ES6 - Quick Guide

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ES6 - Overview

ECMAScript (ES) is a scripting language specification standardized by ECMAScript International. It is used by applications to enable client-side scripting. The specification is influenced by programming languages like Self, Perl, Python, Java etc. Languages like JavaScript, Jscript and ActionScript are governed by this specification.

This tutorial introduces you to ES6 implementation in JavaScript.

JavaScript

JavaScript was developed by Brendan Eich, a developer at Netscape Communications Corporation, in 1995.JavaScript started life with the name Mocha, and was briefly named LiveScript before being officially renamed to JavaScript. It is a scripting language that is executed by the browser, i.e. on the client's end. It is used in conjunction with HTML to develop responsive webpages.

ECMA Script6's implementation discussed here covers the following new features –

- Support for constants
- Block Scope
- Arrow Functions
- Extended Parameter Handling
- Template Literals
- Extended Literals
- Enhanced Object Properties
- De-structuring Assignment
- Modules

Classes

Iterators

Generators

Collections

New built in methods for various classes

Promises

ES6 - Environment

In this chapter, we will discuss the setting up of the environment for ES6.

Local Environment Setup

JavaScript can run on any browser, any host, and any OS. You will need the following to write and test a JavaScript program standard –

Text Editor

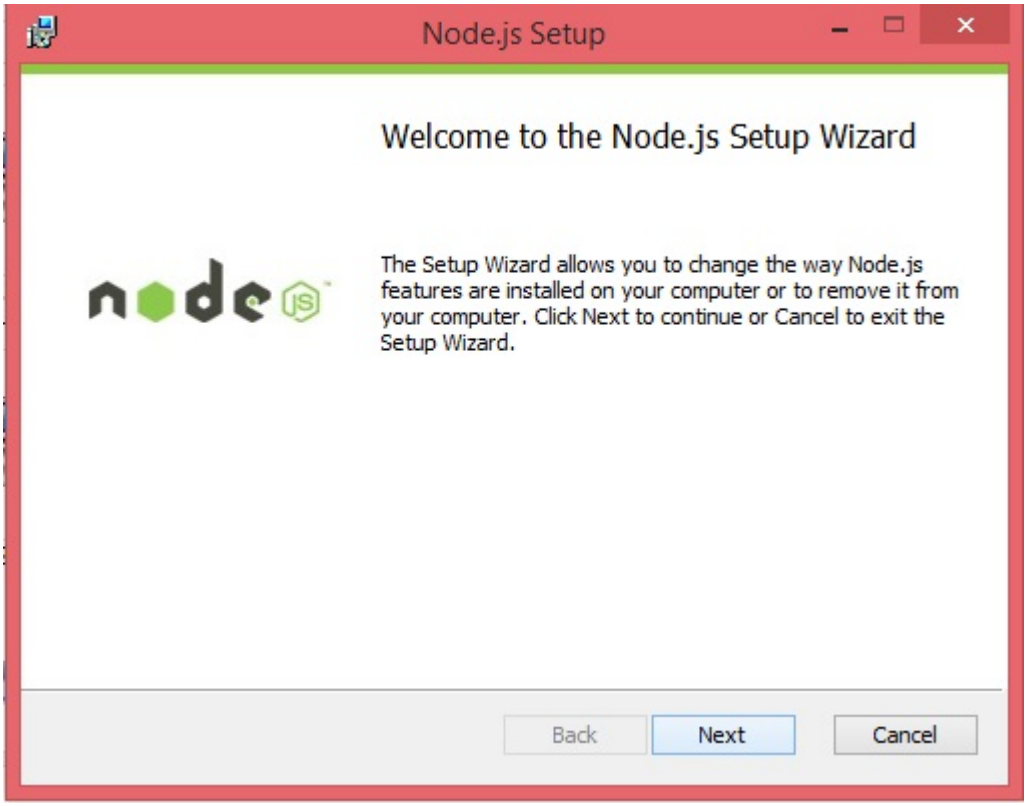
The text editor helps you to write your source code. Examples of few editors include Windows Notepad, Notepad++, Emacs, vim or vi etc. Editors used may vary with the operating systems. The source files are typically named with the **extension .js**

Installing Node.js

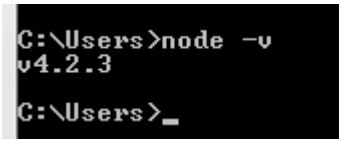
Node.js is an open source, cross-platform runtime environment for server-side JavaScript. Node.js is required to run JavaScript without a browser support. It uses Google V8 JavaScript engine to execute the code. You may download Node.js source code or a pre-built installer for your platform. Node is available at https://nodejs.org/en/download

Installation on Windows

Download and run the **.msi installer** for Node



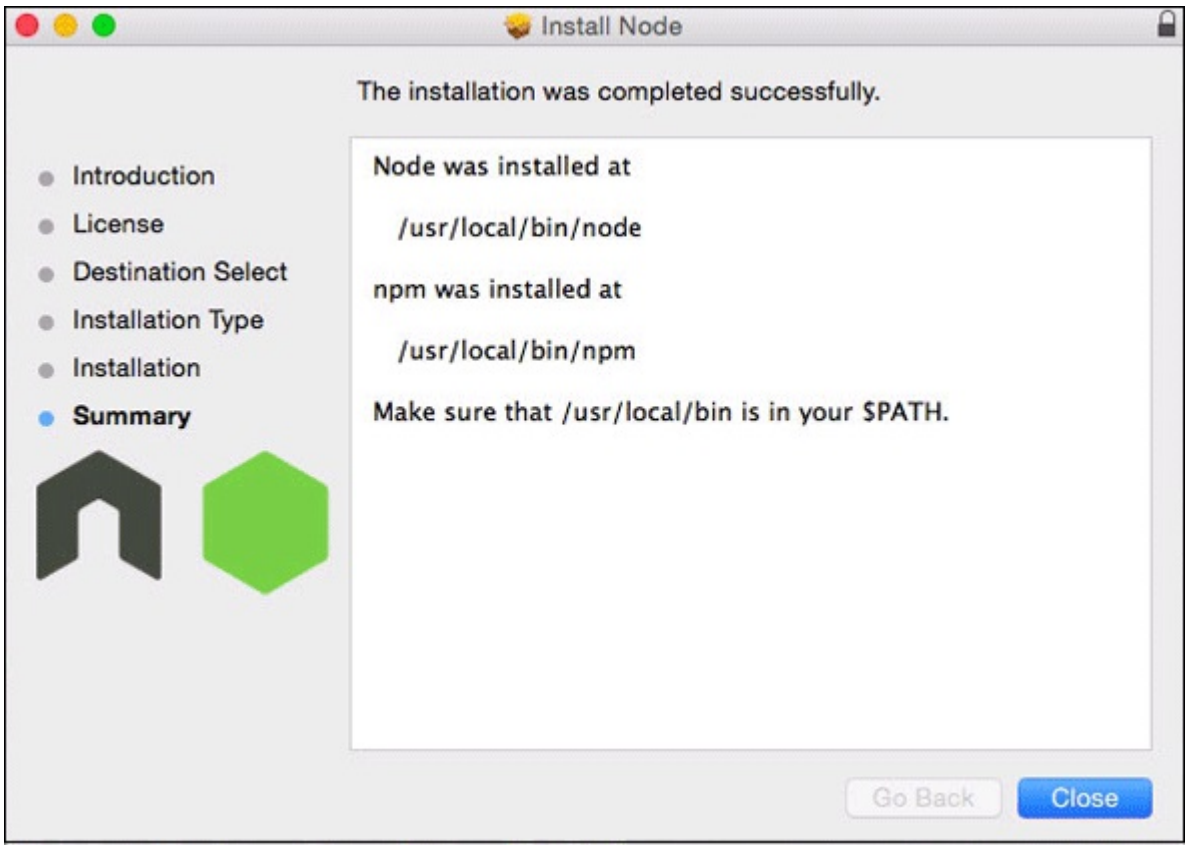
To verify if the installation was successful, enter the command node –v in the terminal window.



Installation on Mac OS X

To install node.js on OS X you can download a pre-compiled binary package which makes a nice and easy installation. Head over to www.nodejs.org and click the install button to download the latest package.

Install the package from the **.dmg** by following along the install wizard which will install both **node** and **npm**. npm is the Node Package Manager which facilitates installs of additional packages for Node.js.



Installation on Linux

You need to install a number of **dependencies** before you can install Node.js and npm.

Ruby and **GCC**. You'll need Ruby 1.8.6 or newer and GCC 4.2 or newer

Homebrew. Homebrew is a package manager originally for the Mac, but it's been ported to Linux as Linuxbrew. You can learn more about Homebrew at the http://brew.sh/ at the http://brew.sh/linuxbrew .

Integrated Development Environment (IDE) Support

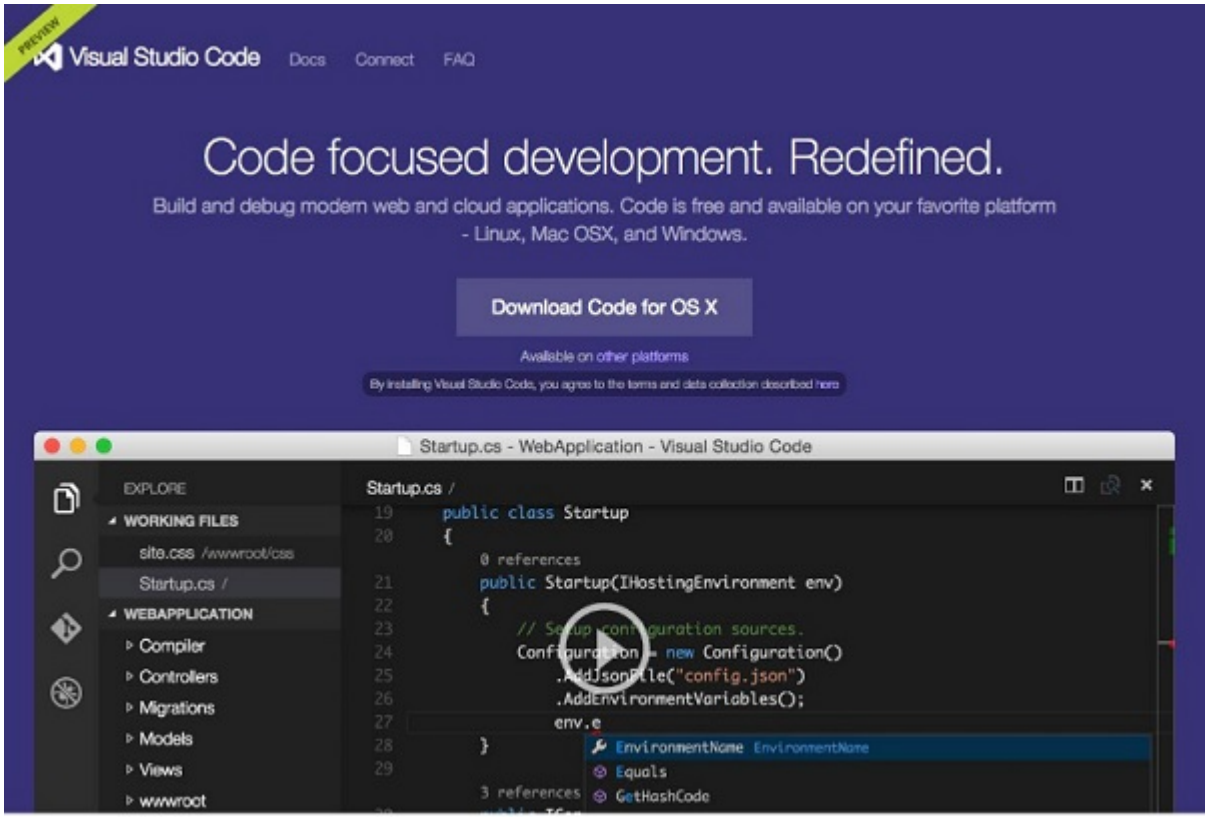
JavaScript can be built on a plethora of development environments like Visual Studio, Sublime Text 2, WebStorm/PHPStorm, Eclipse, Brackets, etc. The Visual Studio Code and Brackets IDE is discussed in this section. The development environment used here is Visual Studio Code (Windows platform).

Visual Studio Code

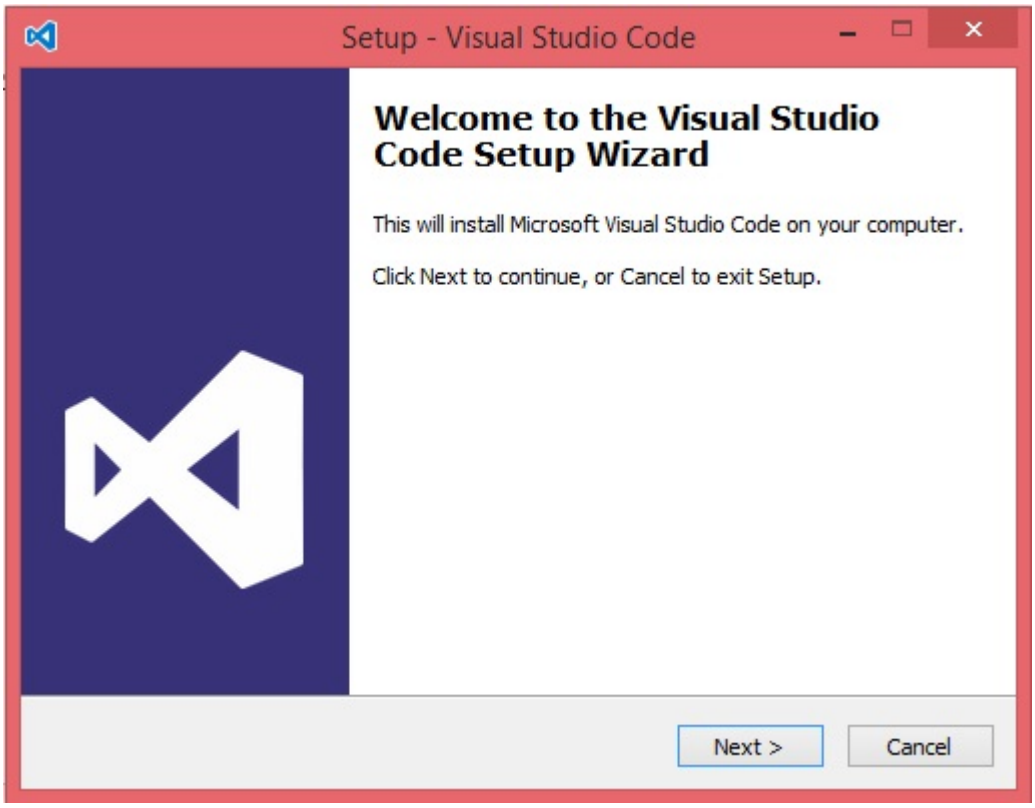
This is open source IDE from Visual Studio. It is available for Mac OS X, Linux, and Windows platforms. VScode is available at https://code.visualstudio.com .

Installation on Windows

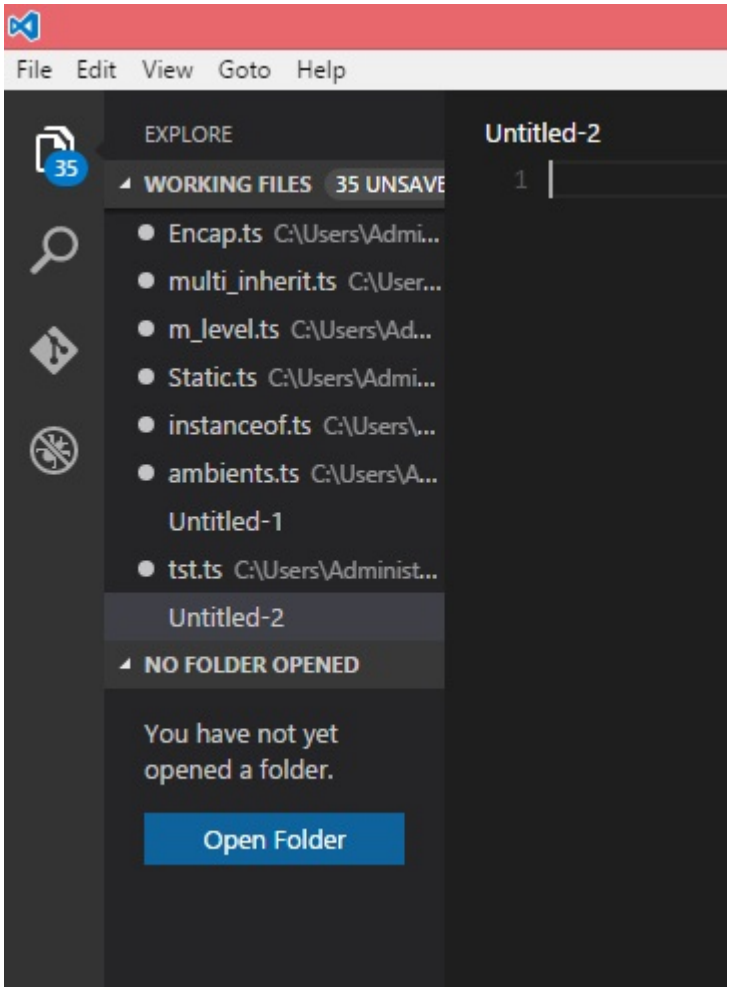
Download Visual Studio Code for Windows.



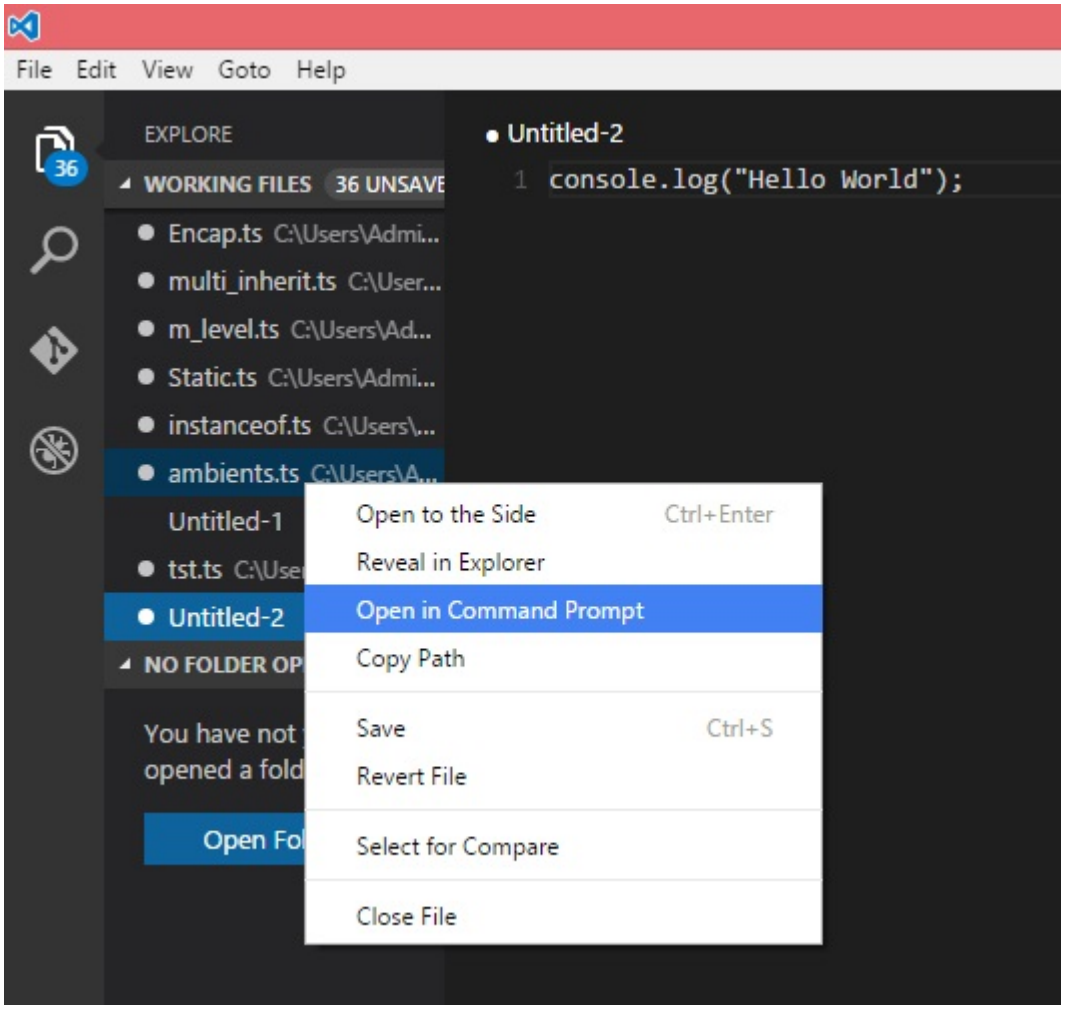
Double-click on VSCodeSetup.exe to launch the setup process. This will only take a minute.



Following is the screenshot of the IDE.



You may directly traverse to the file's path by a right-click on the file → open in command prompt. Similarly, the **Reveal in Explorer** option shows the file in the File Explorer.



Installation on Mac OS X

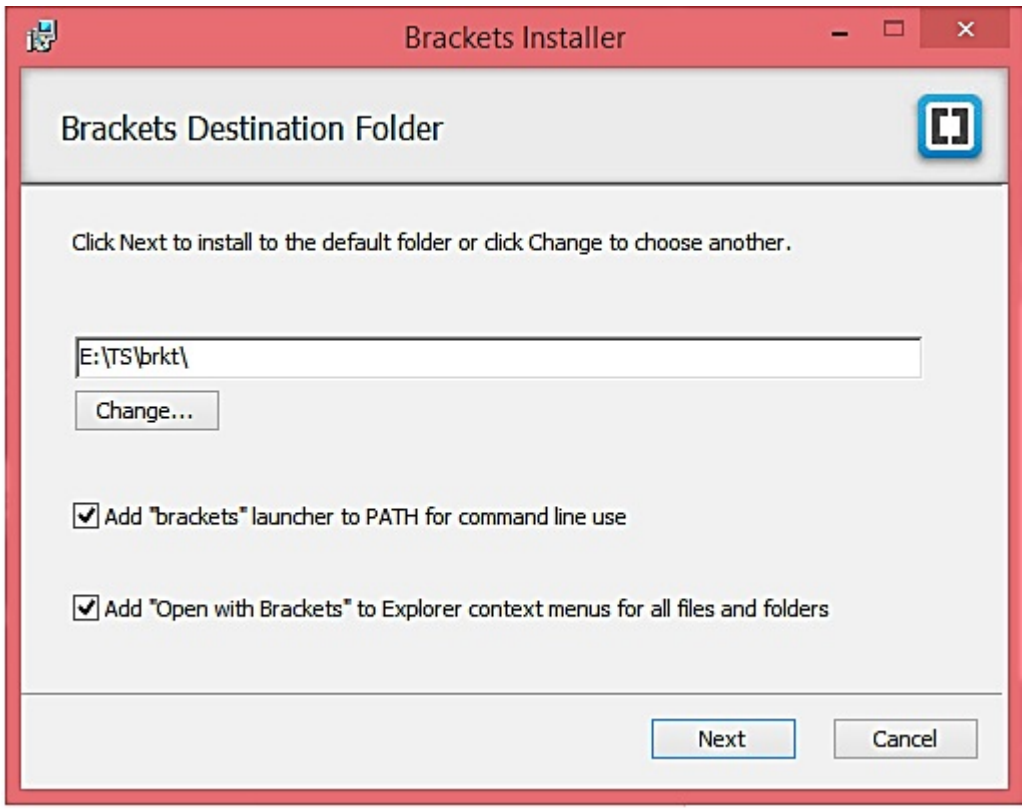
Visual Studio Code's Mac OS X specific installation guide can be found at https://code.visualstudio.com/docs/setup/setup-overview

Installation on Linux

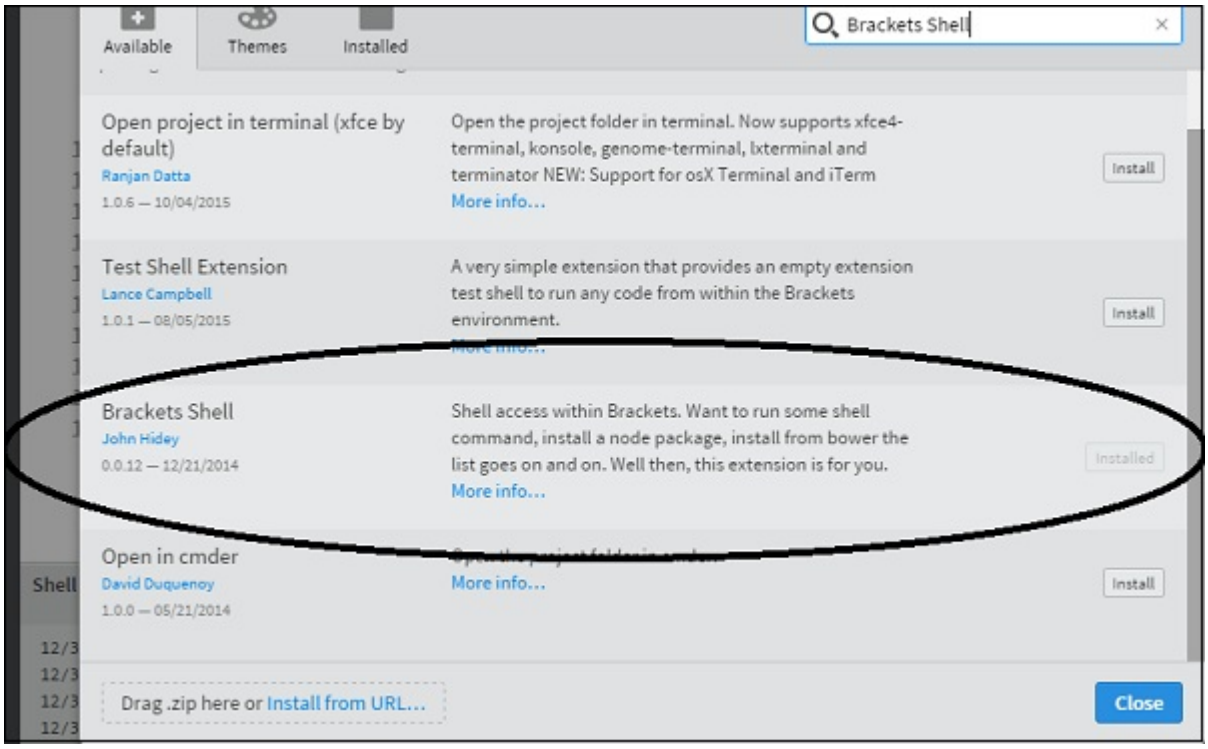
Linux specific installation guide for Visual Studio Code can be found at https://code.visualstudio.com/Docs/editor/setup.

Brackets

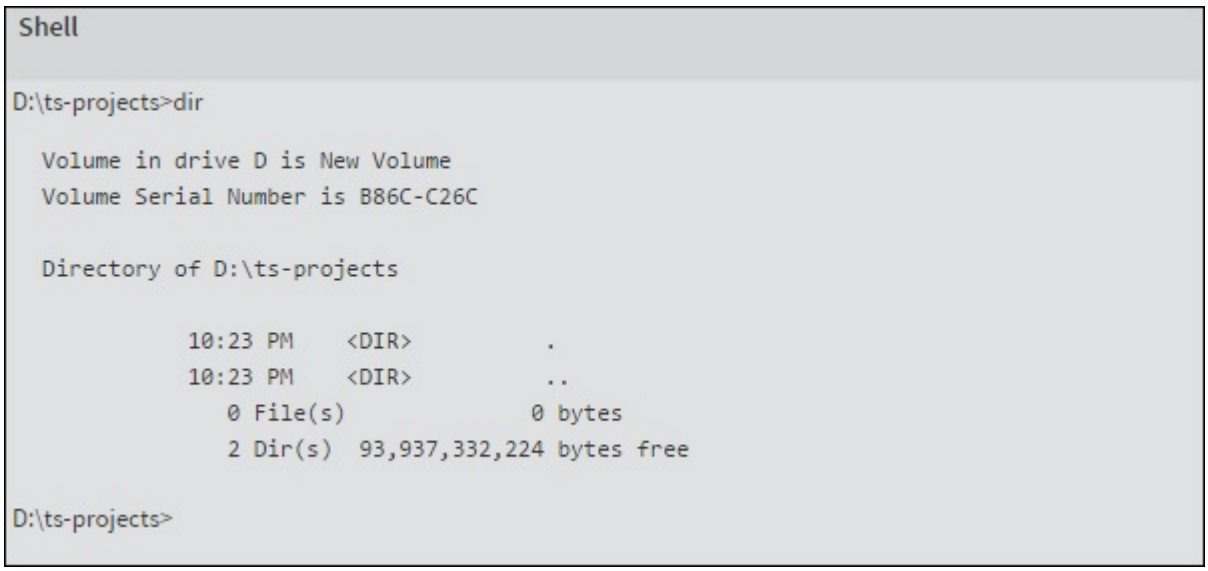
Brackets is a free open-source editor for web development, created by Adobe Systems. It is available for Linux, Windows and Mac OS X. Brackets is available at http://brackets.io .



You can run DOS prompt/Shell within Brackets itself by adding one more extension Brackets Shell.



Upon installation, you will find an icon of shell on the right hand side of the editor  . Once you click on the icon, you will see the shell window as shown in the following screenshot.



You are all set!!!

ES6 - Syntax

Syntax defines the set of rules for writing programs. Every language specification defines its own syntax.

A JavaScript program can be composed of –

Variables – Represents a named memory block that can store values for the program.

Literals – Represents constant/fixed values.

Operators – Symbols that define how the operands will be processed.

Keywords – Words that have a special meaning in the context of a language.

The following table lists some keywords in JavaScript. Some commonly used keywords are listed in the following table.

break	as	any	Switch
case	if	throw	Else
var	number	string	Get
module	type	instanceof	Typeof
finally	for	enum	Export
while	void	this	New
null	super	Catch	let
static	return	True	False

Modules – Represents code blocks that can be reused across different programs/scripts.

Comments – Used to improve code readability. These are ignored by the JavaScript engine.

Identifiers – These are the names given to elements in a program like variables, functions, etc. The rules for identifiers are –

Identifiers can include both, characters and digits. However, the identifier cannot begin with a digit.

Identifiers cannot include special symbols except for underscore (_) or a dollar sign ($).

Identifiers cannot be keywords. They must be unique.

Identifiers are case sensitive. Identifiers cannot contain spaces.

The following table illustrates some valid and invalid identifiers.

Examples of valid identifiers	Examples of invalid identifiers
firstName	Var#
first_name	first name
num1	first-name
$result	1number

Whitespace and Line Breaks

ES6 ignores spaces, tabs, and newlines that appear in programs. You can use spaces, tabs, and newlines freely in your program and you are free to format and indent your programs in a neat and consistent way that makes the code easy to read and understand.

JavaScript is Case-sensitive

JavaScript is case-sensitive. This means that JavaScript differentiates between the uppercase and the lowercase characters.

Semicolons are Optional

Each line of instruction is called a **statement**. Semicolons are optional in JavaScript.

Example

```
console.log("hello world")
console.log("We are learning ES6")
```

A single line can contain multiple statements. However, these statements must be separated by a semicolon.

Comments in JavaScript

Comments are a way to improve the readability of a program. Comments can be used to include additional information about a program like the author of the code, hints about a function/construct, etc. Comments are ignored by the compiler.

JavaScript supports the following types of comments –

Single-line comments (//) – Any text between a // and the end of a line is treated as a comment.

Multi-line comments (/* */) – These comments may span multiple lines.

Example

```
//this is single line comment
/* This is a
Multi-line comment
*/
```

Your First JavaScript Code

Let us start with the traditional “Hello World” example".

```
var message = "Hello World"
console.log(message)
```

The program can be analyzed as –

Line 1 declares a variable by the name message. Variables are a mechanism to store values in a program.

Line 2 prints the variable’s value to the prompt. Here, the console refers to the terminal window. The function log () is used to display the text on the screen.

Executing the Code

We shall use Node.js to execute our code.

Step 1 – Save the file as Test.js

Step 2 – Right-click the Test.js file under the working files option in the project-explorer window of the Visual Studio Code.

Step 3 – Select Open in Command Prompt option.

Step 4 – Type the following command in Node's terminal window.

```
node Test.js
```

The following output is displayed on successful execution of the file.

```
Hello World
```

Node.js and JS/ES6

ECMAScript 2015(ES6) features are classified into three groups –

For Shipping – These are features that V8 considers stable.

Staged Features – These are almost completed features but not considered stable by the V8 team.

In Progress – These features should be used only for testing purposes.

The first category of features is fully supported and turned on by default by node. Staged features require a runtime - - harmony flag to execute.

A list of component specific CLI flags for Node.js can be found here – https://nodejs.org/api/cli.html

The Strict Mode

The fifth edition of the ECMAScript specification introduced the Strict Mode. The Strict Mode imposes a layer of constraint on JavaScript. It makes several changes to normal JavaScript semantics.

The code can be transitioned to work in the Strict Mode by including the following –

```
// Whole-script strict mode syntax
"use strict";
 v = "Hi!  I'm a strict mode script!";  // ERROR: Variable v is not declared
```

In the above snippet, the entire code runs as a constrained variant of JavaScript.

JavaScript also allows to restrict, the Strict Mode within a block's scope as that of a function. This is illustrated as follows –

```
v = 15
function f1() {
   "use strict";
   var v = "Hi!  I'm a strict mode script!";
}
```

In, the above snippet, any code outside the function will run in the non-strict mode. All statements within the function will be executed in the Strict Mode.

ES6 and Hoisting

The JavaScript engine, by default, moves declarations to the top. This feature is termed as **hoisting**. This feature applies to variables and functions. Hoisting allows JavaScript to use a component before it has been declared. However, the concept of hoisting does not apply to scripts that are run in the Strict Mode.

Variable Hoisting and Function Hoisting are explained in the subsequent chapters.

ES6 - Variables

A **variable**, by definition, is "a named space in the memory" that stores values. In other words, it acts as a container for values in a program. Variable names are called **identifiers**. Following are the naming rules for an identifier−

- Identifiers cannot be keywords.
- Identifiers can contain alphabets and numbers.
- Identifiers cannot contain spaces and special characters, except the underscore (_) and the dollar ($) sign.
- Variable names cannot begin with a number.

Type Syntax

A variable must be declared before it is used. ES5 syntax used the **var** keyword to achieve the same. The ES5 syntax for declaring a variable is as follows.

```
//Declaration using var keyword
var  variable_name
```

ES6 introduces the following variable declaration syntax −

- Using the let.
- Using the const.

Variable initialization refers to the process of storing a value in the variable. A variable may be initialized either at the time of its declaration or at a later point in time.

The traditional ES5 type syntax for declaring and initializing a variable is as follows −

```
//Declaration using var keyword
var variable_name = value
```

Example : Using Variables

```
var name = "Tom"
console.log("The value in the variable is: "+name)
```

The above example declares a variable and prints its value.

The following output is displayed on successful execution.

```
The value in the variable is Tom
```

JavaScript and Dynamic Typing

JavaScript is an un-typed language. This means that a JavaScript variable can hold a value of any data type. Unlike many other languages, you don't have to tell JavaScript during variable declaration what type of value the variable will hold. The value type of a variable can change during the execution of a program and JavaScript takes care of it automatically. This feature is termed as **dynamic typing**.

JavaScriptVariable Scope

The scope of a variable is the region of your program in which it is defined. Traditionally, JavaScript defines only two scopes-global and local.

Global Scope – A variable with global scope can be accessed from within any part of the JavaScript code.

Local Scope – A variable with a local scope can be accessed from within a function where it is declared.

Example : Global vs. Local Variable

The following example declares two variables by the name **num** - one outside the function (global scope) and the other within the function (local scope).

```
var num = 10
function test() {
   var num = 100
   console.log("value of num in test() "+num)
}
console.log("value of num outside test() "+num)
test()
```

The variable when referred to within the function displays the value of the locally scoped variable. However, the variable **num** when accessed outside the function returns the globally scoped instance.

The following output is displayed on successful execution.

```
value of num outside test() 10
value of num in test() 100
```

ES6 defines a new variable scope - The Block scope.

The Let and Block Scope

The block scope restricts a variable's access to the block in which it is declared. The **var** keyword assigns a function scope to the variable. Unlike the var keyword, the **let** keyword allows the script to restrict access to the variable to the nearest enclosing block.

```
"use strict"
function test() {
   var num = 100
   console.log("value of num in test() "+num) {
      console.log("Inner Block begins")
      let num = 200
      console.log("value of num : "+num)
   }
}
test()
```

The script declares a variable **num** within the local scope of a function and re-declares it within a block using the let keyword. The value of the locally scoped variable is printed when the variable is accessed outside the inner block, while the block scoped variable is referred to within the inner block.

Note – The strict mode is a way to opt in to a restricted variant of JavaScript.

The following output is displayed on successful execution.

```
value of num in test() 100
Inner Block begins
value of num : 200
```

Example: let v/s var

```
var no = 10;
var no = 20;
console.log(no);
```

The following output is displayed on successful execution of the above code.

```
20
```

Let us re-write the same code using the **let** keyword.

```
let no = 10;
let no = 20;
console.log(no);
```

The above code will throw an error: Identifier 'no' has already been declared. Any variable declared using the let keyword is assigned the block scope.

The const

The **const** declaration creates a read-only reference to a value. It does not mean the value it holds is immutable, just that the variable identifier cannot be reassigned. Constants are block-scoped, much like variables defined using the let statement. The value of a constant cannot change through re-assignment, and it can't be re-declared.

The following rules hold true for a variable declared using the **const** keyword –

Constants cannot be reassigned a value.

A constant cannot be re-declared.

A constant requires an initializer. This means constants must be initialized during its declaration.

The value assigned to a **const** variable is immutable.

Example

```
const x = 10
x = 12 // will result in an error!!
```

The above code will return an error since constants cannot be reassigned a value. Constants variable are immutable.

ES6 and Variable Hoisting

The scope of a variable declared with var is its current execution context, which is either the enclosing function or, for variables declared outside any function, global. Variable hoisting allows the use of a variable in a JavaScript program, even before it is declared.

The following example better explains this concept.

Example: Variable Hoisting

```
var main = function() {
   for(var x = 0;x<5;x++) {
      console.log(x);
   }
   console.log("x can be accessed outside the block scope x value is :"+x);
   console.log('x is hoisted to the function scope');
}
main();
```

The following output is displayed on successful execution of the above code.

```
0
1
2
```

```
3
4
x can be accessed outside the block scope x value is :5
x is hoisted to the function scope
```

The JavaScript engine internally represents the script as –

```
var main = function() {
   var x; // x is hoisted to function scope
   for( x = 0;x<5;x++) {
      console.log(x);
   }
   console.log("x can be accessed outside the block scope x value is :"+x);
   console.log('x is hoisted to the function scope');
}
 main();
```

Note – The concept of hoisting applies to variable declaration but not variable initialization. It is recommended to always declare variables at the top of their scope (the top of global code and the top of function code), to enable the code resolve the variable's scope.

ES6 - Operators

An **expression** is a special kind of statement that evaluates to a value. Every expression is composed of –

Operands – Represents the data.

Operator – Defines how the operands will be processed to produce a value.

Consider the following expression- 2 + 3. Here in the expression, 2 and 3 are operands and the symbol + (plus) is the operator. JavaScript supports the following types of operators –

Arithmetic Operators

Assume the values in variables **a** and **b** are 10 and 5 respectively.

Show Examples

Operator	Function	Example
+	**Addition** Returns the sum of the operands.	a + b is 15
-	**Subtraction** Returns the difference of the values.	a-b is 5

*	**Multiplication** Returns the product of the values.	a*b is 50
/	**Division** Performs a division operation and returns the quotient.	a/b is 2
%	**Modulus** Performs a division and returns the remainder.	a%b is 0
++	**Increment** Increments the value of the variable by one.	a++ is 11
--	**Decrement** Decrements the value of the variable by one.	a-- is 9

Relational Operators

Relational operators test or define the kind of relationship between two entities. Relational operators return a boolean value, i.e. true/false.

Assume the value of A is 10 and B is 20.

Show Examples

Operators	Description	Example
>	Greater than	(A > B) is False
<	Lesser than	(A < B) is True
>=	Greater than or equal to	(A >= B) is False
<=	Lesser than or equal to	(A <= B) is True
==	Equality	(A == B) is False
!=	Not Equal	(A!= B) is True

Logical Operators

Logical operators are used to combine two or more conditions. Logical operators, too, return a Boolean value. Assume the value of variable A is 10 and B is 20.

Show Examples .

Operators	Description	Example
&&	**And** The operator returns true only if all the expressions specified return true.	(A > 10 && B > 10) is False
||	**Or** The operator returns true if at least one of the expressions specified return true.	(A > 10 || B > 10) is True
!	**Not** The operator returns the inverse of the expression's result. For E.g.: !(7>5) returns false.	!(A > 10) is True

Bitwise Operators

JavaScript supports the following bitwise operators. The following table summarizes JavaScript's bitwise operators.

Show Examples .

Operators	Usage	Description
Bitwise AND	a & b	Returns a one in each bit position for which the corresponding bits of both operands are ones
Bitwise OR	a | b	Returns a one in each bit position for which the corresponding bits of either or both operands are ones
Bitwise XOR	a^b	Returns a one in each bit position for which the corresponding bits of either but not both operands are ones
Bitwise NOT	~ a	Inverts the bits of its operand
Left shift	a << b	Shifts a in binary representation b (< 32) bits to the left, shifting in zeroes from the right

Sign-propagating right shift	a >> b	Shifts a in binary representation b (< 32) bits to the right, discarding bits shifted off
Zero-fill right shift	a >>> b	Shifts a in binary representation b (< 32) bits to the right, discarding bits shifted off, and shifting in zeroes from the left

Assignment Operators

The following table summarizes Assignment operators.

Show Examples .

Sr.No	Operator & Description
1	**= (Simple Assignment)** Assigns values from the right side operand to the left side operand. **Example** − C = A + B will assign the value of A + B into C
2	**+= (Add and Assignment)** It adds the right operand to the left operand and assigns the result to the left operand. **Example** − C += A is equivalent to C = C + A
3	**-= (Subtract and Assignment)** It subtracts the right operand from the left operand and assigns the result to the left operand. **Example** C -= A is equivalent to C = C - A
4	***= (Multiply and Assignment)** It multiplies the right operand with the left operand and assigns the result to the left operand. **Example** C *= A is equivalent to C = C * A
5	**/= (Divide and Assignment)** It divides the left operand with the right operand and assigns the result to the left operand.

Note – The same logic applies to Bitwise operators, so they will become <<=, >>=, >>=, &=, |= and ^=.

Miscellaneous Operators

Following are some of the miscellaneous operators.

The negation operator (-)

Changes the sign of a value. The following program is an example of the same.

```
var x = 4
var y = -x;
console.log("value of x: ",x); //outputs 4
console.log("value of y: ",y); //outputs -4
```

The following output is displayed on successful execution of the above program.

```
value of x:  4
value of y:  -4
```

String Operators : Concatenation operator (+)

The + operator when applied to strings appends the second string to the first. The following program helps to understand this concept.

```
var msg = "hello"+"world"
console.log(msg)
```

The following output is displayed on successful execution of the above program.

```
helloworld
```

The concatenation operation doesn't add a space between the strings. Multiple strings can be concatenated in a single statement.

Conditional Operator (?)

This operator is used to represent a conditional expression. The conditional operator is also sometimes referred to as the ternary operator. Following is the syntax.

```
Test ? expr1 : expr2
```

Where,

Test – Refers to the conditional expression

expr1 – Value returned if the condition is true

expr2 – Value returned if the condition is false

Example

```
var num = -2
var result = num > 0 ?"positive":"non-positive"
console.log(result)
```

Line 2 checks whether the value in the variable num is greater than zero. If num is set to a value greater than zero, it returns the string "positive" else a "non-positive" string is returned.

The following output is displayed on successful execution of the above program.

```
non-positive
```

Type Operators

typeof operator

It is a unary operator. This operator returns the data type of the operand. The following table lists the data types and the values returned by the **typeof** operator in JavaScript.

Type	String Returned by typeof
Number	"number"
String	"string"
Boolean	"boolean"
Object	"object"

The following example code displays the number as the output.

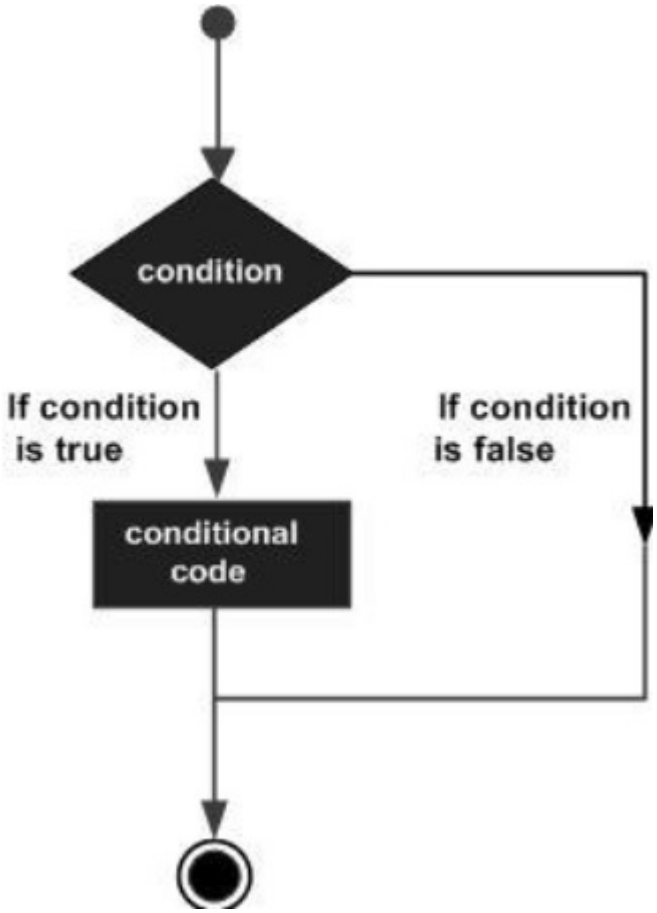
```
var num = 12
console.log(typeof num); //output: number
```

The following output is displayed on successful execution of the above code.

```
number
```

ES6 - Decision Making

A conditional/decision-making construct evaluates a condition before the instruction/s are executed.



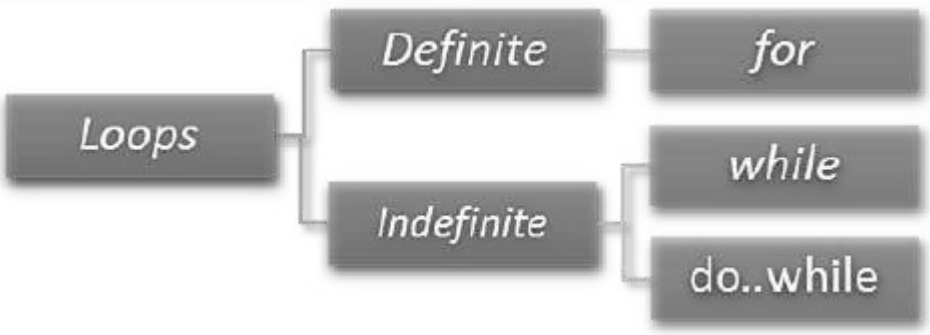
Conditional constructs in JavaScript are classified in the following table.

Sr.No	Statement & Description
1	**if Statement** An 'if' statement consists of a Boolean expression followed by one or more statements .
2	**if...else Statement** An 'if' statement can be followed by an optional 'else' statement, which executes when the Boolean expression is false.
3	**The else.. if ladder/nested if statements** The else…if ladder is useful to test multiple conditions. Following is the syntax of the same.
4	**switch...case Statement** The switch statement evaluates an expression, matches the expression's value to a case clause and executes the statements associated with that case.

ES6 - Loops

At times, certain instructions require repeated execution. Loops are an ideal way to do the same. A loop represents a set of instructions that must be repeated. In a loop's context, a repetition is termed as an **iteration**.

The following figure illustrates the classification of loops –



Definite Loop

A loop whose number of iterations are definite/fixed is termed as a **definite loop**. The 'for loop' is an implementation of a **definite loop**.

```
for (initial_count_value; termination-condition; step) {
   //statements
}
```

Sr.No	Definite Loop & Description
1	**The 'for' loop** The for loop executes the code block for a specified number of times.
2	**The for...in loop** The for loop executes the code block for a specified number of times.
3	**The for...of loop** The for…of loop is used to iterate iterables instead of object literals.

Indefinite Loop

An indefinite loop is used when the number of iterations in a loop is indeterminate or unknown.

Indefinite loops can be implemented using –

Sr.No	Indefinite Loop & Description
1	**The while loop**

	The while loop executes the instructions each time the condition specified evaluates to true.
2	**The do…while loop** The do…while loop is similar to the while loop except that the do...while loop doesn't evaluate the condition for the first time the loop executes.

The Loop Control Statements

Sr.No	Loop Control Statements & Description
1	**The break statement** The break statement is used to take the control out of a construct.
2	**The continue statement** The continue statement skips the subsequent statements in the current iteration and takes the control back to the beginning of the loop.

Using Labels to Control the Flow

A **label** is simply an identifier followed by a colon (:) that is applied to a statement or a block of code. A label can be used with **break** and **continue** to control the flow more precisely.

Line breaks are not allowed between the **'continue'** or **'break'** statement and its label name. Also, there should not be any other statement in between a label name and an associated loop

Sr.No	Label & Description
1	**Label with Break** A label can be used with break and continue to control the flow more precisely.
2	**Label with Continue** Line breaks are not allowed between the 'continue' or 'break' statement and its label name.

ES6 - Functions

Functions are the building blocks of readable, maintainable, and reusable code. Functions are defined using the function keyword. Following is the syntax for defining a standard function.

```
function function_name() {
   // function body
}
```

To force execution of the function, it must be called. This is called as function invocation. Following is the syntax to invoke a function.

```
function_name()
```

Example : Simple function definition

```
//define a  function
function test() {
   console.log("function called")
}
//call the function
test()
```

The example defines a function test(). A pair of delimiters ({ }) define the function body. It is also called as the **function scope**. A function must be invoked to force its execution.

The following output is displayed on successful execution of the above code.

```
function called
```

Classification of Functions

Functions may be classified as **Returning** and **Parameterized** functions.

Returning functions

Functions may also return the value along with control, back to the caller. Such functions are called as returning functions.

Following is the syntax for the returning function.

```
function function_name() {
   //statements
   return value;
}
```

A returning function must end with a return statement.

A function can return at the most one value. In other words, there can be only one return statement per function.

The return statement should be the last statement in the function.

The following code snippet is an example of a returning function –

```
function retStr() {
   return "hello world!!!"
}
var val = retStr()
console.log(val)
```

The above Example defines a function that returns the string "hello world!!!" to the caller. The following output is displayed on successful execution of the above code.

```
hello world!!!
```

Parameterized functions

Parameters are a mechanism to pass values to functions. Parameters form a part of the function's signature. The parameter values are passed to the function during its invocation. Unless explicitly specified, the number of values passed to a function must match the number of parameters defined.

Following is the syntax defining a parameterized function.

```
function func_name( param1,param2 ,…..paramN) {
   ......
   ......
}
```

Example – Parameterized Function

The Example defines a function add that accepts two parameters **n1** and **n2** and prints their sum. The parameter values are passed to the function when it is invoked.

```
function add( n1,n2) {
   var sum = n1 + n2
   console.log("The sum of the values entered "+sum)
}
add(12,13)
```

The following output is displayed on successful execution of the above code.

```
The sum of the values entered 25
```

Default function parameters

In ES6, a function allows the parameters to be initialized with default values, if no values are passed to it or it is undefined. The same is illustrated in the following code.

```
function add(a, b = 1) {
   return a+b;
```

```
}
console.log(add(4))
```

The above function, sets the value of b to 1 by default. The function will always consider the parameter b to bear the value 1 unless a value has been explicitly passed. The following output is displayed on successful execution of the above code.

```
5
```

The parameter's default value will be overwritten if the function passes a value explicitly.

```
function add(a, b = 1) {
   return a + b;
}
console.log(add(4,2))
```

The above code sets the value of the parameter b explicitly to 2, thereby overwriting its default value. The following output is displayed on successful execution of the above code.

```
6
```

Rest Parameters

Rest parameters are similar to variable arguments in Java. Rest parameters doesn't restrict the number of values that you can pass to a function. However, the values passed must all be of the same type. In other words, rest parameters act as placeholders for multiple arguments of the same type.

To declare a rest parameter, the parameter name is prefixed with three periods, known as the spread operator. The following example illustrates the same.

```
function fun1(...params) {
   console.log(params.length);
}
fun1();
fun1(5);
fun1(5, 6, 7);
```

The following output is displayed on successful execution of the above code.

```
0
1
3
```

Note – Rest parameters should be the last in a function's parameter list.

Anonymous Function

Functions that are not bound to an identifier (function name) are called as anonymous functions. These functions are dynamically declared at runtime. Anonymous functions can

accept inputs and return outputs, just as standard functions do. An anonymous function is usually not accessible after its initial creation.

Variables can be assigned an anonymous function. Such an expression is called a **function expression**.

Following is the syntax for anonymous function.

```
var res = function( [arguments] ) { ... }
```

Example – Anonymous Function

```
var f = function(){ return "hello"}
console.log(f())
```

The following output is displayed on successful execution of the above code.

```
hello
```

Example – Anonymous Parameterized Function

```
var func = function(x,y){ return x*y };
function product() {
   var result;
   result = func(10,20);
   console.log("The product : "+result)
}
product()
```

The following output is displayed on successful execution of the above code.

```
The product : 200
```

The Function Constructor

The function statement is not the only way to define a new function; you can define your function dynamically using Function() constructor along with the new operator.

Following is the syntax to create a function using Function() constructor along with the new operator.

```
var variablename = new Function(Arg1, Arg2..., "Function Body");
```

The Function() constructor expects any number of string arguments. The last argument is the body of the function – it can contain arbitrary JavaScript statements, separated from each other by semicolons.

The Function() constructor is not passed any argument that specifies a name for the function it creates.

Example – Function Constructor

```
var func = new Function("x", "y", "return x*y;");
function product() {
   var result;
   result = func(10,20);
   console.log("The product : "+result)
}
product()
```

In the above example, the Function() constructor is used to define an anonymous function. The function accepts two parameters and returns their product.

The following output is displayed on successful execution of the above code.

```
The product : 200
```

Recursion and JavaScript Functions

Recursion is a technique for iterating over an operation by having a function call itself repeatedly until it arrives at a result. Recursion is best applied when you need to call the same function repeatedly with different parameters from within a loop.

Example – Recursion

```
function factorial(num) {
   if(num<=0) {
      return 1;
   } else {
      return (num * factorial(num-1)  )
   }
}
console.log(factorial(6))
```

In the above example the function calls itself. The following output is displayed on successful execution of the above code.

```
720
```

Example – Anonymous Recursive Function

```
(function() {
   var msg = "Hello World"
   console.log(msg)
})()
```

The function calls itself using a pair of parentheses (). The following output is displayed on successful execution of the above code.

```
Hello World
```

Lambda Functions

Lambda refers to anonymous functions in programming. Lambda functions are a concise mechanism to represent anonymous functions. These functions are also called as **Arrow functions**.

Lambda Function - Anatomy

There are 3 parts to a Lambda function –

Parameters – A function may optionally have parameters.

The **fat arrow notation/lambda notation** (=>): It is also called as the goes to operator.

Statements – Represents the function's instruction set.

Tip – By convention, the use of a single letter parameter is encouraged for a compact and precise function declaration.

Lambda Expression

It is an anonymous function expression that points to a single line of code. Following is the syntax for the same.

```
([param1, parma2,…param n] )=>statement;
```

Example – Lambda Expression

```
var foo = (x)=>10+x
console.log(foo(10))
```

The Example declares a lambda expression function. The function returns the sum of 10 and the argument passed.

The following output is displayed on successful execution of the above code.

```
20
```

Lambda Statement

It is an anonymous function declaration that points to a block of code. This syntax is used when the function body spans multiple lines. Following is the syntax of the same.

```
( [param1, parma2,…param n] )=> {
   //code block
}
```

Example – Lambda Statement

```
var msg = ()=> {
   console.log("function invoked")
}
msg()
```

The function's reference is returned and stored in the variable msg. The following output is displayed on successful execution of the above code.

```
function  invoked
```

Syntactic Variations

Optional parentheses for a single parameter.

```
var msg = x=> {
   console.log(x)
}
msg(10)
```

Optional braces for a single statement. Empty parentheses for no parameter.

```
var disp = ()=>console.log("Hello World")
disp();
```

Function Expression and Function Declaration

Function expression and function declaration are not synonymous. Unlike a function expression, a function declaration is bound by the function name.

The fundamental difference between the two is that, function declarations are parsed before their execution. On the other hand, function expressions are parsed only when the script engine encounters it during an execution.

When the JavaScript parser sees a function in the main code flow, it assumes function declaration. When a function comes as a part of a statement, it is a function expression.

Function Hoisting

Like variables, functions can also be hoisted. Unlike variables, function declarations when hoisted, hoists the function definition rather than just hoisting the function's name.

The following code snippet, illustrates function hoisting in JavaScript.

```
hoist_function();
function hoist_function() {
   console.log("foo");
}
```

The following output is displayed on successful execution of the above code.

```
foo
```

However, function expressions cannot be hoisted. The following code snippet illustrates the same.

```
hoist_function(); // TypeError: hoist_function() is not a function
var hoist_function() = function() {
   console.log("bar");
};
```

Immediately Invoked Function Expression

Immediately Invoked Function Expressions (IIFEs) can be used to avoid variable hoisting from within blocks. It allows public access to methods while retaining privacy for variables defined within the function. This pattern is called as a self-executing anonymous function. The following two examples better explain this concept.

Example 1 : IIFE

```
var main = function() {
   var loop = function() {
      for(var x = 0;x<5;x++) {
         console.log(x);
      }
   }();
   console.log("x can not be accessed outside the block scope x value is :"+x);
}
main();
```

Example 2 : IIFE

```
var main = function() {
   (function() {
      for(var x = 0;x<5;x++) {
         console.log(x);
      }
   })();
   console.log("x can not be accessed outside the block scope x value is :"+x);
}
main();
```

Both the Examples will render the following output.

```
0
1
2
3
4
Uncaught ReferenceError: x is not define
```

Generator Functions

When a normal function is invoked, the control rests with the function called until it returns. With generators in ES6, the caller function can now control the execution of a called function. A generator is like a regular function except that –

The function can yield control back to the caller at any point.

When you call a generator, it doesn't run right away. Instead, you get back an iterator. The function runs as you call the iterator's next method.

Generators are denoted by suffixing the function keyword with an asterisk; otherwise, their syntax is identical to regular functions.

The following example illustrates the same.

```
"use strict"
function* rainbow() {
   // the asterisk marks this as a generator
   yield 'red';
   yield 'orange';
   yield 'yellow';
   yield 'green';
   yield 'blue';
   yield 'indigo';
   yield 'violet';
}
for(let color of rainbow()) {
   console.log(color);
}
```

Generators enable two-way communication between the caller and the called function. This is accomplished by using the **yield** keyword.

Consider the following example –

```
function* ask() {
   const name = yield "What is your name?";
   const sport = yield "What is your favorite sport?";
   return `${name}'s favorite sport is ${sport}`;
}
const it = ask();
console.log(it.next());
console.log(it.next('Ethan'));
console.log(it.next('Cricket'));
```

Sequence of the generator function is as follows –

Generator started in paused stated; iterator is returned.

The it.next() yields "What is your name". The generator is paused. This is done by the yield keyword.

The call it.next("Ethan") assigns the value Ethan to the variable name and yields "What is your favorite sport?" Again the generator is paused.

The call it.next("Cricket") assigns the value Cricket to the variable sport and executes the subsequent return statement.

Hence, the output of the above code will be –

```
{
   value: 'What is your name?', done: false
}
{
   value: 'What is your favorite sport?', done: false
}
{
   value: 'Ethan\'s favorite sport is Cricket', done: true
}
```

Note – Generator functions cannot be represented using arrow functions.

ES6 - Events

JavaScript is meant to add interactivity to your pages. JavaScript does this using a mechanism using events. **Events** are a part of the Document Object Model (DOM) Level 3 and every HTML element contains a set of events that can trigger JavaScript Code.

An event is an action or occurrence recognized by the software. It can be triggered by a user or the system. Some common examples of events include a user clicking on a button, loading the web page, clicking on a hyperlink and so on. Following are some of the common HTML events.

Event Handlers

On the occurrence of an event, the application executes a set of related tasks. The block of code that achieves this purpose is called the **eventhandler**. Every HTML element has a set of events associated with it. We can define how the events will be processed in JavaScript by using event handlers.

onclick Event Type

This is the most frequently used event type which occurs when a user clicks the left button of his mouse. You can put your validation, warning, etc. against this event type.

Example

```
<html>
   <head>
      <script type = "text/javascript">
         function sayHello() {
            document.write ("Hello World")
         }
      </script>
   </head>

   <body>
      <p> Click the following button and see result</p>
      <input type = "button" onclick = "sayHello()" value = "Say Hello" />
```

```
   </body>
</html>
```

The following output is displayed on successful execution of the above code.

Click the following button and see result

Say Hello

onsubmitEvent Type

onsubmit is an event that occurs when you try to submit a form. You can put your form validation against this event type.

The following example shows how to use **onsubmit**. Here we are calling a validate() function before submitting a form data to the webserver. If validate() function returns true, the form will be submitted, otherwise it will not submit the data.

Example

```
<html>
   <head>
      <script type = "text/javascript">
         function validation() {
            all validation goes here
            .........
            return either true or false
         }
      </script>
   </head>

   <body>
      <form method = "POST" action = "t.cgi" onsubmit = "return validate()">
         .......
         <input type = "submit" value = "Submit" />
      </form>
   </body>
</html>
```

onmouseover and onmouseout

These two event types will help you create nice effects with images or even with text as well. The **onmouseover** event triggers when you bring your mouse over any element and the **onmouseout** triggers when you move your mouse out from that element.

Example

```
<html>
   <head>
      <script type = "text/javascript">
         function over() {
            document.write ("Mouse Over");
```

```
         }
         function out() {
            document.write ("Mouse Out");
         }
      </script>
   </head>

   <body>
      <p>Bring your mouse inside the division to see the result:</p>
      <div onmouseover = "over()" onmouseout = "out()">
         <h2> This is inside the division </h2>
      </div>
   </body>
</html>
```

The following output is displayed on successful execution of the above code.

Bring your mouse inside the division to see the result:

This is inside the division

HTML 5 Standard Events

The standard HTML 5 events are listed in the following table for your reference. The script indicates a JavaScript function to be executed against that event.

Attribute	Value	Description
offline	script	Triggers when the document goes offline
onabort	script	Triggers on an abort event
onafterprint	script	Triggers after the document is printed
onbeforeonload	script	Triggers before the document load
onbeforeprint	script	Triggers before the document is printed
onblur	script	Triggers when the window loses focus
oncanplay	script	Triggers when the media can start play, but might have to stop for buffering
oncanplaythrough	script	Triggers when the media can be played to the end, without stopping for buffering
onchange	script	Triggers when an element changes
onclick	script	Triggers on a mouse click
oncontextmenu	script	Triggers when a context menu is triggered

ondblclick	script	Triggers on a mouse double-click
ondrag	script	Triggers when an element is dragged
ondragend	script	Triggers at the end of a drag operation
ondragenter	script	Triggers when an element has been dragged to a valid drop target
ondragleave	script	Triggers when an element leaves a valid drop target
ondragover	script	Triggers when an element is being dragged over a valid drop target
ondragstart	script	Triggers at the start of a drag operation
ondrop	script	Triggers when the dragged element is being dropped
ondurationchange	script	Triggers when the length of the media is changed
onemptied	script	Triggers when a media resource element suddenly becomes empty
onended	script	Triggers when the media has reached the end
onerror	script	Triggers when an error occurs
onfocus	script	Triggers when the window gets focus
onformchange	script	Triggers when a form changes
onforminput	script	Triggers when a form gets user input
onhaschange	script	Triggers when the document has changed
oninput	script	Triggers when an element gets user input
oninvalid	script	Triggers when an element is invalid
onkeydown	script	Triggers when a key is pressed
onkeypress	script	Triggers when a key is pressed and released
onkeyup	script	Triggers when a key is released
onload	script	Triggers when the document loads
onloadeddata	script	Triggers when media data is loaded
onloadedmetadata	script	Triggers when the duration and other media data of a media element is loaded

onloadstart	script	Triggers when the browser starts to load the media data
onmessage	script	Triggers when the message is triggered
onmousedown	script	Triggers when a mouse button is pressed
onmousemove	script	Triggers when the mouse pointer moves
onmouseout	script	Triggers when the mouse pointer moves out of an element
onmouseover	script	Triggers when the mouse pointer moves over an element
onmouseup	script	Triggers when a mouse button is released
onmousewheel	script	Triggers when the mouse wheel is being rotated
onoffline	script	Triggers when the document goes offline
ononline	script	Triggers when the document comes online
onpagehide	script	Triggers when the window is hidden
onpageshow	script	Triggers when the window becomes visible
onpause	script	Triggers when the media data is paused
onplay	script	Triggers when the media data is going to start playing
onplaying	script	Triggers when the media data has start playing
onpopstate	script	Triggers when the window's history changes
onprogress	script	Triggers when the browser is fetching the media data
onratechange	script	Triggers when the media data's playing rate has changed
onreadystatechange	script	Triggers when the ready-state changes
onredo	script	Triggers when the document performs a redo
onresize	script	Triggers when the window is resized
onscroll	script	Triggers when an element's scrollbar is being scrolled
onseeked	script	Triggers when a media element's seeking attribute is no longer true, and the seeking has ended
onseeking	script	Triggers when a media element's seeking attribute is true, and the seeking has begun
onselect	script	Triggers when an element is selected

onstalled	script	Triggers when there is an error in fetching media data
onstorage	script	Triggers when a document loads
onsubmit	script	Triggers when a form is submitted
onsuspend	script	Triggers when the browser has been fetching media data, but stopped before the entire media file was fetched
ontimeupdate	script	Triggers when the media changes its playing position
onundo	script	Triggers when a document performs an undo
onunload	script	Triggers when the user leaves the document
onvolumechange	script	Triggers when the media changes the volume, also when the volume is set to "mute"
onwaiting	script	Triggers when the media has stopped playing, but is expected to resume

ES6 - Cookies

Web Browsers and Servers use HTTP protocol to communicate. HTTP is stateless protocol, i.e., it doesn't maintain the client's data across multiple requests made by the client. This complete request-response cycle between the client and the server is defined as a **session**. Cookies are the default mechanism used by browsers to store data pertaining to a user's session.

How It Works?

Your server sends some data to the visitor's browser in the form of a cookie. The browser may accept the cookie. If it does, it is stored as a plain text record on the visitor's hard drive. Now, when the visitor arrives at another page on your site, the browser sends the same cookie to the server for retrieval. Once retrieved, your server knows/remembers what was stored earlier.

Cookies are plain text data record of 5 variable-length fields.

Expires – The date the cookie will expire. If this is blank, the cookie will expire when the visitor quits the browser.

Domain – The domain name of your site.

Path – The path to the directory or web page that sets the cookie. This may be blank, if you want to retrieve the cookie from any directory or page.

Secure – If this field contains the word "secure", then the cookie may only be retrieved with a secure server. If this field is blank, no such restriction exists.

Name = Value – Cookies are set and retrieved in the form of key-value pairs.

Cookies were originally designed for CGI programming. The data contained in a cookie is automatically transmitted between the web browser and the web server, so CGI scripts on the server can read and write cookie values that are stored on the client side.

JavaScript can also manipulate cookies using the cookie property of the Document object. JavaScript can read, create, modify, and delete the cookies that apply to the current web page.

Storing Cookies

The simplest way to create a cookie is to assign a string value to the **document.cookie** object, which looks like this.

```
"document.cookie = "key1 = value1; key2 = value2; expires = date";
```

Here, the 'expires' attribute is optional. If you provide this attribute with a valid date or time, then the cookie will expire on the given date or time and thereafter, the cookies' value will not be accessible.

Note – Cookie values may not include semicolons, commas, or whitespace. For this reason, you may want to use the JavaScript **escape()** function to encode the value before storing it in the cookie. If you do this, you will also have to use the corresponding **unescape()** function when you read the cookie value.

Example

```
<html>
   <head>
      <script type = "text/javascript">
         function WriteCookie() {
            if( document.myform.customer.value == "" ){
               alert ("Enter some value!");
               return;
            }
            cookievalue =  escape(document.myform.customer.value) + ";";
            document.cookie = "name = " + cookievalue;
            document.write ("Setting Cookies : " + "name = " + cookievalue );
         }
      </script>
   </head>

   <body>
      <form name = "myform" action = "">
         Enter name: <input type = "text" name = "customer"/>
         <input type = "button" value = "Set" onclick = "WriteCookie();"/>
      </form>
```

```
   </body>
</html>
```

The following output is displayed on successful execution of the above code.

Now your machine has a cookie called name. You can set multiple cookies using multiple key = value pairs separated by comma.

Reading Cookies

Reading a cookie is just as simple as writing one, because the value of the **document.cookie** object is the cookie. So you can use this string whenever you want to access the cookie. The **document.cookie** string will keep a list of name = value pairs separated by semicolons, where the name is the name of a cookie and the value is its string value.

You can use strings' **split()** function to break a string into key and values as shown in the following example.

Example

```
<html>
   <head>
      <script type = "text/javascript">
         function ReadCookie() {
            var allcookies  =  document.cookie;
            document.write ("All Cookies : " + allcookies );
         }
         // Get all the cookies pairs in an array
         cookiearray = allcookies.split(';');

         // Now take key value pair out of this array
         for(var i = 0; i<cookiearray.length; i++) {
            name  =  cookiearray[i].split('=')[0];
            value = cookiearray[i].split('=')[1];
            document.write ("Key is : " + name + " and Value is : " + value);
         }
      </script>
   </head>

   <body>
      <form name = "myform" action = "">
         <p> click the following button and see the result:</p>
         <input type = "button" value = "Get Cookie" onclick = "ReadCookie()"/>
      </form>
   </body>
</html>
```

Note – Here, length is a method of Array class which returns the length of an array.

There may be some other cookies already set on your machine. The above code will display all the cookies set on your machine.

The following output is displayed on successful execution of the above code.

click the following button and see the result:

Get Cookie

Setting Cookies Expiry Date

You can extend the life of a cookie beyond the current browser session by setting an expiry date and saving the expiry date within the cookie. This can be done by setting the 'expires' attribute to a date and time. The following example illustrates how to extend the expiry date of a cookie by 1 month.

Example

```
<html>
   <head>
      <script type = "text/javascript">
         function WriteCookie() {
            var now = new Date();
            now.setMonth( now.getMonth() + 1 );
            cookievalue = escape(document.myform.customer.value) + ";"
            document.cookie = "name = " + cookievalue;
            document.cookie = "expires = " + now.toUTCString() + ";"
            document.write ("Setting Cookies : " + "name = " + cookievalue );
         }
      </script>
   </head>

   <body>
      <form name = "formname" action = "">
         Enter Cookie Name: <input type = "text" name = "customer"/>
         <input type = "button" value = "Set Cookie" onclick = "WriteCookie()"/>
      </form>
   </body>
</html>
```

The following output is displayed on successful execution of the above code.

Enter Cookie Name: Set Cookie

Deleting a Cookie

Sometimes you will want to delete a cookie so that subsequent attempts to read the cookie return nothing. To do this, you just need to set the expiry date to a time in the

past. The following example illustrates how to delete a cookie by setting its expiry date to one month behind the current date.

Example

```
<html>
   <head>
      <script type = "text/javascript">
         function WriteCookie() {
            var now = new Date();
            now.setMonth( now.getMonth() - 1 );
            cookievalue = escape(document.myform.customer.value) + ";"
            document.cookie = "name=" + cookievalue;
            document.cookie = "expires = " + now.toUTCString() + ";"
            document.write("Setting Cookies : " + "name = " + cookievalue );
         }
      </script>
   </head>

   <body>
      <form name = "formname" action = "">
         Enter Cookie Name: <input type = "text" name = "customer"/>
         <input type = "button" value = "Set Cookie" onclick = "WriteCookie()"/>
      </form>
   </body>
</html>
```

The following output is displayed on successful execution of the above code.

Enter Cookie Name: Set Cookie

ES6 - Page Redirect

Redirect is a way to send both users and search engines to a different URL from the one they originally requested. Page redirection is a way to automatically redirect a web page to another web page. The redirected page is often on the same website, or it can be on a different website or a web server.

JavaScript Page Redirection

window.location and window.location.href

In JavaScript, you can use many methods to redirect a web page to another one. Almost all methods are related to **window.location** object, which is a property of the Window object. It can be used to get the current URL address (web address) and to redirect the browser to a new page. Both usages are same in terms of behavior. **window.location** returns an object. If **.href** is not set, **window.location** defaults to change the parameter **.href**.

Example

```
<!DOCTYPE html>
<html>
   <head>
      <script>
         function newLocation() {
            window.location = "http://www.xyz.com";
         }
      </script>
   </head>

   <body>
      <input type = "button" value = "Go to new location" onclick = "newLocation()">
   </body>
</html>
```

location.replace()

The other most frequently used method is the **replace()** method of window.location object, it will replace the current document with a new one. In replace() method, you can pass a new URL to replace() method and it will perform an HTTP redirect.

Following is the syntax for the same.

```
window.location.replace("http://www.abc.com
```

location.assign()

The location.assign() method loads a new document in the browser window.

Following is the syntax for the same.

```
window.location.assign("http://www.abc.org");
```

assign() vs. replace()

The difference between assign() and replace() method is that the location.replace() method deletes the current URL from the document history, so it is unable to navigate back to the original document. You can't use the browsers "Back" button in this case. If you want to avoid this situation, you should use location.assign() method, because it loads a new Document in the browser.

location.reload()

The location.reload() method reloads the current document in the browser window.

Following is the syntax for the same.

```
window.location.reload("http://www.yahoo.com");
```

window.navigate()

The window.navigate() method is similar to assigning a new value to the window.location.href property. Because it is only available in MS Internet Explorer, so you should avoid using this in cross-browser development.

Following is the syntax for the same.

```
window.navigate("http://www.abc.com");
```

Redirection and Search Engine Optimization

If you want to notify the search engines (SEO) about your URL forwarding, you should add the rel = "canonical" meta tag to your website head part because search engines don't analyze JavaScript to check the redirection.

Following is the syntax for the same.

```
<link rel = "canonical" href = "http://abc.com/" />
```

ES6 - Dialog Boxes

JavaScript supports three important types of dialog boxes. These dialog boxes can be used to raise and alert, or to get confirmation on any input or to have a kind of input from the users. Here we will discuss each dialog box one by one.

Alert Dialog Box

An alert dialog box is mostly used to send a warning message to the users. For example, if one input field requires to enter some text but the user does not provide any input, then as a part of validation, you can use an alert box to send a warning message.

Nonetheless, an alert box can still be used for friendlier messages. Alert box provides only one button "OK" to select and proceed.

Example

```
<html>
   <head>
      <script type = "text/javascript">
         function Warn() {
            alert ("This is a warning message!");
            document.write ("This is a warning message!");
         }
      </script>
   </head>

   <body>
      <p>Click the following button to see the result: </p>
      <form>
         <input type = "button" value = "Click Me" onclick = "Warn();" />
      </form>
   </body>
</html>
```

The following output is displayed on successful execution of the above code.

Click the following button to see the result:

Click Me

Confirmation Dialog Box

A confirmation dialog box is mostly used to take the user's consent on any option. It displays a dialog box with two buttons: OK and Cancel.

If the user clicks on the OK button, the window method **confirm()** will return true. If the user clicks on the Cancel button, then confirm() returns false. You can use a confirmation dialog box as follows.

Example

```
<html>
   <head>
      <script type = "text/javascript">
         function getConfirmation(){
            var retVal = confirm("Do you want to continue ?");

            if( retVal == true ){
               document.write ("User wants to continue!");
               return true;
            } else {
               Document.write ("User does not want to continue!");
               return false;
            }
         }
      </script>
   </head>

   <body>
      <p>Click the following button to see the result: </p>
      <form>
         <input type = "button" value = "Click Me" onclick = "getConfirmation();" />
      </form>
   </body>
</html>
```

The following output is displayed on successful execution of the above code.

Click the following button to see the result:

Click Me

Prompt Dialog Box

The prompt dialog box is very useful when you want to pop-up a text box to get a user input. Thus, it enables you to interact with the user. The user needs to fill in the field and

then click OK.

This dialog box is displayed using a method called **prompt()** which takes two parameters: (i) a label which you want to display in the text box and (ii) a default string to display in the text box.

This dialog box has two buttons: OK and Cancel. If the user clicks the OK button, the window method prompt() will return the entered value from the text box. If the user clicks the Cancel button, the window method prompt() returns null.

Example

```
<html>
   <head>
      <script type = "text/javascript">
         function getValue(){
            var retVal = prompt("Enter your name : ", "your name here");
            document.write("You have entered : " + retVal);
         }
      </script>
   </head>

   <body>
      <p>Click the following button to see the result: </p>
      <form>
         <input type = "button" value = "Click Me" onclick = "getValue();" />
      </form>
   </body>
</html>
```

The following output is displayed on successful execution of the above code.

Click the following button to see the result:

Click Me

ES6 - Void Keyword

void is an important keyword in JavaScript which can be used as a unary operator that appears before its single operand, which may be of any type. This operator specifies an expression to be evaluated without returning a value. The operator evaluates a given expression and then returns undefined.

Following is the syntax for the same.

```
void expression
```

Void and Immediately Invoked Function Expressions

When using an immediately-invoked function expression, void can be used to force the function keyword to be treated as an expression instead of a declaration.

Consider the following example –

```
void function iife_void() {
   var msg = function () {console.log("hello world")};
   msg();
}();
```

The following output is displayed on successful execution of the above code.

```
hello world
```

Void and JavaScript URIs

The **JavaScript: URI** is a commonly encountered syntax in a HTML page. The browser evaluates the URI and replaces the content of the page with the value returned. This is true unless the value returned is undefined. The most common use of this operator is in a client-side **JavaScript: URL**, where it allows you to evaluate an expression for its sideeffects without the browser displaying the value of the evaluated expression.

Consider the following code snippet –

```
<a href = "javascript:void(javascript:alert('hello world!!'))">
  Click here to do nothing
</a>
<br/><br/><br/>
<a href = "javascript:alert('hello');">Click here for an alert</a>
```

Save the above file as an HTML document and open it in the browser. The first hyperlink, when clicked evaluates the javascript :alert("hello") and is passed to the void() operator. However, since the void operator returns undefined, no result is displayed on the page.

On the other hand, the second hyperlink when clicked displays an alert dialog.

ES6 - Page Printing

Many times you would like to place a button on your webpage to print the content of that web page via an actual printer. JavaScript helps you implement this functionality using the print function of the window object.

The JavaScript print function **window.print()** prints the current webpage when executed. You can call this function directly using the onclick event as shown in the following example.

Example

```
<html>
   <body>
      <form>
         <input type = "button" value = "Print" onclick = "window.print()"/>
      </form>
   </body>
</html>
```

The following output is displayed on successful execution of the above code.

Print

ES6 - Objects

JavaScript supports extending data types. JavaScript objects are a great way to define custom data types.

An **object** is an instance which contains a set of key value pairs. Unlike primitive data types, objects can represent multiple or complex values and can change over their life time. The values can be scalar values or functions or even array of other objects.

The syntactic variations for defining an object is discussed further.

Object Initializers

Like the primitive types, objects have a literal syntax: **curly bracesv** ({and}). Following is the syntax for defining an object.

```
var identifier = {
   Key1:value, Key2: function () {
      //functions
   },
   Key3: [“content1”,” content2”]
}
```

The contents of an object are called **properties** (or members), and properties consist of a **name** (or key) and **value**. Property names must be strings or symbols, and values can be any type (including other objects).

Like all JavaScript variables, both the object name (which could be a normal variable) and the property name are case sensitive. You access the properties of an object with a simple dot-notation.

Following is the syntax for accessing Object Properties.

```
objectName.propertyName
```

Example: Object Initializers

```
var person = {
   firstname:"Tom",
   lastname:"Hanks",
   func:function(){return "Hello!!"},
};
//access the object values
console.log(person.firstname)
console.log(person.lastname)
console.log(person.func())
```

The above Example, defines an object person. The object has three properties. The third property refers to a function.

The following output is displayed on successful execution of the above code.

```
Tom
Hanks
Hello!!
```

In ES6, assigning a property value that matches a property name, you can omit the property value.

Example

```
var foo = 'bar'
var baz = { foo }
console.log(baz.foo)
```

The above code snippet defines an object **baz**. The object has a property **foo**. The property value is omitted here as ES6 implicitly assigns the value of the variable foo to the object's key foo.

Following is the ES5 equivalent of the above code.

```
var foo = 'bar'
var baz = { foo:foo }
console.log(baz.foo)
```

The following output is displayed on successful execution of the above code.

```
bar
```

With this shorthand syntax, the JS engine looks in the containing scope for a variable with the same name. If it is found, that variable's value is assigned to the property. If it is not found, a Reference Error is thrown.

The Object() Constructor

JavaScript provides a special constructor function called **Object()** to build the object. The new operator is used to create an instance of an object. To create an object, the new operator is followed by the constructor method.

Following is the syntax for defining an object.

```
var obj_name = new Object();
obj_name.property = value;
OR
obj_name["key"] = value
```

Following is the syntax for accessing a property.

```
Object_name.property_key
OR
Object_name["property_key"]
```

Example

```
var myCar = new Object();
myCar.make = "Ford"; //define an object
myCar.model = "Mustang";
myCar.year = 1987;

console.log(myCar["make"]) //access the object property
console.log(myCar["model"])
console.log(myCar["year"])
```

The following output is displayed on successful execution of the above code.

```
Ford
Mustang
1987
```

Unassigned properties of an object are undefined.

Example

```
var myCar = new Object();
myCar.make = "Ford";
console.log(myCar["model"])
```

The following output is displayed on successful execution of the above code.

```
undefined
```

Note – An object property name can be any valid JavaScript string, or anything that can be converted to a string, including the empty string. However, any property name that is not a valid JavaScript identifier (for example, a property name that has a space or a hyphen, or that starts with a number) can only be accessed using the square bracket notation.

Properties can also be accessed by using a string value that is stored in a variable. In other words, the object's property key can be a dynamic value. For example: a variable. The said concept is illustrated in the following example.

Example

```
var myCar = new Object()
var propertyName = "make";
myCar[propertyName] = "Ford";
console.log(myCar.make)
```

The following output is displayed on successful execution of the above code.

```
Ford
```

Constructor Function

An object can be created using the following two steps –

Step 1 – Define the object type by writing a constructor function.

Following is the syntax for the same.

```
function function_name() {
   this.property_name = value
}
```

The 'this' keyword refers to the current object in use and defines the object's property.

Step 2 – Create an instance of the object with the new syntax.

```
var Object_name= new function_name()
//Access the property value

Object_name.property_name
```

The new keyword invokes the function constructor and initializes the function's property keys.

Example – Using a Function Constructor

```
function Car() {
   this.make = "Ford"
   this.model = "F123"
}
var obj = new Car()
console.log(obj.make)
console.log(obj.model)
```

The above example uses a function constructor to define an object.

The following output is displayed on successful execution of the above code.

```
Ford
F123
```

A new property can always be added to a previously defined object. For example, consider the following code snippet –

```
function Car() {
   this.make = "Ford"
}
var obj = new Car()
obj.model = "F123"
console.log(obj.make)
console.log(obj.model)
```

The following output is displayed on successful execution of the above code.

```
Ford
F123
```

The Object.create Method

Objects can also be created using the **Object.create()** method. It allows you to create the prototype for the object you want, without having to define a constructor function.

Example

```
var roles = {
   type: "Admin", // Default value of properties
   displayType : function() {
      // Method which will display type of role
      console.log(this.type);
   }
}
// Create new role type called super_role
var super_role = Object.create(roles);
super_role.displayType(); // Output:Admin

// Create new role type called Guest
var guest_role = Object.create(roles);
guest_role.type = "Guest";
guest_role.displayType(); // Output:Guest
```

The above example defines an object -roles and sets the default values for the properties. Two new instances are created that override the default properties value for the object.

The following output is displayed on successful execution of the above code.

```
Admin
Guest
```

The Object.assign() Function

The **Object.assign()** method is used to copy the values of all enumerable own properties from one or more source objects to a target object. It will return the target object.

Following is the syntax for the same.

```
Object.assign(target, ...sources)
```

Example – Cloning an Object

```
"use strict"
var det = { name:"Tom", ID:"E1001" };
var copy = Object.assign({}, det);
console.log(copy);
for (let val in copy) {
   console.log(copy[val])
}
```

The following output is displayed on successful execution of the above code.

```
Tom
E1001
```

Example – Merging Objects

```
var o1 = { a: 10 };
var o2 = { b: 20 };
var o3 = { c: 30 };
var obj = Object.assign(o1, o2, o3);
console.log(obj);
console.log(o1);
```

The following output is displayed on successful execution of the above code.

```
{ a: 10, b: 20, c: 30 }
{ a: 10, b: 20, c: 30 }
```

Note – Unlike copying objects, when objects are merged, the larger object doesn't maintain a new copy of the properties. Rather it holds the reference to the properties contained in the original objects. The following example explains this concept.

```
var o1 = { a: 10 };
var obj = Object.assign(o1);
obj.a++
console.log("Value of 'a' in the Merged object after increment  ")
console.log(obj.a);
console.log("value of 'a' in the Original Object after increment ")
console.log(o1.a);
```

The following output is displayed on successful execution of the above code.

```
Value of 'a' in the Merged object after increment
11
value of 'a' in the Original Object after increment
11
```

Deleting Properties

You can remove a property by using the delete operator. The following code shows how to remove a property.

Example

```
// Creates a new object, myobj, with two properties, a and b.
var myobj = new Object;
myobj.a = 5;
myobj.b = 12;

// Removes the ‘a’ property
delete myobj.a;
console.log ("a" in myobj) // yields "false"
```

The following output is displayed on successful execution of the above code.

```
false
```

The code snippet deletes the property from the object. The example prints false as the in operator doesn’t find the property in the object.

Comparing Objects

In JavaScript, objects are a reference type. Two distinct objects are never equal, even if they have the same properties. This is because, they point to a completely different memory address. Only those objects that share a common reference yields true on comparison.

Example 1 – Different Object References

```
var val1 = {name: "Tom"};
var val2 = {name: "Tom"};
console.log(val1 == val2)  // return false
console.log(val1 === val2)  // return false
```

In the above example, **val1** and **val2** are two distinct objects that refer to two different memory addresses. Hence on comparison for equality, the operator will return false.

Example 2 – Single Object Reference

```
var val1 = {name: "Tom"};
var val2 = val1

console.log(val1 == val2) // return true
console.log(val1 === val2) // return true
```

In the above example, the contents in val1 are assigned to val2, i.e. the reference of the properties in val1 are shared with val2. Since, the objects now share the reference to the property, the equality operator will return true for two distinct objects that refer to two

different memory addresses. Hence on comparison for equality, the operator will return false.

Object De-structuring

The term **destructuring** refers to breaking up the structure of an entity. The destructuring assignment syntax in JavaScript makes it possible to extract data from arrays or objects into distinct variables. The same is illustrated in the following example.

Example

```
var emp = { name: 'John', Id: 3 }
var {name, Id} = emp
console.log(name)
console.log(Id)
```

The following output is displayed on successful execution of the above code.

```
John
3
```

Note – To enable destructuring, execute the file in ***node as node – harmony_destructuring file_name***.

ES6 - Number

The Number object represents numerical date, either integers or floating-point numbers. In general, you do not need to worry about Number objects because the browser automatically converts number literals to instances of the number class.

Following is the syntax for creating a number object.

```
var val = new Number(number);
```

In the place of **number**, if you provide any non-number argument, then the argument cannot be converted into a **number**, it returns NaN (Not-a-Number).

Number Properties

Sr.No	Property & Description
1	**Number.EPSILON** The smallest interval between two representable numbers.
2	**Number.MAX_SAFE_INTEGER** The maximum safe integer in JavaScript (2^53 - 1).
3	**Number.MAX_VALUE**

	The largest positive representable number.
4	**MIN_SAFE_INTEGER** The minimum safe integer in JavaScript (-(2^53 - 1)).
5	**Number.MIN_VALUE** The smallest positive representable number - that is, the positive number closest to zero (without actually being zero)
6	**Number.Nan** Special "not a number" value
7	**Number.NEGATIVE_INFINITY** Special value representing negative infinity; returned on overflow
8	**Number.POSITIVE_INFINITY** Special value representing infinity; returned on overflow
9	**Number.prototype** Special value representing infinity; returned on overflow

Number Methods

Sr.No	Method & Description
1	**Number.isNaN()** Determines whether the passed value is NaN.
2	**Number.isFinite()** Determines whether the passed value is a finite number.
3	**Number.isInteger()** Determines whether the passed value is an integer.
4	**Number.isSafeInteger()** Determines whether the passed value is a safe integer (number between -(253 - 1) and 253- 1)
5	**Number.parseFloat()** The value is the same as parseFloat() of the global object

6	**Number.parseInt()** The value is the same as parseInt() of the global object

Number Instances Methods

The Number object contains only the default methods that are a part of every object's definition.

Sr.No	Instance Method & Description
1	**toExponential()** Returns a string representing the number in exponential notation
2	**toFixed()** Returns a string representing the number in fixed-point notation
3	**toLocaleString()** Returns a string with a language sensitive representation of this number
4	**toPrecision()** Returns a string representing the number to a specified precision in fixed-point or exponential notation
5	**toString()** Returns a string representing the specified object in the specified radix (base)
6	**valueOf()** Returns the primitive value of the specified object.

Binary and Octal Literals

Before ES6, your best bet when it comes to binary or octal representation of integers was to just pass them to parseInt() with the radix. In ES6, you could use the 0b and 0o prefix to represent binary and octal integer literals respectively. Similarly, to represent a hexadecimal value, use the **0x** prefix.

The prefix can be written in upper or lower case. However, it is suggested to stick to the lowercase version.

Example – Binary Representation

```
console.log(0b001)
console.log(0b010)
console.log(0b011)
console.log(0b100)
```

The following output is displayed on successful execution of the above code.

```
1
2
3
4
```

Example – Octal Representation

```
console.log(0x010)
console.log(0x100)
```

The following output is displayed on successful execution of the above code.

```
16
256
```

Example – Hexadecimal Representation

```
console.log(0x010)
console.log(0x100)
```

The following output is displayed on successful execution of the above code.

```
16
256
```

ES6 - Boolean

The Boolean object represents two values, either **"true"** or **"false"**. If the value parameter is omitted or is 0, -0, null, false, NaN, undefined, or the empty string (""), the object has an initial value of false.

Use the following syntax to create a **boolean object**.

```
var val = new Boolean(value);
```

Boolean Properties

Following is a list of the properties of Boolean object.

Sr.No	Property & Description
1	**constructor** Returns a reference to the Boolean function that created the object.

2	**prototype** The prototype property allows you to add properties and methods to an object.

Boolean Methods

Following is a list of the methods of Boolean object and their description.

Sr.No	Method & Description
1	**toSource()** Returns a string containing the source of the Boolean object; you can use this string to create an equivalent object.
2	**toString()** Returns a string of either "true" or "false" depending upon the value of the object.
3	**valueOf()** Returns the primitive value of the Boolean object.

ES6 - Strings

The String object lets you work with a series of characters; it wraps JavaScript's string primitive data type with a number of helper methods.

As JavaScript automatically converts between string primitives and String objects, you can call any of the helper methods of the String object on a string primitive.

Use the following syntax to create a String object.

```
var val = new String(string);
```

The string parameter is a series of characters that has been properly encoded. String.

String Properties

Following is a list of the properties of String object and its description.

Sr.No	Property & Description
1	**constructor** Returns a reference to the String function that created the object .
2	**length**

	Returns the length of the string.
3	**Prototype** The prototype property allows you to add properties and methods to an object .

String Methods

Here is a list of the methods available in String object along with their description.

Sr.No	Method & Description
1	**charAt()** Returns the character at the specified index.
2	**charCodeAt()** Returns a number indicating the Unicode value of the character at the given index.
3	**concat()** Combines the text of two strings and returns a new string.
4	**indexOf()** Returns the index within the calling String object of the first occurrence of the specified value, or -1 if not found.
5	**lastIndexOf()** Returns the index within the calling String object of the last occurrence of the specified value, or -1 if not found.
6	**localeCompare()** Returns a number indicating whether a reference string comes before or after or is the same as the given string in a sorted order.
7	**match()** Used to match a regular expression against a string.
8	**replace()** Used to find a match between a regular expression and a string, and to replace the matched substring with a new substring.
9	**search()**

	Executes the search for a match between a regular expression and a specified string.
10	**slice()** Extracts a section of a string and returns a new string.
11	**split()** Splits a String object into an array of strings by separating the string into substrings.
12	**substr()** Returns the characters in a string beginning at the specified location through the specified number of characters.
13	**substring()** Returns the characters in a string between two indexes into the string.
14	**toLocaleLowerCase()** The characters within a string are converted to lower case while respecting the current locale.
15	**toLocaleupperCase()** The characters within a string are converted to uppercase while respecting the current locale.
16	**toLowerCase()** Returns the calling string value converted to lowercase.
17	**toString()** Returns a string representing the specified object.
18	**toUpperCase()** Returns the calling string value converted to uppercase.
19	**valueOf()** Returns the primitive value of the specified object.

ES6 - New String Methods

Following is a list of methods with their description.

Sr.No	Method & Description
1	**String.prototype.startsWith(searchString, position = 0)** Returns true if the receiver starts with searchString; the position lets you specify where the string to be checked starts.
2	**String.prototype.endsWith(searchString, endPosition = searchString.length)** Returns true if the receiver starts with searchString; the position lets you specify where the string to be checked starts.
3	**String.prototype.includes(searchString, position = 0)** Returns true if the receiver contains searchString; position lets you specify where the string to be searched starts.
4	**String.prototype.repeat(count)** Returns the receiver, concatenated count times.

Template Literals

Template literals are string literals that allow embedded expressions. **Templatestrings** use back-ticks (``) rather than the single or double quotes. A template string could thus be written as –

```
var greeting = `Hello World!`;
```

String Interpolation and Template literals

Template strings can use placeholders for string substitution using the ${ } syntax, as demonstrated.

Example 1

```
var name = "Brendan";
console.log('Hello, ${name}!');
```

The following output is displayed on successful execution of the above code.

```
Hello, Brendan!
```

Example 2: Template literals and expressions

```
var a = 10;
var b = 10;
console.log(`The sum of ${a} and ${b} is  ${a+b} `);
```

The following output is displayed on successful execution of the above code.

```
The sum of 10 and 10 is 20
```

Example 3: Template literals and function expression

```
function fn() { return "Hello World"; }
console.log(`Message: ${fn()} !!`);
```

The following output is displayed on successful execution of the above code.

```
Message: Hello World !!
```

Multiline Strings and Template Literals

Template strings can contain multiple lines.

Example

```
var multiLine = `
   This is
   a string
   with multiple
   lines`;
console.log(multiLine)
```

The following output is displayed on successful execution of the above code.

```
This is
a string
with multiple
line
```

String.raw()

ES6 includes the tag function String.raw for raw strings, where backslashes have no special meaning. **String.raw** enables us to write the backslash as we would in a regular expression literal. Consider the following example.

```
var text =`Hello \n World`
console.log(text)

var raw_text = String.raw`Hello \n World `
console.log(raw_text)
```

The following output is displayed on successful execution of the above code.

```
Hello
World
Hello \n World
```

String.fromCodePoint()

The static String.**fromCodePoint()** method returns a string created by using the specified sequence of unicode code points. The function throws a RangeError if an invalid code point is passed.

```
console.log(String.fromCodePoint(42))
console.log(String.fromCodePoint(65, 90))
```

The following output is displayed on successful execution of the above code.

```
*
AZ
```

ES6 - Arrays

The use of variables to store values poses the following limitations –

- Variables are scalar in nature. In other words, a variable declaration can only contain a single at a time. This means that to store n values in a program, n variable declarations will be needed. Hence, the use of variables is not feasible when one needs to store a larger collection of values.
- Variables in a program are allocated memory in random order, thereby making it difficult to retrieve/read the values in the order of their declaration.

JavaScript introduces the concept of arrays to tackle the same.

An array is a homogenous collection of values. To simplify, an array is a collection of values of the same data type. It is a user-defined type.

Features of an Array

- An array declaration allocates sequential memory blocks.
- Arrays are static. This means that an array once initialized cannot be resized.
- Each memory block represents an array element.
- Array elements are identified by a unique integer called as the subscript/index of the element.
- Arrays too, like variables, should be declared before they are used.
- Array initialization refers to populating the array elements.
- Array element values can be updated or modified but cannot be deleted.

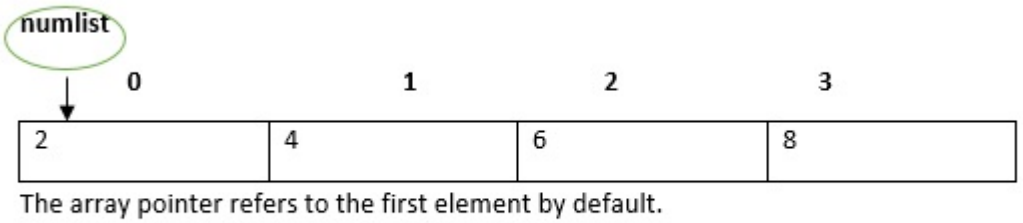
Declaring and Initializing Arrays

To declare and initialize an array in JavaScript use the following syntax –

```
var array_name; //declaration
array_name = [val1,val2,valn..]   //initialization
OR
var array_name = [val1,val2…valn]
```

Note – The pair of [] is called the dimension of the array.

For example, a declaration like: **var numlist = [2,4,6,8]** will create an array as shown in the following figure.



The array pointer refers to the first element by default.

Accessing Array Elements

The array name followed by the subscript is used to refer to an array element.

Following is the syntax for the same.

```
array_name[subscript]
```

Example: Simple Array

```
var alphas;
alphas = ["1","2","3","4"]
console.log(alphas[0]);
console.log(alphas[1]);
```

The following output is displayed on successful execution of the above code.

```
1
2
```

Example: Single Statement Declaration and Initialization

```
var nums = [1,2,3,3]
console.log(nums[0]);
console.log(nums[1]);
console.log(nums[2]);
console.log(nums[3]);
```

The following output is displayed on successful execution of the above code.

```
1
2
3
3
```

Array Object

An array can also be created using the Array object. The Array constructor can be passed as –

A numeric value that represents the size of the array or.

A list of comma separated values.

The following Examples create an array using this method.

Example

```
var arr_names = new Array(4)
for(var i = 0;i<arr_names.length;i++) {
   arr_names[i] = i * 2
   console.log(arr_names[i])
}
```

The following output is displayed on successful execution of the above code.

```
0
2
4
6
```

Example: Array Constructor Accepts Comma-separated Values

```
var names = new Array("Mary","Tom","Jack","Jill")
for(var i = 0;i<names.length;i++) {
   console.log(names[i])
}
```

The following output is displayed on successful execution of the above code.

```
Mary
Tom
Jack
Jill
```

Array Methods

Following is the list of the methods of the Array object along with their description.

Sr.No	Method & Description
1	**concat()** Returns a new array comprised of this array joined with other array(s) and/or value(s)
2	**every()** Returns true if every element in this array satisfies the provided testing function.
3	**filter()** Creates a new array with all of the elements of this array for which the provided filtering function returns true.
4	**forEach()** Calls a function for each element in the array.
5	**indexOf()** Returns the first (least) index of an element within the array equal to the specified value, or -1 if none is found.
6	**join()** Joins all elements of an array into a string.
7	**lastIndexOf()** Returns the last (greatest) index of an element within the array equal to the specified value, or -1 if none is found.
8	**map()** Creates a new array with the results of calling a provided function on every element in this array.
9	**pop()** Removes the last element from an array and returns that element.
10	**push()** Adds one or more elements to the end of an array and returns the new length of the array.
11	**reduce()** Applies a function simultaneously against two values of the array (from left-to-right) as to reduce it to a single value.

12	**reduceRight()** Applies a function simultaneously against two values of the array (from right-to-left) as to reduce it to a single value.
13	**reverse()** Reverses the order of the elements of an array -- the first becomes the last, and the last becomes the first.
14	**shift()** Removes the first element from an array and returns that element slice.
15	**slice()** Extracts a section of an array and returns a new array.
16	**some()** Returns true if at least one element in this array satisfies the provided testing function.
17	**toSource()** Represents the source code of an object.
18	**sort()** Sorts the elements of an array.
19	**splice()** Adds and/or removes elements from an array.
20	**toString()** Returns a string representing the array and its elements.
21	**unshift()** Adds one or more elements to the front of an array and returns the new length of the array.

ES6 – Array Methods

Following are some new array methods introduced in ES6.

Array.prototype.find

find lets you iterate through an array and get the first element back that causes the given callback function to return true. Once an element has been found, the function immediately returns. It's an efficient way to get at just the first item that matches a given condition.

Example

```
var numbers = [1, 2, 3];
var oddNumber = numbers.find((x) => x % 2 == 1);
console.log(oddNumber); // 1
```

The following output is displayed on successful execution of the above code.

```
1
```

Note – The ES5 **filter()** and the ES6 **find()** are not synonymous. Filter always returns an array of matches (and will return multiple matches), find always returns the actual element.

Array.prototype.findIndex

findIndex behaves similar to find, but instead of returning the element that matched, it returns the index of that element.

```
var numbers = [1, 2, 3];
var oddNumber = numbers.findIndex((x) => x % 2 == 1);
console.log(oddNumber); // 0
```

The above example will return the index of the value 1 (0) as output.

Array.prototype.entries

entries is a function that returns an Array Iterator that can be used to loop through the array's keys and values. Entries will return an array of arrays, where each child array is an array of [index, value].

```
var numbers = [1, 2, 3];
var val = numbers.entries();
console.log(val.next().value);
console.log(val.next().value);
console.log(val.next().value);
```

The following output is displayed on successful execution of the above code.

```
[0,1]
[1.2]
[2,3]
```

Alternatively, we can also use the spread operator to get back an array of the entries in one go.

```
var numbers = [1, 2, 3];
var val= numbers.entries();
console.log([...val]);
```

The following output is displayed on successful execution of the above code.

```
[[0,1],[1,2],[2,3]]
```

Array.from

Array.from() enables the creation of a new array from an array like object. The basic functionality of Array.from() is to convert two kinds of values to Arrays –

Array-like values.

Iterable values like Set and Map.

Example

```
"use strict"
for (let i of Array.from('hello')) {
   console.log(i)
}
```

The following output is displayed on successful execution of the above code.

```
h
e
l
l
o
```

Array.prototype.keys()

This function returns the array indexes.

Example

```
console.log(Array.from(['a', 'b'].keys()))
```

The following output is displayed on successful execution of the above code.

```
[ 0, 1 ]
```

Array Traversal using for...in loop

One can use the for… in loop to traverse through an array.

```
"use strict"
var nums = [1001,1002,1003,1004]
```

```
for(let j in nums) {
   console.log(nums[j])
}
```

The loop performs an index-based array traversal. The following output is displayed on successful execution of the above code.

```
1001
1002
1003
1004
```

Arrays in JavaScript

JavaScript supports the following concepts about Arrays –

Sr.No	Concept & Description
1	**Multi-dimensional arrays** JavaScript supports multidimensional arrays. The simplest form of the multidimensional array is the two-dimensional array
2	**Passing arrays to functions** You can pass to the function a pointer to an array by specifying the array's name without an index.
3	**Return array from functions** Allows a function to return an array.

Array De-structuring

JavaScript supports de-structuring in the context of an array.

Example

```
var arr = [12,13]
var[x,y] = arr
console.log(x)
console.log(y)
```

The following output is displayed on successful execution of the above code.

```
12
13
```

ES6 - Date

The **Date object** is a datatype built into the JavaScript language. Date objects are created with the new **Date ()** as shown in the following syntax.

Once a Date object is created, a number of methods allow you to operate on it. Most methods simply allow you to get and set the year, month, day, hour, minute, second, and millisecond fields of the object, using either local time or UTC (universal, or GMT) time.

The ECMAScript standard requires the Date object to be able to represent any date and time, to millisecond precision, within 100 million days before or after 1/1/1970. This is a range of plus or minus 273,785 years, so JavaScript can represent date and time till the year 275755.

You can use any of the following syntax to create a Date object using **Date () constructor**.

```
new Date( )
new Date(milliseconds)
new Date(datestring)
new Date(year,month,date[,hour,minute,second,millisecond ])
```

Note – Parameters in the brackets are always optional.

Date Properties

Here is a list of the properties of the Date object along with their description.

Sr.No	Property & Description
1	**constructor** Specifies the function that creates an object's prototype
2	**prototype** The prototype property allows you to add properties and methods to an object

Date Methods

Following is a list of different date methods along with the description.

Sr.No	Method & Description
1	**Date()** Returns today's date and time
2	**getDate()** Returns the day of the month for the specified date according to the local time

3	**getDay()** Returns the day of the week for the specified date according to the local time
4	**getFullYear()** Returns the year of the specified date according to the local time
5	**getHours()** Returns the hour in the specified date according to the local time
6	**getMilliseconds()** Returns the milliseconds in the specified date according to the local time
7	**getMinutes()** Returns the minutes in the specified date according to the local time
8	**getMonth()** Returns the month in the specified date according to the local time
9	**getSeconds()** Returns the seconds in the specified date according to the local time
10	**getTime()** Returns the numeric value of the specified date as the number of milliseconds since January 1, 1970, 00:00:00 UTC
11	**getTimezoneOffset()** Returns the time-zone offset in minutes for the current locale
12	**getUTCDate()** Returns the day (date) of the month in the specified date according to the universal time
13	**getUTCDay()** Returns the day of the week in the specified date according to the universal time
14	**getUTCFullYear()** Returns the year in the specified date according to the universal time
15	**getutcHours()** Returns the hours in the specified date according to the universal time

16	**getUTCMilliseconds()** Returns the milliseconds in the specified date according to the universal time
17	**getUTCMinutes()** Returns the minutes in the specified date according to the universal time
18	**getUTCMonth()** Returns the month in the specified date according to the universal time
19	**getUTCSeconds()** Returns the seconds in the specified date according to the universal time
20	**setDate()** Sets the day of the month for a specified date according to the local time
21	**setFullYear()** Sets the full year for a specified date according to the local time
22	**setHours()** Sets the hours for a specified date according to the local time
23	**setMilliseconds()** Sets the milliseconds for a specified date according to the local time
24	**setMinutes()** Sets the minutes for a specified date according to the local time
25	**setMonth()** Sets the month for a specified date according to the local time
26	**setSeconds()** Sets the seconds for a specified date according to the local time
27	**setTime()** Sets the Date object to the time represented by a number of milliseconds since January 1, 1970, 00:00:00 UTC
28	**setUTCDate()** Sets the Date object to the time represented by a number of milliseconds since January 1, 1970, 00:00:00 UTC
29	**setUTCFullYear()**

	Sets the full year for a specified date according to the universal time
30	**setUTCHours()** Sets the hour for a specified date according to the universal time
31	**setUTCMilliseconds()** Sets the milliseconds for a specified date according to the universal time
32	**setUTCMinutes()** Sets the minutes for a specified date according to the universal time
33	**setUTCMonth()** Sets the month for a specified date according to the universal time
34	**setUTCSeconds()** Sets the seconds for a specified date according to the universal time
35	**todatestring()** Returns the "date" portion of the Date as a human-readable string
36	**toLocaleDateString()** Returns the "date" portion of the Date as a string, using the current locale's conventions
37	**toLocaleString()** Converts a date to a string, using the current locale's conventions
38	**toLocaleTimeString()** Returns the "time" portion of the Date as a string, using the current locale's conventions
39	**toString()** Returns a string representing the specified Date object
40	**toTimeString()** Returns the "time" portion of the Date as a human-readable string
41	**toUTCString()** Converts a date to a string, using the universal time convention
42	**valueOf()**

	Returns the primitive value of a Date object

ES6 - Math

The math object provides you properties and methods for mathematical constants and functions. Unlike other global objects, **Math** is not a constructor. All the properties and methods of Math are static and can be called by using Math as an object without creating it.

Math Properties

Following is a list of all Math properties and its description.

Sr.No	Property & Description
1	**E** Euler's constant and the base of natural logarithms, approximately 2.718
2	**LN2** Natural logarithm of 2, approximately 0.693
3	**LN10** Natural logarithm of 10, approximately 2.302
4	**LOG2E** Base 2 logarithm of E, approximately 1.442
5	**LOG10E** Base 10 logarithm of E, approximately 0.434
6	**PI** Ratio of the circumference of a circle to its diameter, approximately 3.14159
7	**SQRT1_2** Square root of 1/2; equivalently, 1 over the square root of 2, approximately 0.707
8	**SQRT2** Square root of 2, approximately 1.414

Exponential Functions

The basic exponential function is **Math.pow()**, and there are convenience functions for square root, cube root, and powers of e, as shown in the following table.

Sr.No	Function & Description
1	**Math.pow(x, y)** Returns **x** raised to the power **y**
2	**Math.sqrt(x)** Returns the square root of the number **x**
3	**Math.cbrt(x)** This method returns the cube root of a number **x**
4	**Math.exp(x)** Equivalent to Math.pow(Math.E, x)
5	**Math.expm1(x)** Equivalent to Math.exp(x) – 1
6	**Math.hypot(x1, x2,…)** Returns the square root of the sum of arguments

Logarithmic Functions

The basic natural logarithm function is **Math.log ()**. In JavaScript, "log" means "natural logarithm." ES6 introduced Math.log10 for convenience.

Sr.No	Function & Description
1	**Math.log(x)** Natural logarithm of **x**
2	**Math.log10(x)** Base 10 logarithm of **x**
3	**Math.log2(x)** Base 2 logarithm of **x**
4	**Math.log1p(x)** Natural logarithm of **1 + x**

Miscellaneous Algebraic Functions

Following is a list of miscellaneous algebraic functions with their description.

Sr.No	Function & Description
1	**Math.abs(x)** Absolute value of x
2	**Math.sign(x)** The sign of x: if x is negative,−1; if x is positive, 1; and if x is 0, 0
3	**Math.ceil(x)** The ceiling of x: the smallest integer greater than or equal to x
4	**Math.floor(x)** The floor of x: the largest integer less than or equal to x
5	**Math.trunc(x)** The integral part of x (all fractional digits are removed)
6	**Math.round(x)** x rounded to the nearest integer
7	**Math.min(x1, x2,...)** Returns the minimum argument
8	**Math.max((x1, x2,...)** Returns the minimum argument

Trigonometric Functions

All trigonometric functions in the Math library operate on radians, not degrees.

Sr.No	Function & Description
1	**Math.sin(x)** Sine of x radians
2	**Math.cos(x)** Cosine of x radians

3	**Math.tan(x)** Tangent of x radians
4	**Math.asin(x)** Inverse sine (arcsin) of x (result in radians)
5	**Math.acos(x)** Inverse cosine (arccos) of x (result in radians)
6	**Math.atan(x)** Inverse tangent (arctan) of x (result in radians)
7	**Math.atan2(y, x0)** Counterclockwise angle (in radians) from the x-axis to the point (x, y)

Math.random()

The **Math.random()** function returns a pseudorandom number between 0 (inclusive) and 1 (exclusive).

Example: Pseudorandom Number Generation (PRNG)

```
var value1 = Math.random();
console.log("First Test Value : " + value1 );

var value2 = Math.random();
console.log("Second Test Value : " + value2 );

var value3 = Math.random();
console.log("Third Test Value : " + value3 );

var value4 = Math.random();
console.log("Fourth Test Value : " + value4 );
```

Output

```
First Test Value : 0.5782922627404332
Second Test Value : 0.5624510529451072
Third Test Value : 0.9336334094405174
Fourth Test Value : 0.4002739654388279
```

ES6 - RegExp

A regular expression is an object that describes a pattern of characters. Regular expressions are often abbreviated "**regex**" or "**regexp**".

The JavaScript **RegExp** class represents regular expressions, and both String and RegExp define methods that use regular expressions to perform powerful pattern-matching and search-and-replace functions on the text.

A regular expression can be defined as –

```
var pattern = new RegExp(pattern, attributes);
OR
var pattern = /pattern/attributes;
```

The attribute can have any combination of the following values.

Sr.No	Attribute & Description
1	**G** Global Match
2	**I** Ignore case
3	**M** Multiline; treat the beginning and end characters (^ and $) as working over multiple lines (i.e., match the beginning or the end of each line (delimited by \n or \r), not only the very beginning or end of the whole input string)
4	**U** Unicode; treat the pattern as a sequence of unicode code points
5	**Y** Sticky; matches only from the index indicated by the lastIndex property of this regular expression in the target string (and does not attempt to match from any later indexes)

Constructing Regular Expressions

Brackets

Brackets ([]) have a special meaning when used in the context of regular expressions. They are used to find a range of characters.

Sr.No	Expression & Description

1	**[...]** Any one character between the brackets
2	**[^...]** Any one character not between the brackets
3	**[0-9]** It matches any decimal digit from 0 through 9
4	**[a-z]** It matches any character from lowercase **a** through lowercase **z**
5	**[A-Z]** It matches any character from uppercase **A** through uppercase Z
6	**[a-Z]** It matches any character from lowercase **a** through uppercase Z

The ranges shown above are general; you could also use the range [0-3] to match any decimal digit ranging from 0 through 3, or the range [b-v] to match any lowercase character ranging from b through v.

Quantifiers

The frequency or position of the bracketed character sequences and the single characters can be denoted by a special character. Each special character has a specific connotation. The **+, *, ?,** and **$** flags all follow a character sequence.

Sr.No	Expression & Description
1	**p+** It matches any string containing at least one **p**.
2	**p*** It matches any string containing zero or more **p's**
3	**p?** It matches any string containing one or more **p's**

4	**p{N}** It matches any string containing a sequence of **N p's**
5	**p{2,3}** It matches any string containing a sequence of two or three **p's**
6	**p{2, }** It matches any string containing a sequence of at least two **p's**
7	**p$** It matches any string with **p** at the end of it
8	**^p** It matches any string with **p** at the beginning of it
9	**[^a-zA-Z]** It matches any string not containing any of the characters ranging from **a** through **z** and **A** through **Z**
10	**p.p** It matches any string containing **p**, followed by any character, in turn followed by another **p**
11	**^.{2}$** It matches any string containing exactly two characters
12	**(.*)** It matches any string enclosed within and
13	**p(hp)*** It matches any string containing a **p** followed by zero or more instances of the sequence **hp**

Literal Characters

Sr.No	Character & Description
1	**Alphanumeric** Itself
2	**\0** The NULL character (\u0000)
3	**\t** Tab (\u0009)
4	**\n** Newline (\u000A)
5	**\v** Vertical tab (\u000B)
6	**\f** Form feed (\u000C)
7	**\r** Carriage return (\u000D)
8	**\xnn** The Latin character specified by the hexadecimal number **nn;** for example, \x0A is the same as **\n**
9	**\uxxxx** The Unicode character specified by the hexadecimal number **xxxx**; for example, \u0009 is the same as **\t**
10	**\cX** The control character ^X; for example, \cJ is equivalent to the newline character **\n**

Meta-characters

A **meta-character** is simply an alphabetical character preceded by a backslash that acts to give the combination a special meaning.

For instance, you can search for a large sum of money using the **'\d'** meta-character: /([\d]+)000/. Here, **\d** will search for any string of the numerical character.

The following table lists a set of meta-characters which can be used in PERL Style Regular Expressions.

Sr.No	Character & Description
1	**.** A single character
2	**\s** A whitespace character (space, tab, newline)
3	**\S** Non-whitespace character
4	**\d** A digit (0-9)
5	**\D** A non-digit
6	**\w** A word character (a-z, A-Z, 0-9, _)
7	**\W** A non-word character
8	**[\b]** A literal backspace (special case)
9	**[aeiou]**

	Matches a single character in the given set
10	**[^aeiou]** Matches a single character outside the given set
11	**(foo|bar|baz)** Matches any of the alternatives specified

RegExp Properties

Sr.No	Properties & Description
1	**RegExp.prototype.flags** A string that contains the flags of the RegExp object
2	**RegExp.prototype.global** Whether to test the regular expression against all possible matches in a string, or only against the first
3	**RegExp.prototype.ignoreCase** Whether to ignore case while attempting a match in a string
4	**RegExp.prototype.multiline** Whether or not to search in strings across multiple lines
5	**RegExp.prototype.source** The text of the pattern
6	**RegExp.prototype.sticky** Whether or not the search is sticky

RegExp Methods

Sr.No	Method & Description
1	**RegExp.prototype.exec()** Executes a search for a match in its string parameter
2	**RegExp.prototype.test()**

	Tests for a match in its string parameter
3	**RegExp.prototype.match()** Performs a match to the given string and returns the match result
4	**RegExp.prototype.replace()** Replaces matches in the given string with a new substring
5	**RegExp.prototype.search()** Searches the match in the given string and returns the index the pattern found in the string
6	**RegExp.prototype.split()** Splits the given string into an array by separating the string into substring
7	**RegExp.prototype.toString()** Returns a string representing the specified object. Overrides theObject.prototype.toString() method

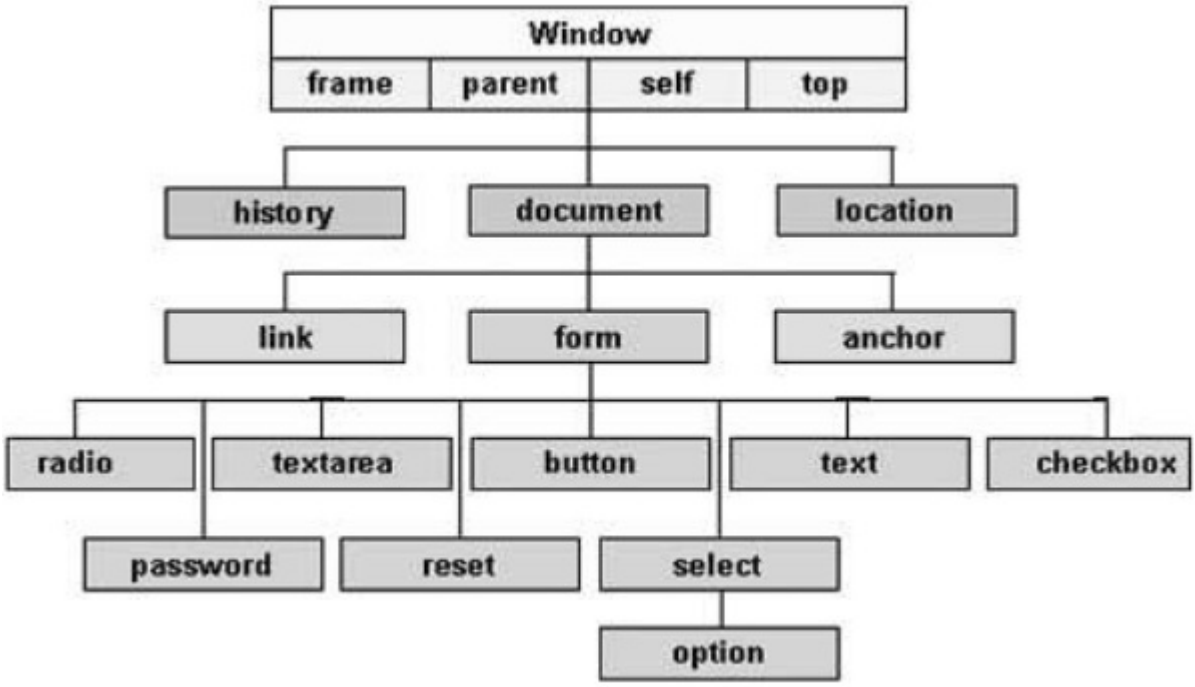
ES6 - HTML DOM

Every web page resides inside a browser window, which can be considered as an object.

A **document object** represents the HTML document that is displayed in that window. The document object has various properties that refer to other objects which allow access to and modification of the document content.

The way a document content is accessed and modified is called the **Document Object Model**, or **DOM**. The objects are organized in a hierarchy. This hierarchical structure applies to the organization of objects in a web document.

Following is a simple hierarchy of a few important objects –



There are several DOMs in existence. The following sections explain each of these DOMs in detail and describe how you can use them to access and modify the document content.

The Legacy DOM – This is the model which was introduced in early versions of JavaScript language. It is well supported by all browsers, but allows access only to certain key portions of documents, such as forms, form elements, and images.

The W3C DOM – This document object model allows access and modification of all document content and is standardized by the World Wide Web Consortium (W3C). This model is supported by almost all the modern browsers.

The IE4 DOM – This document object model was introduced in Version 4 of Microsoft's Internet Explorer browser. IE 5 and later versions include support for most basic W3C DOM features.

The Legacy DOM

This is the model which was introduced in the early versions of JavaScript language. It is well supported by all browsers, but allows access only to certain key portions of the documents, such as forms, form elements, and images.

This model provides several read-only properties, such as title, URL, and lastModified provide information about the document as a whole. Apart from that, there are various methods provided by this model which can be used to set and get the document property values.

Document Properties in Legacy DOM

Following is a list of the document properties which can be accessed using Legacy DOM.

Sr.No	Property & Description
1	**alinkColor** Deprecated – A string that specifies the color of activated links. **Example** : document.alinkColor
2	**anchors[ ]** An array of anchor objects, one for each anchor that appears in the document. **Example** : document.anchors[0], document.anchors[1] and so on
3	**applets[ ]** An array of applet objects, one for each applet that appears in the document. **Example** : document.applets[0], document.applets[1] and so on
4	**bgColor** Deprecated – A string that specifies the background color of the document. **Example** : document.bgColor
5	**Cookie** A string valued property with special behavior that allows the cookies associated with this document to be queried and set. **Example** : document.cookie
6	**Domain** A string that specifies the Internet domain the document is from. Used for security purposes. **Example** : document.domain
7	**embeds[ ]** An array of objects that represent data embedded in the document with the <embed> tag. A synonym for plugins []. Some plugins and ActiveX controls can be controlled with JavaScript code. **Example** : document.embeds[0], document.embeds[1] and so on
8	**fgColor**

	A string that specifies the default text color for the document. **Example** : document.fgColor
9	**forms[ ]** An array of form objects, one for each HTML form that appears in the document. **Example** : document.forms[0], document.forms[1] and so on
10	**images[ ]** An array of form objects, one for each HTML form that appears in the document with the HTML <img> tag. **Example** : document.forms[0], document.forms[1] and so on
11	**lastModified** A read-only string that specifies the date of the most recent change to the document. **Example** : document.lastModified
12	**linkColor** Deprecated – A string that specifies the color of unvisited links. **Example** : document.linkColor
13	**links[ ]** It is a document link array. **Example** : document.links[0], document.links[1] and so on
14	**Location** The URL of the document. Deprecated in favor of the URL property. **Example** : document.location
15	**plugins[ ]** A synonym for the embeds[ ] **Example** : document.plugins[0], document.plugins[1] and so on
16	**Referrer**

	A read-only string that contains the URL of the document, if any, from which the current document was linked. **Example** : document.referrer
17	**Title** The text contents of the <title> tag. **Example** : document.title
18	**URL** A read-only string that specifies the URL of the document. **Example** : document.URL
19	**vlinkColor** Deprecated – A string that specifies the color of the visited links. **Example** : document.vlinkColor

Document Methods in Legacy DOM

Following is a list of methods supported by Legacy DOM.

Sr.No	Property & Description
1	**clear( )** Deprecated – Erases the contents of the document and returns nothing. **Example** : document.clear( )
2	**close( )** Closes a document stream opened with the open( ) method and returns nothing.
3	**open( )** Deletes the existing document content and opens a stream to which the new document contents may be written. Returns nothing. **Example** : document.open( )
4	**write(value, ...)**

	Inserts the specified string or strings into the document currently being parsed or appends to the document opened with open( ). Returns nothing. **Example** : document.write(value, ...)
5	**writeln(value, ...)** Identical to write( ), except that it appends a newline character to the output. Returns nothing. **Example** : document.writeln(value, ...)

We can locate any HTML element within any HTML document using HTML DOM. For instance, if a web document contains a form element, then using JavaScript, we can refer to it as document.forms[0]. If your Web document includes two form elements, the first form is referred to as document.forms[0] and the second as document.forms[1].

Using the hierarchy and properties given above, we can access the first form element using document.forms[0].elements[0] and so on.

Example

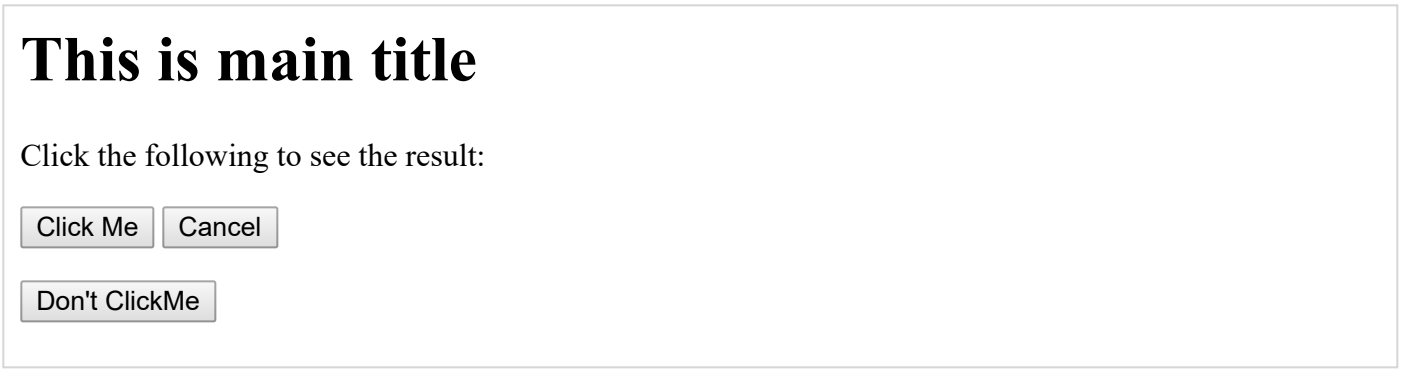
Following is an example to access document properties using Legacy DOM method.

```
<html>
   <head>
      <title> Document Title </title>

      <script type = "text/javascript">
         <!--
            function myFunc() {
               var ret = document.title;
               alert("Document Title : " + ret );
               var ret = document.URL;
               alert("Document URL : " + ret );
               var ret = document.forms[0];
               alert("Document First Form : " + ret );
               var ret = document.forms[0].elements[1];
               alert("Second element : " + ret );
            } //
         -->
      </script>
   </head>

   <body>
      <h1 id = "title">This is main title</h1>
      <p>Click the following to see the result:</p>

      <form name = "FirstForm">
         <input type = "button" value = "Click Me" onclick = "myFunc();" />
         <input type = "button" value = "Cancel">
      </form>

      <form name = "SecondForm">
```

```
        <input type = "button" value = "Don't ClickMe"/>
      </form>
   </body>

</html>
```

Output

The following output is displayed on successful execution of the above code.



Note – This example returns the objects for forms and elements. We would have to access their values by using those object properties which are not discussed in this tutorial.

ES6 - Collections

ES6 introduces two new data structures: Maps and Sets.

Maps – This data structure enables mapping a key to a value.

Sets – Sets are similar to arrays. However, sets do not encourage duplicates.

Maps

The Map object is a simple key/value pair. Keys and values in a map may be primitive or objects.

Following is the syntax for the same.

```
new Map([iterable])
```

The parameter iterable represents any iterable object whose elements comprise of a key/value pair. Maps are ordered, i.e. they traverse the elements in the order of their insertion.

Map Properties

Sr.No	Property & Description
1	**Map.prototype.size** This property returns the number of key/value pairs in the Map object.

Understanding basic Map operations

The set() function sets the value for the key in the Map object. The set() function takes two parameters namely, the key and its value. This function returns the Map object.

The has() function returns a boolean value indicating whether the specified key is found in the Map object. This function takes a key as parameter.

```
var map = new Map();
map.set('name','Tutorial Point');
map.get('name'); // Tutorial point
```

The above example creates a map object. The map has only one element. The element key is denoted by **name**. The key is mapped to a value **Tutorial point**.

Note – Maps distinguish between similar values but bear different data types. In other words, an **integer key 1** is considered different from a **string key "1"**. Consider the following example to better understand this concept

```
var map = new Map();
map.set(1,true);
console.log(map.has("1")); //false

map.set("1",true);
console.log(map.has("1")); //true
```

Output

```
false
true
```

The **set()** method is also chainable. Consider the following example.

```
var roles = new Map();
roles.set('r1', 'User')
.set('r2', 'Guest')
.set('r3', 'Admin');
console.log(roles.has('r1'))
```

Output

```
True
```

The above example, defines a map object. The example chains the set() function to define the key/value pair.

The **get()** function is used to retrieve the value corresponding to the specified key.

The Map constructor can also be passed an array. Moreover, map also supports the use of spread operator to represent an array.

Example

```
var roles = new Map([
   ['r1', 'User'],
   ['r2', 'Guest'],
   ['r3', 'Admin'],
]);
console.log(roles.get('r2'))
```

The following output is displayed on successful execution of the above code.

```
Guest
```

Note – The get() function returns undefined if the key specified doesn't exist in the map.

The set() replaces the value for the key, if it already exists in the map. Consider the following example.

```
var roles = new Map([
   ['r1', 'User'],
   ['r2', 'Guest'],
   ['r3', 'Admin'],
]);
console.log(`value of key r1 before set(): ${roles.get('r1')}`)
roles.set('r1','superUser')
console.log(`value of key r1 after set(): ${roles.get('r1')}`)
```

The following output is displayed on successful execution of the above code.

```
value of key r1 before set(): User
value of key r1 after set(): superUser
```

Map Methods

Sr.No	Method & Description
1	**Map.prototype.clear()** Removes all key/value pairs from the Map object.
2	**Map.prototype.delete(key)** Removes any value associated to the key and returns the value that Map.prototype.has(key) would have previously returned. Map.prototype.has(key) will return false afterwards.
3	**Map.prototype.entries()**

	Returns a new Iterator object that contains **an array of** [key, value] for each element in the Map object in insertion order.
4	**Map.prototype.forEach(callbackFn[, thisArg])** Calls **callbackFn** once for each key-value pair present in the Map object, in insertion order. If a thisArg parameter is provided to forEach, it will be used as the 'this' value for each callback .
5	**Map.prototype.keys()** Returns a new Iterator object that contains the **keys** for each element in the Map object in insertion order.
6	**Map.prototype.values()** Returns a new Iterator object that contains **an array of** [key, value] for each element in the Map object in insertion order.

The for...of Loop

The following example illustrates traversing a map using the for…of loop.

```
'use strict'
var roles = new Map([
   ['r1', 'User'],
   ['r2', 'Guest'],
   ['r3', 'Admin'],
]);
for(let r of roles.entries())
console.log(`${r[0]}: ${r[1]}`);
```

The following output is displayed on successful execution of the above code.

```
r1: User
r2: Guest
r3: Admin
```

Weak Maps

A weak map is identical to a map with the following exceptions –

Its keys must be objects.

Keys in a weak map can be Garbage collected. **Garbage collection** is a process of clearing the memory occupied by unreferenced objects in a program.

A weak map cannot be iterated or cleared.

Example : Weak Map

```
'use strict'
let weakMap = new WeakMap();
let obj = {};
console.log(weakMap.set(obj,"hello"));
console.log(weakMap.has(obj));// true
```

The following output is displayed on successful execution of the above code.

```
WeakMap {}
true
```

Sets

A set is an ES6 data structure. It is similar to an array with an exception that it cannot contain duplicates. In other words, it lets you store unique values. Sets support both primitive values and object references.

Just like maps, sets are also ordered, i.e. elements are iterated in their insertion order. A set can be initialized using the following syntax.

Set Properties

Sr.No	Property & Description
1	**Set.prototype.size** Returns the number of values in the Set object.

Set Methods

Sr.No	Method & Description
1	**Set.prototype.add(value)** Appends a new element with the given value to the Set object. Returns the Set object.
2	**Set.prototype.clear()** Removes all the elements from the Set object.
3	**Set.prototype.delete(value)** Removes the element associated to the value.
4	**Set.prototype.entries()**

	Returns a new Iterator object that contains **an array of** [value, value] for each element in the Set object, in insertion order. This is kept similar to the Map object, so that each entry has the same value for its key and value here.
5	**Set.prototype.forEach(callbackFn[, thisArg])** Calls **callbackFn** once for each value present in the Set object, in insertion order. If **athisArg** parameter is provided to forEach, it will be used as the 'this' value for each callback.
6	**Set.prototype.has(value)** Returns a boolean asserting whether an element is present with the given value in the Set object or not.
7	**Set.prototype.values()** Returns a new Iterator object that contains the **values** for each element in the Set object in insertion order.

Weak Set

Weak sets can only contain objects, and the objects they contain may be garbage collected. Like weak maps, weak sets cannot be iterated.

Example: Using a Weak Set

```
'use strict'
   let weakSet = new WeakSet();
   let obj = {msg:"hello"};
   weakSet.add(obj);
   console.log(weakSet.has(obj));
   weakSet.delete(obj);
   console.log(weakSet.has(obj));
```

The following output is displayed on successful execution of the above code.

```
true
false
```

Iterator

Iterator is an object which allows to access a collection of objects one at a time. Both set and map have methods which returns an iterator.

Iterators are objects with **next()** method. When next() method is invoked, it returns an object with **'value'** and **'done'** properties . 'done' is boolean, this will return true after reading all items in the collection

Example 1: Set and Iterator

```
var  set = new Set(['a','b','c','d','e']);
var iterator = set.entries();
console.log(iterator.next())
```

The following output is displayed on successful execution of the above code.

```
{ value: [ 'a', 'a' ], done: false }
```

Since, the set does not store key/value, the value array contains similar key and value. done will be false as there are more elements to be read.

Example 2: Set and Iterator

```
var  set = new Set(['a','b','c','d','e']);
var iterator = set.values();
console.log(iterator.next());
```

The following output is displayed on successful execution of the above code.

```
{ value: 'a', done: false }
```

Example 3: Set and Iterator

```
var  set = new Set(['a','b','c','d','e']);
var iterator = set.keys();
console.log(iterator.next());
```

The following output is displayed on successful execution of the above code.

```
{ value: 'a', done: false }
```

Example 4: Map and Iterator

```
var map = new Map([[1,'one'],[2,'two'],[3,'three']]);
var iterator = map.entries();
console.log(iterator.next());
```

The following output is displayed on successful execution of the above code.

```
{ value: [ 1, 'one' ], done: false }
```

Example 5: Map and Iterator

```
var map = new Map([[1,'one'],[2,'two'],[3,'three']]);
var iterator = map.values();
console.log(iterator.next());
```

The following output is displayed on successful execution of the above code.

```
{value: "one", done: false}
```

Example 6: Map and Iterator

```
var map = new Map([[1,'one'],[2,'two'],[3,'three']]);
var iterator = map.keys();
console.log(iterator.next());
```

The following output is displayed on successful execution of the above code.

```
{value: 1, done: false}
```

ES6 - Classes

Object Orientation is a software development paradigm that follows real-world modelling. Object Orientation, considers a program as a collection of objects that communicates with each other via mechanism called **methods**. ES6 supports these object-oriented components too.

Object-Oriented Programming Concepts

To begin with, let us understand

Object − An object is a real-time representation of any entity. According to Grady Brooch, every object is said to have 3 features −

State − Described by the attributes of an object.

Behavior − Describes how the object will act.

Identity − A unique value that distinguishes an object from a set of similar such objects.

Class − A class in terms of OOP is a blueprint for creating objects. A class encapsulates data for the object.

Method − Methods facilitate communication between objects.

Let us translate these Object-Oriented concepts to the ones in the real world. For example: A car is an object that has data (make, model, number of doors, Vehicle Number, etc.) and functionality (accelerate, shift, open doors, turn on headlights, etc.)

Prior to ES6, creating a class was a fussy affair. Classes can be created using the class keyword in ES6.

Classes can be included in the code either by declaring them or by using class expressions.

Syntax: Declaring a Class

```
class Class_name {
}
```

Syntax: Class Expressions

```
var var_name = new Class_name {
}
```

The class keyword is followed by the class name. The rules for identifiers (already discussed) must be considered while naming a class.

A class definition can include the following –

Constructors – Responsible for allocating memory for the objects of the class.

Functions – Functions represent actions an object can take. They are also at times referred to as methods.

These components put together are termed as the data members of the class.

Note – A class body can only contain methods, but not data properties.

Example: Declaring a class

```
class Polygon {
   constructor(height, width) {
      this.height = height;
      this.width = width;
   }
}
```

Example: Class Expression

```
var Polygon = class {
   constructor(height, width) {
      this.height = height;
      this.width = width;
   }
}
```

The above code snippet represents an unnamed class expression. A named class expression can be written as.

```
var Polygon = class Polygon {
   constructor(height, width) {
      this.height = height;
      this.width = width;
   }
}
```

Note – Unlike variables and functions, classes cannot be hoisted.

Creating Objects

To create an instance of the class, use the new keyword followed by the class name. Following is the syntax for the same.

```
var object_name= new class_name([ arguments ])
```

Where,

The new keyword is responsible for instantiation.

The right hand side of the expression invokes the constructor. The constructor should be passed values if it is parameterized.

Example: Instantiating a class

```
var obj = new Polygon(10,12)
```

Accessing Functions

A class's attributes and functions can be accessed through the object. Use the '.' **dot notation** (called as the period) to access the data members of a class.

```
//accessing a function
obj.function_name()
```

Example: Putting them together

```
'use strict'
class Polygon {
   constructor(height, width) {
      this.h = height;
      this.w = width;
   }
   test() {
      console.log("The height of the polygon: ", this.h)
      console.log("The width of the polygon: ",this. w)
   }
}

//creating an instance
var polyObj = new Polygon(10,20);
polyObj.test();
```

The Example given above declares a class 'Polygon'. The class's constructor takes two arguments - height and width respectively. The **'this'** keyword refers to the current instance of the class. In other words, the constructor above initializes two variables h and w with the parameter values passed to the constructor. The **test ()** function in the class, prints the values of the height and width.

To make the script functional, an object of the class Polygon is created. The object is referred to by the **polyObj** variable. The function is then called via this object.

The following output is displayed on successful execution of the above code.

```
The height of the polygon:  10
The width of the polygon:  20
```

The Static Keyword

The static keyword can be applied to functions in a class. Static members are referenced by the class name.

Example

```
'use strict'
class StaticMem {
   static disp() {
      console.log("Static Function called")
   }
}
StaticMem.disp() //invoke the static metho
```

Note – It is not mandatory to include a constructor definition. Every class by default has a constructor by default.

The following output is displayed on successful execution of the above code.

```
Static Function called
```

The instanceof operator

The instanceof operator returns true if the object belongs to the specified type.

Example

```
'use strict'
class Person{ }
var obj = new Person()
var isPerson = obj instanceof Person;
console.log(" obj is an instance of Person " + isPerson);
```

The following output is displayed on successful execution of the above code.

```
obj is an instance of Person True
```

Class Inheritance

ES6 supports the concept of **Inheritance**. Inheritance is the ability of a program to create new entities from an existing entity - here a class. The class that is extended to create

newer classes is called the **parent class/super class**. The newly created classes are called the **child/sub classes**.

A class inherits from another class using the 'extends' keyword. Child classes inherit all properties and methods except constructors from the parent class.

Following is the syntax for the same.

```
class child_class_name extends parent_class_name
```

Example: Class Inheritance

```
'use strict'
class Shape {
   constructor(a) {
      this.Area = a
   }
}
class Circle extends Shape {
   disp() {
      console.log("Area of the circle:  "+this.Area)
   }
}
var obj = new Circle(223);
obj.disp()
```

The above example declares a class Shape. The class is extended by the Circle class. Since, there is an inheritance relationship between the classes, the child class i.e., the class Circle gets an implicit access to its parent class attribute i.e., area.

The following output is displayed on successful execution of the above code.

```
Area of Circle: 223
```

Inheritance can be classified as –

Single – Every class can at the most extend from one parent class.

Multiple – A class can inherit from multiple classes. ES6 doesn't support multiple inheritance.

Multi-level – Consider the following example.

```
'use strict'
class Root {
   test() {
      console.log("call from parent class")
   }
}
class Child extends Root {}
class Leaf extends Child

//indirectly inherits from Root by virtue of inheritance {}
var obj = new Leaf();
obj.test()
```

The class Leaf derives the attributes from the Root and the Child classes by virtue of multilevel inheritance.

The following output is displayed on successful execution of the above code.

```
call from parent class
```

Class Inheritance and Method Overriding

Method Overriding is a mechanism by which the child class redefines the superclass method. The following example illustrates the same –

```
'use strict' ;
class PrinterClass {
   doPrint() {
      console.log("doPrint() from Parent called… ");
   }
}
class StringPrinter extends PrinterClass {
   doPrint() {
      console.log("doPrint() is printing a string…");
   }
}
var obj = new StringPrinter();
obj.doPrint();
```

In the above Example, the child class has changed the superclass function's implementation.

The following output is displayed on successful execution of the above code.

```
doPrint() is printing a string…
```

The Super Keyword

ES6 enables a child class to invoke its parent class data member. This is achieved by using the **super** keyword. The super keyword is used to refer to the immediate parent of a class.

Consider the following example –

```
'use strict'
class PrinterClass {
   doPrint() {
      console.log("doPrint() from Parent called…")
   }
}
class StringPrinter extends PrinterClass {
   doPrint() {
      super.doPrint()
      console.log("doPrint() is printing a string…")
   }
}
```

```
var obj = new StringPrinter()
obj.doPrint()
```

The **doPrint()** redefinition in the class StringWriter, issues a call to its parent class version. In other words, the super keyword is used to invoke the doPrint() function definition in the parent class - PrinterClass.

The following output is displayed on successful execution of the above code.

```
doPrint() from Parent called.
doPrint() is printing a string.
```

ES6 - Promises

Promises are a clean way to implement async programming in JavaScript (ES6 new feature). Prior to promises, Callbacks were used to implement async programming. Let's begin by understanding what async programming is and its implementation, using Callbacks.

Understanding Callback

A function may be passed as a parameter to another function. This mechanism is termed as a **Callback**. A Callback would be helpful in events.

The following example will help us better understand this concept.

```
<script>
   function notifyAll(fnSms, fnEmail) {
      console.log('starting notification process');
      fnSms();
      fnEmail();
   }
   notifyAll(function() {
      console.log("Sms send ..");
   },
   function() {
      console.log("email send ..");
   });
   console.log("End of script");
   //executes last or blocked by other methods
</script>
```

In the **notifyAll()** method shown above, the notification happens by sending SMS and by sending an e-mail. Hence, the invoker of the notifyAll method has to pass two functions as parameters. Each function takes up a single responsibility like sending SMS and sending an e-mail.

The following output is displayed on successful execution of the above code.

```
starting notification process
Sms send ..
```

```
Email send ..
End of script
```

In the code mentioned above, the function calls are synchronous. It means the UI thread would be waiting to complete the entire notification process. Synchronous calls become blocking calls. Let's understand non-blocking or async calls now.

Understanding AsyncCallback

Consider the above example.

To enable the script, execute an asynchronous or a non-blocking call to notifyAll() method. We shall use the **setTimeout()** method of JavaScript. This method is async by default.

The setTimeout() method takes two parameters –

A callback function.

The number of seconds after which the method will be called.

In this case, the notification process has been wrapped with timeout. Hence, it will take a two seconds delay, set by the code. The notifyAll() will be invoked and the main thread goes ahead like executing other methods. Hence, the notification process will not block the main JavaScript thread.

```
<script>
   function notifyAll(fnSms, fnEmail) {
      setTimeout(function() {
         console.log('starting notification process');
         fnSms();
         fnEmail();
      }, 2000);
   }
   notifyAll(function() {
      console.log("Sms send ..");
   },
   function() {
      console.log("email send ..");
   });
   console.log("End of script"); //executes first or not blocked by others
</script>
```

The following output is displayed on successful execution of the above code.

```
End of script
starting notification process
Sms send ..
Email send ..
```

In case of multiple callbacks, the code will look scary.

```
<script>
   setTimeout(function() {
      console.log("one");
      setTimeout(function() {
         console.log("two");
         setTimeout(function() {
            console.log("three");
         }, 1000);
      }, 1000);
   }, 1000);
</script>
```

ES6 comes to your rescue by introducing the concept of promises. Promises are "Continuation events" and they help you execute the multiple async operations together in a much cleaner code style.

Example

Let's understand this with an example. Following is the syntax for the same.

```
var promise = new Promise(function(resolve , reject) {
   // do a thing, possibly async , then..
   if(/*everthing turned out fine */)    resolve("stuff worked");
   else
   reject(Error("It broke"));
});
return promise;
// Give this to someone
```

The first step towards implementing the promises is to create a method which will use the promise. Let's say in this example, the **getSum()** method is asynchronous i.e., its operation should not block other methods' execution. As soon as this operation completes, it will later notify the caller.

The following example (Step 1) declares a Promise object 'var promise'. The Promise Constructor takes to the functions first for the successful completion of the work and another in case an error happens.

The promise returns the result of the calculation by using the resolve callback and passing in the result, i.e., n1+n2

Step 1 – resolve(n1 + n2);

If the getSum() encounters an error or an unexpected condition, it will invoke the reject callback method in the Promise and pass the error information to the caller.

Step 2 – reject(Error("Negatives not supported"));

The method implementation is given in the following code (STEP 1).

```
function getSum(n1, n2) {
   varisAnyNegative = function() {
```

```
      return n1 < 0 || n2 < 0;
   }
   var promise = new Promise(function(resolve, reject) {
      if (isAnyNegative()) {
         reject(Error("Negatives not supported"));
      }
      resolve(n1 + n2)
   });
   return promise;
}
```

The second step details the implementation of the caller (STEP 2).

The caller should use the 'then' method, which takes two callback methods - first for success and second for failure. Each method takes one parameter, as shown in the following code.

```
getSum(5, 6)
.then(function (result) {
   console.log(result);
},
function (error) {
   console.log(error);
});
```

The following output is displayed on successful execution of the above code.

```
11
```

Since the return type of the getSum() is a Promise, we can actually have multiple 'then' statements. The first 'then' will have a return statement.

```
getSum(5, 6)
.then(function(result) {
   console.log(result);
   returngetSum(10, 20);
   // this returns another promise
},
function(error) {
   console.log(error);
})
.then(function(result) {
   console.log(result);
},
function(error) {
   console.log(error);
});
```

The following output is displayed on successful execution of the above code.

```
11
30
```

The following example issues three then() calls with getSum() method.

```
<script>
   function getSum(n1, n2) {
      varisAnyNegative = function() {
         return n1 < 0 || n2 < 0;
      }
      var promise = new Promise(function(resolve, reject) {
         if (isAnyNegative()) {
            reject(Error("Negatives not supported"));
         }
         resolve(n1 + n2);
      });
      return promise;
   }
   getSum(5, 6)
   .then(function(result) {
      console.log(result);
      returngetSum(10, 20);
      //this returns another Promise
   },
   function(error) {
      console.log(error);
   })
   .then(function(result) {
      console.log(result);
      returngetSum(30, 40);
      //this returns another Promise
   },
   function(error) {
      console.log(error);
   })
   .then(function(result) {
      console.log(result);
   },
   function(error) {
      console.log(error);
   });
   console.log("End of script ");
</script>
```

The following output is displayed on successful execution of the above code.

The program displays 'end of script' first and then results from calling getSum() method, one by one.

```
End of script
11
30
70
```

This shows getSum() is called in async style or non-blocking style. Promise gives a nice and clean way to deal with the Callbacks.

ES6 - Modules

Consider a scenario where parts of JavaScript code need to be reused. ES6 comes to your rescue with the concept of Modules.

A **module** is nothing more than a chunk of JavaScript code written in a file. The functions or variables in a module are not available for use, unless the module file exports them.

In simpler terms, the modules help you to write the code in your module and expose only those parts of the code that should be accessed by other parts of your code.

ES6 modules will have to be transpiled to ES5 code so that we can run and test the code. **Transpilation** is the process of converting code from one language into its counterpart equivalent. The ES6 Module Transpiler is a tool that takes your ES6 module and compiles it into ES5 compatible code in the CommonJS or AMD style.

ES6 modules is a very powerful concept. Although support is not available everywhere yet, you can play with ES6 code today and transpile into ES5. You can use Grunt, Gulp, Babel or some other transpiler to compile the modules during a build process. For the purpose of demonstration, the lesson uses Node.js to transpile and execute the code as it is console based and easy to understand.

Exporting a Module

To make available certain parts of the module, use the export keyword. Following is the syntax to export a module.

Export a single value or element - Use export default

```
export default element_name
```

Export multiple values or elements

```
export {element_name1,element_name2,....}
```

Importing a Module

To be able to consume a module, use the import keyword. Following is the syntax for the same.

Import a single value or element

import element name from module_name

Export multiple values or elements

```
import {element_name1,element_name2,....} from module_name
```

Consider a JavaScript file, **Message.js**, with a method printMsg() in it. To be able to reuse the functionality provided by this method, include the following in the Message.js file −

```
exportdefault printMsg
```

The script file that intends to consume the function, say User.js, will have to import the function from the Message module by including the following –

```
import printMsg from './Message.js'
```

Note – Note: Multiple elements in the export statement should be delimited by a comma separator. The same holds true for the import.

Example: Defining and Using ES6 modules

Defining a module: Message_module.js

```
function display_message() {
   console.log("Hello World")
}
export default display_message
```

Importing the module: consume_module.js

```
import display_message from './MessageModule.js'
display_message()
```

Install the es6-module-transpiler via **npm**using the following command –

```
npm install -g es6-module-transpiler
```

Assume the directory structure of the given JS project as below –

```
D:/
ES6/
   scripts/
      app.js
      utility.js
   out/
```

where, **scripts** is the directory containing my ES6 code samples. We shall transpile the ES6 code into ES5 and save them to the directory shown above.

Following are the steps for the same –

Step 1 – Navigate to the D:/ ES6/scripts directory and transpile the ES6 code into **CommonJS** format. You may also choose to transpile into the **AMD** Format and then use a browser to run the same.

Type the following in the node window to transpile the code into CommonJS format –

```
compile-modules convert -I scripts -o out Message_module.js
   consume_module.js -format commonjs
```

The above command will transpile all JS files in the script directory and place their transpiled versions into the out subdirectory.

Step 2 – Execute the script code.

```
cd out
node consume_module.js
```

Following will be the output of the above code.

```
Hello World
```

Note – A module can also be re-exported, i.e. the code that imports a module can also export it.

ES6 - Error Handling

There are three types of errors in programming: Syntax Errors, Runtime Errors, and Logical Errors.

Syntax Errors

Syntax errors, also called **parsing errors**, occur at compile time in traditional programming languages and at interpret time in JavaScript. When a syntax error occurs in JavaScript, only the code contained within the same thread as the syntax error is affected and the rest of the code in other threads get executed assuming nothing in them depends on the code containing the error.

Runtime Errors

Runtime errors, also called **exceptions**, occur during execution (after compilation/interpretation). Exceptions also affect the thread in which they occur, allowing other JavaScript threads to continue normal execution.

Logical Errors

Logic errors can be the most difficult type of errors to track down. These errors are not the result of a syntax or runtime error. Instead, they occur when you make a mistake in the logic that drives your script and you do not get the result as expected.

You cannot catch those errors, because it depends on your business requirement, what type of logic you want to put in your program.

JavaScript throws instances of the Error object when runtime errors occur. The following table lists predefined types of the Error object.

Sr.No	Error Object & Description
1	**EvalError**

	Creates an instance representing an error that occurs regarding the global function **eval()**.
2	**RangeError** Creates an instance representing an error that occurs when a numeric variable or parameter is outside of its valid range.
3	**ReferenceError** Creates an instance representing an error that occurs when dereferencing an invalid reference.
4	**SyntaxError** Creates an instance representing a syntax error that occurs while parsing the code.
5	**TypeError** Creates an instance representing an error that occurs when a variable or parameter is not of a valid type.
6	**URIError** Creates an instance representing an error that occurs when **encodeURI()** or **decodeURI()** are passed invalid parameters.

Throwing Exceptions

An error (predefined or user defined) can be raised using the **throw statement**. Later these exceptions can be captured and you can take an appropriate action. Following is the syntax for the same.

Syntax: Throwing a generic exception

```
throw new Error([message])
OR
throw([message])
```

Syntax: Throwing a specific exception

```
throw new Error_name([message])
```

Exception Handling

Exception handling is accomplished with a **try...catch statement**. When the program encounters an exception, the program will terminate in an unfriendly fashion. To safeguard against this unanticipated error, we can wrap our code in a try...catch statement.

The try block must be followed by either exactly one catch block or one finally block (or one of both). When an exception occurs in the try block, the exception is placed in e and the catch block is executed. The optional finally block executes unconditionally after try/catch

Following is the syntax for the same.

```
try {
   // Code to run
   [break;]
} catch ( e ) {
   // Code to run if an exception occurs
   [break;]
}[ finally {
   // Code that is always executed regardless of
   // an exception occurring
}]
```

Example

```
var a = 100;
var b = 0;
try {
   if (b == 0 ) {
      throw("Divide by zero error.");
   } else {
      var c = a / b;
   }
}
catch( e ) {
   console.log("Error: " + e );
}
```

Output

The following output is displayed on successful execution of the above code.

```
Error: Divide by zero error
```

Note – Note: You can raise an exception in one function and then you can capture that exception either in the same function or in the caller function using a **try...catch** block.

The onerror( ) Method

The **onerror** event handler was the first feature to facilitate error handling in JavaScript. The error event is fired on the window object whenever an exception occurs on the page.

Example

```
<html>
   <head>
      <script type = "text/javascript">
         window.onerror  =  function () {
            document.write ("An error occurred.");
         }
      </script>
   </head>

   <body>
      <p>Click the following to see the result:</p>
      <form>
         <input type = "button" value = "Click Me" onclick = "myFunc();" />
      </form>
   </body>
</html>
```

Output

The following output is displayed on successful execution of the above code.

Click the following to see the result:

Click Me

The onerror event handler provides three pieces of information to identify the exact nature of the error −

Error message − The same message that the browser would display for the given error.

URL − The file in which the error occurred.

Line number − The line number in the given URL that caused the error.

The following example shows how to extract this information.

Example

```
<html>
   <head>
      <script type = "text/javascript">
         window.onerror  =  function (msg, url, line) {
            document.write ("Message : " + msg );
            document.write ("url : " + url );
            document.write ("Line number : " + line );
         }
      </script>
   </head>
```

```
   <body>
      <p>Click the following to see the result:</p>
      <form>
         <input type = "button" value = "Click Me" onclick = "myFunc();" />
      </form>
   </body>
</html>
```

Custom Errors

JavaScript supports the concept of custom errors. The following example explains the same.

Example 1: Custom Error with default message

```
function MyError(message) {
   this.name = 'CustomError';
   this.message = message || 'Error raised with default message';
}
try {
   throw new MyError();
} catch (e) {
   console.log(e.name);
   console.log(e.message);  // 'Default Message'
}
```

The following output is displayed on successful execution of the above code.

```
CustomError
Error raised with default message
```

Example 2: Custom Error with user-defined error message

```
function MyError(message) {
   this.name = 'CustomError';
   this.message = message || 'Default Error Message';
} try {
   throw new MyError('Printing Custom Error message');
}
catch (e) {
   console.log(e.name);
   console.log(e.message);
}
```

The following output is displayed on successful execution of the above code.

```
CustomError
Printing Custom Error message
```

ES6 - Validations

Form validation normally used to occur at the server, after the client had entered all the necessary data and then pressed the Submit button. If the data entered by the client was incorrect or was simply missing, the server would have to send all the data back to the client and request that the form be resubmitted with the correct information. This was really a lengthy process which used to put a lot of burden on the server.

JavaScript provides a way to validate the form's data on the client's computer before sending it to the web server. Form validation generally performs two functions.

> **Basic Validation** – First of all, the form must be checked to make sure all the mandatory fields are filled in. It would require just a loop through each field in the form and check for data.
>
> **Data Format Validation** – Secondly, the data that is entered must be checked for correct form and value. Your code must include appropriate logic to test the correctness of data.

Example

We will take an example to understand the process of validation. Here is a simple form in html format.

```
<html>

   <head>
      <title>Form Validation</title>
      <script type = "text/javascript">
         <!--
            // Form validation code will come here.
            //
         -->
      </script>
   </head>

   <body>
      <form action = "/cgi-bin/test.cgi" name = "myForm" onsubmit = "return(validate());">
         <table cellspacing = "2" cellpadding = "2" border = "1">
            <tr>
               <td align = "right">Name</td>
               <td><input type = "text" name = "Name" /></td>
            </tr>
            <tr>
               <td align = "right">EMail</td>
               <td><input type = "text" name = "EMail" /></td>
            </tr>
            <tr>
               <td align = "right">Zip Code</td>
               <td><input type = "text" name = "Zip" /></td>
            </tr>
            <tr>
               <td align = "right">Country</td>
               <td>
                  <select name = "Country">
                     <option value = "-1" selected>[choose yours]</option>
```

```
                  <option value = "1">USA</option>
                  <option value = "2">UK</option>
                  <option value = "3">INDIA</option>
               </select>
            </td>
         </tr>
         <tr>
            <td align = "right"></td>
            <td><input type = "submit" value = "Submit" /></td>
         </tr>
      </table>
   </form>
</body>

</html>
```

Output

The following output is displayed on successful execution of the above code.

Name	
EMail	
Zip Code	
Country	[choose yours] ▼
	Submit

Basic Form Validation

First let us see how to do a basic form validation. In the above form, we are calling **validate()** to validate data when **onsubmit** event is occurring. The following code shows the implementation of this validate() function.

```
<script type = "text/javascript">
   <!--
      // Form validation code will come here. function validate() {
         if( document.myForm.Name.value == "" ) {
            alert( "Please provide your name!" );
            document.myForm.Name.focus() ;
            return false;
         }
         if( document.myForm.EMail.value == "" ) {
            alert( "Please provide your Email!" );
            document.myForm.EMail.focus() ;
            return false;
         }
         if( document.myForm.Zip.value == "" ||
         isNaN( document.myForm.Zip.value ) ||
         document.myForm.Zip.value.length != 5 ) {
            alert( "Please provide a zip in the format #####." );
            document.myForm.Zip.focus() ;
            return false;
         }
```

```
         if( document.myForm.Country.value == "-1" ) {
            alert( "Please provide your country!" );
            return false;
         }
         return( true );
      }
      //
   -->
</script>
```

Data Format Validation

Now we will see how we can validate our entered form data before submitting it to the web server.

The following example shows how to validate an entered email address. An email address must contain at least a '@' sign and a dot (.). Also, the '@' must not be the first character of the email address, and the last dot must at least be one character after the '@' sign

Example

Try the following code for email validation.

```
<script type = "text/javascript">
   <!--
      function validateEmail() {
         var emailID = document.myForm.EMail.value;
         atpos = emailID.indexOf("@");
         dotpos = emailID.lastIndexOf(".");

         if (atpos < 1 || ( dotpos - atpos < 2 )) {
            alert("Please enter correct email ID")
            document.myForm.EMail.focus() ;
            return false;
         }
         return( true );
      }
      //
   --<
</script>
```

ES6 - Animation

You can use JavaScript to create a complex animation having, but not limited to, the following elements –

- Fireworks
- Fade effect
- Roll-in or Roll-out
- Page-in or Page-out
- Object movements

In this chapter, we will see how to use JavaScript to create an animation.

JavaScript can be used to move a number of DOM elements (<img />, , or any other HTML element) around the page according to some sort of pattern determined by a logical equation or function.

JavaScript provides the following functions to be frequently used in animation programs.

setTimeout(function, duration) – This function calls the function after duration milliseconds from now.

setInterval(function, duration) – This function calls the function after every duration milliseconds.

clearTimeout(setTimeout_variable) – This function clears any timer set by the setTimeout() function.

JavaScript can also set a number of attributes of a DOM object including its position on the screen. You can set the top and the left attribute of an object to position it anywhere on the screen. Following is the syntax for the same.

```
// Set distance from left edge of the screen.
object.style.left = distance in pixels or points;
or
// Set distance from top edge of the screen.
object.style.top = distance in pixels or points;
```

Manual Animation

So let's implement one simple animation using DOM object properties and JavaScript functions as follows. The following list contains different DOM methods.

We are using the JavaScript function **getElementById()** to get a DOM object and then assigning it to a global variable **imgObj**.

We have defined an initialization function **init()** to initialize imgObj where we have set its position and left attributes.

We are calling initialization function at the time of window load.

We are calling **moveRight()** function to increase the left distance by 10 pixels. You could also set it to a negative value to move it to the left side.

Example

Try the following example

```
<html>
   <head>
```

```
      <title>JavaScript Animation</title>
      <script type = "text/javascript">
         <!--
            var imgObj = null; function init(){
               imgObj = document.getElementById('myImage');
               imgObj.style.position = 'relative';
               imgObj.style.left = '0px';
            }
            function moveRight(){
               imgObj.style.left = parseInt(
               imgObj.style.left) + 10 + 'px';
            }
            window.onload = init;
            //
         -->
      </script>
   </head>

   <body>
      <form>
         <img id = "myImage" src = "/images/html.gif" />
         <p>Click button below to move the image to right</p>
         <input type = "button" value = "Click Me" onclick = "moveRight();" />
      </form>
   </body>

</html>
```

The following output is displayed on successful execution of the above code.

Click button below to move the image to right

Click Me

Automated Animation

In the above example, we saw how an image moves to the right with every click. We can automate this process by using the JavaScript function **setTimeout()** as follows.

Here we have added more methods. So, let's see what is new here.

> The **moveRight()** function is calling setTimeout() function to set the position of imgObj.

We have added a new function **stop()** to clear the timer set by setTimeout() function and to set the object at its initial position.

Example

Try the following example code.

```
<html>
   <head>
      <title>JavaScript Animation</title>
      <script type = "text/javascript">
         <!--
            var imgObj = null; var animate ; function init(){
               imgObj = document.getElementById('myImage');
               imgObj.style.position = 'relative';
               imgObj.style.left = '0px';
            }
            function moveRight(){
               imgObj.style.left = parseInt(imgObj.style.left) + 10 + 'px';
               animate = setTimeout(moveRight,20);
               // call moveRight in 20msec
            }
            function stop() {
               clearTimeout(animate);
               imgObj.style.left = '0px';
            }
            window.onload = init;
            //
         -->
      </script>
   </head>

   <body>
      <form>
         <img id = "myImage" src = "/images/html.gif" />
         <p>Click the buttons below to handle animation</p>
         <input type="button" value="Start" onclick = "moveRight();" />
         <input type = "button" value="Stop" onclick = "stop();" />
      </form>
   </body>
</html>
```

The following output is displayed on successful execution of the above code.

Click the buttons below to handle animation

Start Stop

Rollover with a Mouse Event

Here is a simple example showing the image rollover with a mouse event.

Let's see what we are using in the following example –

At the time of loading this page, the 'if' statement checks for the existence of the image object. If the image object is unavailable, this block will not be executed.

The **Image()** constructor creates and preloads a new image object called **image1**.

The **src** property is assigned the name of the external image file called **/images/html.gif**.

Similarly, we have created **image2** object and assigned **/images/http.gif** in this object.

The **#** (hash mark) disables the link so that the browser does not try to go to a URL when clicked. This link is an image.

The **onMouseOver** event handler is triggered when the user's mouse moves onto the link, and the **onMouseOut** event handler is triggered when the user's mouse moves away from the link (image).

When the mouse moves over the image, the HTTP image changes from the first image to the second one. When the mouse is moved away from the image, the original image is displayed.

When the mouse is moved away from the link, the initial image **html.gif** will reappear on the screen.

```
<html>
   <head>
      <title>Rollover with a Mouse Events</title>
      <script type = "text/javascript">
         <!--
            if(document.images) {
```

```
            var image1 = new Image();
            // Preload an image image1.src = "/images/html.gif";

            var image2 = new Image();
            // Preload second image image2.src = "/images/http.gif";
         }
         //
      -->
   </script>
</head>

<body>
   <p>Move your mouse over the image to see the result</p>
   <a href = "#" onMouseOver = "document.myImage.src = image2.src;"
      onMouseOut = "document.myImage.src = image1.src;">
      <img name = "myImage" src = "/images/html.gif" />
   </a>
</body>

</html>
```

The following output is displayed on successful execution of the above code.

Move your mouse over the image to see the result

ES6 - Multimedia

The JavaScript navigator object includes a child object called **plugins**. This object is an array, with one entry for each plug-in installed on the browser. The **navigator.plugins** object is supported only by Netscape, Firefox, and Mozilla.

Example

The following example shows how to list down all the plug-ins installed in your browser.

```
<html>
   <head>
      <title>List of Plug-Ins</title>
   </head>

   <body>
      <table border = "1">
         <tr>
            <th>Plug-in Name</th>
            <th>Filename</th>
            <th>Description</th>
         </tr>
```

```
        <script LANGUAGE = "JavaScript" type = "text/javascript">
           for (i = 0; i<navigator.plugins.length; i++) {
              document.write("<tr><td>");
              document.write(navigator.plugins[i].name);
              document.write("</td><td>");
              document.write(navigator.plugins[i].filename);
              document.write("</td><td>");
              document.write(navigator.plugins[i].description);
              document.write("</td></tr>");
           }
        </script>
      </table>
   </body>

</html>
```

Output

The following output is displayed on successful execution of the above code.

Plug-in Name	Filename	Description
Chrome PDF Plugin	internal-pdf-viewer	Portable Document Format
Chrome PDF Viewer	mhjfbmdgcfjbbpaeojofohoefgiehjai	
Native Client	internal-nacl-plugin	

Checking for Plugins

Each plug-in has an entry in the array. Each entry has the following properties –

name – The name of the plug-in.

filename – The executable file that was loaded to install the plug-in.

description – A description of the plug-in, supplied by the developer.

mimeTypes – An array with one entry for each MIME type supported by the plugin.

You can use these properties in a script to find out the installed plug-ins, and then using JavaScript, you can play the appropriate multimedia file. Take a look at the following code.

```
<html>
   <head>
      <title>Using Plug-Ins</title>
   </head>

   <body>
      <script language = "JavaScript" type = "text/javascript">
```

```
         media  =  navigator.mimeTypes["video/quicktime"]; if (media) {
            document.write("<embed src = 'quick.mov' height = 100 width = 100>");
         } else {
            document.write("<img src = 'quick.gif' height = 100 width = 100>");
         }
      </script>
   </body>
</html>
```

Note – Here we are using HTML **<embed> tag** to embed a multimedia file.

Controlling Multimedia

Let us take a real example which works in almost all the browsers.

```
<html>
   <head>
      <title>Using Embeded Object</title>

      <script type = "text/javascript">
         <!--
            function play() {
               if (!document.demo.IsPlaying()) {
                  document.demo.Play();
               }
            }
            function stop() {
               if (document.demo.IsPlaying()){
                  document.demo.StopPlay();
               }
            }
            function rewind() {
               if (document.demo.IsPlaying()){
                  document.demo.StopPlay();
               }
               document.demo.Rewind();
            }
            //
         -->
      </script>
   </head>

   <body>
      <embed id = "demo" name = "demo"
         src = "http://www.amrood.com/games/kumite.swf"
         width = "318" height = "300" play = "false" loop = "false"
         pluginspage = "http://www.macromedia.com/go/getflashplayer"
         swliveconnect = "true">
      </embed>

      <form name = "form" id = "form" action = "#" method = "get">
         <input type = "button" value = "Start" onclick = "play();" />
         <input type = "button" value = "Stop" onclick = "stop();" />
         <input type = "button" value = "Rewind" onclick = "rewind();" />
      </form>
   </body>
</html>
```

ES6 - Debugging

Every now and then, developers commit mistakes while coding. A mistake in a program or a script is referred to as a **bug**.

The process of finding and fixing bugs is called **debugging** and is a normal part of the development process. This chapter covers the tools and techniques that can help you with debugging tasks.

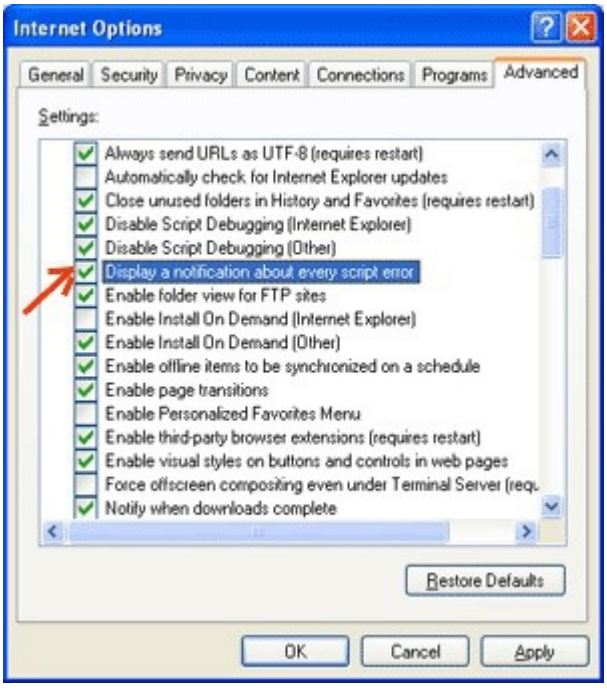
Error Messages in IE

The most basic way to track down errors is by turning on the error information in your browser. By default, the Internet Explorer shows an error icon in the status bar when an error occurs on the page.

Double-clicking this icon takes you to a dialog box showing information about the specific error that has occurred.

Since this icon is easy to overlook, Internet Explorer gives you the option to automatically show the Error dialog box whenever an error occurs.

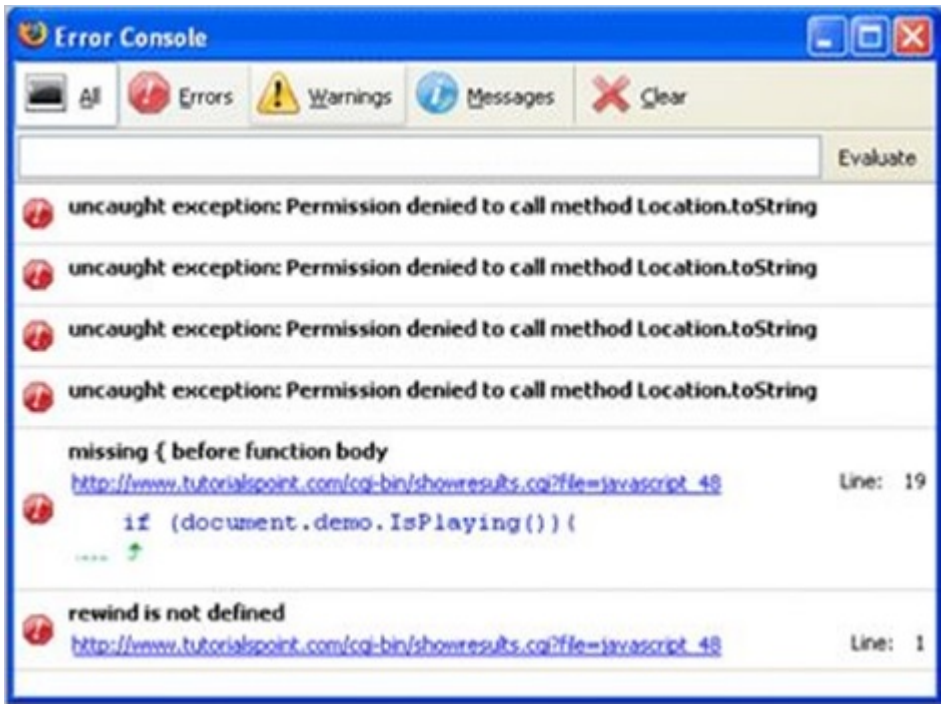
To enable this option, select **Tools** → **Internet Options** → **Advanced tab** and then finally check the "**Display a NotificationaboutEvery Script Error**" box option as shown in the following screenshot.



Error Messages in Firefox or Mozilla

Other browsers like Firefox, Netscape, and Mozilla send error messages to a special window called the **JavaScript Console** or **Error Console**. To view the console, select **Tools → Error Console or Web Development**.

Unfortunately, since these browsers give no visual indication when an error occurs, you must keep the Console open and watch for errors as your script executes.



Error Notifications

Error notifications that show up on the Console or through Internet Explorer dialog boxes are the result of both syntax and runtime errors. These error notifications include the line number at which the error occurred.

If you are using Firefox, then you can click on the error available in the error console to go to the exact line in the script having the error.

Debugging a Script

There are various ways to debug your JavaScript. Following are some of the methods.

Use a JavaScript Validator

One way to check your JavaScript code for strange bugs is to run it through a program that checks it to make sure it is valid and that it follows the official syntax rules of the language. These programs are called **validating parsers** or just validators for short, and often come with commercial HTML and JavaScript editors.

The most convenient validator for JavaScript is Douglas Crockford's JavaScript Lint, which is available for free at Douglas Crockford's JavaScript Lint.

Simply visit the web page, paste your JavaScript (Only JavaScript) code into the text area provided, and click the **jslint** button. This program will parse through your JavaScript code, ensuring that all the variable and function definitions follow the correct syntax. It will also check JavaScript statements, such as if and while, to ensure they too follow the correct format.

Add Debugging Code to Your Program

You can use the **alert()** or **document.write()** methods in your program to debug your code. For example, you might write something as follows –

```
var debugging = true; var whichImage = "widget";
if( debugging )
   alert( "Calls swapImage() with argument: " + whichImage );
   var swapStatus = swapImage( whichImage );
if( debugging )
alert( "Exits swapImage() with swapStatus=" + swapStatus );
```

By examining the content and order of the alert() as they appear, you can examine the health of your program very easily.

Use a JavaScript Debugger

A **debugger** is an application that places all aspects of script execution under the control of the programmer. Debuggers provide fine-grained control over the state of the script through an interface that allows you to examine and set values as well as control the flow of execution.

Once a script has been loaded into a debugger, it can be run one line at a time or instructed to halt at certain breakpoints. Once the execution is halted, the programmer can examine the state of the script and its variables in order to determine if something is amiss. You can also watch variables for changes in their values.

The latest version of the Mozilla JavaScript Debugger (code-named Venkman) for both Mozilla and Netscape browsers can be downloaded from – www.hacksrus.com/~ginda/venkman .

Useful Tips for Developers

You can keep the following tips in mind to reduce the number of errors in your scripts and simplify the debugging process –

Use plenty of comments. Comments enable you to explain why you wrote the script the way you did and to explain particularly the difficult sections of the code.

Always use indentation to make your code easy to read. Indenting statements also makes it easier for you to match up the beginning and ending tags, curly braces,

and other HTML and script elements.

Write modular code. Whenever possible, group your statements into functions. Functions let you group related statements, and test as well as reuse portions of the code with minimal effort.

Be consistent in the way you name your variables and functions. Try using names that are long enough to be meaningful and that describe the contents of the variable or the purpose of the function.

Use consistent syntax when naming variables and functions. In other words, keep them all lowercase or all uppercase; if you prefer Camel-Back notation, use it consistently.

Test long scripts in a modular fashion. In other words, do not try to write the entire script before testing any portion of it. Write a piece and get it to work before adding the next portion of the code.

Use descriptive variable and function names and avoid using single character names.

Watch your quotation marks. Remember that quotation marks are used in pairs around strings and that both quotation marks must be of the same style (either single or double).

Watch your equal signs. You should not use a single = for comparison purpose.

Declare variables explicitly using the **var** keyword.

Debugging with Node.js

Node.js includes a full-featured debugging utility. To use it, start Node.js with the debug argument followed by the path to the script to debug.

```
node debug test.js
```

A prompt indicating that the debugger has started successfully will be launched.

To apply a breakpoint at a specified location, call the debugger in the source code as shown in the following code.

```
// myscript.js
x = 5;
setTimeout(() => {
   debugger;
   console.log('world');
}, 1000);
console.log('hello');
```

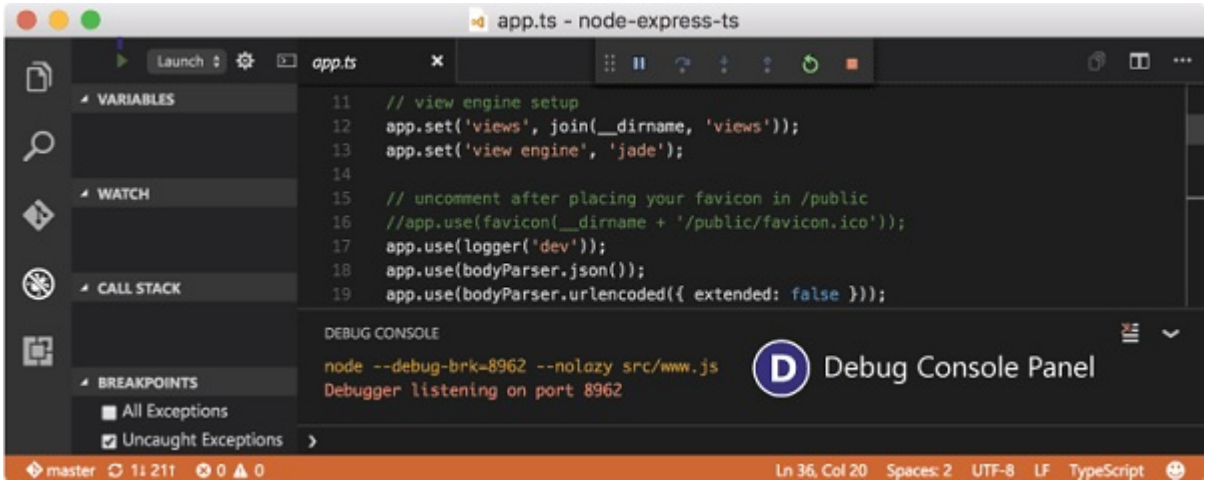
Following is a set of stepping commands that one can use with Node.

Sr.No	Stepping Commands & Description
1	**cont,c** Continue
2	**next,n** Next
3	**step,s** Step in
4	**out,o** Step out
5	**pause** Pause the code. Similar to pause in the developer tools

A complete list of Node's debugging commands can be found here – https://nodejs.org/api/debugger.html.

Visual Studio Code and Debugging

One of the key features of Visual Studio Code is its great in-built debugging support for Node.js Runtime. For debugging code in other languages, it provides debugger extensions.



The debugger provides a plethora of features that allow us to launch configuration files, apply/remove/disable and enable breakpoints, variable, or enable data inspection, etc.

A detailed guide on debugging using VS Code can be found here – https://code.visualstudio.com/docs/editor/debugging

ES6 - Image Map

You can use JavaScript to create a client-side image map. Client-side image maps are enabled by the usemap attribute for the **<img />** tag and defined by special <map> and **<area>** extension tags.

The image that is going to form the map is inserted into the page using the <img /> element as normal, except that it carries an extra attribute called usemap. The value of the **usemap** attribute is the value of the name attribute on the <map> element, which you are about to meet, preceded by a pound or a hash sign.

The <map> element actually creates the map for the image and usually follows directly after the <img /> element. It acts as a container for the <area /> elements that actually define the clickable hotspots. The <map> element carries only one attribute, the name attribute, which is the name that identifies the map. This is how the <img /> element knows which <map> element to use.

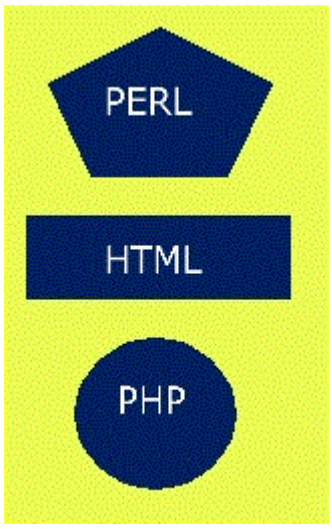
The <area> element specifies the shape and the coordinates that define the boundaries of each clickable hotspot.

The following code combines imagemaps and JavaScript to produce a message in a text box when the mouse is moved over different parts of an image.

```
<html>
   <head>
      <title>Using JavaScript Image Map</title>

      <script type="text/javascript">
         <!--
            function showTutorial(name) {
               document.myform.stage.value = name
            }
            //
         -->
      </script>
   </head>

   <body>
      <form name = "myform">
         <input type = "text" name = "stage" size = "20" />
      </form>

      <!-- Create  Mappings -->
      <img src = "//images/usemap.gif" alt = "HTML Map"
         border = "0" usemap = "#tutorials"/>
      <map name = "tutorials">
         <area shape = "poly"
            coords = "74,0,113,29,98,72,52,72,38,27"
            href = "/perl/index.htm" alt = "Perl Tutorial"
            target = "_self"
            onMouseOver = "showTutorial('perl')"
            onMouseOut = "showTutorial('')"/>
         <area shape = "rect"
```

```
            coords = "22,83,126,125"
            href = "/html/index.htm" alt = "HTML Tutorial" target = "_self"
            onMouseOver = "showTutorial('html')"
            onMouseOut = "showTutorial('')"/>
         <area shape = "circle"  coords = "73,168,32"
            href = "/php/index.htm" alt = "PHP Tutorial" target = "_self"
            onMouseOver = "showTutorial('php')"
            onMouseOut = "showTutorial('')"/>
      </map>
   </body>

</html>
```

The following output is displayed on successful execution of the above code. You can feel the map concept by placing the mouse cursor on the image object.



ES6 - Browsers

It is important to understand the differences between different browsers in order to handle each in the way it is expected. So it is important to know which browser your web page is running in. To get information about the browser your webpage is currently running in, use the built-in navigator object.

Navigator Properties

There are several Navigator related properties that you can use in your webpage. The following is a list of the names and its description.

Sr.No	Property & Description
1	**appCodeName**

	This property is a string that contains the code name of the browser, Netscape for Netscape and Microsoft Internet Explorer for Internet Explorer.
2	**appVersion** This property is a string that contains the version of the browser as well as other useful information such as its language and compatibility.
3	**language** This property contains the two-letter abbreviation for the language that is used by the browser. Netscape only.
4	**mimTypes[]** This property is an array that contains all MIME types supported by the client. Netscape only.
5	**platform[]** This property is a string that contains the platform for which the browser was compiled. "Win32" for 32-bit Windows operating systems.
6	**plugins[]** This property is an array containing all the plug-ins that have been installed on the client. Netscape only.
7	**userAgent[]** This property is a string that contains the code name and version of the browser. This value is sent to the originating server to identify the client.

Navigator Methods

There are several Navigator-specific methods. Here is a list of their names and descriptions.

Sr.No	Methods & Description
1	**javaEnabled()** This method determines if JavaScript is enabled in the client. If JavaScript is enabled, this method returns true; otherwise, it returns false.

2	**plugings.refresh** This method makes newly installed plug-ins available and populates the plugins array with all new plug-in names. Netscape only
3	**preference(name,value)** This method allows a signed script to get and set some Netscape preferences. If the second parameter is omitted, this method will return the value of the specified preference; otherwise, it sets the value. Netscape only
4	**taintEnabled()** This method returns true if data tainting is enabled; false otherwise

Browser Detection

The following JavaScript code can be used to find out the name of a browser and then accordingly an HTML page can be served to the user.

```
<html>
   <head>
      <title>Browser Detection Example</title>
   </head>

   <body>
      <script type = "text/javascript">
         <!--
            var userAgent   = navigator.userAgent;
            var opera       = (userAgent.indexOf('Opera')
            ! = -1); var ie          = (userAgent.indexOf('MSIE')
            != -1); var gecko        = (userAgent.indexOf('Gecko')
            ! = -1); var netscape    = (userAgent.indexOf('Mozilla')
            ! = -1); var version     = navigator.appVersion;

            if (opera) {
               document.write("Opera based browser");
               // Keep your opera specific URL here.
            } else if (gecko) {
               document.write("Mozilla based browser");
               // Keep your gecko specific URL here.
            } else if (ie) {
               document.write("IE based browser");
               // Keep your IE specific URL here.
            } else if (netscape) {
               document.write("Netscape based browser");
               // Keep your Netscape specific URL here.
            } else {
               document.write("Unknown browser");
            }
            // You can include version to along with any above condition.
            document.write("<br /> Browser version info : " + version );
```

```
            //
         -->
      </script>
   </body>

</html>
```

The following output is displayed on successful execution of the above code.

```
Mozilla based browser
Browser version info : 5.0
```

(Windows NT 6.3; WOW64) AppleWebKit/537.36 (KHTML, like Gecko) Chrome/41.0.2272.101 Safari/537.36

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