

FIT5032 - Internet Applications Development

Fundamental Client Side JavaScript

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Before we venture into JavaScript...

It is assumed that you have the basic background of

- A general understanding of the Internet and the World Wide Web
- Good working knowledge of HyperText Markup Language (Background topics & Self Learning)
- Programming Experience. (Completed a foundation programming unit)



- HTML is the markup language that we use to structure and give meaning to our web content, for example defining paragraphs, headings, and data tables, or embedding images and videos in the page.
- CSS is a language of style rules that we use to apply styling to our HTML content, for example setting background colors and fonts, and laying out our content in multiple columns.
- JavaScript is a scripting language that enables you to create dynamically updating content, control multimedia, animate images, and pretty much everything else. (Traditionally)

JavaScript Style Guide



A style guide is a **set of standards** that outline how code should be written and organized. As you read through these guides, you can get an idea for how code is written at the respective companies.

The main reason we need style guides is because everyone codes differently and it is important to have consistency amongst a group of developers.

There are several JavaScript style guides.

- Airbnb JavaScript Style Guide - <https://github.com/airbnb/javascript>
- Google JavaScript Style Guide - <https://google.github.io/styleguide/jsguide.html>
- JavaScript Standard Style Guide - <https://github.com/standard/standard>

In FIT5032, our Style Guide of choice is the AirBnB Style Guide. However, it does not matter which Style Guide we use as, it is more important for you to understand its **importance of a style guide**.

For those interested, here is a story <https://github.com/airbnb/javascript/issues/102>

Wait..... JavaScript?

Internet software war flares up

Sun, Netscape release JavaScript program

By Evan Ramstad

Associated Press NEW YORK — A fight to shape the direction of the Internet sharpened Monday when Sun Microsystems Inc. and Netscape Communications Corp. rolled out a new product, hoping it will become the standard language from Microsoft.

The new product, called Java, was designed to let everyday computer users, not just skilled programmers, write software that works easily on electronic networks, particularly the Internet.

Microsoft is due to promote its own Java-like language, called JScript, on Tuesday.

It will likely be months, if not years, before consumers and most businesses benefit. But the competition is already drawing the attention and respect of computer experts, who say what products become standard.

"The people they're trying to convince are the developers,"

said Jerry Michalek, managing editor of Release 1.0, an industry newsletter.

The rapid evolution of faster communications lines and new computer hardware has experts believing big opportunities are ahead for software that can run on computers from different manufacturers.

Sun and Netscape hope to capture some of that market, which has been dominated by Microsoft, which has dominated the Internet since its operating program became standard in 1985.

Sun earlier this year announced a language called Java to write programs that can run on any computer. In October, the company released a beta version of Java, and Java was ready for mass market tests.

"A test version of Java

marketing for Netscape, said people who can create a specialized function in spreadsheets or word processors without learning JavaScript.

Netscape also lined up 20 companies to help promote and use Java.

"Eric Schmidt, chief technology officer of Sun

was made available with the test version of Netscape's Java interpreter program, which people using the Internet can download for free.

On Thursday, Microsoft is expected to release its own Java-like Basic language, now used to do related programs to go on sale.

"Microsoft is also expected to release its own Java-like language, now used to do related programs to go on sale.

"Mike Houser, vice president of

told about Java during a luncheon Monday in New York. Microsoft chairman Bill Gates was not worried about the competition.

"Java is there to overtake what we have," he said. "We feel very confident that things will work out well for us, we are ahead of the good things that are probably going to happen."

But Sun, Netscape and others advocate the ability to use networked computers on any kind of machine, not just Windows-equipped personal computers.

"Having the market be dominated by one company is not what we do not want to have," said Jim Andreessen, vice president of technology at Netscape.

Sun announced the Java language this spring. Though there are other Java-like languages now available, it has become closely associated with the Internet.

A reintroduction to JavaScript



- JavaScript is considered to be the **most misunderstood programming language**.
- A common misconception is that JavaScript is **just another language**, but in actual fact, it is probably one of the **most important languages** to learn these days.
- It is often derided as being a toy, but beneath its layer of deceptive simplicity, **powerful language feature awaits**.
- In an ill-fated marketing decision, it was named JavaScript to capitalize on the popularity of Java. In actual fact, it has **nothing** to do with Java.
- JavaScript language has **no concept** of input and output.
- It is designed to **run as a scripting language in a host environment**, and it is up to the host environment to provide mechanisms for communicating with the outside world.
- The most common host environment is the **browser**.

What is JavaScript?

- often shortened to **(JS)**
- is a **lightweight, interpreted or JIT compiled** programming language with **first class function**.
- the standard for JavaScript is **ECMAScript**
- is the most well known as the **scripting language** for Web pages.
- is a **prototype-based, multi-paradigm, dynamic scripting language, supporting object-oriented, imperative and declarative styles**.
- Please do **NOT** confuse JavaScript with the Java programming language. They are two different programming language with **different syntax, semantics and uses**.
- These day it is important to understand that, there are
 - **Client Side JavaScript** (JavaScript Code that is ran on the client, browser)
 - **Server Side JavaScript** (Runs on the server, for example `node.js`)
- These slides aims to cover **Client Side JavaScript**, we will cover server side in later weeks.
- Client side JavaScript can change the way the web pages look.

What is ECMAScript?

- is the scripting language that forms the **basis of JavaScript**
- is currently at **version 7** (however most browsers have full support for version 5)
- JavaScript is **standardized at ECMA International**. (European association for standardizing information and communication systems)
- The ECMAScript standard is documented in the ECMA-262 specification.
- The ECMAScript specification does not describe the Document Object Model (DOM), which is standardized by the World Wide Web Consortium (W3C) and/or WHATWG (Web Hypertext Application Technology Working Group).
- ECMA Standard is based on several originating technologies, the most well known being JavaScript (Netscape) and Jscript (Microsoft).
- So, **JavaScript is the most popular implementation** of the EMCA Script standard.

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Declarative vs Imperative Programming

Characteristic	Declarative	Imperative
Example	HTML, XML, CSS, SQL, Prolog, Haskell, F# and Lisp. Functional programming is a form of declarative programming.	Object oriented programming belongs under imperative paradigm. Examples are like C# and Java
Explanation	The code focuses on building logic of software without actually describing its flow.	The code focuses on creating statements that change program state by creating algorithm that tell the computer how to do things.
State Changes	Non-existent.	Important.
Order of execution	Low importance	Important
Primary Flow Control	Function calls, including recursion.	Loops, conditionals, and function (method) calls.
Primary manipulation unit	Functions as first-class objects and data collections.	Instances of structures or classes.
Example	<pre>const sum = a => b => a + b; console.log (add (5) (3)); // 8</pre>	<pre>class Number { constructor (number = 0) { this.number = number; } }</pre>
	This example here uses something known as JavaScript arrow functions.	

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JavaScript is a multi paradigm language

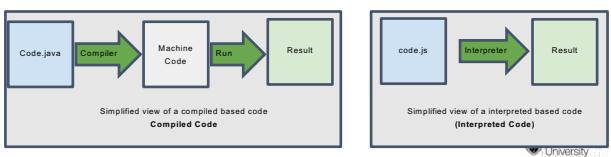
- Programming paradigms are a way to classify programming languages based on their features.** Languages can be classified into multiple paradigms.
- For example, in object-oriented programming (OOP), code is organised into objects that contain state that is only modified by the code that is part of the object. For example Java.
- A multi-paradigm programming language is a programming language that **supports more than one programming paradigm**.
- JavaScript is a **multi paradigm** language.
- JavaScript supports
 - Declarative & Imperative Programming
 - Prototype based supporting object oriented

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Interpreted vs Compiled Code

- JavaScript is an **interpreted programming** language.
- The code is run from **top to bottom** and the result of the running code is immediately returned.
- You **do not have to transform** the code into a different form before the browser runs it (interpreted)
- For example a language like **Java** on the other hand are transformed (compiled) into another form before they are run by the computer.
- Remember that a language is **never bound to either interpreted or compiled**, but the implementation of the language is. This is true for both Java (FIT9131) & Python (FIT9133) *.



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JIT Compiled Programming Language

- JavaScript has "**no**" compilation "step". It has an interpreter.
- An interpreter in the browser reads over the JavaScript code.
- It interprets each line and runs it.
- Modern browsers use a term they know as **Just-In-Time compilation**, which compiles JavaScript into executable binary just about it is to run.
- At the end of the day, programming languages are created for humans. **It must be translated into machine language**. So in a way, the must be a "compilation" step but it happens **Just In Time**.
- JIT is not specific to JavaScript. Languages like Java also do have these mechanisms to compile the code just before the execution.
- The most important concept when describing an interpreted language is, the compiled language takes a longer time to prepare itself to start executing while an interpreted language like JS starts executing in **no time**.

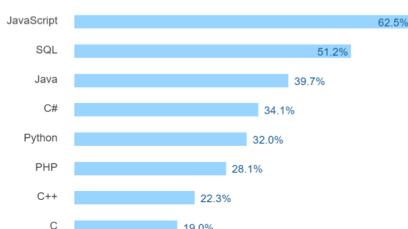
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JIT happens microseconds before code is executed. This ensures the fastest performance.

Most popular technologies



Based on a Stack Overflow Developer Survey (2017), JavaScript is currently the **most popular technology**.

Java is the 3rd most popular technology. While C# is the 4th most popular. (This might be due to Unity)



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Higher Order Function (callback function)

JS

In mathematics & computer science, a higher-order function is a function that **does at least one of the following**

- takes or more functions as arguments
- returns a function as a result

Both of these requirements rely on JavaScript functions being first class objects in a language.

Because of this characteristic, it is well suited for **functional programming**.



Server-side versus client-side code

JS

- Client-side code is code that is ran on the user's computer - when the page is viewed, the client side code is downloaded and then run and displayed by the browser. This is what we call client-side JavaScript.
- Server-side code is ran on the server. Then the results are downloaded and displayed on the browser. Examples of popular server side web languages include, PHP, Python, Ruby and ASP.NET.
- JavaScript can also be used as server-side. Recently, there is a huge surge in the popularity of using JavaScript as server side code in the Node.js environment.



First Class Function?

JS

A programming language is said to have first class functions when **functions are treated like any other variable**.

A function can be **passed as an argument to other functions, can also be returned by another function, can be assigned as a value to a variable or stored into a data structure**.

For example, in JavaScript, you can do something like

```
function sayHello() {  
    return function() {  
        console.log("Hello!");  
    }  
}
```



In this example, we returned a **function from another function**. The reason we can do this is because we treat function in JavaScript as a value.

This is a **very important concept** in JavaScript.



Closures

JS

- A closure is the combination of a **function and the lexical environment** within which that function was declared.
- A closure is one way of supporting first-class functions; it is an expression that can reference variables within its scope, be assigned to a variable, be passed as an argument to a function or be returned as a function result.
- Functions in JavaScript form closures.**

```
function makeAdder(x) {  
    return function(y) {  
        return x + y;  
    }  
}  
  
var add5 = makeAdder(5);  
var add10 = makeAdder(10);  
console.log(add5(2)); // 7  
console.log(add10(2)); // 12
```

The example explained.....

- makeAdder is a function which takes a single argument x and returns a new function. The function it returns takes a single argument y, and returns the sum of x and y.
- In a way, makeAdder is a function factory. It creates functions which can add a specific value to their argument.
- add5 and add10 are both closures. They share the same function body definition and store in different lexical environments.
- add5's lexical environment, x is 5 while add10, x = 10



Dynamic versus static code

JS

- The word **dynamic** is used to describe both client-side JavaScript and server-side languages.
- It refers to the ability to update the display of a web page to show different things in different circumstances. In a way, generating new contents when required.
- Server side code dynamically generates new contents on the server, whereas client side JavaScript dynamically generates new contents inside the browser on the client. For example, creating a new HTML table, filling it with data requested from the server, then displaying the table in a web page shown to the user.
- For FIT5032, we will use ASP.NET for the server side codes. So, in combination these two will work together.
- A web page with no dynamically updating content is referred to as **static**. It just shows the same content all the time.



In short.....

JavaScript is a **prototype-based, multi-paradigm, dynamic scripting language**, supporting **object-oriented, imperative and declarative** styles.



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Data Structures and Types

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The latest ECMAScript standard defines seven data types:

1. Boolean → true and false.
2. null → A special keyword denoting a null value. Because JavaScript is case-sensitive, null is not the same as Null, NULL, or any other variant.
3. undefined → A top-level property whose value is not defined.
4. Number → An integer or floating point number. For example: 42 or 3.14159.
5. String → A sequence of characters that represent a text value. For example: "Howdy"
6. Symbol (new in ECMAScript 2015) → A data type whose instances are unique and immutable.
7. Object

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JavaScript Basics

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- JavaScript borrows most of its syntax from Java, but is also influenced by Awk, Perl and Python.
- JavaScript is case-sensitive and uses the Unicode character set. For example, the word Fröh (which means 'early' in German) could be used as a variable name.
- But, the variable fröh is not the same as Fröh because JavaScript is case sensitive.
- In JavaScript, instructions are called statements and are separated by a semicolon (;) .
- A semicolon is **not necessary after every statement** if we are writing a command from a new line.
- If we want to write more than one statement in one line, then they should be separated by a semicolon.
- The source text of JavaScript script gets scanned from left to right and is converted into a sequence of input elements which are tokens, control characters, line terminators, comments or whitespace.
- ECMAScript also defines certain keywords and literals and has **rules for automatic insertion of semicolons (ASI)** to end statements.
- It is recommended to always add semicolons to end your statements; it will avoid side effects

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0.1 + 0.2

```
Elements Console Sources Network Performance Memory > 
[disabled] | ktp | Filter Default levels Group similar 
Console was cleared 305302.1 
> 0.1 + 0.2 
> 0.30000000000000004
```

Floating number can't store properly all decimal numbers, because they store stuff in binary.

So, when $0.1 + 0.2$ happens the value given is inaccurate, this is due to the nature of computers store these numbers.

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JavaScript Libraries

jQuery

- Pre Written JavaScript which allows for easier development of JavaScript applications.
- Examples of JavaScript libraries are like
 - jQuery
 - jQueryUI
 - Google Maps Platform
 - Leaflet.js
- Please also note there is a difference between a JavaScript library and a JavaScript framework. A framework defines would define the entire application design.
- Examples of a framework would be like (**Shown on Week 10**)
 - AngularJS
 - Vue.js
 - React

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What is jQuery?

- jQuery is a fast, small and feature-rich JavaScript library.
- It makes things like **HTML document traversal and manipulation, even handling, animation and AJAX much simpler with easy-to-use API**.
- jQuery works across a multitude of browsers.
- As of 30th April 2018, jQuery is at version 3.3.1 with versions 1 and 2 no longer being patched.
- These days, there are less and less people using jQuery as there are a lot more tools which can do a better job in comparison to jQuery. [Link](#)
- However, millions of websites still use jQuery and it is currently the number 1 choice of developers for small and medium web applications. It is the most widely deployed JavaScript library by a large margin.
- It is recommended for every web developer to at least understand the capabilities of jQuery due to its usage.

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What is jQuery UI?

- jQuery UI is a collection of GUI widgets, animated visual effects, and themes implemented with jQuery.
- One of the more common reasons to use jQuery UI is for their widgets.

A Datepicker interface showing a calendar for May 2018. The calendar has days from Sunday to Saturday. A yellow box highlights the 5th of May. Below the calendar, there is a list of sections: Section 1, Section 2, Section 3, and Section 4.



A Datepicker

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Google Maps JavaScript API

- Google Maps Platform
- The Google Maps JavaScript API lets you customize maps with your own content and imagery for display on web pages and mobile devices.
- Using maps is a very common use case.



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Leaflet.js

- An open source JavaScript library for mobile-friendly interactive maps.
- It is the leading open-source JavaScript library for mobile-friendly interactive maps. (With just 38 KB of JS).
- It is designed with simplicity, performance and usability in mind.



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d3.js

d3.js is a JavaScript library for manipulating documents based on data. D3 helps you bring data to life using HTML, SVG, and CSS. This is considered to be basic visualisation technique.



You can view the showcase at <https://github.com/d3/d3/wiki/Gallery>

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DataTables

DataTables is a plug-in for the jQuery Javascript library. It is a highly flexible tool, build upon the foundation of progressive enhancement, that adds all of these advanced features to any HTML table.

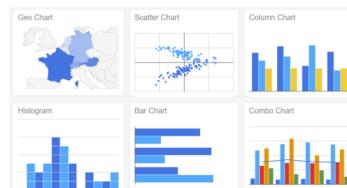
- Pagination
- Instant Search
- Multi Column Ordering
- Use almost any data source
- Mobile Friendly
- Fully internationalisable

Name	Position	Office	Age	Start date
Am Satou	Accountant	Tokyo	33	2008/11/28
Angela Ramos	Chief Executive Officer (CEO)	London	47	2009/10/09
Ashwin Cole	Junior Technical Author	San Francisco	66	2008/01/12
Brady Greer	Software Engineer	London	41	2010/05/13
Brendon Wagner	Software Engineer	San Francisco	28	2011/06/07
Bretelle Williamson	Integration Specialist	New York	61	2012/12/02
Bruno Nash	Software Engineer	London	38	2011/05/03
Cesar Vance	Pre-Sales Support	New York	21	2011/12/12
Cars Stevens	Sales Assistant	New York	46	2011/11/26
Cedric Kelly	Senior JavaScript Developer	Edinburgh	22	2010/03/29

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Google Charts

- provides a perfect way to visualize data on your website



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Chart JS

Simple yet flexible JavaScript charting for designers & developers



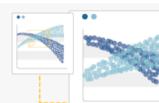
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Baidu eCharts

- ECharts (a contraction of Enterprise Charts) is a commercial charting solution originally intended to address the report need of the Company's various business systems, Baidu.



DRAG-RECALCULATE



BIG DATA MODE



SCALE ROAMING

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Recommended readings for JavaScript

