

Revision Lecture

VSP2017 Summer Course - Building Modern Web Applications

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L1: HTML and CSS



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- 1 L1: HTML and CSS
- 2 L2a: Basic Javascript
- 3 L2b: Objects and Functions
- 4 L3: DOM Manipulation
- 5 L4: Closures, Window Object and Events
- 6 L5: Prototypes and Reflection
- 7 L6: AJAX and JSON
- 8 L7: Node.js

HTML Page



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- Base of any web application
- Defines the *structure* and the *data*
- Hierarchical layout: DOM
- Should not containing styling information! $\Rightarrow$ better to link externally!
- Should not contain scripts! $\Rightarrow$ better to link externally!

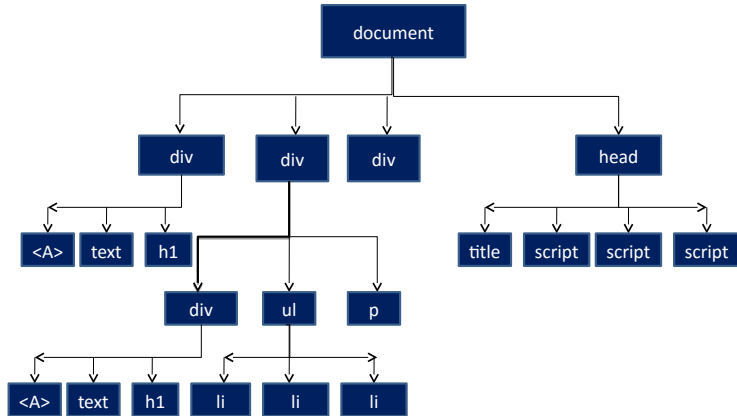
HTML - DOM Example



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```
<html>
<head>
  <title> .... </title>
  <script> .... </script>
  <script> ... </script>
  <script> ... </script>
</head>
<body>
  <div> <A> .... </A> <text> ... </text> <hl> ... </hl> </div>
  <div>
    <div> <A> .... </A> <text> ... </text> <hl> ... </hl> </div>
    <ul> <li>...</li> <li>...</li><li> ... </li> </ul>
    <p> ... </p>
  </div>
  <div> ... </div>
</body>
</html>
```

HTML - DOM Example - Tree



Some special tags



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- **head**: nodes not pertaining to the visual representation of the page (title, stylesheets, scripts, meta-information, etc.).
- **div**: logically regroup elements (i.e., for styling)
- **span**: logically regroup *inline* elements
- **script**: includes JS code (inline or through an external JS file)
- **style**: define CSS styling information (inline)
- **link**: include an external resource (usually to include an external CSS stylesheet)

CSS - Principles



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- Declarative language used to apply styles (mostly visual) to the DOM tree of the web page
- Made of a set of rules
 - Selector: query to match some of the nodes
 - Styling rule definitions: apply to matching nodes AND all their descendants

Common selectors:

- By ID (**#id**)
- By Class (**.class**)
- By Tag (**tag**)

Conflicting rules (i.e., same rule defined for the same node):

- Most specific selector (i.e., ID > Class > Tag)
- Most specific node (i.e., the node itself > parent > etc.)

CSS - Example

```

1 <!doctype html>
2 <html>
3   <head>
4     <meta charset="UTF-8">
5     <title>Sample document</title>
6     <link rel="stylesheet" href="style1.css">
7   </head>
8   <body>
9     <p id="first">
10       <strong class="carrot">C</strong>ascading
11       <strong class="spinach">S</strong>tyle
12       <strong class="spinach">S</strong>heets
13     </p>
14     <p id="second">
15       <strong>C</strong>ascading
16       <strong>S</strong>tyle
17       <strong>S</strong>heets
18     </p>
19   </body>
20 </html>

```

```

1 strong { color: red; }
2 .carrot { color: orange; }
3 .spinach { color: green; }
4 #first { font-style: italic; }

```



Cascading Style Sheets

Cascading Style Sheets



L2a: Basic Javascript

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Variables, Comments and Functions

```
1 // This is a comment
2 /*
3    This is also a comment
4 */
5
6 // This is a function
7 function areaOfCircle(radius) {
8     var PI = 3.1416;
9     return PI * square(radius);
10 }
11
12 function square(x) {
13     return x*x;
14 }
15
16 // This is a variable
17 var A = areaOfCircle(2);
```

L2b: Objects and Functions



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Associative Arrays as Objects

```
1 // Initializing an empty object
2 var empty_object = {};
3
4 // Object with two attributes
5 var name = {
6     firstName: "Karthik",
7     lastName: "Pattabiraman";
8 };
```

NOTE: You don't need a quote around firstName and lastName as they're valid JavaScript identifiers

```
1 name["firstName"]
2 // Equivalent to:
3 name.firstName
4
5 name["lastName"]
6 // Equivalent to:
7 name.lastName
8
9 name["firstName"] = "Different firstName";
10 name.lastName = "Different lastName";
```

Objects, Object Instances and Constructor



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- Similar in spirit to defining classes in OO languages

```
1 var Person = function(firstName, lastName, gender) {  
2   this.firstName = firstName;  
3   this.lastName = lastName;  
4   this.gender = gender;  
5  
6   this.printName = function() {  
7     console.log(this.firstName + " " + this.lastName);  
8   };  
9 }  
10 var p = new Person("John", "Smith", "Male");
```

Variadic Functions



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- Unknown number of arguments

```
1 var addAll = function( ) {  
2     var p = new Point(0,0);  
3     for (var i=0; i<arguments.length; i++) {  
4         var point = arguments[i];  
5         p.x = p.x + point.x;  
6         p.y = p.y + point.y;  
7     }  
8     return p;  
9 }
```

Exceptions

- Flagging an error condition

```
1  var addAll = function( ) {  
2      var p = new Point(0,0);  
3      for (var i=0; i<arguments.length; i++) {  
4          var point = arguments[i];  
5          if ( p.x==undefined || p.y==undefined )  
6              throw { name: TypeError,  
7                  message: "Object " + point + " is not of type  
                        Point"  
8          };  
9          p.x = p.x + point.x;  
10         p.y = p.y + point.y;  
11     }  
12     return p;  
13 }
```

Functions as Objects



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- A function can be passed to another function
 - Anonymous functions

```
1  var map = function( array , fn ) {  
2    // Applies fn to each element of list, returns a new list  
3    var result = [];  
4    for (var i = 0; i < array.length; i++) {  
5      var element = array[i];  
6      result.push( fn(element) );  
7    }  
8    return result;  
9  }  
10  
11 map( [3, 1, 5, 7, 2], function(num) { return num + 10; } );
```

L3: DOM Manipulation



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Selecting nodes in the DOM: Selectors

getElementById

```
1 if (document.getElementById("Section1") == null)
2     throw new Error("No element found: " + name);
```

getElementsByTagName

```
1 var imgs = document.getElementsByTagName("img");
2 for (var i=0; i<images.length; i++)
3     imgs[i].display = "none";
```

getElementsByClassName

```
1 var warnings = document.getElementsByClassName("
    warning");
2 if (warnings.length > 0) { /* do something */ }
```

Alternative: QuerySelector API

- Perform more complex selection queries
- Results are *not* live lists !
- `querySelector()` returns the first element
- `querySelectorAll()` returns all elements

```
1  "#nav"           // Any element with id=nav
2
3  "div"            // Any <div> element
4
5  ".warning"       // Any element with "warning" class
6
7  "#log span"      // Any <span> descendant of id="log"
8
9  "#log > span"    // Any span child element of id="log"
10
11 "body>h1:first-child" // first <h1> child of <body>
12
13 "div, #log"       // All div elements, element with id="log"
```

DOM Nodes Properties: Traversal

parentNode

Parent node of this one, or null

childNodes

A read only array-like object containing all the (live) child nodes of this one

firstChild, lastChild

The first and lastChild of a node, or null if it has no children

nextSibling, previousSibling

The next and previous siblings of a node (in the order in which they appear in the document)

DOM Nodes Properties: Extracting Information

nodeType: 'kind of node'

- Document nodes: 9
- Element nodes: 1
- Text nodes: 3
- Comment node: 8

nodeValue

Textual content of Text of comment node

nodeName

Tag name of a node, converted to upper-case

Creating, Copying and Inserting and Removing Nodes

- Creating a new node:

```
1 var newNode = document.createTextNode("hello");  
2 var elNode = document.createElement("h1");
```

- *Cloning* a node:

```
1 var existingNode = document.getElementById("my");  
2 var newNode = existingNode.cloneNode(true);
```

- **appendChild**: adds a new child node at the end
- **insertBefore**: similar, but inserts it before another child node

```
1 var s = document.getElementById("my");  
2 s.appendChild(newNode);  
3 s.insertBefore(newNode, s.firstChild);
```

- **removeChild**: remove a given node
- **replaceChild**: replace a given child node with another node



L4: Closures, Window Object and Events

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Closures - Counter Example with *that*

```
1  function Counter( initial ) {
2      var val;
3      var that = this;
4
5      this.init = function() {
6          val = initial;
7      }
8      this.init();
9
10     return {
11         increment: function() { val += 1; },
12         reset: function() { that.init(); }
13         get: function() { return val; }
14     }
15 };
16
17 var f = Counter(5), g = Counter(10);
18 f.increment(); f.reset(); f.increment();
19 g.increment(); g.increment();
20 console.log( f.get() + " , " + g.get() );
```



window object - Timers

- **setTimeout**: schedule a future event asynchronously **once** after a specified no of milliseconds
 - Clear: **clearTimeout** method
- **setInterval** schedule a future event asynchronously **that periodically repeats itself** after a specified interval (milliseconds)
 - Clear: **clearInterval** method

```
1 var intervalHandler = function(message) {  
2     var i = 0;  
3     return function() {  
4         alert(message + ' ' + i);  
5         i += 1;  
6     }  
7 };  
8 var ret = setInterval(intervalHandler("invocation"),1000);  
9 // [...]  
10 if (flag) clearInterval(ret);
```

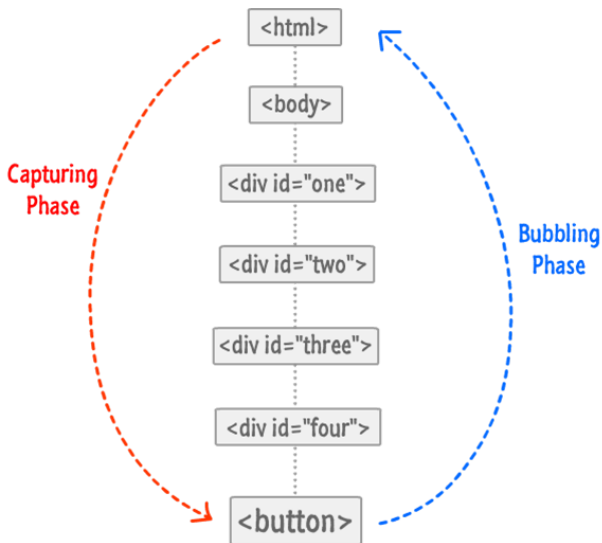


DOM 2.0 Events

- Allowing to be notified of internal events and user actions in all nodes of the DOM
- `addEventListener` for adding a event handler
- `removeEventListener` for removing event handlers
- `stopPropagation` and `stopImmediatePropagation` for stopping the propagation of an event

```
1 var b = document.getElementById("mybutton");
2 b.addEventListener("click", function() {
3     alert("hello");
4 }, false);
5 b.addEventListener("click", function() {
6     alert("world");
7 }, false);
```

DOM 2.0 Events - Capture and Bubbling Phases



L5: Prototypes and Reflection



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Prototype Field



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```
1 var p = new Person("John", "Smith", "Male");  
2 console.log( Object.getPrototypeOf(p) );
```

- Prototypes of objects created through `{ }` is
 - `Object.prototype`
- Prototype of objects created using `new Object`
 - `Object.prototype`
- Prototype of objects created using `new` and constructors functions (e.g., `Person`)
 - Prototype field set according to the constructor function (if `object`) (e.g., `Person`)



Prototype - Example

```
1  function Point( x, y) {  
2      this.x = x; this.y = y;  
3  
4  };  
5  
6  
7  var p1 = new Point(2,3);  
8  var p2 = new Point(5,7);  
9  
10 console.log(Object.getPrototypeOf(p1) === Object.  
    getPrototypeOf(p2));  
11 console.log(Object.getPrototypeOf(p1).constructor);
```

```
1  Point.prototype.toString = function( ) {  
2      return "(" + this.x + " , " + this.y + ")";  
3  }
```

Prototype Inheritance

```
1  var Employee = function(firstName, lastName, Gender, title)
    {
2      Person.call( this, firstName, lastName, Gender );
3      this.title = title;
4  }
5
6  Employee.prototype = new Person();
7      /* Why should you create a new person object ? */
8
9  Employee.prototype.constructor = Employee;
10
11 var emp = new Employee("ABC", "XYZ", "Male", "Manager");
12 console.log(emp.firstName); // OK - Property defined in
    Person
```

Prototype Inheritance - Assoc. array / *Object.create*

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```
1  var Person = {
2    firstName: "John";
3    lastName: "Smith";
4    gender: "Male";
5    print : function() {
6      console.log( "Person : " + this.firstName
7                  + this.lastName + this.gender;
8    }
9  };
10 var e = Object.create( Person );
11 e.title = "Manager";
```



Reflection and Type-Checking

- In JS, you can query an object for its type, prototype, and properties at runtime
 - To get the Prototype: `getPrototypeOf()`
 - To get the type of: `typeof`
 - To check if it's of certain instance: `instanceof`
 - To check if it has a certain property: `in`
 - To check if it has a property, and the property was not inherited through the prototype chain: `hasOwnProperty()`

Iterating over all properties

```
1 var name;  
2 for (name in obj) {  
3     if ( typeof( obj[name] ) !== "function" ) {  
4         document.writeln(name + " : " + obj[name]);  
5     }  
6 }
```



L6: AJAX and JSON

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AJAX - XHR2 Model - Example (1)



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- Launching a request and getting the response:

```
1 var xhr = new XMLHttpRequest();
2 xhr.open("GET", "example.html");
3 xhr.onload = function() {
4     if (xhr.status==200) {
5         console.log( xhr.responseText );
6         console.log("Request success");
7     }
8 }
9 xhr.send();
```

- Aborting a request: **abort** method

```
1 xhr.onabort = function() {
2     console.log("Request aborted");
3 }
```

AJAX - XHR2 Model - Example (2)



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- Handling timeouts:

```
1 xhr.timeout = 200; // 200 ms timeout
2 xhr.ontimeout = function() {
3     console.log("Request timed out");
4 };
```

- Handling errors (all other errors which are NOT status code-related!)

```
1 xhr.onerror = function() {
2     console.log("error occurred on request");
3 }
```

JSON



- `JSON.parse(string)`: converts string to JavaScript (code/data)
- `JSON.stringify(object)`: converts object to JSON notation
- Header must be set to `"Application/JSON"`

Example

```
1  var xhr = new XMLHttpRequest();
2  xhr.open("GET", "example.html");
3  xhr.onload = function() {
4      if (xhr.status==200) {
5          if ( xhr.getResponseHeader("Content-type")
              == JSON) {
6              var result = JSON.parse(xhr.responseText);
7              // Do something with the result variable
              here
8          }
9      }
10  xhr.send();
```

L7: Node.js



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Node.js - Motivation



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- Writing JS programs that can be run independently of a browser, as JS is a powerful programming language on it's own
 - Notable use: web server / web services
- Easy sharing of code and data between a JS web app and a Node.js web service

```
1 console.log("Hello"); // Same as before
2 setTimeout( function() { // Same as before
3     console.log("World") }, 1000);
4
5 // New stuff - can't do this in client-side JavaScript
6 var fs = require("fs"); // Load file system object
7 var contents = fs.readFileSync( fileName );
8 console.log(contents);
```

Modules

Calculator.js

```
1 function sum(a, b) { return a + b; }  
2 module.exports.sum = sum;
```

Shapes.js

```
1 var Point = function(x, y) {  
2     this.x = x; this.y = y; }  
3 module.exports = Point;
```

```
1 var calculator = require("Calculator.js");  
2 calculator.sum(10, 20);  
3  
4 var Point = require("Shapes.js");  
5 var p = new Point(1, 2);
```



Event Streams

- Registering an event: **on**
- Triggering an event: **emit**

```
1 var EventEmitter = require('events').EventEmitter;
2 if (! EventEmitter) process.exit(1);
3 var myEmitter = new EventEmitter();
4
5 // Add event handlers
6 myEmitter.on("connection", function(id) { /* ... */ });
7 myEmitter.on("message", function(msg) { /* ... */ });
8
9 // Emit the events
10 myEmitter.emit("connection", 100);
11 myEmitter.emit("message", "hello");
```



File I/O: Reading a File

- Synchronous read: bad!

```
1 var f= fs.readFileSync(fileName);
```

- Asynchronous reads: much better

```
1 var fs = require("fs");    // Filesystem module in node.js
2 var length = 0;
3 var fileName = "sample.txt";
4
5 fs.readFile(fileName, function(err, buf) {
6     if (err) throw err;
7     length = buf.length;
8     console.log("Number of characters read = " + length);
9 } );
```



File I/O: Reading a File using Streams

```
1 var fs = require('fs');
2 var length = 0;
3 var fileName = "sample.txt";
4 var readStream = fs.createReadStream(fileName);
5
6 readStream.on("data", function(blob) {
7     console.log("Read " + blob.length);
8     length += blob.length;
9 } );
10
11 readStream.on("end", function() {
12     console.log("Total number of chars read = " + length);
13 } );
14
15 readStream.on("error", function() {
16     console.log("Error occurred when reading from file " +
17         fileName);
17 } );
```



Piping Streams

- To copy a file, one can pipe the *output* of the read stream to the *input* of the write stream

```
1 var fs = require("fs");
2
3 // Open the read and write streams
4 var readStream = fs.createReadStream("sample.txt");
5 var writeStream = fs.createWriteStream("sample-copy.txt");
6
7 // Copies contents of read stream to write stream
8 readStream.pipe( writeStream );
```



Handling Http Connections using Streams

```
1  var http = require('http');
2
3  // Create a simple function to serve a request
4  var serveRequest = function(request, response) {
5      console.log("Received request " + request);
6      response.writeHead(200, { "Content-type": "text/htm" });
7      response.write("Received: " + request.url);
8      response.end();
9  };
10
11 // Start the server on the port and setup response
12 var port = 8080;
13 var server = http.createServer();
14 server.on("request", serveRequest);
15 server.listen(port);
```

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