WEB222 - Web Programming Principles

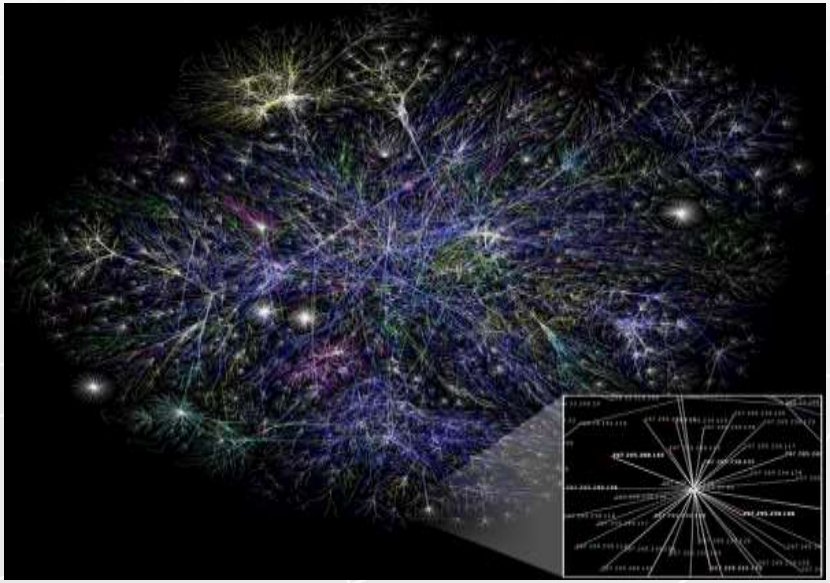
Week 1: Internet Architecture and Introduction to JavaScript

Agenda

- Course introduction
- Internet architecture
- Web client-side programming
- Introduction to JavaScript

Internet Architecture

- The internet is a collection of networks connected to each other. The networks are connected together to form the single entity that we know as the Internet.
- The Internet architecture is described in its name, a short form of the two words - interconnected networks.



Internet Protocol Suite

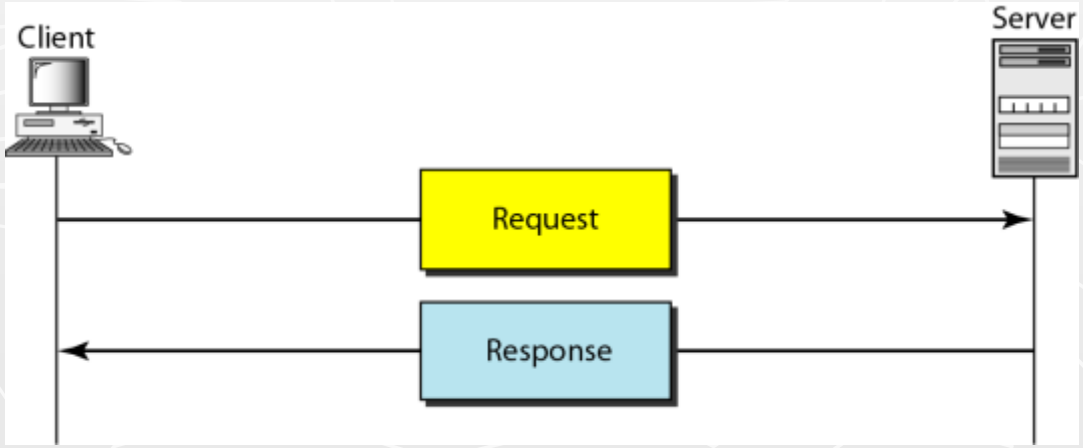
- Communications protocol
  - A communication protocol is a system of rules for exchanging message over the Internet.
- Internet Protocol Layers
  - Application layer
    - HTTP - HyperText Transfer Protocol
    - SSH - Secure Shell
    - SFTP - Secure File Transfer
    - DNS - Domain Name System
    - SMTP - Simple Mail Transfer Protocol
    - … …
  - Transport layer
    - TCP (Transmission Control Protocol),
  - Network layer : IP (Internet Protocol)
  - Physical and data link layers: Ethernet, token ring

Services Provided by the Internet

- World Wide Web
  - Abbreviation: **WWW** or **W3**,
  - Commonly known as **the Web**.
  - It is a collection of web pages connected through **hyperlinks** and **URL**s.
  - With a web browser, one can view web pages that may contain text, images, videos, and other multimedia and navigate between them via hyperlinks.
  - It is governed by the Hyper Text Transfer Protocol (**HTTP**) that deals with the linking of files, documents and other resources of the web.
- Other services:
  - Email, Mailing List, File Transfer Protocol (FTP), Instant Messaging, News Groups, Chat Rooms, … …

Client Server Model

- The www uses a client-server model
  - client software (web browser) requests an html page
  - the request is sent as a message to the particular web server
  - requested page is sent as a message from the server to the client
  - the client software interprets and displays the html page



Uniform Resource Locators (URL)

- Also known as a web address. It is a reference (an address) to a resource on the Internet.

https://scs.senecac.on.ca:443/~wei.song/index.html#timetable

  - protocol = **https://**
  - domain / host = **scs.senecac.on.ca**
  - port = **443**, default for HTTPS
  - file / resource ID = **~wei.song/index.html**
  - reference = **#timetable**

- URLs are typically transmitted via HTTP

HTML URL Encoding

- URL encoding converts characters into a format that can be transmitted over the Internet.
  - URLs can only be sent over the Internet using the ASCII character-set.
  - URLs often contain characters outside the ASCII set
    - has to be converted into a valid ASCII format.
  - URLs cannot contain spaces.
- Example: https://www.youtube.com/results?search_query=web222&feature=related
- URL encoding replaces unsafe ASCII characters with a "%" followed by two hexadecimal digits. e.g.

'&' → %26 ' ' → %20

'<' → %3C '>' → %3E

DNS (Domain Name System/Server)

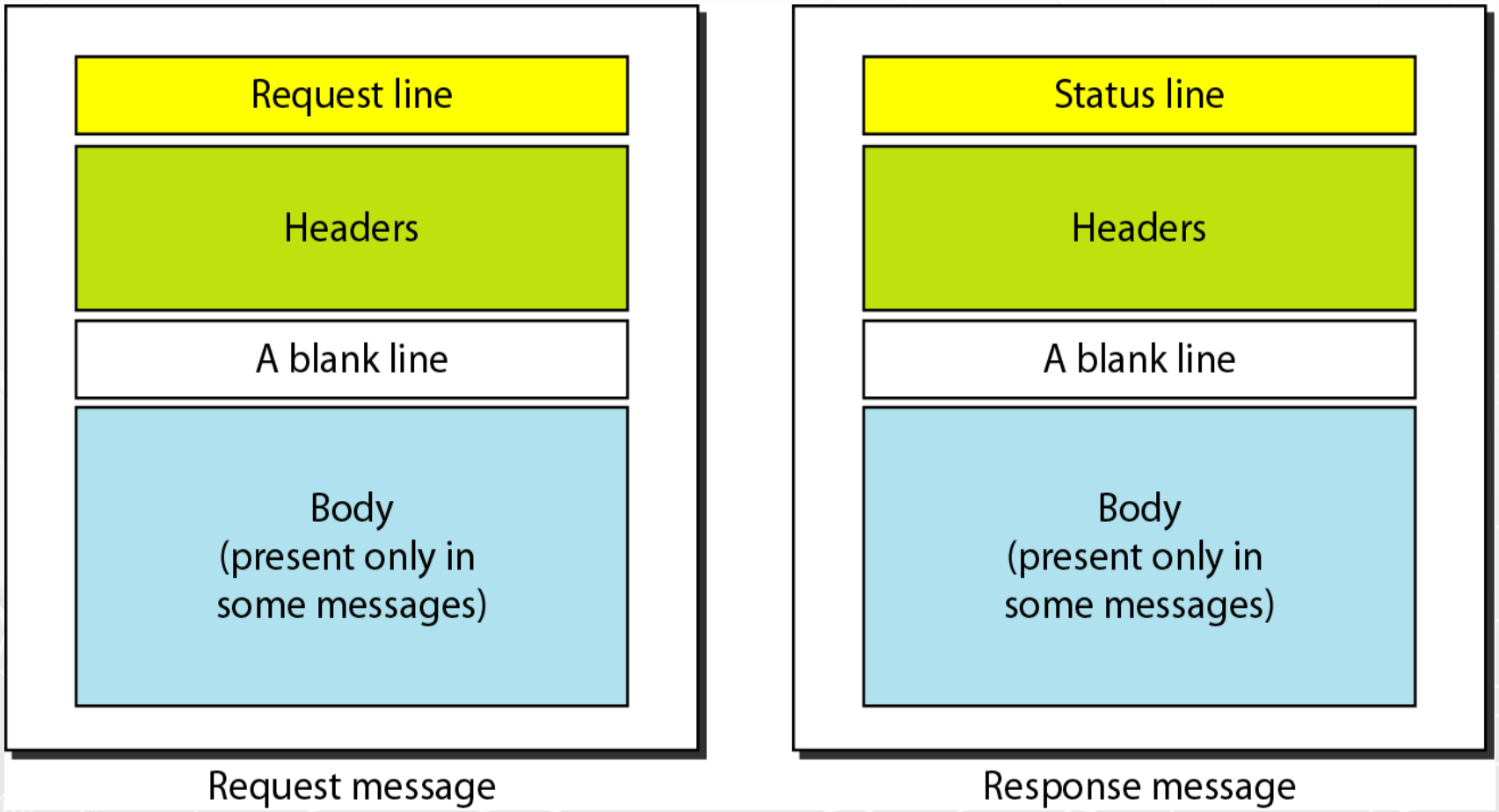
- DNS is used to give names to IP addresses. DNS servers (name servers) associate the domain names with the IP address
- e.g.

  zenit.senecac.on.ca is used to identify IP address 142.204.140.203.
- In addition to ".ca", other common domains include
  - .com - commercial
  - .edu - educational
  - .gov - governmental
  - .net - isp
  - .org - non-profit
  - and many more
- ICANN - Internet Corporation for Assigned Names and Numbers- oversees assignment of names and IP addresses and certifies domain name registrars to manage the process.

Hypertext Transfer Protocol

- HTTP, the Hypertext Transfer Protocol, is the application-layer protocol that is used to transfer data on the (World Wide) Web.
- HTTP comprises the rules governing the format and content of the conversation between a web client and server.
- HTTP functions as a request-response protocol in the client-server computing model.
- HTTP is stateless.
  - The server doesn't keep any data (state) between two requests.

HTTP Request and Response Messages



HTTP Request

- HTTP request example: sending the form result to a server:

```
POST /contact_form.php HTTP/1.1
Host: developer.mozilla.org
Content-Length: 64
Content-Type: application/x-www-form-urlencoded

name=Joe%20User&request=Send%20me%20one%20of%20your%20catalogue
```

- HTTP request methods
  - GET, POST
  - PUT, DELETE, HEAD, TRACE

HTTP Response

- HTTP response example: successful reception of a web page:

```
HTTP/1.1 200 OK
Date: Sat, 09 Oct 2010 14:28:02 GMT
Server: Apache
Last-Modified: Tue, 01 Dec 2009 20:18:22 GMT
ETag: "51142bc1-7449-479b075b2891b"
Accept-Ranges: bytes
Content-Length: 29769
Content-Type: text/html

<!DOCTYPE html... (here comes the 29769 bytes of the requested web page)
```

- HTTP Response Status Codes
  - 1xx - information
  - 2xx – success. e.g. 200 = request succeeded.
  - 3xx - redirection
  - 4xx – client error. e.g. 403 = forbidden page
  - 5xx – server error. e.g. 500 = internal server error.

HTTP Secure

- Hypertext Transfer Protocol Secure (HTTPS) is a communications protocol for secure communication over a computer network, with especially wide deployment on the Internet.
- Technically, it is not a protocol in and of itself; rather, it is the result of simply layering the HTTP on top of the SSL(Secure Sockets Layer) / TLS (Transport Layer Security) protocol, thus adding the security capabilities of SSL/TLS to standard HTTP communications.

Web Application

- A web application or web app:
  - A distributed application that uses Web-based technologies (and generally relies on Web browsers for the presentation of user-interfaces) is typically considered a Web application.
  - Update and maintain web applications without distributing and installing software on potentially thousands of client computers
  - inherent support for cross-platform compatibility.
- Common web applications include:
  - Webmail, online retail sales, online auctions, wikis and more…

Front-end Web Application

- The rising popularity of "modern" web apps means that web developers are focusing on writing more and more front-end, or client-side code.
- Although back-end, or server-side code still plays an important factor, the fact is that web developers are working more directly with HTML5, CSS3, JavaScript and the DOM.

Front-end Web Application

- The four pillars of front-end web development:
  - HyperText Markup Language (HTML5)
    - The main language for creating web pages
    - Content and structure of the Document
  - Cascading Style Sheets (CSS)
    - Used for describing the appreance and formatting of a web page
    - Presentation or style web pages
  - JavaScript (JS)
    - Allows client-side scripts to interact with the user
    - Behavior and State of the frontend
  - Document Object Model (DOM)
    - 2-way programming API for JavaScript

Firefox Developer Tool: Scratchpad

- Why use Scratchpad?
  - JavaScript always runs inside a host environment (mostly the browser).
- Starting Scratchpad
  - Go to the "Web Developer" menu. Then select "Scratchpad" from that menu, and you'll get a text editor window.

    Keyboard shortcut: Shift+F4
  - For Mac users: look for the "Web Developer" menu under "Tools".

    Shortcut: fn+Shift+F4 (The "fn" key is just to the right of the main set of QWERTY keys)
- More on Developer tools:
  - Firefox developer tools
  - Chrome developer tools
  - JSLint – validator & error checker

Scratchpad

- How to run a script:

1. Enter some code
2. Select a portion of the code
3. Choose one of the three commands from the Execute

console.log()

- The console.log function to show a messages in a web console.
- Example code:

```
var anObject = { str: "Some text", id: 5 };
console.log(anObject);
```

- open web console in Firefox:
  - Ctrl + Shift + k
  - For Mac users: Cmd + Opt + k / Cmd + Opt + I

prompt()

- Prompt box, displays a dialog box (Modal window) that prompts the user for input.
- Returns a string entered by the user input; or return the value null.
- Example code:

```
var cl = prompt("Enter your favorite color", "green");

if (cl) { // if cl is not null
    console.log (cl);
} else {  // cl is null
    console.log ("No color entered.");
}
```

- Note: you should not use this function in a web app.

Introduction to JavaScript

- JavaScript (sometimes shortened to JS) is a lightweight, interpreted, high-level language used along with html code.
- The language syntax is somewhat similar but not the same as the C language. Today, JavaScript is the scripting language for Web pages.
- JavaScript is not Java
- An interpreted language interprets and executes each statement - one-by-one - in the order they appear.
- JavaScript always runs inside a host environment (mostly the browser).
- The JavaScript standard is based on the European Computer Manufacturers Association (ECMAScript). As of 2012, all modern browsers fully support ECMAScript 5.1.

Introduction to JavaScript (cont'd)

- JavaScript is useful for making dynamic web pages, validating user input and changing the way the web page responds to events on the web page.
- JavaScript statements can be stored in an external file with a .js file extension or embedded within HTML code.
- JavaScript is one of the world's most popular programming languages.
  - the role as the scripting language of the WWW.
  - simple and easy to learn
- JavaScript is the world's most misunderstood programming language.
  - The name, typecasting, used by amateurs, object-oriented,…
- JavaScript may be, in the future, the most important language you will learn.

Basic JavaScript Rules

- JavaScript is **case-sensitive**
  - When writing a JavaScript script, be aware of upper and lower case characters.
  - CustomerCount is not the same as Customercount nor is it the same as customerCount
- JavaScript statement
  - A JavaScript typically consists of a series of statements.
  - A statement is a single line of instruction to the computer made up of objects, expressions, variables, and events/eventhandlers.
- Command block
  - A Command block is a group of statements that is treated as a single entity and are grouped within braces - the curly brackets - { }

Basic JavaScript Rules

- Matching Pairs
  - Opening and closing symbols need to work in pairs.
  - For example, if you use the left brace { to indicate the start of a command block, then you must use the right brace } to end the command block. The same matching pairs applies to single '.....' and double "....." quotes to designate text strings.
- The use of comments
  - Block/Multi-line comment: /* */
  - Single line comments: //
- The use of white Space
  - JavaScript ignores extras spaces however it is recommended that you use them to make your scripts easier to read.

JavaScript data types

- There are 3 main (primitive) data types:
  - string
    - must be enclosed in single or double quotes
  - number
    - can be integers or floating point
    - Special number: Infinity, NaN
  - boolean
    - values are binary, with the values (1) "true" and (0) "false" (without the quotes)
- Other types:
  - undefined, null, object, function

JavaScript data types

- JavaScript is a loosely typed language.
  - You do not have to specify the data type of a variable when you declare it.
  - Data types are converted automatically as needed during script execution.

JavaScript Variable

- Variable naming rules are: Must start with a letter, underscore (_), or dollar sign ($)
- Cannot be a reserved (key) word
- Subsequent characters can be letters
  - upper case (A...Z) or lower case (a...z),
  - numbers
  - underscores
- JavaScript reserved words
  - Similar to other programming languages, JavaScript has a list of words that are considered "reserved".

Declare and Refer Variables

- You must use the "var" keyword to precede a variable name.
- Unlike the C language, you do not need a type specifier.
  - The variable's initial value will set its initial type.
- Declaration syntax:

```
var variableName;
```

Or:

```
var variableName = "Summer";

// Referring to and using syntax:
variableName = 2015;
console.log(variableName);
```

- Dynamic typing
  - a JavaScript variable can have a different type in different parts of a program

Variables Example

Declaration	Type	Value
var identOne = "some text";	String	some text
var identOne = 'some text';	String	some text
var IdentOne = '172';	String	172
var _identOne = 25;	Number (Integer)	25
var _identTwo = 56.2564;	Number (float)	56.2564
var ident_A = true;	Boolean	true (1)
var ident_B = false;	Boolean	false (0)
var ident_C;	undefined	undefined
var ident_D="Yes", ident_E="No";	String / String	Yes / No

Special values

- Infinity
  - Number data type
  - e.g. console.log(12/0);
- NaN
  - means "Not a Number"; Number data type
- null
  - both a value and a data type
- undefined
  - both a value and a data type
  - e.g. var x;
    console.log(x);

Expressions

- An expression is any valid set of literals, variables, operators, and expressions that evaluates to a single value.
- The value may be a number, a string, or a logical value.
- Two types of expressions:
  1. those that assign a value to a variable, e.g. x = 7 .
  2. those that simply have a value, e.g., 3 + 4 simply evaluates to 7; it does not perform an assignment.
- JavaScript has the following kinds of expressions:
  1. Arithmetic - evaluates to a number
  2. String - evaluates to a character string
  3. Logical - evaluates to true or false

Expressions - Ternary Operator

- A conditional expression can have one of two values based on a condition. The syntax:

(condition) ? val1 : val2;

- If the condition is true, the expression has the value of val1, Otherwise it has the value of val2.

condition	When True	When False

var status = (age >= 18) ? "adult" : "minor";

Arithmetic Operators

Operator	Operation	Example
+	addition of numbers Concatenation of strings	y + x; "INT" + "222"
-	subtraction	x - y;
*	multiplication	x * y;
/	division	x / y;
%	modulo	x % y; // remainder of x divided by y

++	post/pre -increment	x = y++; // assign y to x, then increment y (y+=1)
		x = ++y; //increment y < (y+=1), then assign y to x

--	post/pre decrement	x = y--; // assign y to x, then decrement y (y-=1)
		x = --y; // decrement y < (y-=1), then assign y to x

Arithmetic Operators - Assigning Values

Operator	Example	Equivalent	For
=	a = b;	a = b;	Numbers, strings, …
+=	a += b;	a = (a + b);	numbers or strings
-=	a -= b;	a = (a - b);	numbers
*=	a *= b;	a = (a * b);	numbers
/=	a /= b;	a = (a / b);	numbers
%=	a %= b;	a = (a % b); // divide a by b, // assign remainder to a	numbers

Logical Operators

- Given x = 2;

Operator	Operation	Example
&&	Logical AND	(x > 3 && x == 2) is false
||	Logical OR	(true || x > 10) is true
!	Logical NOT	!(x ==2) is false

Comparison Operators

Operator	Description	Example
==	Equal (The operands are converted to the same type before being compared.)	1 == 1 is true 1 == "1" is true 1 == true is true 0 == false is true
===	Strictly equal (There is no type conversion.)	1 === 1 is true 1 === "1" is false 1 === true is false 0 === false is false
!=	Not equal (with type conversion)	1 != 1 is false 1 != '1' is false
!==	Not equal (without type conversion)	1 !== 1 is false 1 !== '1' is true
>	Greater than	expr1 > expr2
>=	greater than or equal to	expr1 >= expr2
<	Less than	expr1 < expr2
<=	less than or equal to	expr1 <= expr2

Other Operators

- The typeof operator (for variable or values):
  - possible return values:

```
typeof "John"                 // Returns string
typeof 3.14                   // Returns number
typeof false                  // Returns boolean
typeof [1,2,3,4]              // Returns object
typeof {name:'John', age:34}  // Returns object
```

- The instanceof operator
  - Used for objects

Strings and Quotation Marks

- Literal strings can be denoted by either single or double quotes, which gives you some flexibility about how to handle awkward situations such as quotation marks inside a string:

Expression	Values
"Let's start with JavaScript"	Let's start with JavaScript
'Not "it"!'	Not "it"!

Concatenation of Strings

- The main operation on strings is the concatenation operator, +:

Expression	Value
`"WEB" + "222"`	`WEB222`
`"John" + " Smith"`	`John Smith`

Adding Strings and Numbers

- x =5+5;
  console.log(x); // Output: 10
- x="5"+"5";
  console.log(x); // Output: 55
- x=5+"5";
  console.log(x); // Output: 55
- x="5"+5;
  console.log(x); // Output: 55

Example - Evaluating Expressions

```
var x = 5;
x = x + "2";
console.log("The value of x is " + x);

x = 2 * x;
console.log("The new value of x is now " + x);

x = x + 1;
console.log("x is now " + x);
console.log("x divided by 3 is: " + x/3);
```

Programming Constructs

- JavaScript execution flow is determined using the following four (4) basic control structures:
  1. Sequential:
     an instruction is executed when the previous one is finished.
  2. Conditional
     a logical condition is used to determine which instruction will be executed next - similar to the "if" and "switch" statements in C.
  3. Looping
     a series of instructions are repeatedly executed until some condition is satisfied - similar to the "for" and "while" statements in C.
  4. Transfer
     jump to a different part of the code - similar to calling a function in C.

Construct (1) - Sequence

- Tasks are executed one after another in "sequence" – e.g.

```
var a = 3;
var b = 6;
var c = a + b;

console.log(c);
```

Construct (2) - Selection

- Make decisions and perform single or multiple tasks based on the outcome of the decision (true or false).
- Types of conditional statements :
  - if
  - if / else
  - switch / case

if-else Example

```
var grade, mark = 86;

if (mark >= 90)
    grade='A+';
else if (mark >= 80)
    grade='A';
else if (mark >= 70)
    grade='B';
else if (mark >= 60)
    grade='C';
else if (mark >= 50)
    grade='D';
else
    grade="F";

console.log( "Your grade: " + grade);
```

Switch-case Example

```
var semester = 3;

switch (semester) {
        case '1':   console.log("IPC144, ULI101");
                    break;
        case '2':   console.log("OOP244, WEB222");
                    break;
        case '3':   console.log("OOP344, INT322");
                    break;
        case '4':   console.log("JAC444, INT422");
                    break;
        default:
                    console.log("You may have graduated from CPD");
}
```

Construct (3) - Iteration

- Loop - an action that occurs again and again until a certain condition is met.
- Continuously check a condition and based on the outcome, either terminate the loop or repeat a set of statements.
- Three basic types of loop structures:
  - The for loop
  - The for / in loop
  - The while loop
  - The do-while loop

for loop Example

```
var days = "The days in september: \n";

for (var ident = 1 ; ident <= 30 ; ident++) {
        days += ident + "\n";
}
console.log(days);
```

for in loop Example

- Iterates over the enumerable properties of an object, in arbitrary order. For each distinct property, statements can be executed.

```
var student = {name:"John", program:"CPD", semester:2};
var str = "Student info:\n\n";

for (var x in student) { // x is the current property ('key') – ie: name, program, or semester
    str += x + ": " + student[x] + "\n";
}
console.log(str);
```

while & do…while loop Examples

```
var text = "";
var i = 0;
while (i < 10) {
    text += "\nThe number is " + i++;
}
console.log(text);
```

```
var i=10;
do {
    console.log("week " + i++);
} while (i<15)
```

break and continue Statements

- break: breaks the loop and continue executing the code that follows after the loop (if any).

```
var i=1;
while (i<5)    {
  console.log("week "+i);
  if (i==3)
    break;
  else
    i++;
}
```

- continue: breaks one iteration (in the loop), and continues with the next iteration in the loop.

```
var i=1, j=1;
while (i<5) {
   console.log('week: ' + i );
   for (j=1; j<=7; j++){
      console.log('day:'+ j +'of week:'+ i);
      if (j==3) continue;
   } // for
   i++;
}
```

Thank you!

Any Questions?