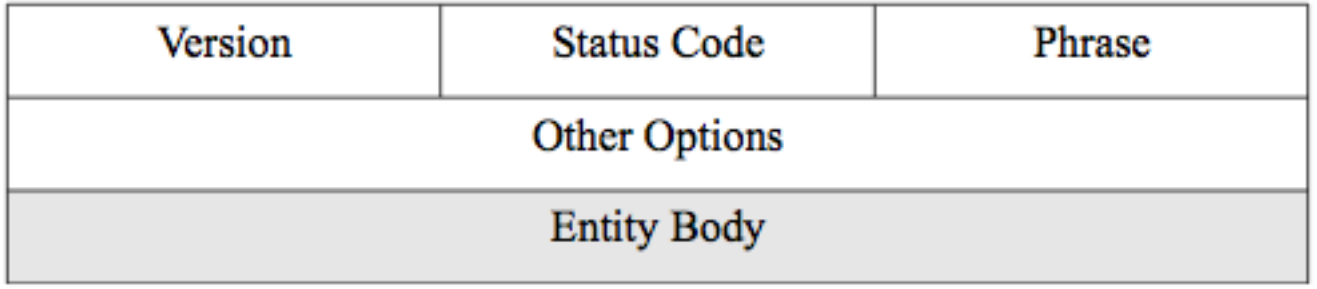
- URL Structure
  - *http://userpages.umbc.edu:80/~jianwu/is651/651.ref.f20.html#ch2*
    - protocol
    - host
    - port
    - path from web root
    - anchor

HTTP Request and Response

- HTTP Request
  - Method: GET, POST, etc.
  - Path: requested file under the web root directory
  - Entity body: data sent to server
- HTTP Response
  - Status code: standard code for the response
  - Phrase : an English version of the status code
  - Entity body: Data for web browser to display



HTTP Request



HTTP Response

HTTP Request and Response Demo

- Use Curl command to see request and response message
  - $> curl -v -k **https**://swe.umbc.edu/~jianwu/test.html
- Guess what will happen with
  - $> curl -v -k **http**://swe.umbc.edu/~jianwu/test.html

Client-side Techniques

- HTML
  - Fundamental markup language for web pages
  - Define the content of web pages
- Cascading style sheets (CSS)
  - Used to set the presentational properties (or layout) of an HTML page: colors, fonts, layout, alignments, borders, etc.
  - It has its own syntax
- JavaScript
  - Program the behavior of web pages
  - It is an object-oriented, dynamically typed scripting language that can be run by an interpreter inside the web browser and therefore included inside web page code

HTML

- DOCTYPE: defines the document type to be HTML
  - DOCTYPE is also used in XML
  - XHTML (Extensible HTML): define an HTML as an XML document, stricter than HTML, well-formed XML
  - PUBLIC refers a public, often standard, dtd url
- <html> : an HTML document
- <head>: information about the document. Javascripts and CSS are often defined here.
- <body>: the visible page content
- <h1>: the most important heading

```
<!DOCTYPE html PUBLIC "-//W3C//DTD XHTML
1.0 Strict//EN"
"http://www.w3.org/TR/xhtml1/DTD/xhtml1-
strict.dtd">
<html>
    <head>
    </head>
    <body>
        <h1>Hello World!</h1>
        <button type="button" onclick="">
            Set text color
        </button>
    </body>
</html>
```

Cascading Style Sheets (CSS)

- Syntax: selector {prop1:value1; prop2: value2; …}
- Selector: select HTML elements based on element name, id, class, attribute, etc.
- Styling can be added to HTML elements in 3 ways: inline, internal, external
- Cascading: a cascading order where the different types of stylesheets take priority and override a previous one
  - The four stylesheet types with increasing priority: browser default, external, internal, and inline

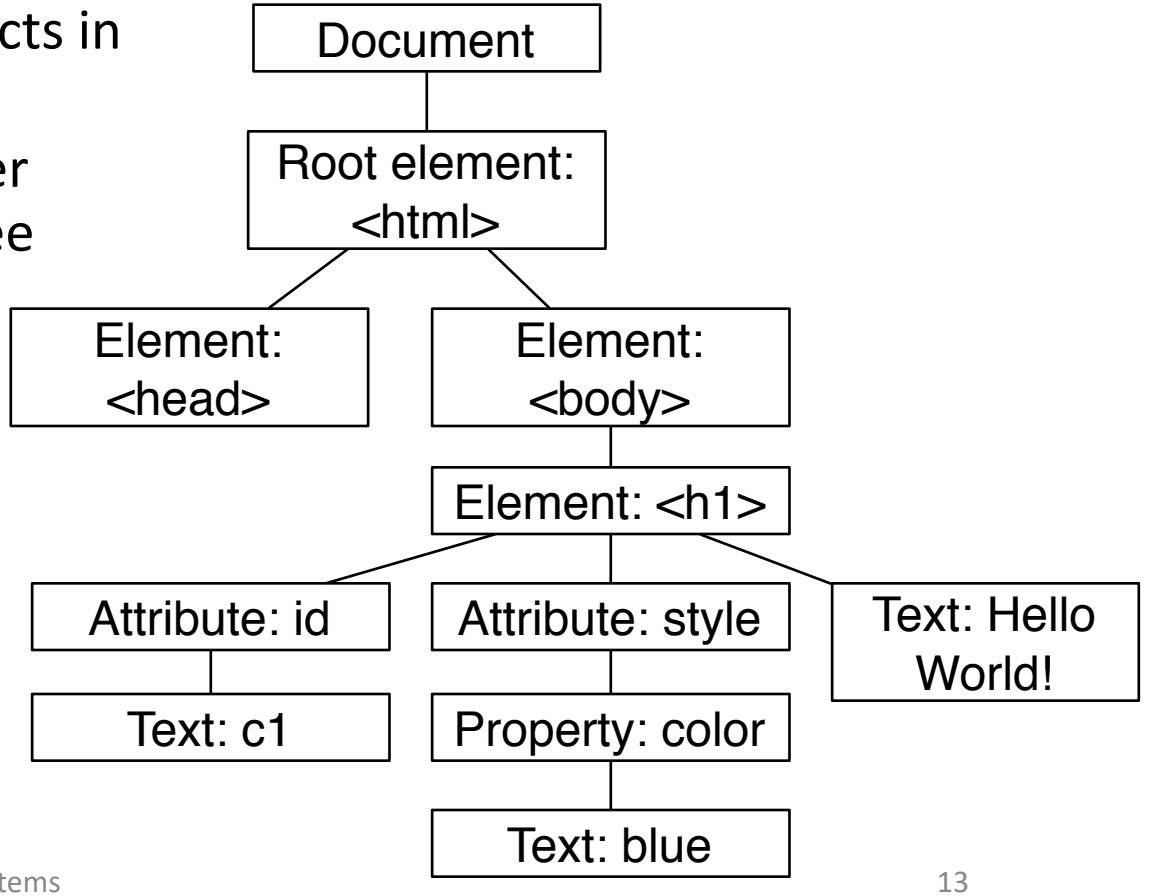
```
<html>
<head>
   <style type="text/css">
      h1 {color: red;}
   </style>
</head>
<body>
   <h1 id='c1' style='color: blue'>Hello
World!</h1>
   <button type="button" onclick="">
        Set text color
   </button>
   <h1>H1 heading</h1>
   <h2>H2 heading</h2>
</body>
</html>
```

Internal

Inline

Document Object Model

- Document Object Model (DOM)
  - A cross-platform and language-independent standard to represent and interact with objects in HTML, XHTML, and XML documents
  - When a web page is loaded, the web browser creates a DOM of the page organized in a tree structure, called the **DOM tree**
- HTML DOM includes
  - The HTML elements as **objects**
  - The **properties** of all HTML elements
  - The **methods** to access all HTML elements
  - The **events** for all HTML elements



JavaScript

- A program language to dynamically change a web page based on its DOM
  - Add, change, and remove HTML elements and attributes
  - Change CSS styles
  - React to existing events
  - Create new events
- Basic logic
  - Define event handler function
  - Associate an event with a function
- HTML DOM Events
  - Mouse event: onclick, oncontextmenu, …
  - Keyboard Events: onkeydown, onkeyup, …

```
<script type="text/javascript">
      function displayResult()
      {
         // the DOM object is captured from the
h1 element id.
         var x = document.getElementById('c1');
         // the x variable is now the DOM object
and is styled using the object method style with
the CSS property color and assignment to the
value 'red.'
         x.style.color = "red";
      }
   </script>
<button type="button" onclick="displayResult()">
       Set text color
</button>
```

function definition

DOM method

function event association

HTML JavaScript CSS Demo

- Demo link: http://userpages.umbc.edu/~jianwu/is651/programs/ch3/jsexample.html
  - Right click to see page source: 'View Page Source' on Chrome

- You can write your own on gl server or w3schools
  - http://www.w3schools.com/html/tryit.asp?filename=tryhtml_default

Asynchronous JavaScript and XML (AJAX)

- By default, JavaScript runs locally, manipulates the DOM without communicating with server.
- AJAX allows JavaScript to send asynchronous requests to a server, receive the response, and processes it without user interaction or a page reload
- AJAX uses
  - (Internally) XMLHttpRequest object (to retrieve data from a web server)
  - JavaScript/DOM (to display/use the data)
- Advantage: more efficient, no need to reload the entire page

jQuery

- jQuery is a cross-platform JavaScript library designed to simplify the client-side scripting of HTML.
- It supports
  - DOM manipulation
  - AJAX support
  - …
- Import jQuery
  - Direct download from http://jquery.com/download/
  - Include it from a CDN (Content Delivery Network), such as Google and Microsoft
- jQuery has its own syntax on how to select (query) HTML elements and manipulate them

AJAX and jQuery Demo

- Ajax demo: http://userpages.umbc.edu/~jianwu/is651/programs/ch3/ajax.html
- jQueryAjax demo: http://userpages.umbc.edu/~jianwu/is651/programs/ch3/jqueryAjax.html

Server-Side Techniques (for Dynamic Web Pages)

- Common gateway interface (CGI)
  - CGI is a standard for communications between a web server and any programming language that has a CGI library
  - One disadvantage is its poor performance. It forks a new **process** for each request, which is not scalable
- Web server application programming interfaces (APIs)
  - Plug-ins for web servers that allow the web server process to spin off new **threads** for each request rather than a process, which much more light-weight
  - The scripts can be embedded in html using special **template tags** such as <%...%>
  - Script languages include PHP, JSP, ASP, etc.
- Java Servlet API: a special type of server API
  - Allows a Java virtual machine to work as a plug-in to a web server
  - A servlet is a java class that receives a request, then prepares and sends a response
  - Normally work with Java Server Pages (JSP) together for dynamic web pages

PHP

- Originally stands for Personal Home Page, but it is now a recursive backronym: PHP: Hypertext Preprocessor.
- PHP scripts are embedded using <? ?>. They can be part of a html or not.
- PHP scripts (optionally) read some inputs from client request, generate output as html content
  - Read input: $_GET, $_POST
  - Generate output: echo/print
- You won't see php source code using "View Page Source" option
  - Local web browser only get html content generated by PHP script

PHP Demo: HTML Form

- Demo link:
  - http://userpages.umbc.edu/~jianwu/is651/programs/ch3/form.html
  - https://userpages.umbc.edu/~jianwu/is651/programs/ch3/formPost.html
- GET VS. POST
  - GET causes a querystring to be appended to the calling URL
  - POST puts the querystring in the HTTP entity body and not in the URL

form.html

```
<!--The form action calls the PHP program form.php as a relative url. -->
<form action="form.php" method="get">
<p>Choose a number between 1 and 6 for a random friend.</p>
<!-- The name attribute of the input tag will be used in the PHP. -->
Friend Number: <input type="text" name="friend" />
<p>Give your random friend a last name.</p>
Friend Last Name: <input type="text" name="lname" />
<input type="submit" />
</form>
```

PHP Demo: PHP Script

- form.php

```
Jim, Tom, Sue
Hege, Tim, Qu
```

Data File

```
<html>
<h2>My possible friends are:</h2> <!--static output-->
<?php //php program starts here
$f=$_GET['friend']; //read value for parameter 'friend' from link
$l=$_GET['lname']; //read value for parameter 'lname' from link
$file = fopen("contacts.csv","r")  //read data file
$array=array();
while(! feof($file)) //loop until the end of file
  {
  $a=(fgetcsv($file)); //read a line from csv file
  $array=array_merge($array, $a); //array merge
  }
//output every element of array with <br/>
foreach($array as $x) echo $x."<br/>";
//construct output string based on inputs
echo "<p> My random friend is <strong>".$array[$f-1].
" ".$l."</strong></p>";
fclose($file); //close file
?>
</html>
```