ES6

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About the Tutorial

European Computer Manufacturers Association (ECMAScript) or (ES) is a standard for scripting languages like JavaScript, ActionScript and JScript. It was initially created to standardize JavaScript, which is the most popular implementation of ECMAScript. This tutorial adopts a simple and practical approach through JavaScript to describe the new features in ECMAScript 2015 (ES6), ECMAScript 2016 (ES7), ECMAScript 2017(ES8) and ECMAScript 2018 (ES9).

Audience

This tutorial is designed for the stemplate oftware programmers who have already worked with JavaScript and wishes to gain in-depth knowledge about the ECMAScript. The tutorial will give you enough understanding on the functionalities of ECMAScript and also about ES6, ES7, ES8 and ES9.

Prerequisites

An understanding of JavaScript programming concepts is necessary to gain maximum knowledge from this tutorial.

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1. 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

ECMAScript Versions

There are nine editions of ECMA-262 which are as follows:

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Edition	Name	Description
1	ECMAScript 1	First Edition released in 1997
2	ECMAScript 2	Second Edition released in 1998, minor changes to meet ISO/IEC 16262 standard
3	ECMAScript 3	Third Edition released in 1999 with language enhancements
4	ECMAScript 4	Fourth Edition release plan was dropped, few features added later in ES6 & other complex features dropped
5	ECMAScript 5	Fifth Edition released in 2009
5.1	ECMAScript 5.1	5.1 Edition released in 2011, minor changes to meet ISO/IEC 16262:2011 standard
6	ECMAScript 2015/ES6	Sixth Edition released in 2015, see ES6 chapters for new features
7	ECMAScript 2016/ES7	Seventh Edition released in 2016, see ES7 chapters for new features
8	ECMAScript 2017/ES8	Eight Edition released in 2017, see ES8 chapters for new features
9	ECMAScript 2018/ES9	Ninth Edition released in 2018, see ES9 chapters for new features

2. 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

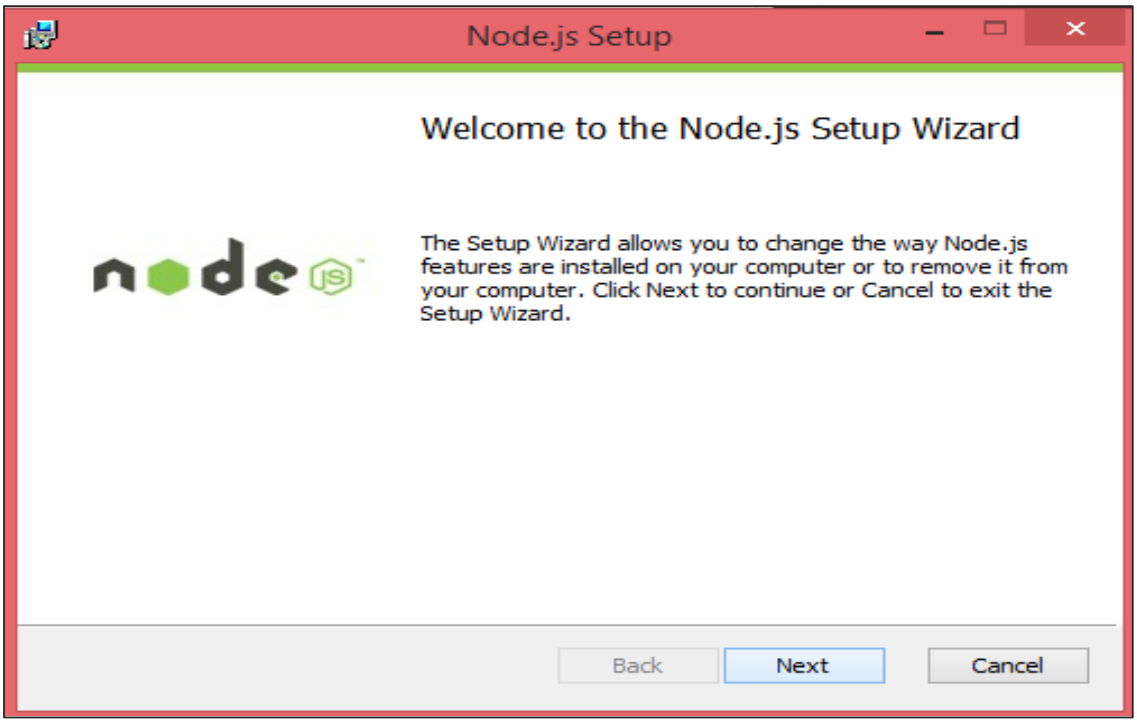
The text editor helps you to write your source code. Examples of few editors include Windows Notepad, Notepad++, Emacs, vim or vi etc. Editors used may vary with the operating systems. The source files are typically named with the **extension .js**.

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.

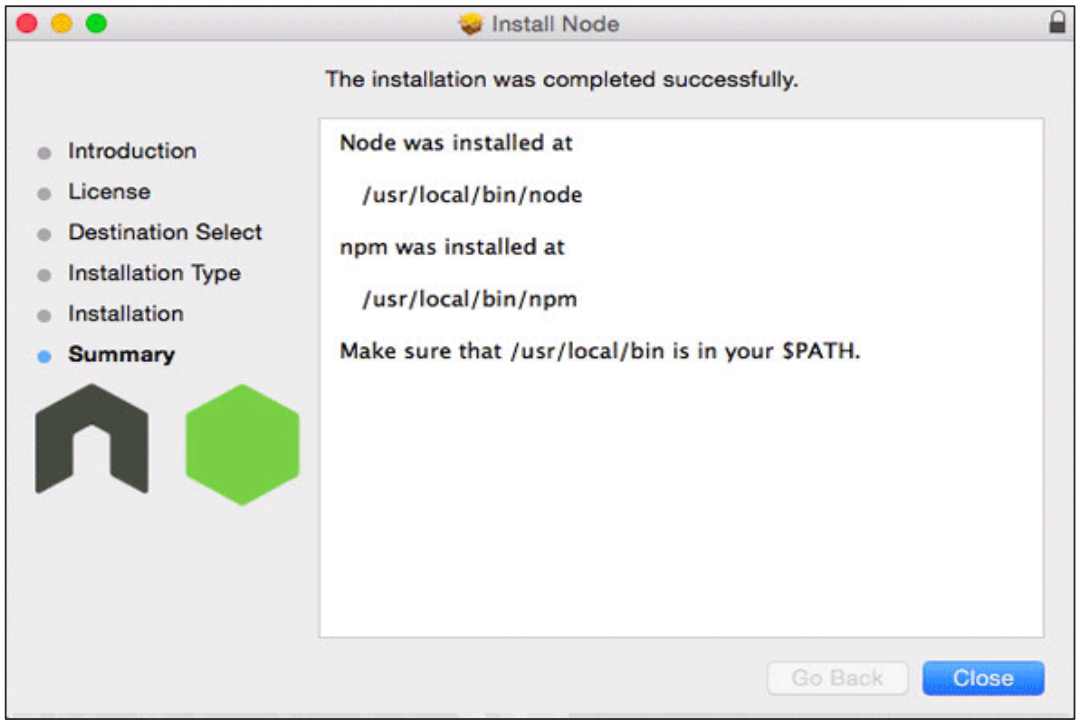
```
C:\Users>node -v
v4.2.3

C:\Users>_
```

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 http://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.shand Linuxbrew at the http://brew.sh/linuxbrew**.**

Integrated Development Environment (IDE) Support

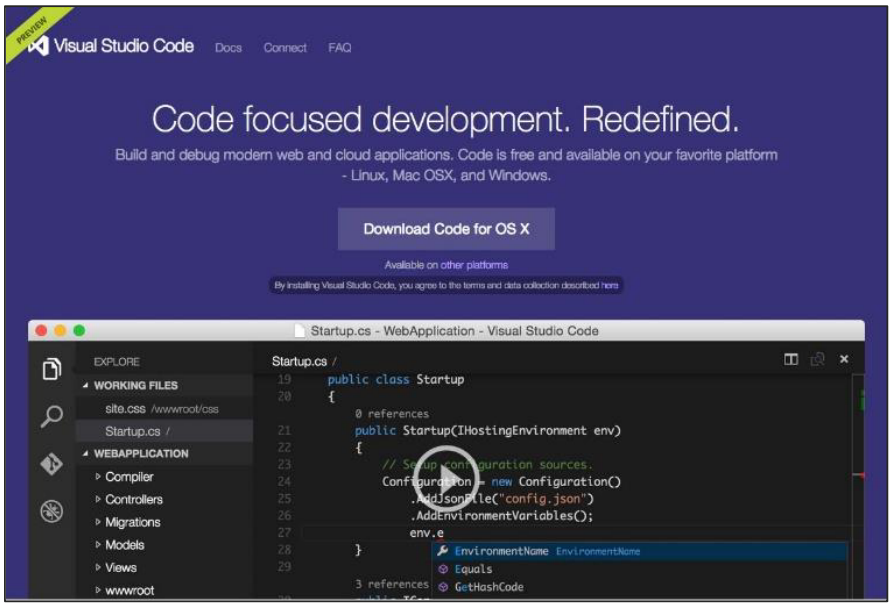
JavaScript can be built on a plethora of development environments like Visual Studio, Sublime Text 2, WebStorm/PHPStorm, Eclipse, Brackets, etc. The Visual Studio Code and Brackets IDE is discussed in this section. The development environment used here is Visual Studio Code (Windows platform).

Visual Studio Code

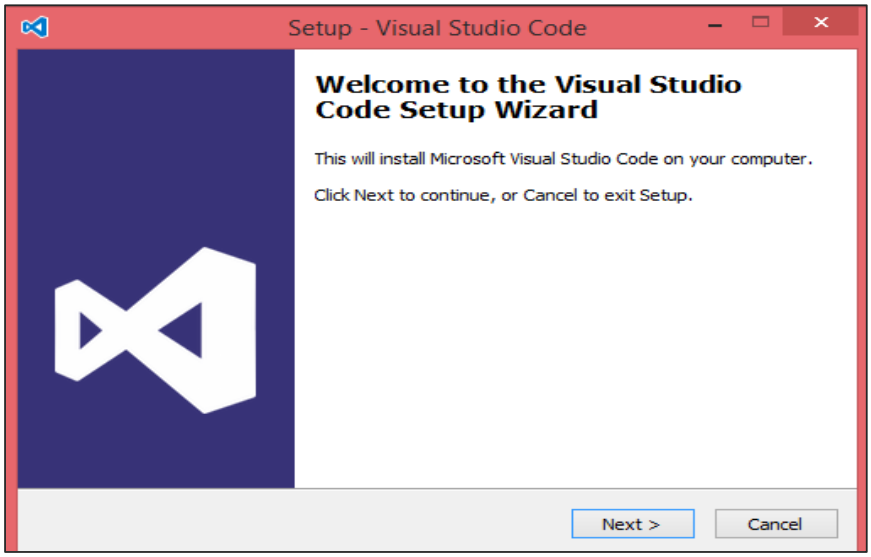
This is open source IDE from Visual Studio. It is available for Mac OS X, Linux, and Windows platforms. VScode is available athttps://code.visualstudio.com

Installation on Windows

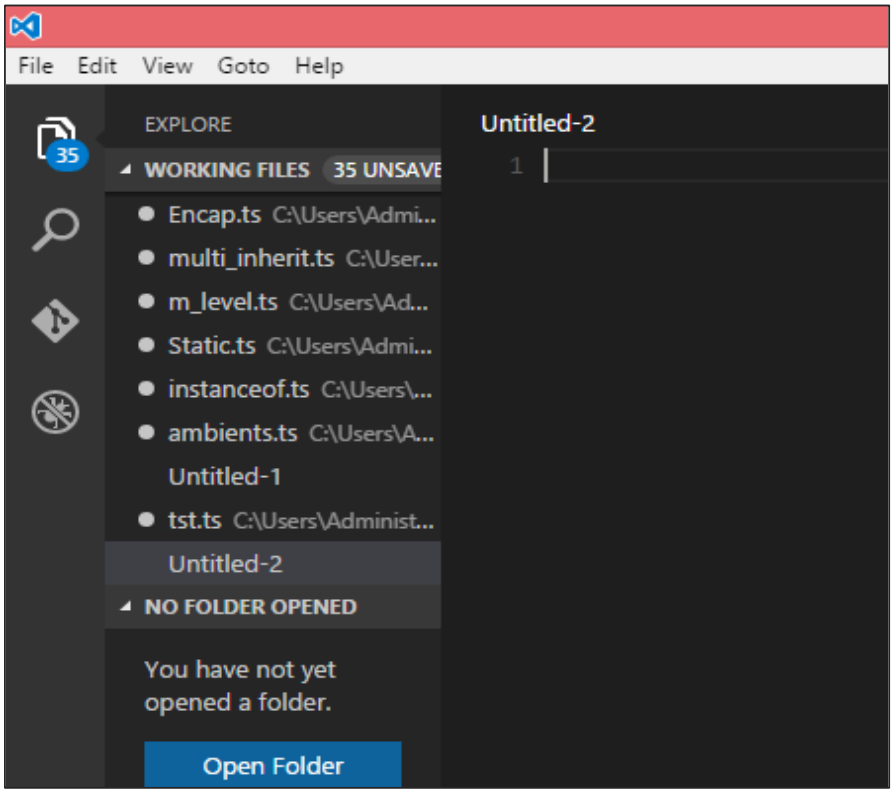
Download Visual Studio Code for Windows.



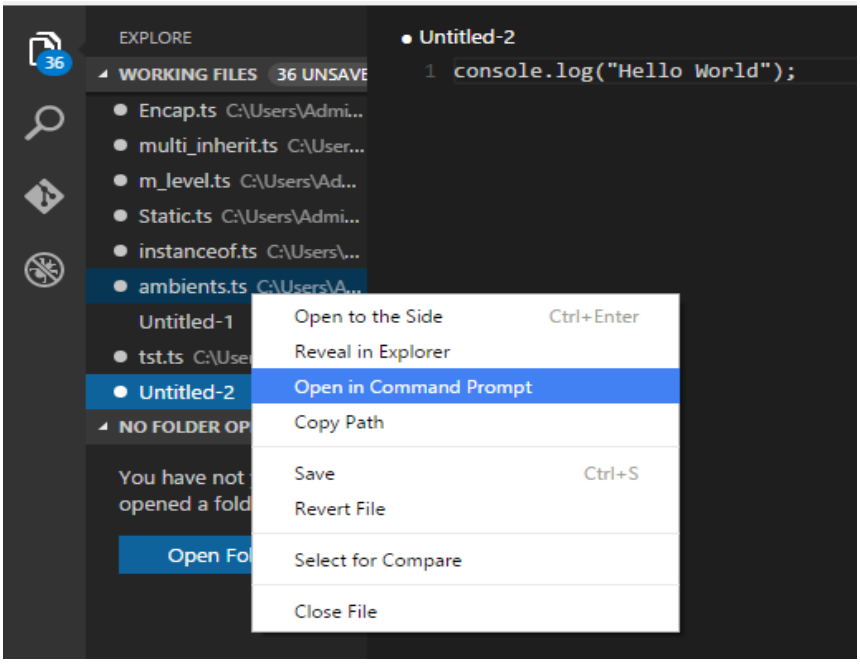
Double-click on VSCodeSetup.exe to launch the setup process. This will only take a minute.



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

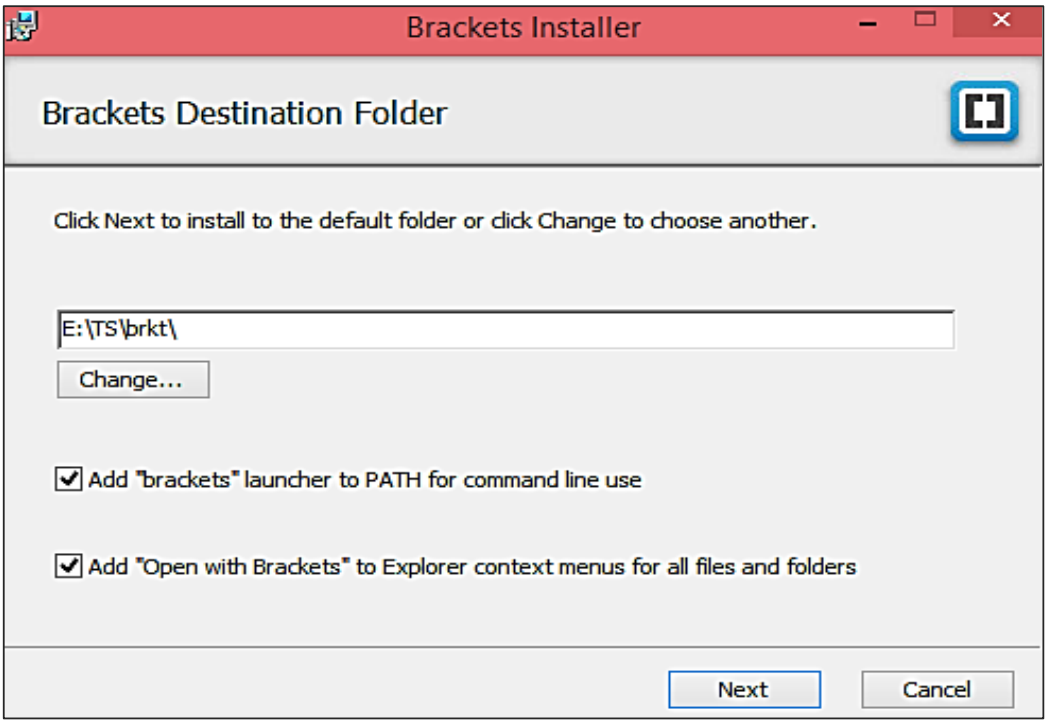
Visual Studio Code's Mac OS X specific installation guide can be found at https://code.visualstudio.com/Docs/editor/setup

Installation on Linux

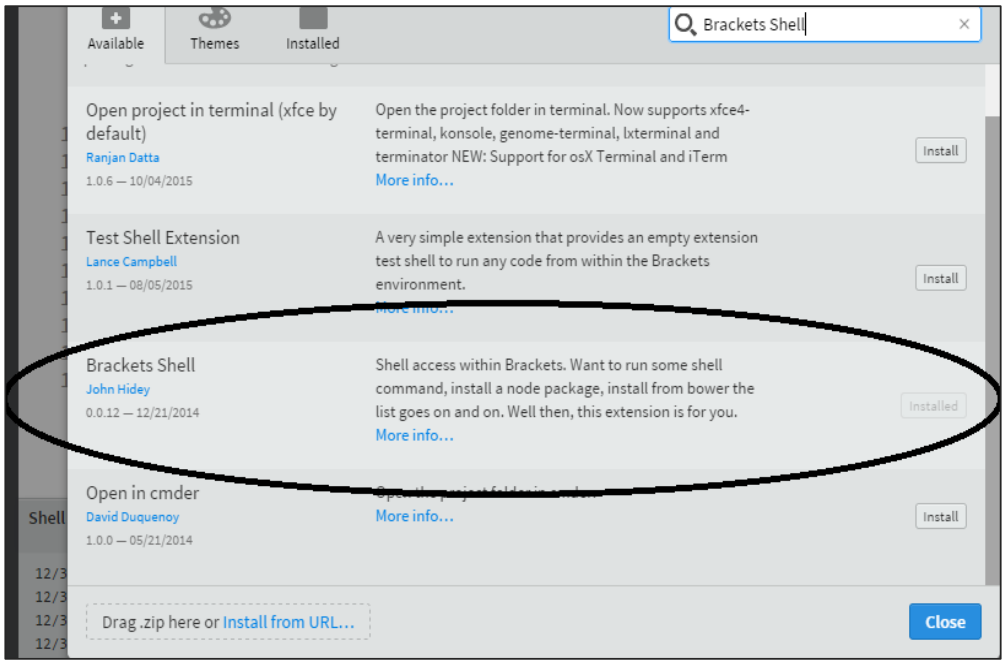
Linux specific installation guide for Visual Studio Code can be found at https://code.visualstudio.com/Docs/editor/setup

Brackets

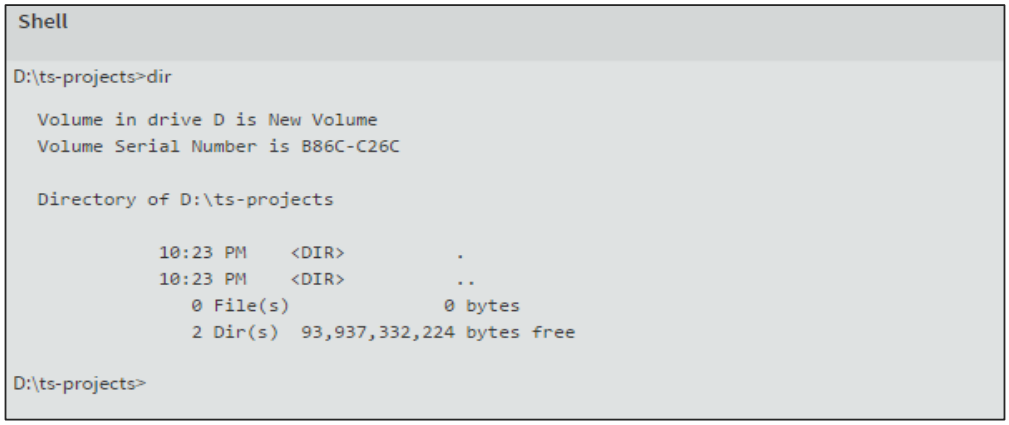
Brackets is a free open-source editor for web development, created by Adobe Systems. It is available for Linux, Windows and Mac OS X. Brackets is available at http://brackets.io



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!!!

3. 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.

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The following table illustrates some valid and invalid identifiers.

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

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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
```


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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-script mode. All statements within the function will be executed in the Strict Mode.

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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.

4. 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 outside test() 100
```

ES6 defines a new variable scope - The Block scope.

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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
```


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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.

let and block level safety

If we try to declare a **let** variable twice within the same block, it will throw an error. Consider the following example:

```
<script>
let balance = 5000 // number type
console.log(typeof balance)

let balance = {message:"hello"} // changing number to object type
console.log(typeof balance)

</script>
```

The above code will result in the following error:

```
Uncaught SyntaxError: Identifier 'balance' has already been declared
```

let and multiple blocks

However, the same **let** variable can be used in different block level scopes without any syntax errors.

Example

```
<script>
let count=100
for (let count =1;count<=10;count++){
    //inside for loop brackets ,count value starts from 1
console.log("count value inside loop is ",count);
}
//outside for loop brackets ,count value is 100
console.log("count value after loop is",count);
```

```
if(count==100){
    //inside  if brackets ,count value is 50
  let count=50;
  console.log("count inside if block",count);
}

console.log(count);
</script>
```

The output of the above code will be as follows:

```
 count value inside loop is  1
 count value inside loop is  2
 count value inside loop is  3
 count value inside loop is  4
 count value inside loop is  5
 count value inside loop is  6
 count value inside loop is  7
 count value inside loop is  8
 count value inside loop is  9
 count value inside loop is  10
 count value after loop is 100
 count inside if block 50
 100
```

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 mutable.

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.

Constants are Immutable

Unlike variables declared using **let** keyword, **constants** are immutable. This means its value cannot be changed. For example, if we try to change value of the constant variable, an error will be displayed.

```
<script>
      let income = 100000
      const INTEREST_RATE = 0.08
      income += 50000 // mutable
      console.log("changed income value is ",income)
      INTEREST_RATE += 0.01
      console.log("changed rate is ",INTEREST_RATE) //Error: not mutable
  </script>
```

The output of the above code will be as follows:

```
changed income value is  150000
Uncaught TypeError: Assignment to constant variable
```

const and arrays

The following example shows how to create an immutable array. New elements can be added to the array. However, reinitializing the array will result in an error as shown below:

```
<script>
        const DEPT_NOS = [10,20,30,50]
        DEPT_NOS.push(40)
        console.log('dept numbers is ',DEPT_NOS)

        const EMP_IDS = [1001,1002,1003]
```

```
        console.log('employee ids',EMP_IDS)
        //re assigning variable employee ids
        EMP_IDS = [2001,2002,2003]
        console.log('employee ids after changing',EMP_IDS)
    </script>
```

The output of the above code will be as shown below:

```
dept numbers is  (5) [10, 20, 30, 50, 40]
employee ids (3) [1001, 1002, 1003]
Uncaught TypeError: Assignment to constant variable.
```

The var keyword

Prior to ES6, the **var** keyword was used to declare a variable in JavaScript. Variables declared using **var** do not support block level scope. This means if a variable is declared in a loop or **if block** it can be accessed outside the loop or the **if block**. This is because the variables declared using the **var** keyword support hoisting.

var and hoisting

Variable hoisting allows the use of a variable in a JavaScript program, even before it is declared. Such variables will be initialized to **undefined** by default. JavaScript runtime will scan for variable declarations and put them to the top of the function or script. Variables declared with **var** keyword get hoisted to the top. Consider the following example:

```
<script>
// variable company is hoisted to top , var company = undefined
console.log(company); // using variable before declaring
var company = "TutorialsPoint"; // declare and initialized here
console.log(company);


</script>
```

The output of the above code will be as shown below:

```
undefined
TutorialsPoint
```

var 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. Variables declared using the **var** keyword do not have a block scope. Consider the following example:

```
<script>
  //hoisted to top ; var i = undefined
for (var i=1;i<=5;i++){
    console.log(i);
}
console.log("after the loop i value is "+i);

</script>
```

The output of the above code will be as follows:

```
1
2
3
4
5
after the loop i value is 6
```

The variable **i** is declared inside the for loop using the **var** keyword. The variable **i** is accessible outside the loop. However, at times, there might be a need to restrict a variable's access within a block. We cannot use the **var** keyword in this scenario. ES6 introduces the **let** keyword to overcome this limitation.

var and block level safety

If we declare the same **variable** twice using the **var keyword** within a block, the compiler will not throw an error. However, this may lead to unexpected logical errors at runtime.

```
<script>
var balance = 5000
console.log(typeof balance)
var balance = {message:"hello"}
console.log(typeof balance)
</script>
```

The output of the above code is as shown below:

```
number
```


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```
object
```

5. 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
- Logical operators
- Relational operators
- Bitwise operators
- Assignment operators
- Ternary/conditional operators
- String operators
- Type operators
- The void operator

Arithmetic Operators

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

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
%		a % b is 2

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	Modulus: Performs a division and returns the remainder	
++	Increments the value of the variable by one	a++ is 11
--	Decrements the value of the variable by one	A- - is 9

Example: Arithmetic Operators

```
var num1=10
var num2=2
var res=0
res= num1+num2
console.log("Sum:        "+ res);
res=num1-num2;
console.log("Difference: "+res)
res=num1*num2
console.log("Product:    "+res)
res=num1/num2
console.log("Quotient:   "+res)
res=num1%num2
console.log("Remainder:   "+res)
num1++
console.log("Value of num1 after increment "+num1)
num2--
console.log("Value of num2 after decrement "+num2)
```

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

```
Sum: 12
Difference: 8
Product: 20
Quotient : 5
Remainder: 0
Value of num1 after increment: 11
Value of num2 after decrement: 1
```

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.

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 True
!=	Not equal	(A!=B) is True

Example

```
var num1 = 5;
var num2 = 9;
console.log("Value of num1: " + num1);
console.log("Value of num2 :" + num2);
var res = num1 > num2;
console.log("num1 greater than num2: " + res);
res = num1 < num2;
console.log("num1 lesser than num2: " + res);
res = num1 >= num2;
console.log("num1 greater than or equal to  num2: " + res);
res = num1 <= num2;
console.log("num1 lesser than or equal to num2: " + res);
res = num1 == num2;
console.log("num1 is equal to num2: " + res);
res = num1 != num2;
console.log("num1 not equal to  num2: " + res);
```


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

```
Value of num1: 5
Value of num2 :9
num1 greater than num2: false
num1 lesser than num2: true
num1 greater than or equal to num2: false
num1 lesser than or equal to num2: true
14 num1 is equal to num2: false
16 num1 not equal to num2: 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.

Operator	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

Example

```
var avg = 20;
var percentage = 90;
console.log("Value of avg: " + avg + " ,value of percentage: " + percentage);
var res = ((avg > 50) && (percentage > 80));
console.log("(avg>50)&&(percentage>80): ", res);
var res = ((avg > 50) || (percentage > 80));
console.log("(avg>50)||(percentage>80): ", res);
var res = !((avg > 50) && (percentage > 80));
console.log("!((avg>50)&&(percentage>80)): ", res);
```

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

```
Value of avg: 20 ,value of percentage: 90
(avg>50)&&(percentage>80):  false
(avg>50)||(percentage>80):  true
!((avg>50)&&(percentage>80)):  true
```

Short-circuit Operators

The **&&** and **||** operators are used to combine expressions.

The && operator returns true only when both the conditions return true. Let us consider an expression:

```
var a=10
var result=( a<10 && a>5)
```

In the above example, a<10 and a>5 are two expressions combined by an && operator. Here, the first expression returns false. However, the && operator requires both the expressions to return true. So, the operator skips the second expression.

The || operator returns true, if one of the expressions return true. For example:

```
var a=10
var result=( a>5 || a<10)
```

In the above snippet, two expressions a>5 and a<10 are combined by a || operator. Here, the first expression returns true. Since, the first expression returns true, the || operator skips the subsequent expression and returns true.

Due to this behavior of the && and || operator, they are called as short-circuit operators.

Bitwise Operators

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

Operator	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

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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

Example

```
var a = 2; // Bit presentation 10
var b = 3; // Bit presentation 11
var result;
result = (a & b);
console.log("(a & b) => ", result);
result = (a | b);
console.log("(a | b) => ", result);
result = (a ^ b);
console.log("(a ^ b) => ", result);
result = (~b);
console.log("(~b) => ", result);
result = (a << b);
console.log("(a << b) => ", result);
result = (a >> b);
console.log("(a >> b) => ", result);
```

Output

```
(a & b) =>  2
(a | b) =>  3
(a ^ b) =>  1
(~b) =>  -4
(a << b) =>  16
(a >> b) =>  0
```

Assignment Operators

The following table summarizes Assignment operators.

Sr. No.	Operator and 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 ^=

Example

```
var a = 12;
var b = 10;
a = b;
```


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```
console.log("a=b: " + a);
a += b;
console.log("a+=b: " + a);
a -= b;
console.log("a-=b: " + a);
a *= b;
console.log("a*=b: " + a);
a /= b;
console.log("a/=b: " + a);
a %= b;
console.log("a%=b: " + a);
```

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

```
a=b: 10
a+=b: 20
a-=b: 10
a*=b: 100
a/=b: 10
a%=b: 0
```

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
```


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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
```

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

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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
```

Spread Operator

ES6 provides a new operator called the **spread operator**. The spread operator is represented by three dots **"..."** . The spread operator converts an array into individual array elements.

Spread operator and function

The following example illustrates the use of spread operators in a function:

```
<script>
    function addThreeNumbers(a,b,c){
        return a+b+c;
    }

    const arr = [10,20,30]
    console.log('sum is :',addThreeNumbers(...arr))
    console.log('sum is ',addThreeNumbers(...[1,2,3]))
   </script>
```

The output of the above code will be as seen below:

```
sum is : 60
```

```
sum is  6
```

Spread operator and Array copy and concat

The spread operator can be used to copy one array into another. It can also be used to concatenate two or more arrays. This is shown in the example below:

Example

```
<script>

     //copy array using spread operator
      let source_arr = [10,20,30]
      let dest_arr = [...source_arr]
      console.log(dest_arr)

      //concatenate two arrays
      let arr1 = [10,20,30]
      let arr2 =[40,50,60]
      let arr3 = [...arr1,...arr2]
      console.log(arr3)

</script>
```

The output of the above code will be as stated below:

```
 [10, 20, 30]
[10, 20, 30, 40, 50, 60]
```

Spread Operator and Object copy and concatenation

The spread operator can be used to copy one object into another. It can also be used to concatenate two or more objects. This is shown in the example below:

```
  <script>

      //copy object
      let student1 ={firstName:'Mohtashim',company:'TutorialsPoint'}
      let student2 ={...student1}
      console.log(student2)
      //concatenate objects
```

```
      let student3 = {lastName:'Mohammad'}
      let student4 = {...student1,...student3}
      console.log(student4)
</script>
```

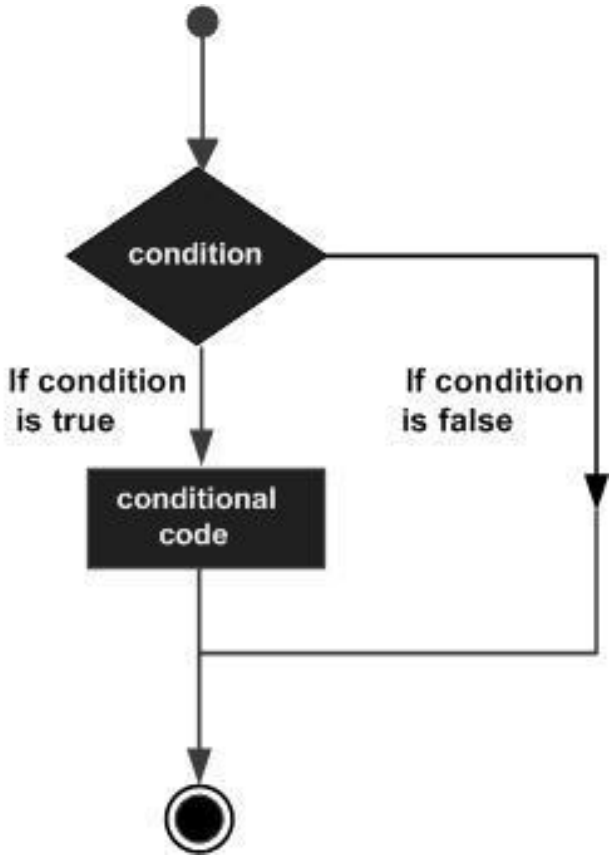
The output of the above code will be as given below:

```
{firstName: "Mohtashim", company: "TutorialsPoint"}


{firstName: "Mohtashim", company: "TutorialsPoint", lastName: "Mohammad"}
```

6. 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.

Statement	Description
if statement	An 'if' statement consists of a Boolean expression followed by one or more statements
if...else statement	An 'if' statement can be followed by an optional 'else' statement, which executes when the Boolean expression is false
The else.. if ladder / nested if statements	You can use one 'if' or 'else if' statement inside another 'if' or 'else if' statement(s)
switch statement	A 'switch' statement allows a variable to be tested for equality against a list of values

The if Statement

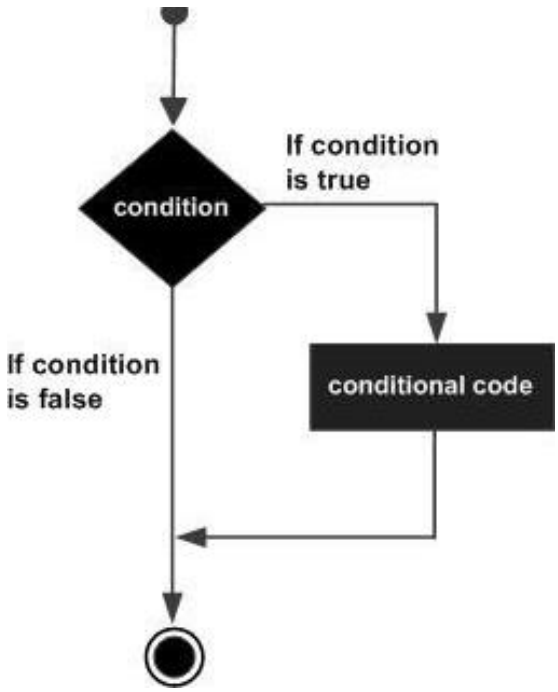
The 'if…else' construct evaluates a condition before a block of code is executed.

Following is the syntax.

```
if(boolean_expression)
{
     // statement(s) will execute if the Boolean expression is true
}
```

If the Boolean expression evaluates to true, then the block of code inside the if statement will be executed. If the Boolean expression evaluates to false, then the first set of code after the end of the if statement (after the closing curly brace) will be executed.

Flowchart



Example

```
var  num=5
if (num>0)
{
  console.log("number is positive")
}
```

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

```
number is positive
```

The above example will print "number is positive" as the condition specified by the if block is true.

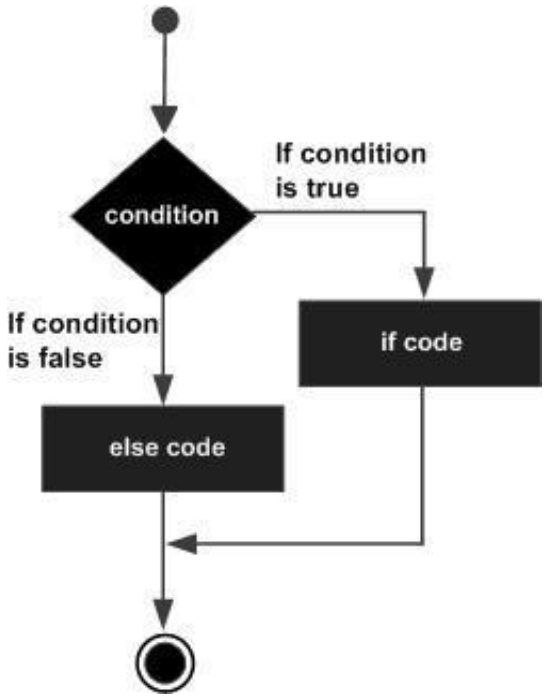
The if…else Statement

An if can be followed by an optional else block. The else block will execute if the Boolean expression tested by if evaluates to false.

Following is the syntax.

```
if(boolean_expression)
{
// statement(s) will execute if the Boolean expression is true
}
else
{
// statement(s) will execute if the Boolean expression is false
}
```

Flowchart



The if block guards the conditional expression. The block associated with the if statement is executed if the Boolean expression evaluates to true. The if block may be followed by an optional else statement. The instruction block associated with the else block is executed if the expression evaluates to false.

Example: Simple if…else

```
var num= 12;
if (num % 2==0)
{
  console.log("Even");
}
else
{
 console.log("Odd");
}
```

The above example prints whether the value in a variable is even or odd. The if block checks the divisibility of the value by 2 to determine the same.

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

```
Even
```

The else…if Ladder

The else…if ladder is useful to test multiple conditions. Following is the syntax of the same.

```
if (boolean_expression1)
{
     //statements if the expression1 evaluates to true
}
else if (boolean_expression2)
{
     //statements if the expression2 evaluates to true
}
else
{
     //statements if both expression1 and expression2 result to false
}
```

When using if…else statements, there are a few points to keep in mind.

- An if can have zero or one else's and it must come after any else if's.
- An if can have zero to many else if's and they must come before the else.
- Once an else if succeeds, none of the remaining else if's or else's will be tested.

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Example: else…if ladder

```
var num=2
if(num > 0)
{
console.log(num+" is positive")
}
else if(num < 0)
{
console.log(num+" is negative")
}
else
{
console.log(num+" is neither positive nor negative")
}
```

The code displays whether the value is positive, negative, or zero.

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

```
2 is positive
```

The 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.

Following is the syntax.

```
switch(variable_expression)


   {
     case constant_expr1:
              {
            //statements;
            break;
               }
     case constant_expr2:
            {


             //statements;
```

```
            break;
            }
         default:
            {
                  //statements;
                  break;
            }
}
```

The value of the **variable_expression** is tested against all cases in the switch. If the variable matches one of the cases, the corresponding code block is executed. If no case expression matches the value of the variable_expression, the code within the default block is associated.

The following rules apply to a switch statement:

- There can be any number of case statements within a switch.
- The case statements can include only constants. It cannot be a variable or an expression.
- The data type of the variable_expression and the constant expression must match.
- Unless you put a break after each block of code, the execution flows into the next block.
- The case expression must be unique.
- The default block is optional.

Flowchart

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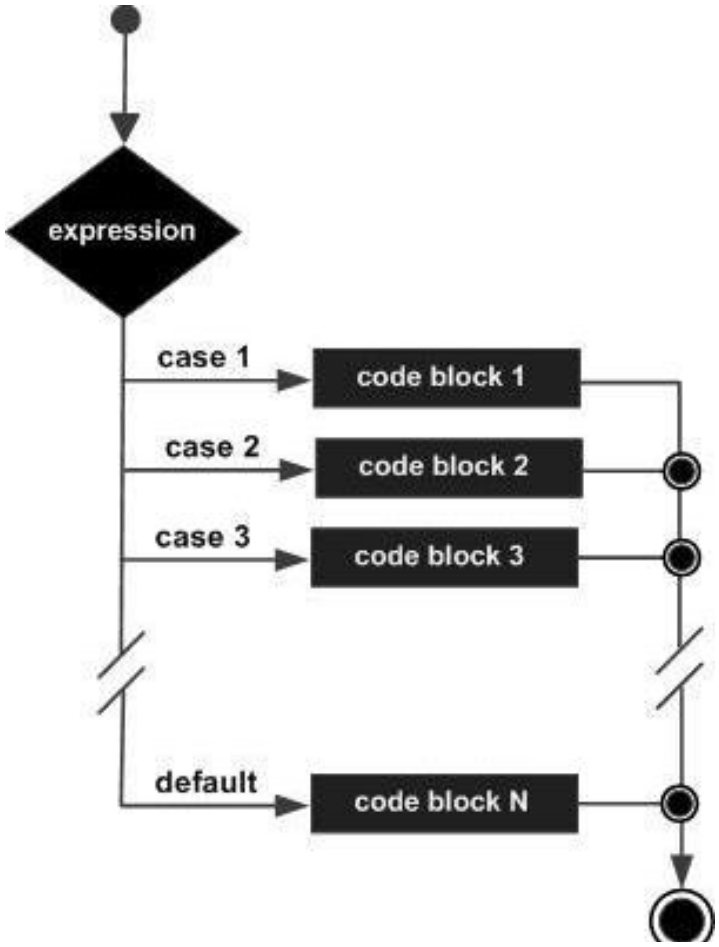

Example: switch…case

```
var grade="A";
switch(grade)
{
              case "A":
                 {
                     console.log("Excellent");
                     break;
                 }
              case "B":
                {
                     console.log("Good");
                     break;
                }
```

```
                case "C":
                  {
                        console.log("Fair");
                        break;
                  }
                case "D":
                   {
                         console.log("Poor");
                         break;
                   }
                default:
                   {
                         console.log("Invalid choice");
                         break;
                   }
}
```

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

```
Excellent
```

The example verifies the value of the variable grade against the set of constants (A, B, C, D, and E) and executes the corresponding blocks. If the value in the variable doesn't match any of the constants mentioned above, the default block will be executed.

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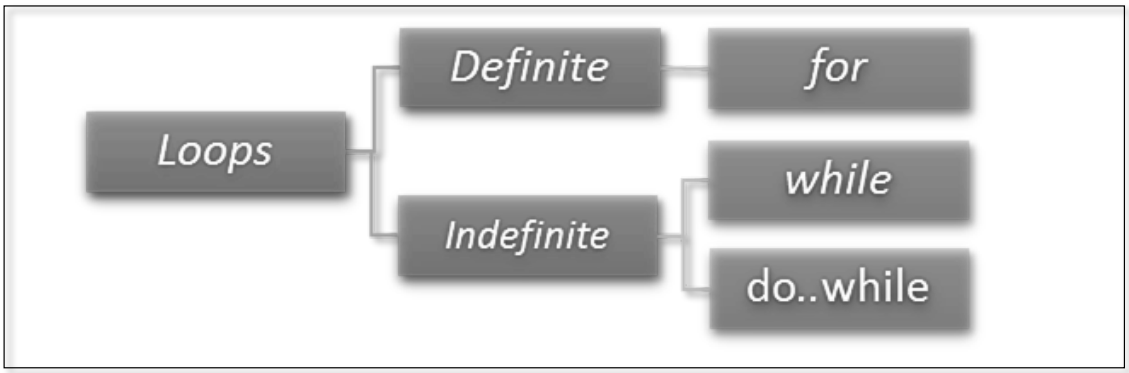
7. ES6 – Loops

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
}
```

The 'for' loop

The for loop executes the code block for a specified number of times. It can be used to iterate over a fixed set of values, such as an array. Following is the syntax of the for loop.

```
var num=5
var factorial=1;
for( let i = num ; i >= 1; i-- )
{
   factorial *= i ;
}
console.log(factorial);
```

The for loop has three parts: the initializer (i=num), the condition (i>=1) and the final expression (i--).

The program calculates the factorial of the number 5 and displays the same. The for loop generates the sequence of numbers from 5 to 1, calculating the product of the numbers in every iteration.

Multiple assignments and final expressions can be combined in a for loop, by using the comma operator (,). For example, the following for loop prints the first eight Fibonacci numbers:

Example

```
"use strict"
for(let temp, i=0, j=1; j<30; temp = i, i = j, j = i + temp)
console.log(j);
```

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

```
1
1
2
3
5
8
13
21
```

The for…in loop

The for...in loop is used to loop through an object's properties.

Following is the syntax of 'for…in' loop.

```
for (variablename in object)
{
     statement or block to execute
}
```

In each iteration, one property from the object is assigned to the variable name and this loop continues till all the properties of the object are exhausted.

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Example

```
var obj = {a:1, b:2, c:3};


for (var prop in obj) {
  console.log(obj[prop]);
}
```

The above example illustrates iterating an object using the for... in loop. The following output is displayed on successful execution of the code.

```
1
2
3
```

The for…of loop

The for…of loop is used to iterate iterables instead of object literals.

Following is the syntax of 'for…of' loop.

```
for (variablename of object){
statement or block to execute
}
```

Example

```
for (let val of[12 , 13 , 123]){


console.log(val)
}
```

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

```
12
13
123
```


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Indefinite Loop

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

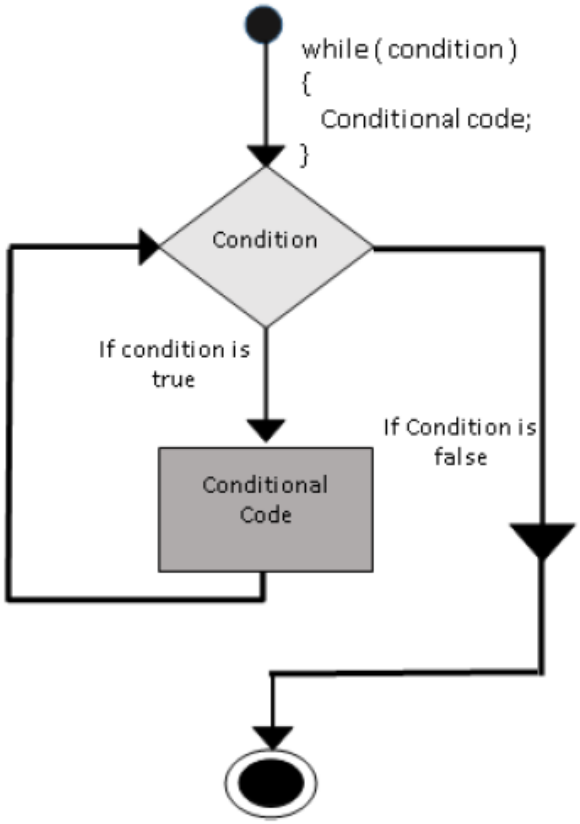
Indefinite loops can be implemented using:

- while loop
- do…while loop

The while loop

The while loop executes the instructions each time the condition specified evaluates to true. In other words, the loop evaluates the condition before the block of code is executed.

Flow chart



Following is the syntax for the while loop.

```
while (expression)
{
     Statement(s) to be executed if expression is true
}
```

Example

```
var num=5;
var factorial=1;
while(num >=1)
{
    factorial=factorial * num;
    num--;
}
console.log("The factorial  is "+factorial);
```

The above code uses a while loop to calculate the factorial of the value in the variable num.

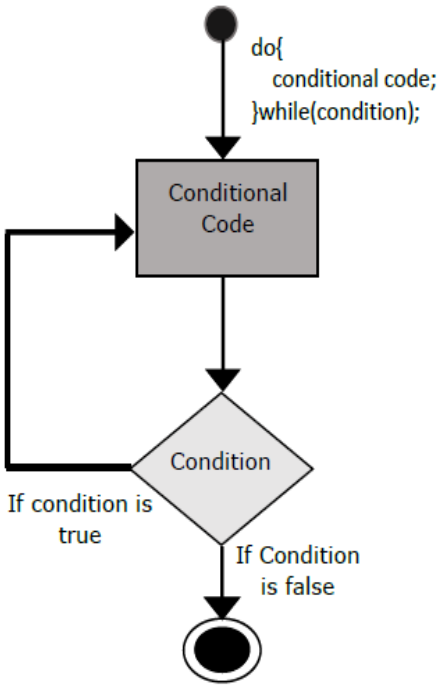
The following output is displayed on successful execution of the code.

```
The factorial is 120
```

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. However, the condition is evaluated for the subsequent iterations. In other words, the code block will be executed at least once in a **do…while** loop.

Flowchart



Following is the syntax for do-while loop in JavaScript.

```
do{
     Statement(s) to be executed;
} while (expression);
```

Note: Don't miss the semicolon used at the end of the do...while loop.

Example

```
var n=10;
do
{
    console.log(n);
    n--;
} while(n>=0);
```

The example prints numbers from 0 to 10 in the reverse order.

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

```
10
9
8
7
6
5
4
3
2
1
0
```

Example: while versus do…while

do…while loop:

```
var n=10;
do
{
   console.log(n);
   n--;
```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```
}
while(n>=0);
```

while loop:

```
var n=10;
while(n>=0)
{
   console.log(n);
   n--;
}
```

In the above example, the while loop is entered only if the expression passed to while evaluates to true. In this example, the value of **n** is not greater than zero, hence the expression returns false and the loop is skipped.

On the other hand, the do…while loop executes the statement once. This is because the initial iteration does not consider the boolean expression. However, for the subsequent iteration, the while checks the condition and takes the control out of the loop.

The Loop Control Statements

The break statement

The break statement is used to take the control out of a construct. Using break in a loop causes the program to exit the loop. Following is an example of the break statement.

Example

```
var i=1
while(i<=10)
{
   if (i % 5 == 0)
  {
     console.log("The first multiple of 5  between 1 and 10 is : "+i)
     break     //exit the loop if the first multiple is found
  }
  i++
}
```

The above code prints the first multiple of 5 for the range of numbers within 1 to 10.

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If a number is found to be divisible by 5, the if construct forces the control to exit the loop using the break statement. The following output is displayed on successful execution of the above code.

```
The first multiple of 5 between 1 and 10 is: 5
```

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. Unlike the break statement, the continue doesn't exit the loop. It terminates the current iteration and starts the subsequent iteration. Following is an example of the continue statement.

```
var num=0
var count=0;
for(num=0;num<=20;num++)
{
  if (num % 2==0)
   {
      continue
   }
   count++
}
console.log(" The count of odd values between 0 and 20 is: "+count)
```

The above example displays the number of even values between 0 and 20. The loop exits the current iteration if the number is even. This is achieved using the continue statement.

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

```
The count of odd values between 0 and 20 is: 10
```

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.

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Example: Label with Break

```
outerloop: // This is the label name
for (var i = 0; i < 5; i++)
{
console.log("Outerloop: " + i);
innerloop:
for (var j = 0; j < 5; j++){
if (j > 3 ) break ; // Quit the innermost loop
if (i == 2) break innerloop; // Do the same thing
if (i == 4) break outerloop; // Quit the outer loop
console.log("Innerloop: " + j);
}
}
```

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

```
Outerloop: 0
Innerloop: 0
Innerloop: 1
Innerloop: 2
Innerloop: 3
Outerloop: 1
Innerloop: 0
Innerloop: 1
Innerloop: 2
Innerloop: 3
Outerloop: 2
Outerloop: 3
Innerloop: 0
Innerloop: 1
Innerloop: 2
Innerloop: 3
Outerloop: 4
```

Example: Label with continue

```
outerloop: // This is the label name
for (var i = 0; i < 3; i++)
{
console.log("Outerloop: " + i);
for (var j = 0; j < 5; j++)
{
if (j == 3){
continue outerloop;
}
console.log("Innerloop: " + j );
}
}
```

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

```
Outerloop: 0
Innerloop: 0
Innerloop: 1
Innerloop: 2
Outerloop: 1
Innerloop: 0
Innerloop: 1
Innerloop: 2
Outerloop: 2
Innerloop: 0
Innerloop: 1
Innerloop: 2
```


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8. 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.

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```
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: Parametrized 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
```


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For better understanding, let us consider the below example.

Example 1

The following example shows a function which takes two parameters and returns their sum. The second parameter has a default value of 10. This means, if no value is passed to the second parameter, its value will be 10.

```
<script>
       function addTwoNumbers(first,second=10){
           console.log('first parameter is :',first)
           console.log('second parameter is :',second)
           return first+second;
       }

       console.log("case 1 sum:",addTwoNumbers(20)) // no value
       console.log("case 2 sum:",addTwoNumbers(2,3))
       console.log("case 3 sum:",addTwoNumbers())
       console.log("case 4 sum",addTwoNumbers(1,null))//null passed
       console.log("case 5 sum",addTwoNumbers(3,undefined))
   </script>
```

The output of the above code will be as mentioned below:

```
first parameter is : 20
second parameter is : 10
case 1 sum: 30
first parameter is : 2
second parameter is : 3
case 2 sum: 5
first parameter is : undefined
second parameter is : 10
case 3 sum: NaN
first parameter is : 1
second parameter is : null
 case 4 sum 1
 first parameter is : 3
 second parameter is : 10
 case 5 sum 13
```

Example 2

```
 <script>
           let DEFAULT_VAL = 30
              function addTwoNumbers(first,second=DEFAULT_VAL){
                  console.log('first parameter is :',first)
                  console.log('second parameter is :',second)
                  return first+second;
              }
              console.log("case 1 sum",addTwoNumbers(1))
              console.log("case 2 sum",addTwoNumbers(3,undefined))
 </script>
```

The output of the above code will be as shown below:

```
first parameter is : 1
second parameter is : 30
case 1 sum 31
first parameter is : 3
second parameter is : 30
case 2 sum 33
```

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())
```


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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;
```


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```
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()
{
```


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```
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.

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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
5
Uncaught ReferenceError: x is not defined
```

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'));
```


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```
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.

Arrow Functions

Arrow functions which are introduced in ES helps in writing the functions in JavaScript in a concise manner. Let us now learn about the same in detail.

ES5 and Anonymous functions

JavaScript makes heavy use of anonymous functions. An **anonymous function** is a function that does not have a name attached to it. Anonymous functions are used during **function callback**. The following example illustrates the use of an anonymous function in ES5:

```
<script>
 setTimeout(function(){
          console.log('Learning at TutorialsPoint is fun!!')
        },1000)
</script>
```

The above example passes an anonymous function as a parameter to the predefined **setTimeout() function**. The setTimeout() function will callback the anonymous function after 1 second.

The following output is shown after 1 second:

```
Learning at TutorialsPoint is fun!!
```

Arrow Function Syntax

ES6 introduces the concept of **arrow function** to simplify the usage of **anonymous function**. There are 3 parts to an arrow function which are as follows:

- **Parameters**: An arrow function may optionally have parameters
- **The fat arrow 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 arrow function declaration.

Syntax

```
//Arrow function that points to a single line of code


()=>some_expression
```

OR

```
//Arrow function that points to a block of code


()=> { //some statements }`
```

OR

```
//Arrow function with parameters


(param1,param2)=>{//some statement}
```


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Example: Arrow function in ES6

The following example defines two function expressions **add** and **isEven** using arrow function:

```
<script>

 const add = (n1,n2) => n1+n2
 console.log(add(10,20))

 const isEven = (n1) => {
     if(n1%2 ==0)
     return true;
     else
     return false;

 }

 console.log(isEven(10))



</script>
```

The output of the above code will be as mentioned below:

```
30
true
```

Array.prototype.map() and arrow function

In the following example, an arrow function is passed as a parameter to the **Array.prototype.map() function**. The **map()** function executes the arrow function for each element in the array. The arrow function in this case, displays each element in the array and its index.

```
 <script>
      const names = ['TutorialsPoint','Mohtashim','Bhargavi','Raja']
        names.map((element,index)=>{
           console.log('inside arrow function')
            console.log('index is '+index+' element value is :'+element)
        })


</script>
```

The output of the above code will be as given below:

```
inside arrow function
index is 0 element value is :TutorialsPoint
inside arrow function
index is 1 element value is :Mohtashim
inside arrow function
index is 2 element value is :Bhargavi
inside arrow function
index is 3 element value is :Raja
```

Example: window.setTimeout() and arrow function

The following example passes an arrow function as a parameter to the predefined **setTimeout() function**. The **setTimeout()** function will callback the arrow function after 1 second.

```
<script>
 setTimeout(()=>{
          console.log('Learning at TutorialsPoint is fun!!')
        },1000)
</script>
```

The following output is shown after 1 second:

```
Learning at TutorialsPoint is fun!!
```

Arrow function and "this"

Inside an arrow function if we use **this pointer**, it will point to the enclosing lexical scope. This means arrow functions do not create a new **this pointer** instance whenever it is invoked. Arrow functions makes use of its enclosing scope. To understand this, let us see an example.

```
    <script>
          //constructor function
        function Student(rollno,firstName,lastName) {
            this.rollno = rollno;
            this.firstName = firstName;
            this.lastName = lastName;

            this.fullNameUsingAnonymous = function(){
                  setTimeout(function(){

                      //creates a new instance of this ,hides outer scope of
this
                      console.log(this.firstName+ " "+this.lastName)
                  },2000)
            }

            this.fullNameUsingArrow = function(){
                  setTimeout(()=>{
```

```
                    //uses this instance of outer scope
                    console.log(this.firstName+ " "+this.lastName)
                },3000)
            }



        }
        const s1 = new Student(101,'Mohammad','Mohtashim')
        s1.fullNameUsingAnonymous();
        s1.fullNameUsingArrow();

    </script>
```

When an anonymous function is used with **setTimeout()**, the function gets invoked after 2000 milliseconds. A new instance of **"this"** is created and it shadows the instance of the Student function. So, the value of **this.firstName** and **this.lastName** will be **undefined**. The function doesn't use the lexical scope or the context of current execution. This problem can be solved by using an **arrow function**.

The output of the above code will be as follows:

```
undefined undefined
Mohammad Mohtashim
```

9. 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 loads
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

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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

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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

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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

10. 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";
```


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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 Cookie" onclick="WriteCookie();"/>
</form>
</body>
</html>
```

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

Enter name: Set

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

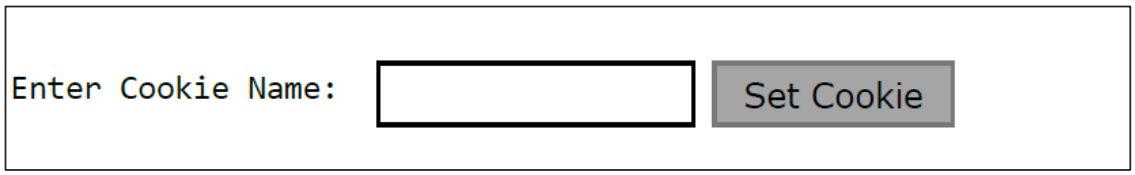
You can extend the life of a cookie beyond the current browser session by setting an expiry date and saving the expiry date within the cookie. This can be done by setting the 'expires' attribute to a date and time. The following example illustrates how to extend the expiry date of a cookie by 1 month.

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 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.



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 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

11. 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.

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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/" />
```


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12. 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
```

13. 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 side-effects 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
```


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```
</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.

14. ES6 – Page Printing

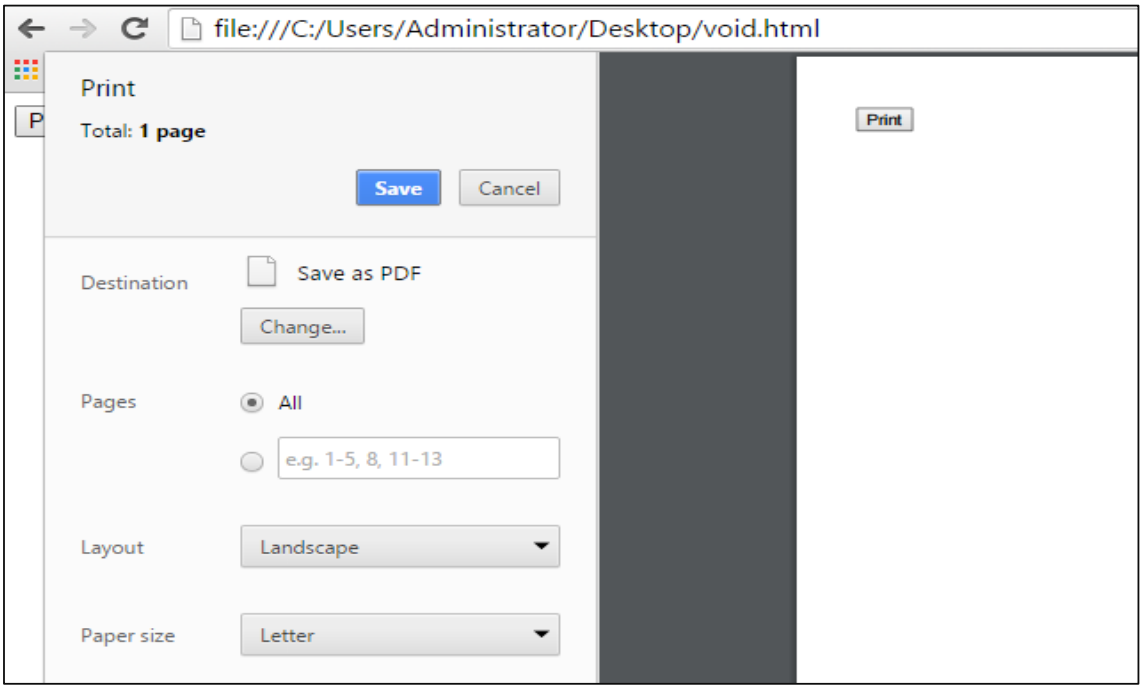
Many times you would like to place a button on your webpage to print the content of that web page via an actual printer. JavaScript helps you implement this functionality using the print function of the window object.

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.



15. 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 braces** ({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)
```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```
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.

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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
```


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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.

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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
```


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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)
```


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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
```


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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 1

When destructuring an object the variable names and the object property names must match.

```
<script>
let student = {
       rollno:20,
       name:'Prijin',
       cgpa:7.2
   }


 //destructuring to same property name
  let {name,cgpa} = student


  console.log(name)
  console.log(cgpa)


 //destructuring to different name
```


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```
 let {name:student_name,cgpa:student_cgpa}=student
 console.log(student_cgpa)
 console.log("student_name",student_name)
</script>
```

The output of the above code will be as seen below:

```
Prijin
7.2
7.2
student_name Prijin
```

Example 2

If the variable and assignment are in two different steps, then the destructuring object syntax will be surrounded by **()** as shown in the example **({rollno} = student):**

```
  <script>
   let student = {
       rollno:20,
       name:'Prijin',
       cgpa:7.2
   }

  // destructuring to already declared variable
  let rollno;

   ({rollno} = student)
   console.log(rollno)

  // assign default values to variables

  let product ={ id:1001,price:2000} //discount is not product property

  let {id,price,discount=.10} = product
  console.log(id)
  console.log(price)
  console.log(discount)
</script>
```

The output of the above code will be as mentioned below:

```
20
1001
2000
0.1
```

Example 3

The below example shows **destructuring** using the **rest operator** and how to destruct nested objects.

```
<script>
// rest operator with object destructuring

   let customers= {
       c1:101,
       c2:102,
       c3:103
   }

  let {c1,...others} = customers
  console.log(c1)
  console.log(others)

  //nested objects
  let emp = {
       id:101,
       address:{
           city:'Mumbai',
           pin:1234
       }
  }

let {address} = emp;
console.log(address)
```

```
let {address:{city,pin}} = emp
console.log(city)


  </script>
```

The output of the above code will be as seen below:

```
101
{c2: 102, c3: 103}
{city: "Mumbai", pin: 1234}
Mumbai
```

16. 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

Property	Description
Number.EPSILON	The smallest interval between two representable numbers
Number.MAX_SAFE_INTEGER	The maximum safe integer in JavaScript (2^53 - 1)
Number.MAX_VALUE	The largest positive representable number
Number.MIN_SAFE_INTEGER	The minimum safe integer in JavaScript (-(2^53 - 1))
Number.MIN_VALUE	The smallest positive representable number - that is, the positive number closest to zero (without actually being zero)
Number.NaN	Special "not a number" value
Number.NEGATIVE_INFINITY	Special value representing negative infinity; returned on overflow
Number.POSITIVE_INFINITY	Special value representing infinity; returned on overflow
Number.prototype	Allows the addition of properties to a Number object

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EPSILON

This property represents the smallest interval between two representable numbers.

Example

```
var interval=Number.EPSILON
console.log(interval)
```

Output

```
2.220446049250313e-16
```

MAX_SAFE_INTEGER

This property represents the maximum safe integer in JavaScript i.e. (2^ 53 - 1)

Example

```
var interval=Number.MAX_SAFE_INTEGER
console.log(interval)
```

Output

```
9007199254740991
```

MAX_VALUE

The Number.MAX_VALUE property belongs to the static Number object. It represents constants for the largest possible positive numbers that JavaScript can work with.

The actual value of this constant is 1.7976931348623157 x 10308

Syntax

```
var val = Number.MAX_VALUE;
```

Example

```
var val = Number.MAX_VALUE;
console.log("Value of Number.MAX_VALUE : " + val );
```

Output

```
Value of Number.MAX_VALUE : 1.7976931348623157e+308
```


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MIN_SAFE_INTEGER

The Number.MIN_SAFE_INTEGER constant represents the minimum safe integer in JavaScript (-(2^ 53 - 1)). The MIN_SAFE_INTEGER constant has a value of -9007199254740991.

Syntax

```
var val = Number.MIN_SAFE_INTEGER;
```

Example

```
var val = Number.MIN_SAFE_INTEGER;

console.log("Value of Number. MIN_SAFE_INTEGER: " + val );
```

Output

```
Value of Number. MIN_SAFE_INTEGER: -9007199254740991
```

MIN_VALUE

The Number.MIN_VALUE property belongs to the static Number object. It represents constants for the smallest possible positive numbers that JavaScript can work with.

This constant has actual value 5 x 10-324

Syntax

```
var val = Number.MIN_VALUE;
```

Example

```
var val = Number.MAX_VALUE;

console.log("Value of Number.MIN_VALUE : " + val );
```

Output

```
Value of Number.MIN_VALUE : 1.7976931348623157e+308
```


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Nan

Unquoted literal constant NaN is a special value representing Not-a-Number. Since NaN always compares unequal to any number, including NaN, it is usually used to indicate an error condition for a function that should return a valid number.

Syntax

```
var val = Number.NaN;
```

Example

```
var dayOfMonth = 50;
if (dayOfMonth < 1 || dayOfMonth > 31)
{
      dayOfMonth = Number.NaN
      console.log("Day of Month must be between 1 and 31.")
}
else
{
      console.log("day of month "+dayOfMonth)
}
```

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

```
Day of Month must be between 1 and 31.
```

NEGATIVE_INFINITY

This is a special numeric value representing a value less than Number.MIN_VALUE. This value is represented as "-Infinity". It resembles an infinity in its mathematical behavior. For example, anything multiplied by NEGATIVE_INFINITY is NEGATIVE_INFINITY, and anything divided by NEGATIVE_INFINITY is zero. Because NEGATIVE_INFINITY is a constant, it is a read-only property of Number.

Syntax

```
var val = Number.NEGATIVE_INFINITY;
```

Example

```
var val = Number.NEGATIVE_INFINITY;
console.log("Value of Number.NEGATIVE_INFINITY : " + val );
```


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Output

```
Value of Number.NEGATIVE_INFINITY: -Infinity
```

POSITIVE_INFINITY

This is a special numeric value representing any value greater than Number.MAX_VALUE. This value is represented as "Infinity". It resembles an infinity in its mathematical behavior. For example, anything multiplied by POSITIVE_INFINITY is POSITIVE_INFINITY, and anything divided by POSITIVE_INFINITY is zero. As POSITIVE_INFINITY is a constant, it is a read-only property of Number.

Syntax

```
var val = Number.POSITIVE_INFINITY;
```

Example

```
var val = Number.POSITIVE_INFINITY;

console.log("Value of Number.POSITIVE_INFINITY : " + val );
```

Output:

```
Value of Number.POSITIVE_INFINITY : Infinity
```

Number Methods

Method	Description
Number.isNaN()	Determines whether the passed value is NaN
Number.isFinite()	Determines whether the passed value is a finite number
Number.isInteger()	Determines whether the passed value is an integer
Number.isSafeInteger()	Determines whether the passed value is a safe integer (number between -(253 - 1) and 253- 1)
Number.parseFloat()	The value is the same as parseFloat() of the global object
Number.parseInt()	The value is the same as parseInt() of the global object

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Number.isNaN()

The Number.isNaN() method determines whether the passed value is NaN.

Syntax

```
var res=Number.isNaN(value);
```

Parameter Details

Value to determine if it is a NaN

Return Value

Returns a Boolean value true if the value is a not a number.

Example

```
var res=Number.isNaN(10);
console.log(res);
```

Number.isFinite

The Number.isFinite() method determines whether the passed value is a finite number.

Syntax

```
var res=Number.isFinite(value);
```

Parameter Details

Value to be tested for finiteness.

Return Value

Returns a Boolean value, true or false.

Example

```
var res=Number.isFinite(10);
console.log(res);
```

Output

```
true
```


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Number.isInteger()

The Number.isInteger() method determines whether the passed value is an integer.

Syntax

```
var res=Number.isInteger(value);
```

Parameter Details

Value to be tested for for being an integer.

Return Value

Returns a Boolean value, true or false.

Example

```
console.log(Number.isInteger(0));         // true
console.log(Number.isInteger(1));         // true
console.log(Number.isInteger(-100000));   // true
console.log(Number.isInteger(0.1));       // false
onsole.log(Number.isInteger(Infinity));   // false
console.log(Number.isInteger("10"));      // false
console.log(Number.isInteger(true));      // false
console.log(Number.isInteger(false));     // false
```

Output

```
true
```

Number.isSafeInteger()

The Number.isSafeInteger() method determines whether the passed value is a safe integer.

Syntax

```
var res=Number.isSafeInteger(value);
```

Parameter Details

Value to be tested for for being a safe integer.

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Return Value

Returns a Boolean value, true or false.

Example

```
var res=Number.isSafeInteger(10);
console.log(res);
```

Output

```
true
```

Number.parseInt()

This method parses a string argument and returns an integer of the specified radix.

Syntax

```
Number.parseInt(string,[ radix ])
```

Parameters

- **string**: value to parse
- **radix**: integer between 2 and 36 that represents the base.

Return value

An integer representation of the string.

Example

```
console.log(Number.parseInt("10"));
console.log(Number.parseInt("10.23"));
```

Output

```
10
10
```

Number.parseFloat()

This method parses a string argument and returns a float representation of the passed string.

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Syntax

```
Number.parseFloat(string)
```

Parameters

- **string**: value to parse

Return value

A float representation of the string.

Example

```
console.log(Number.parseFloat("10"));
console.log(Number.parseFloat("10.23"));
```

Output

```
10
10.23
```

Number Instances Methods

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

Instance Method	Description
toExponential()	Returns a string representing the number in exponential notation
toFixed()	Returns a string representing the number in fixed-point notation
toLocaleString()	Returns a string with a language sensitive representation of this number
toPrecision()	Returns a string representing the number to a specified precision in fixed-point or exponential notation
toString()	Returns a string representing the specified object in the specified radix (base)
valueOf()	Returns the primitive value of the specified object

toExponential()

This method returns a string representing the number object in exponential notation.

Syntax

```
number.toExponential( [fractionDigits] )
```


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Parameter Details

- **fractionDigits** – An integer specifying the number of digits after the decimal point. Defaults to as many digits as necessary to specify the number.

Return Value

A string representing a Number object in exponential notation with one digit before the decimal point, rounded to fractionDigits digits after the decimal point. If the fractionDigits argument is omitted, the number of digits after the decimal point defaults to the number of digits necessary to represent the value uniquely.

Example

```
//toExponential()
var num1=1225.30
var val= num1.toExponential();
console.log(val)
```

Output

```
1.2253e+
```

toFixed()

This method formats a number with a specific number of digits to the right of the decimal.

Syntax

```
number.toFixed( [digits] )
```

Parameter Details

- **digits** – The number of digits to appear after the decimal point.

Return Value

A string representation of number that does not use exponential notation and has the exact number of digits after the decimal place.

Example

```
var num3=177.234
console.log("num3.toFixed() is "+num3.toFixed())
console.log("num3.toFixed(2) is "+num3.toFixed(2))
console.log("num3.toFixed(6) is "+num3.toFixed(6))
```


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Output

```
num3.toFixed() is 177
num3.toFixed(2) is 177.23
num3.toFixed(6) is 177.234000
```

toLocaleString()

This method converts a number object into a human readable string representing the number using the locale of the environment.

Syntax

```
number.toLocaleString()
```

Return Value

Returns a human readable string representing the number using the locale of the environment.

Example

```
var num = new Number(177.1234);
console.log( num.toLocaleString());
```

Output

```
177.1234
```

toPrecision()

This method returns a string representing the number object to the specified precision.

Syntax

```
number.toPrecision( [ precision ] )
```

Parameter Details

- **precision** – An integer specifying the number of significant digits.

Return Value

Returns a string representing a Number object in fixed-point or exponential notation rounded toprecision significant digits.

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Example

```
var num = new Number(7.123456);
console.log(num.toPrecision());
console.log(num.toPrecision(1));
console.log(num.toPrecision(2));
```

Output

```
7.123456
7
7.1
```

toString()

This method returns a string representing the specified object. The toString() method parses its first argument, and attempts to return a string representation in the specified radix (base).

Syntax

```
number.toString( [radix] )
```

Parameter Details

- **radix** – An integer between 2 and 36 specifying the base to use for representing numeric values.

Return Value

Returns a string representing the specified Number object.

Example

```
var num = new Number(10);
console.log(num.toString());
console.log(num.toString(2));
console.log(num.toString(8));
```


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Output

```
10
1010
12
```

valueOf()

This method returns the primitive value of the specified number object.

Syntax

```
number.valueOf()
```

Return Value

Returns the primitive value of the specified Number object.

Example

```
var num = new Number(10);
console.log(num.valueOf());
```

Output

```
10
```

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.

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```
1
2
3
4
```

Example: Octal Representation

```
console.log(0o010)
console.log(0o100)
```

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

```
8
64
```

Example: Hexadecimal Representation

```
console.log(0o010)
console.log(0o100)
```

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

```
255
384
```

Object literal Extension

ES6 introduces following **syntax changes** in object literals declaration.

- Object property initializer syntax
- Computed properties syntax
- Concise method syntax

Object property initializer

In **object property initializer syntax**, we can initialize an object directly with variables. This will create attributes which have same name as that of the variables.

```
<script>
       let firstName='Tutorials',lastName='Point'

       let company={
           firstName,
```

```
            lastName
        }

        console.log(company)
        console.log(company.firstName)
        console.log(company.lastName)

    </script>
```

The output of the above code will be as given below:

```
{firstName: "Tutorials", lastName: "Point"}
Tutorials
 Point
```

Computed Properties

In **computed properties syntax** the property of object can be dynamically created from variables. In the following example, a variable by the name **suffix** is used to compute the **company** object.

```
<script>
        let suffix='Name'

        let company= {
            ['first'+suffix]:'Tutorials',
            ['last'+suffix]:'Point'
        }

        console.log(company)
        console.log(company['firstName'])
        console.log(company['lastName'])
    </script>
```

The output of the above code will be as shown below:

```
{firstName: "Tutorials", lastName: "Point"}
Tutorials
Point
```

Concise method syntax

In **Concise method syntax** we can use and declare a method directly without the use of **function** keyword. This is a simplified syntax to include functions in object literals.

```
<script>
    let firstName='Tutorials',lastName='Point'

    let company={
        firstName,
        lastName,
        getFullName(){
            return this.firstName+" - "+this.lastName
        }
    }
    console.log(company.getFullName())
    console.log(company)
</script>
```

The output of the above code will be as mentioned below:

```
Tutorials - Point
{firstName: "Tutorials", lastName: "Point", getFullName: ƒ}
```

17. 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.

Property	Description
constructor	Returns a reference to the Boolean function that created the object.
prototype	The prototype property allows you to add properties and methods to an object.

In the following sections, we will look at a few examples to illustrate the properties of Boolean object.

constructor ()

Javascript Boolean **constructor()** method returns a reference to the Boolean function that created the instance's prototype.

Use the following syntax to create a Boolean constructor() method. It returns the function that created this object's instance.

```
boolean.constructor()
```

Example

```
<html>
<head>
<title>JavaScript constructor() Method</title>
</head>
<body>
<script type="text/javascript">
     var bool = new Boolean( );
     document.write("bool.constructor() is : " + bool.constructor);
</script>
```


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

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

```
bool.constructor() is : function Boolean() { [native code] }
```

Prototype

The **prototype** property allows you to add properties and methods to any object (Number, Boolean, String and Date, etc.).

Note: Prototype is a global property which is available with almost all the objects.

Use the following syntax to create a Boolean prototype.

```
object.prototype.name = value
```

Example

The following example shows how to use the prototype property to add a property to an object.

```
<html>
<head>
<title>User-defined objects</title>
<script type="text/javascript">
     function book(title, author){
     this.title = title;
     this.author = author;
}
</script>
</head>
<body>
<script type="text/javascript">
var myBook = new book("Perl", "Tom");
book.prototype.price = null;
myBook.price = 100;
document.write("Book title is : " + myBook.title + "<br>");
document.write("Book author is : " + myBook.author + "<br>");
document.write("Book price is : " + myBook.price + "<br>");
</script>
```

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

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

```
Book title is : Perl
Book author is : Tom
Book price is : 100
```

Boolean Methods

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

Method	Description
toSource()	Returns a string containing the source of the Boolean object; you can use this string to create an equivalent object.
toString()	Returns a string of either "true" or "false" depending upon the value of the object.
valueOf()	Returns the primitive value of the Boolean object.

In the following sections, we will take a look at a few examples to demonstrate the usage of the Boolean methods.

toSource ()

Javascript boolean **toSource()** method returns a string representing the source code of the object.

Note: This method is not compatible with all the browsers.

Following is the syntax for the same.

```
boolean.toSource()
```

Example

```
<html>
<head>
<title>JavaScript toSource() Method</title>
</head>
<body>
<script type="text/javascript">
function book(title, publisher, price)
{
```

```
this.title = title;
this.publisher = publisher;
this.price = price;
}
var newBook = new book("Perl","Leo Inc",200);
document.write("newBook.toSource() is : "+ newBook.toSource());
</script>
</body>
</html>
```

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

```
({title:"Perl", publisher:"Leo Inc", price:200})
```

toString ()

This method returns a string of either "true" or "false" depending upon the value of the object.

Following is the syntax for the same.

```
boolean.toString()
```

Example

```
<html>
<head>
<title>JavaScript toString() Method</title>
</head>
<body>
<script type="text/javascript">
var flag = new Boolean(false);
document.write( "flag.toString is : " + flag.toString() );
</script>
</body>
</html>
```

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

```
flag.toString is : false
```

valueOf ()

Javascript Boolean **valueOf()** method returns the primitive value of the specified **Boolean** object.

Following is the syntax for the same.

```
boolean.valueOf()
```

Example

```
<html>
<head>
<title>JavaScript toString() Method</title>
</head>
<body>
<script type="text/javascript">
var flag = new Boolean(false);
document.write( "flag.valueOf is : " + flag.valueOf() );
</script>
</body>
</html>
```

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

```
flag.valueOf is : false
```

18. 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 Properties

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

Property	Description
constructor	Returns a reference to the String function that created the object
length	Returns the length of the string
prototype	The prototype property allows you to add properties and methods to an object

Constructor

A constructor returns a reference to the string function that created the instance's prototype.

Syntax

```
string.constructor
```

Return Value

Returns the function that created this object's instance.

Example: String constructor property

```
var str = new String( "This is string" );
console.log("str.constructor is:" + str.constructor)
```

Output

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```
str.constructor is:function String() { [native code] }
```

Length

This property returns the number of characters in a string.

Syntax

```
string.length
```

Example: String length property

```
var uname= new String("Hello World")
console.log(uname)
console.log("Length "+uname.length)   // returns the total number of characters
                                      // including whitespace
```

Output

```
Hello World
Length 11
```

Prototype

The prototype property allows you to add properties and methods to any object (Number, Boolean, String, Date, etc.).

Note: Prototype is a global property which is available with almost all the objects.

Syntax

```
string.prototype
```

Example:Object prototype

```
function employee(id, name) {
    this.id = id;
    this.name = name;
}
var emp = new employee(123, "Smith");
employee.prototype.email = "smith@abc.com";
console.log("Employee 's Id: " + emp.id);
```


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```
console.log("Employee's name: " + emp.name);
console.log("Employee's Email ID: " + emp.email);
```

Output

```
Employee’s Id: 123
Employee’s name: Smith
Employee’s Email ID: smith@abc.com
```

String Methods

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

Method	Description
charAt()	Returns the character at the specified index
charCodeAt()	Returns a number indicating the Unicode value of the character at the given index
concat()	Combines the text of two strings and returns a new string
indexOf()	Returns the index within the calling String object of the first occurrence of the specified value, or -1 if not found
lastIndexOf()	Returns the index within the calling String object of the last occurrence of the specified value, or -1 if not found
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
match()	Used to match a regular expression against a string
replace()	Used to find a match between a regular expression and a string, and to replace the matched substring with a new substring
search()	Executes the search for a match between a regular expression and a specified string
slice()	Extracts a section of a string and returns a new string
split()	Splits a String object into an array of strings by separating the string into substrings

substr()	Returns the characters in a string beginning at the specified location through the specified number of characters
substring()	Returns the characters in a string between two indexes into the string
toLocaleLowerCase()	The characters within a string are converted to lower case while respecting the current locale
toLocaleUpperCase()	The characters within a string are converted to uppercase while respecting the current locale
toLowerCase()	Returns the calling string value converted to lowercase
toString()	Returns a string representing the specified object
toUpperCase()	Returns the calling string value converted to uppercase
valueOf()	Returns the primitive value of the specified object

charAt

charAt() is a method that returns the character from the specified index.Characters in a string are indexed from left to right. The index of the first character is 0, and the index of the last character in a string, called stringName, is stringName.length – 1.

Syntax

```
string.charAt(index);
```

Argument Details

- index – An integer between 0 and 1 less than the length of the string.

Return Value

Returns the character from the specified index.

Example

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```
var str = new String("This is string");
console.log("str.charAt(0) is:" + str.charAt(0));
console.log("str.charAt(1) is:" + str.charAt(1));
console.log("str.charAt(2) is:" + str.charAt(2));
console.log("str.charAt(3) is:" + str.charAt(3));
console.log("str.charAt(4) is:" + str.charAt(4));
console.log("str.charAt(5) is:" + str.charAt(5));
```

Output

```
str.charAt(0) is:T
str.charAt(1) is:h
str.charAt(2) is:i
str.charAt(3) is:s
str.charAt(4) is:
str.charAt(5) is:i
```

charCodeAt()

This method returns a number indicating the Unicode value of the character at the given index. Unicode code points range from 0 to 1,114,111. The first 128 Unicode code points are a direct match of the ASCII character encoding. charCodeAt()always returns a value that is less than 65,536.

Syntax

```
string.charCodeAt(index);
```

Argument Details

- **index** – An integer between 0 and 1 less than the length of the string; if unspecified, defaults to 0.

Return Value

Returns a number indicating the Unicode value of the character at the given index. It returns NaN if the given index is not between 0 and 1 less than the length of the string.

Example

```
var str = new String("This is string");
console.log("str.charAt(0) is:" + str.charCodeAt(0));
console.log("str.charAt(1) is:" + str.charCodeAt(1));
```


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```
console.log("str.charAt(2) is:" + str.charCodeAt(2));
console.log("str.charAt(3) is:" + str.charCodeAt(3));
console.log("str.charAt(4) is:" + str.charCodeAt(4));
console.log("str.charAt(5) is:" + str.charCodeAt(5));
```

Output

```
str.charAt(0) is:84
str.charAt(1) is:104
str.charAt(2) is:105
str.charAt(3) is:115
str.charAt(4) is:32
str.charAt(5) is:105
```

concat()

This method adds two or more strings and returns a new single string.

Syntax

```
string.concat(string2, string3[, ..., stringN]);
```

Argument Details

- string2...stringN – These are the strings to be concatenated.

Return Value

Returns a single concatenated string.

Example

```
var str1 = new String( "This is string one" );
var str2 = new String( "This is string two" );
var str3 = str1.concat( str2 );
console.log("str1 + str2 : "+str3)
```

Output

```
str1 + str2 : This is string oneThis is string two
```


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indexOf()

This method returns the index within the calling String object of the first occurrence of the specified value, starting the search at fromIndex or -1 if the value is not found.

Syntax

```
string.indexOf(searchValue[, fromIndex])
```

Argument Details

- **searchValue** – A string representing the value to search for.
- **fromIndex –** The location within the calling string to start the search from. It can be any integer between 0 and the length of the string. The default value is 0.

Return Value

Returns the index of the found occurrence, otherwise -1 if not found.

Example

```
var str1 = new String( "This is string one" );

var index = str1.indexOf( "string" );
console.log("indexOf found String :" + index );

var index = str1.indexOf( "one" );
console.log("indexOf found String :" + index );
```

Output

```
indexOf found String :8
indexOf found String :15
```

lastIndexOf()

This method returns the index within the calling String object of the last occurrence of the specified value, starting the search at fromIndex or -1 if the value is not found.

Syntax

```
string.lastIndexOf(searchValue[, fromIndex])
```


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Argument Details

- **searchValue** – A string representing the value to search for.
- **fromIndex** – The location within the calling string to start the search from. It can be any integer between 0 and the length of the string. The default value is 0.

Return Value

Returns the index of the last found occurrence, otherwise -1 if not found.

Example

```
var str1 = new String( "This is string one and again string" );
var index = str1.lastIndexOf( "string" );
console.log("lastIndexOf found String :" + index );

index = str1.lastIndexOf( "one" );
console.log("lastIndexOf found String :" + index );
```

Output

```
lastIndexOf found String :29

lastIndexOf found String :15
```

localeCompare()

This method returns a number indicating whether a reference string comes before or after or is the same as the given string in sorted order.

Syntax

```
string.localeCompare( param )
```

Argument Details

- param – A string to be compared with string object.

Return Value

- 0 – If the string matches 100%.
- 1 – no match, and the parameter value comes before the string object's value in the locale sort order

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- A negative value – no match, and the parameter value comes after the string object's value in the local sort order

Example

```
var str1 = new String( "This is beautiful string" );

var index = str1.localeCompare( "This is beautiful string");

console.log("localeCompare first :" + index );
```

Output

```
localeCompare first :0
```

replace()

This method finds a match between a regular expression and a string, and replaces the matched substring with a new substring.

The replacement string can include the following special replacement patterns –

Pattern	Inserts
$$	Inserts a "$".
$&	Inserts the matched substring.
$`	Inserts the portion of the string that precedes the matched substring.
$'	Inserts the portion of the string that follows the matched substring.
$n or $nn	Where **n** or **nn** are decimal digits, inserts the nth parenthesized submatch string, provided the first argument was a RegExp object.

Syntax

```
string.replace(regexp/substr, newSubStr/function[, flags]);
```

Argument Details

- **regexp** – A RegExp object. The match is replaced by the return value of parameter #2.
- **substr** – A String that is to be replaced by newSubStr.
- **newSubStr** – The String that replaces the substring received from parameter #1.
- **function** – A function to be invoked to create the new substring.
- **flags** – A String containing any combination of the RegExp flags: g

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Return Value

It simply returns a new changed string.

Example

```
var re = /apples/gi;
var str = "Apples are round, and apples are juicy.";
var newstr = str.replace(re, "oranges");
console.log(newstr)
```

Output

```
oranges are round, and oranges are juicy.
```

Example

```
var re = /(\w+)\s(\w+)/;
var str = "zara ali";
var newstr = str.replace(re, "$2, $1");
console.log(newstr);
```

Output

```
ali, zara
```

search()

This method executes the search for a match between a regular expression and this String object.

Syntax

```
string.search(regexp);
```

Argument Details

regexp – A regular expression object. If a non-RegExp object obj is passed, it is implicitly converted to a RegExp by using new RegExp(obj).

Return Value

If successful, the search returns the index of the regular expression inside the string. Otherwise, it returns -1.

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Example

```
var re = /apples/gi;
var str = "Apples are round, and apples are juicy.";

if ( str.search(re) == -1 )
{
            console.log("Does not contain Apples" );
}

else
{
               console.log("Contains Apples" );
}
```

Output

```
Contains Apples
```

slice()

This method extracts a section of a string and returns a new string.

Syntax

```
string.slice( beginslice [, endSlice] );
```

Argument Details

- **beginSlice** – The zero-based index at which to begin extraction.
- **endSlice** – The zero-based index at which to end extraction. If omitted, slice extracts to the end of the string

Return Value

If successful, **slice** returns the index of the regular expression inside the string. Otherwise, it returns -1.

Example

```
var str = "Apples are round, and apples are juicy.";
var sliced = str.slice(3, -2);
```


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```
console.log(sliced);
```

Output

```
les are round, and apples are juic
```

split()

This method splits a String object into an array of strings by separating the string into substrings.

Syntax

```
string.split([separator][, limit]);
```

Argument Details

- **separator** – Specifies the character to use for separating the string. Ifseparator is omitted, the array returned contains one element consisting of the entire string.

- **limit** – Integer specifying a limit on the number of splits to be found.

Return Value

The split method returns the new array. Also, when the string is empty, split returns an array containing one empty string, rather than an empty array.

Example

```
var str = "Apples are round, and apples are juicy.";
var splitted = str.split(" ", 3);
console.log(splitted)
```

Output

```
[ 'Apples', 'are', 'round,' ]
```

substr()

This method returns the characters in a string beginning at the specified location through the specified number of characters.

Syntax

```
string.substr(start[, length]);
```


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Argument Details

- **start –** Location at which to start extracting characters (an integer between 0 and one less than the length of the string).
- **length –** The number of characters to extract.

Note – If **start** is negative, then **substr** uses it as a character index from the end of the string.

Return Value

The substr() method returns the new sub-string based on given parameters.

Example

```
var str = "Apples are round, and apples are juicy.";
console.log("(1,2): "    + str.substr(1,2));
console.log("(-2,2): "   + str.substr(-2,2));
console.log("(1): "      + str.substr(1));
console.log("(-20, 2): " + str.substr(-20,2));
console.log("(20, 2): "  + str.substr(20,2));
```

Output

```
(1,2): pp
(-2,2): y.
(1): pples are round, and apples are juicy.
(-20, 2): nd
(20, 2): d
```

substring()

This method returns a subset of a String object.

Syntax

```
string.substring(indexA, [indexB])
```

Argument Details

- **indexA** – An integer between 0 and one less than the length of the string.
- **indexB** – (optional) An integer between 0 and the length of the string.

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Return Value

The **substring** method returns the new sub-string based on given parameters.

Example

```
var str = "Apples are round, and apples are juicy.";
console.log("(1,2): "    + str.substring(1,2));
console.log("(0,10): "   + str.substring(0, 10));
console.log("(5): "      + str.substring(5));
```

Output

```
(1,2): p
(0,10): Apples are
(5): s are round, and apples are juicy.
```

toLocaleLowerCase()

This method is used to convert the characters within a string to lowercase while respecting the current locale. For most languages, it returns the same output as toLowerCase.

Syntax

```
string.toLocaleLowerCase( )
```

Return Value

Returns a string in lowercase with the current locale.

Example

```
var str = "Apples are round, and Apples are Juicy.";
console.log(str.toLocaleLowerCase( ));
```

Output

```
apples are round, and apples are juicy.
```


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toLowerCase()

This method returns the calling string value converted to lowercase.

Syntax

```
string.toLowerCase( )
```

Return Value

Returns the calling string value converted to lowercase.

Example

```
var str = "Apples are round, and Apples are Juicy.";
console.log(str.toLowerCase( ))
```

Output

```
apples are round, and apples are juicy.
```

toString()

This method returns a string representing the specified object.

Syntax

```
string.toString( )
```

Return Value

Returns a string representing the specified object.

Example

```
var str = "Apples are round, and Apples are Juicy.";
console.log(str.toString( ));
```

Output

```
Apples are round, and Apples are Juicy.
```


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toUpperCase()

This method returns the calling string value converted to uppercase.

Syntax

```
string.toUpperCase( )
```

Return Value

Returns a string representing the specified object.

Example

```
var str = "Apples are round, and Apples are Juicy.";
console.log(str.toUpperCase( ));
```

Output

```
APPLES ARE ROUND, AND APPLES ARE JUICY.
```

valueOf()

This method returns the primitive value of a String object.

Syntax

```
string.valueOf( )
```

Return Value

Returns the primitive value of a String object.

Example

```
var str = new String("Hello world");
console.log(str.valueOf( ));
```


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19. ES6 — Symbol

Introduction to Symbol

ES6 introduces a new primitive type called Symbol. They are helpful to implement metaprogramming in JavaScript programs.

Syntax

```
const mySymbol = Symbol()
const mySymbol = Symbol(stringDescription)
```

A symbol is just a piece of memory in which you can store some data. Each symbol will point to a different memory location. Values returned by a **Symbol()** constructor are unique and immutable.

Example

Let us understand this through an example. Initially, we created two symbols without description followed by symbols with same description. In both the cases the equality operator will return false when the symbols are compared.

```
<script>
    const s1 = Symbol();
    const s2 = Symbol();

    console.log(typeof s1)
    console.log(s1===s2)
    const s3 = Symbol("hello");//description
    const s4 = Symbol("hello");
    console.log(s3)
    console.log(s4)
    console.log(s3==s4)
</script>
```

The output of the above code will be as mentioned below:

```
symbol
false
```


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```
Symbol(hello)
Symbol(hello)
false
```

Sharing Symbols

ES6 provides a **global symbols registry**, that allows programmers to share Symbols globally. We can add Symbols to registry and reuse them later. In this way, symbols can be shared.

- Some common methods associated with Symbols are given below:

Sr.No	Name	Description
1	Symbol.for(key)	searches for existing symbols in a symbol registry with the given key and returns it, if found. Otherwise, a new symbol gets created in the global symbol registry with this key.
2	Symbol.keyFor(sym)	Retrieves a shared symbol key from the global symbol registry for the given symbol.

Symbol.for()

This function creates a symbol and adds to registry. If the symbol is already present in the registry it will return the same; else a new symbol is created in the global symbol registry.

Syntax

```
Symbol.for(key)
```

where, **key** is the **identifier** of the symbol

Example

The following example shows the difference between **Symbol()** *and* **Symbol.for()**

```
<script>
   const userId = Symbol.for('userId') // creates a new Symbol in registry
   const user_Id = Symbol.for('userId') // reuses already created Symbol

   console.log(userId == user_Id)
```

```
      const studentId = Symbol("studentID") // creates symbol but not in
registry
      const student_Id = Symbol.for("studentID")// creates a new Symbol in
registry
      console.log(studentId == student_Id)
    </script>
```

The output of the above code will be as shown below:

```
true
false
```

Symbol.keyFor

This method retrieves a shared symbol key from the global symbol registry for the given symbol.

Syntax

The syntax for Symbol.keyFor is mentioned below where, *sym* is the symbol to find a key for.

```
Symbol.keyFor(sym)
```

Example

```
  <script>
     const user_Id = Symbol.for('userId') // creates a new Symbol in registry
     console.log(Symbol.keyFor(user_Id)) // returns the key of a symbol in
registry


     const userId = Symbol("userId")// symbol not in registry
     console.log(Symbol.keyFor(userId)) //userId symbol is not in registry
    </script>
```

The output of the code is as given below:

```
userId
undefined
```

Symbol & Classes

A symbol can be used with classes to define the properties in the class. The advantage is that if property is a symbol as shown below, the property can be accessed outside the package only if the symbol name is known. So, data is much encapsulated when symbols are used as properties.

Example

```
<script>
    const COLOR = Symbol()
    const MODEL = Symbol()
    const MAKE = Symbol()

    class Bike {
        constructor(color ,make,model){
            this[COLOR] = color;
            this[MAKE] = make;
            this[MODEL] = model;
        }

    }

 let bike  = new Bike('red','honda','cbr')
 console.log(bike)

 //property can be accessed ony if symbol name is known
 console.log(bike[COLOR])
</script>
```

The output of the above code will be as stated below:

```
Bike {Symbol(): "red", Symbol(): "honda", Symbol(): "cbr"}
red
```


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20. ES6 – New String Methods

Following is a list of methods with their description.

Method	Description
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
String.prototype.endsWith(searchString, endPosition=searchString.length)	Returns true if the receiver ends with searchString; endPosition lets you specify where the string to be checked ends
String.prototype.includes(searchString, position=0)	Returns true if the receiver contains searchString; position lets you specify where the string to be searched starts
String.prototype.repeat(count)	Returns the receiver, concatenated count times

startsWith

The method determines if a string starts with the specified character.

Syntax

```
str.startsWith(searchString[, position])
```

Parameters

- **searchString**: The characters to be searched for at the start of this string.
- **Position**: The position in this string at which to begin searching for searchString; defaults to 0

Return Value

true if the string begins with the characters of the search string; otherwise, **false**.

Example

```
var str = 'hello world!!!';

console.log(str.startsWith('hello'));
```


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Output

```
true
```

endsWith

This function determines whether a string ends with the characters of another string.

Syntax

```
str.endsWith(matchstring[, position])
```

Parameters

- **matchstring**: The characters that the string must end with. It is case sensitive.
- **Position**: The position to match the matchstring. This parameter is optional.

Return Value

true if the string ends with the characters of the match string; otherwise, **false**.

Example

```
var str = 'Hello World !!! ';

console.log(str.endsWith('Hello'));
console.log(str.endsWith('Hello',5));
```

Output

```
false
true
```

includes()

The method determines if a string is a substring of the given string.

Syntax

```
str.includes(searchString[, position])
```


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Parameters

- **searchString** : The substring to search for.
- **Position**: The position in this string at which to begin searching for searchString; defaults to 0

Return Value

true if the string contains the substring ; otherwise, **false**.

Example

```
var str = 'Hello World';


console.log(str.includes('hell'))
console.log(str.includes('Hell'));


console.log(str.includes('or'));
console.log(str.includes('or',1))
```

Output

```
false
true
true
true
```

repeat()

This function repeats the specified string for a specified number of times.

Syntax

```
str.repeat(count)
```

Parameters

- **Count**: number of times the string should be repeated.

Return Value

Returns a new string.

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Example

```
var myBook = new String("Perl");
console.log(myBook.repeat(2));
```

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

```
PerlPerl
```

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"; }
```


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```
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
```

Tagged Templates

A **tag** is a function which can interpret and process a template literal. A tag appears in front of the template literal. Syntax is shown below.

Syntax

```
  let output_fromTag = tagFunction `Template literal with ${variable1} ,
${variable2}`
```

The tag function implementation syntax is as given below:

```
function tagFunction(literals,...variable_values){
    //process
    return "some result"
}
```

Example

Following Example defines a tag function **myTagFn()**. It displays the parameters passed to it. After displaying it returns **Done** to the caller.

```
<script>
         function myTagFn(literals,...values){

            console.log("literal values are");
            for(let c of literals){
                console.log(c)
            }

            console.log("variable values are ");
            for(let c of values){
                console.log(c)
            }

            return "Done"
         }
         let company = `TutorialsPoint`
         let   company_location = `Mumbai`
```

```
        let result = myTagFn `Hello this is ${company} from
${company_location}`


        console.log(result)


    </script>
```

The output of the above code will be as stated below:

```
//literal
literal values are
 Hello this is
  from
//values
 variable values are
 TutorialsPoint
 Mumbai
 Done
```

Example

The below **tag function** takes a **template literal** and converts it to upper case as shown below:

```
 <script>
       function convertToUpperTagFn(literals, ...values) {


           let result = "";


           for (let i = 0; i < literals.length; i++) {
               result += literals[i];
               if (i < values.length) {
                   result += values[i];
               }
           }


           return result.toUpperCase();
       }
       let company = `TutorialsPoint`
```

```
        let company_location = `Mumbai`
        let result = convertToUpperTagFn `Hello this is ${company} from
${company_location}`

        console.log(result)

    </script>
```

The output of the above code will be as mentioned below:

```
HELLO THIS IS TUTORIALSPOINT FROM MUMBAI
```

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
```

21. 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.

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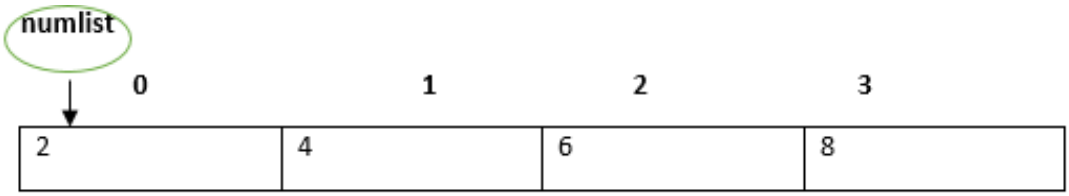
For example, a declaration like: **var numlist = [2,4,6,8]** will create an array as shown in the following figure.



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
```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Array Methods

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

Method	Description
concat()	Returns a new array comprised of this array joined with other array(s) and/or value(s)
every()	Returns true if every element in this array satisfies the provided testing function
filter()	Creates a new array with all of the elements of this array for which the provided filtering function returns true
forEach()	Calls a function for each element in the array
indexOf()	Returns the first (least) index of an element within the array equal to the specified value, or -1 if none is found
join()	Joins all elements of an array into a string
lastIndexOf()	Returns the last (greatest) index of an element within the array equal to the specified value, or -1 if none is found
map()	Creates a new array with the results of calling a provided function on every element in this array
pop()	Removes the last element from an array and returns that element
push()	Adds one or more elements to the end of an array and returns the new length of the array
reduce()	Applies a function simultaneously against two values of the array (from left-to-right) as to reduce it to a single value
reduceRight()	Applies a function simultaneously against two values of the array (from right-to-left) as to reduce it to a single value
reverse()	Reverses the order of the elements of an array -- the first becomes the last, and the last becomes the first

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shift()	Removes the first element from an array and returns that element
slice()	Extracts a section of an array and returns a new array
some()	Returns true if at least one element in this array satisfies the provided testing function
toSource()	Represents the source code of an object
sort()	Sorts the elements of an array
splice()	Adds and/or removes elements from an array
toString()	Returns a string representing the array and its elements
unshift()	Adds one or more elements to the front of an array and returns the new length of the array

concat()

concat() method returns a new array comprised of this array joined with two or more arrays.

Syntax

```
array.concat(value1, value2, ..., valueN);
```

Parameters

- **valueN** – Arrays and/or values to concatenate to the resulting array.

Return Value

Returns a new array.

Example

```
var alpha = ["a", "b", "c"];
var numeric = [1, 2, 3];
```

```
var alphaNumeric = alpha.concat(numeric);
console.log("alphaNumeric : " + alphaNumeric );
```

Output

```
alphaNumeric : a,b,c,1,2,3
```

every()

every method tests whether all the elements in an array passes the test implemented by the provided function

Syntax

```
array.every(callback[, thisObject]);
```

Parameter Details

- **callback** – Function to test for each element.
- **thisObject** – Object to use as this when executing callback.

Return Value

Returns **true** if every element in this array satisfies the provided testing function.

Example

```
function isBigEnough(element, index, array) {
            return (element >= 10);
         }

 var passed = [12, 5, 8, 130, 44].every(isBigEnough);
 console.log("Test Value : " + passed );
```

Output

```
Test Value : false
```

filter()

filter() method creates a new array with all elements that pass the test implemented by the provided function.

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Syntax

```
array.filter(callback[, thisObject]);
```

Parameter Details

- **callback** – Function to test for each element.
- **thisObject** – Object to use as this when executing callback.

Return Value

Returns created array.

Example

```
function isBigEnough(element, index, array) {
            return (element >= 10);
         }

 var passed = [12, 5, 8, 130, 44].filter(isBigEnough);
 console.log("Test Value : " + passed );
```

Output

```
Test Value :12,130,44
```

forEach()

forEach() method calls a function for each element in the array

Syntax

```
array.forEach(callback[, thisObject]);
```

Parameter Details

- **callback** – Function to test for each element.
- **thisObject** – Object to use as this when executing callback.

Return Value

Returns created array.

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Example:forEach()

```
var nums=new Array(12,13,14,15)

console.log("Printing original array......")

nums.forEach(function(val,index){
    console.log(val)
})

nums.reverse()           //reverses the array element
console.log("Printing Reversed array....")

nums.forEach(function(val,index){
    console.log(val)
})
```

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

```
Printing Original Array….
12
13
14
15
Printing Reversed array…
15
14
13
12
```

indexOf()

indexOf() method returns the first index at which a given element can be found in the array, or -1 if it is not present.

Syntax

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```
array.indexOf(searchElement[, fromIndex]);
```

Parameter Details

- **searchElement** – Element to locate in the array.
- **fromIndex** – The index at which to begin the search. Defaults to 0, i.e. the whole array will be searched. If the index is greater than or equal to the length of the array, -1 is returned.

Return Value

Returns the index of the found element.

Example

```
var index = [12, 5, 8, 130, 44].indexOf(8);
console.log("index is : " + index );
```

Output

```
index is : 2
```

join()

join() method joins all the elements of an array into a string.

Syntax

```
array.join(separator);
```

Parameter Details

- **separator** – Specifies a string to separate each element of the array. If omitted, the array elements are separated with a comma.

Return Value

Returns a string after joining all the array elements.

Example

```
var arr = new Array("First","Second","Third");

var str = arr.join();
```


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```
console.log("str : " + str );

var str = arr.join(", ");
console.log("str : " + str );

var str = arr.join(" + ");
console.log("str : " + str );
```

Output

```
str : First,Second,Third
str : First, Second, Third
str : First + Second + Third
```

lastIndexOf()

lastIndexOf() method returns the last index at which a given element can be found in the array, or -1 if it is not present. The array is searched backwards, starting at fromIndex.

Syntax

```
array.lastIndexOf(searchElement[, fromIndex]);
```

Parameter Details

- **searchElement** – Element to locate in the array.
- **fromIndex** – The index at which to start searching backwards. Defaults to the array's length, i.e., the whole array will be searched. If the index is greater than or equal to the length of the array, the whole array will be searched. If negative, it is taken as the offset from the end of the array.

Return Value

Returns the index of the found element from the last.

Example

```
var index = [12, 5, 8, 130, 44].lastIndexOf(8);
console.log("index is : " + index );
```


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Output

```
index is : 3
```

map()

map() method creates a new array with the results of calling a provided function on every element in this array.

Syntax

```
array.map(callback[, thisObject]);
```

Parameter Details

- **callback** – Function that produces an element of the new Array from an element of the current one.

- **thisObject** – Object to use as this when executing callback.

Return Value

Returns the created array.

Example

```
var numbers = [1, 4, 9];
var roots = numbers.map(Math.sqrt);
console.log("roots is : " + roots );
```

Output

```
roots is : 1,2,3
```

pop()

pop() method removes the last element from an array and returns that element.

Syntax

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```
array.pop();
```

Return Value

Returns the removed element from the array.

Example

```
var numbers = [1, 4, 9];

var element = numbers.pop();
console.log("element is : " + element );

var element = numbers.pop();
console.log("element is : " + element );
```

Output

```
element is : 9
element is : 4
```

push()

push() method appends the given element(s) in the last of the array and returns the length of the new array.

Syntax

```
array.push(element1, ..., elementN);
```

Parameter Details

- element1, ..., elementN: The elements to add to the end of the array.

Return Value

Returns the length of the new array.

Example

```
var numbers = new Array(1, 4, 9);
```


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```
var length = numbers.push(10);
console.log("new numbers is : " + numbers );
length = numbers.push(20);
console.log("new numbers is : " + numbers );
```

Output

```
new numbers is : 1,4,9,10
new numbers is : 1,4,9,10,20
```

reduce()

reduce() method applies a function simultaneously against two values of the array (from left-to-right) as to reduce it to a single value.

Syntax

```
array.reduce(callback[, initialValue]);
```

Parameter Details

- **callback** – Function to execute on each value in the array.
- **initialValue** – Object to use as the first argument to the first call of the callback.

Return Value

Returns the reduced single value of the array.

Example

```
var total = [0, 1, 2, 3].reduce(function(a, b){ return a + b; });
console.log("total is : " + total );
```

Output

```
total is : 6
```

reduceRight()

reduceRight() method applies a function simultaneously against two values of the array (from right-to-left) as to reduce it to a single value

Syntax

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```
array.reduceRight(callback[, initialValue]);
```

Parameter Details

- **callback** – Function to execute on each value in the array.
- **initialValue** – Object to use as the first argument to the first call of the callback.

Return Value

Returns the reduced right single value of the array.

Example

```
var total = [0, 1, 2, 3].reduceRight(function(a, b){ return a + b; });
console.log("total is : " + total );
```

Output

```
total is : 6
```

reverse()

reverse() method reverses the element of an array. The first array element becomes the last and the last becomes the first.

Syntax

```
array.reverse();
```

Return Value

Returns the reversed single value of the array.

Example

```
var arr = [0, 1, 2, 3].reverse();
console.log("Reversed array is : " + arr );
```

Output

```
Reversed array is : 3,2,1,0
```


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shift()

shift()method removes the first element from an array and returns that element.

Syntax

```
array.shift();
```

Return Value

Returns the removed single value of the array

Example

```
var arr = [10, 1, 2, 3].shift();
console.log("Shifted value is : " + arr );
```

Output

```
Shifted value is : 10
```

slice()

slice() method extracts a section of an array and returns a new array.

Syntax

```
array.slice( begin [,end] );
```

Parameter Details

- **begin** – Zero-based index at which to begin extraction. As a negative index, start indicates an offset from the end of the sequence.
- **end** – Zero-based index at which to end extraction.

Return Value

Returns the extracted array based on the passed parameters.

Example

```
var arr = ["orange", "mango", "banana", "sugar", "tea"];
console.log("arr.slice( 1, 2) : " + arr.slice( 1, 2) );
```


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```
console.log("arr.slice( 1, 3) : " + arr.slice( 1, 3) );
```

Output

```
arr.slice( 1, 2) : mango
arr.slice( 1, 3) : mango,banana
```

some()

some() method tests whether some element in the array passes the test implemented by the provided function.

Syntax

```
array.some(callback[, thisObject]);
```

Parameter Details

- callback – Function to test for each element.
- thisObject – Object to use as this when executing callback.

Return Value

If some element passes the test, then it returns true, otherwise false.

Example

```
function isBigEnough(element, index, array)
 {
            return (element >= 10);

 }

var retval = [2, 5, 8, 1, 4].some(isBigEnough);
console.log("Returned value is : " + retval );

var retval = [12, 5, 8, 1, 4].some(isBigEnough);
console.log("Returned value is : " + retval );
```

Output

```
Returned value is : false
```


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```
Returned value is : true
```

sort()

sort() method sorts the elements of an array.

Syntax

```
array.sort( compareFunction );
```

Parameter Details

compareFunction – Specifies a function that defines the sort order. If omitted, the array is sorted lexicographically.

Return Value

Returns a sorted array.

Example

```
var arr = new Array("orange", "mango", "banana", "sugar");
var sorted = arr.sort();
console.log("Returned string is : " + sorted );
```

Output

```
Returned string is : banana,mango,orange,sugar
```

splice()

splice() method changes the content of an array, adding new elements while removing old elements.

Syntax

```
array.splice(index, howMany, [element1][, ..., elementN]);
```

Parameter Details

- **index** – Index at which to start changing the array.
- **howMany** – An integer indicating the number of old array elements to remove. If howMany is 0, no elements are removed.
- **element1, ..., elementN** – The elements to add to the array. If you don't specify any elements, splice simply removes the elements from the array.

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Return Value

Returns the extracted array based on the passed parameters.

Example

```
var arr = ["orange", "mango", "banana", "sugar", "tea"];

var removed = arr.splice(2, 0, "water");

console.log("After adding 1: " + arr );

console.log("removed is: " + removed);

removed = arr.splice(3, 1);

console.log("After adding 1: " + arr );

console.log("removed is: " + removed);
```

On compiling, it will generate the same code in JavaScript

Output

```
After adding 1: orange,mango,water,banana,sugar,tea
removed is:
After adding 1: orange,mango,water,sugar,tea
removed is: banana
```

toString()

toString() method returns a string representing the source code of the specified array and its elements.

Syntax

```
array.toString();
```

Return Value

Returns a string representing the array.

Example

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```
var arr = new Array("orange", "mango", "banana", "sugar");
var str = arr.toString();
console.log("Returned string is : " + str );
```

Output

```
Returned string is : orange,mango,banana,sugar
```

unshift()

unshift() method adds one or more elements to the beginning of an array and returns the new length of the array.

Syntax

```
array.unshift( element1, ..., elementN );
```

Parameter Details

- element1, ..., elementN – The elements to add to the front of the array.

Return Value

Returns the length of the new array. It returns undefined in IE browser.

Example

```
var arr = new Array("orange", "mango", "banana", "sugar");
var length = arr.unshift("water");
console.log("Returned array is : " + arr );
console.log("Length of the array is : " + length );
```

Output

```
Returned array is : water,orange,mango,banana,sugar
Length of the array is : 5
```

ES6 – Array Methods

Following are some new array methods introduced in ES6.

Array.prototype.find

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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]
```


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```
[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:

Concept	Description
Multi-dimensional arrays	JavaScript supports multidimensional arrays. The simplest form of the multidimensional array is the two-dimensional array
Passing arrays to functions	You can pass to the function a pointer to an array by specifying the array's name without an index
Return array from functions	Allows a function to return an array

Multidimensional Arrays

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An array element can reference another array for its value. Such arrays are called as **multi-dimensionalarrays**. ES6 supports the concept of multi-dimensional arrays. The simplest form of a multi-dimensional array is a two-dimensional array.

Declaring a Two-dimensional Array

```
var arr_name=[ [val1,val2,val3],[v1,v2,v3] ]
```

Accessing a Two-dimensional Array Element

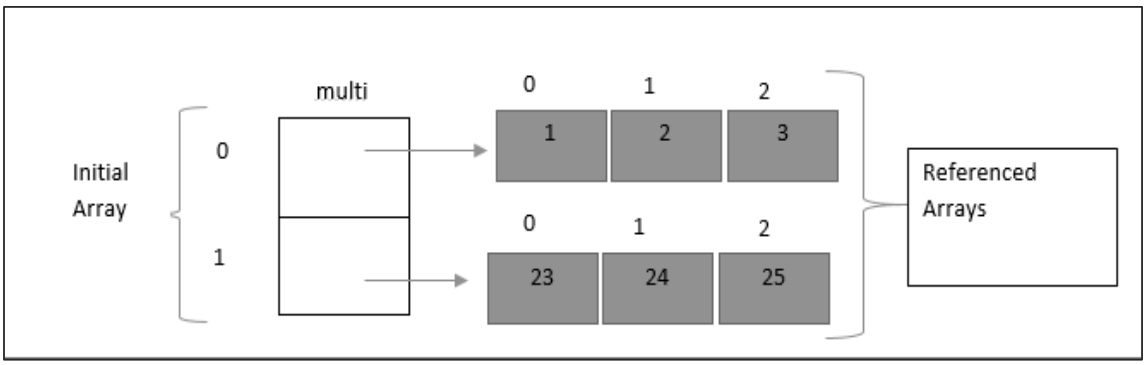
```
var arr_name[initial_array_index][referenced_array_index]
```

The following example better explains this concept.

Example

```
var multi=[[1,2,3],[23,24,25]]
console.log(multi[0][0])
console.log(multi[0][1])
console.log(multi[0][2])
console.log(multi[1][0])
console.log(multi[1][1])
console.log(multi[1][2])
```

The above example initially declares an array with 2 elements. Each of these elements refer to another array having 3 elements. Following is the pictorial representation of the above array.



While referring to an array element here, the subscript of the initial array element must be followed by the subscript of the referenced array element. This is illustrated in the above code.

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

```
1
2
3
23
24
25
```

Example: Passing Arrays to Functions

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

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

```
Mary
Tom
Jack
Jill
```

Example: Function Returning an Array

```
function disp()
{
    return new Array("Mary","Tom","Jack","Jill")
}
var nums=disp()
for(var i in nums)
{
    console.log(nums[i])
}
```

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

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```
Mary
Tom
Jack
Jill
```

Array De-structuring

Destructuring refers to extracting individual values from an array or an object into distinct variables. Consider a scenario where the values of an array need to be assigned to individual variables. The traditional way of doing this is given below:

```
var a= array1[0]
var b= array1[1]
var c= array1[2]
```

Destructuring helps to achieve the same in a concise way.

Syntax

```
//destructuring an array

let [variable1,variable2]=[item1,item2]

//destructuring an object

let {property1,property2} = {property1:value1,property2:value2}
```

Example

```
<script>

     let names = ['Mohtashim','Kannan','Kiran']
     let [n1,n2,n3] = names;

     console.log(n1)
     console.log(n2)
     console.log(n3);

     //rest operator with array destructuring
     let locations=['Mumbai','Hyderabad','Chennai']
```

```
    let [l1,...otherValues] =locations
    console.log(l1)
    console.log(otherValues)

    //variables already declared
    let name1,name2;
    [name1,name2] =names
    console.log(name1)
    console.log(name2)

    //swapping
    let first=10,second=20;
    [second,first] = [first,second]
    console.log("second is ",second) //10
    console.log("first is ",first) //20



   </script>
```

The output of the above code will be as shown below:

```
Mohtashim
Kannan
Kiran
Mumbai
["Hyderabad", "Chennai"]
Mohtashim
Kannan
second is  10
first is  20
```

22. 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.

Property	Description
constructor	Specifies the function that creates an object's prototype
prototype	The prototype property allows you to add properties and methods to an object

Constructor

Javascript date constructor property returns a reference to the array function that created the instance's prototype.

Syntax

```
date.constructor
```


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Return value

Returns the function that created this object's instance.

Example: constructor

```
var dt = new Date();
console.log("dt.constructor is : " + dt.constructor);
```

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

```
dt.constructor is : function Date() { [native code] }
```

prototype

The prototype property allows you to add properties and methods to any object (Number, Boolean, String, Date, etc.). Note: Prototype is a global property which is available with almost all the objects.

Syntax

```
object.prototype.name = value
```

Example:Date.prototype

```
var myBook = new book("Perl", "Mohtashim");
book.prototype.price = null;
myBook.price = 100;
console.log("Book title is : " + myBook.title + "<br>");
console.log("Book author is : " + myBook.author + "<br>");
console.log("Book price is : " + myBook.price + "<br>");
```

The output of the above code will be as given below:

```
Book title is : Perl
Book author is : Mohtashim
Book price is : 100
```


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Date Methods

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

Method	Description
Date()	Returns today's date and time
getDate()	Returns the day of the month for the specified date according to the local time
getDay()	Returns the day of the week for the specified date according to the local time
getFullYear()	Returns the year of the specified date according to the local time
getHours()	Returns the hour in the specified date according to the local time
getMilliseconds()	Returns the milliseconds in the specified date according to the local time
getMinutes()	Returns the minutes in the specified date according to the local time
getMonth()	Returns the month in the specified date according to the local time
getSeconds()	Returns the seconds in the specified date according to the local time
getTime()	Returns the numeric value of the specified date as the number of milliseconds since January 1, 1970, 00:00:00 UTC
getTimezoneOffset()	Returns the time-zone offset in minutes for the current locale
getUTCDate()	Returns the day (date) of the month in the specified date according to the universal time
getUTCDay()	Returns the day of the week in the specified date according to the universal time
getUTCFullYear()	Returns the year in the specified date according to the universal time
getUTCHours()	Returns the hours in the specified date according to the universal time
getUTCMilliseconds()	Returns the milliseconds in the specified date according to the universal time
getUTCMinutes()	Returns the minutes in the specified date according to the universal time
getUTCMonth()	Returns the month in the specified date according to the universal time
getUTCSeconds()	Returns the seconds in the specified date according to the universal time
setDate()	Sets the day of the month for a specified date according to the local time
setFullYear()	Sets the full year for a specified date according to the local time
setHours()	Sets the hours for a specified date according to the local time
setMilliseconds()	

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	Sets the milliseconds for a specified date according to the local time
setMinutes()	Sets the minutes for a specified date according to the local time
setMonth()	Sets the month for a specified date according to the local time
setSeconds()	Sets the seconds for a specified date according to the local time
setTime()	Sets the Date object to the time represented by a number of milliseconds since January 1, 1970, 00:00:00 UTC
setUTCDate()	Sets the day of the month for a specified date according to the universal time
setUTCFullYear()	Sets the full year for a specified date according to the universal time
setUTCHours()	Sets the hour for a specified date according to the universal time
setUTCMilliseconds()	Sets the milliseconds for a specified date according to the universal time
setUTCMinutes()	Sets the minutes for a specified date according to the universal time
setUTCMonth()	Sets the month for a specified date according to the universal time
setUTCSeconds()	Sets the seconds for a specified date according to the universal time
toDateString()	Returns the "date" portion of the Date as a human-readable string
toLocaleDateString()	Returns the "date" portion of the Date as a string, using the current locale's conventions
toLocaleString()	Converts a date to a string, using the current locale's conventions
toLocaleTimeString()	Returns the "time" portion of the Date as a string, using the current locale's conventions

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toString()	Returns a string representing the specified Date object
toTimeString()	Returns the "time" portion of the Date as a human-readable string
toUTCString()	Converts a date to a string, using the universal time convention
valueOf()	Returns the primitive value of a Date object

Date()

Javascript Date() method returns today's date and time and does not need any object to be called.

Syntax

```
Date()
```

Return Value

Returns today's date and time.

Example

```
var dt = Date();
console.log("Current Date ",dt);
```

Output

```
Current Date Tue Sep 20 2016 22:24:31 GMT+0530 (India Standard Time)
```

getDate()

Javascript date getDate() method returns the day of the month for the specified date according to local time. The value returned by getDate is an integer between 1 and 31.

Syntax

```
Date.getDate()
```

Return Value

Returns today's date and time.

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Example

```
var dt = new Date("December 25, 1995 23:15:00");
console.log("getDate() : " + dt.getDate() );
```

Output

```
getDate() : 25
```

getDay()

Javascript date getDay() method returns the day of the week for the specified date according to local time. The value returned by getDay is an integer corresponding to the day of the week: 0 for Sunday, 1 for Monday, 2 for Tuesday, and so on.

Syntax

```
Date.getDay()
```

Return Value

Returns the day of the week for the specified date according to local time.

Example

```
var dt = new Date("December 25, 1995 23:15:00");
console.log("getDay() : " + dt.getDay() );
```

Output

```
getDay() : 1
```

getFullYear()

Javascript date getFullYear() method returns the year of the specified date according to local time. The value returned by getFullYear is an absolute number. For dates between the years 1000 and 9999, getFullYear returns a four-digit number, for example, 2008.

Syntax

```
Date.getFullYear()
```

Return Value

Returns the year of the specified date according to local time.

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Example

```
var dt = new Date("December 25, 1995 23:15:00");
console.log("getFullYear() : " + dt.getFullYear() );
```

Output

```
getFullYear() : 1995
```

getHours()

Javascript Date getHours() method returns the hour in the specified date according to local time. The value returned by getHours is an integer between 0 and 23.

Syntax

```
Date.getHours()
```

Return Value

Returns the hour in the specified date according to local time.

Example

```
var dt = new Date("December 25, 1995 23:15:00");
console.log("getHours() : " + dt.getHours() );
```

Output

```
getHours() : 23
```

getMilliseconds()

Javascript date getMilliseconds() method returns the milliseconds in the specified date according to local time. The value returned by getMilliseconds is a number between 0 and 999.

Syntax

```
Date.getMilliseconds ()
```

Return Value

Returns the milliseconds in the specified date according to local time.

Example

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```
var dt = new Date("December 25, 1995 23:15:00");
console.log("getMilliseconds() : " + dt.getMilliseconds() );
```

Output

```
getMilliseconds() : 0
```

getMinutes()

Javascript date getMinutes() method returns the minutes in the specified date according to local time. The value returned by getMinutes is an integer between 0 and 59.

Syntax

```
Date.getMinutes ()
```

Return Value

Returns the minutes in the specified date according to local time.

Example

```
var dt = new Date("December 25, 1995 23:15:00");
console.log("getMinutes() : " + dt.getMinutes() );
```

Output

```
getMinutes() : 15
```

getMonth()

Javascript date getMonth() method returns the month in the specified date according to local time. The value returned by getMonth is an integer between 0 and 11. 0 corresponds to January, 1 to February, and so on.

Syntax

```
Date.getMonth ()
```

Return Value

Returns the Month in the specified date according to local time.

Example

```
var dt = new Date("December 25, 1995 23:15:00");
```


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```
console.log("getMinutes() : " + dt.getMinutes() );
```

Output

```
getMonth() : 11
```

getSeconds()

Javascript date getSeconds() method returns the seconds in the specified date according to local time. The value returned by getSeconds is an integer between 0 and 59.

Syntax

```
Date.getSeconds ()
```

Return Value

Returns the seconds in the specified date according to local time.

Example

```
var dt = new Date("December 25, 1995 23:15:00");
console.log("getSeconds() : " + dt.getSeconds() );
```

Output

```
getSeconds() : 0
```

getTime()

Javascript date getTime() method returns the numeric value corresponding to the time for the specified date according to universal time. The value returned by the getTime method is the number of milliseconds since 1 January 1970 00:00:00.

You can use this method to help assign a date and time to another Date object.

Syntax

```
Date.getTime ()
```

Return Value

Returns the numeric value corresponding to the time for the specified date according to universal time.

Example

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```
var dt = new Date("December 25, 1995 23:15:00");
console.log("getTime() : " + dt.getTime() );
```

Output

```
getTime() : 819913500000
```

getTimezoneOffset()

Javascript date getTimezoneOffset() method returns the time-zone offset in minutes for the current locale. The time-zone offset is the minutes in difference, the Greenwich Mean Time (GMT) is relative to your local time.

For example, if your time zone is GMT+10, -600 will be returned. Daylight savings time prevents this value from being a constant.

Syntax

```
Date.getTimezoneOffset()
```

Return Value

Returns the time-zone offset in minutes for the current locale.

Example

```
var dt = new Date("December 25, 1995 23:15:00");
console.log("getTimezoneoffset() : " + dt.getTimezoneOffset() );
```

Output

```
getTimezoneoffset() : -330
```

getUTCDate()

Javascript date getUTCDate() method returns the day of the month in the specified date according to universal time. The value returned by getUTCDate is an integer between 1 and 31.

Syntax

```
Date.getUTCDate ()
```

Return Value

Returns the day of the month in the specified date according to universal time.

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Example

```
var dt = new Date( "December 25, 1995 23:15:20" );
console.log("getUTCDate() : " + dt.getUTCDate() );
```

Output

```
getUTCDate() : 25
```

getUTCDay()

Javascript date getUTCDay() method returns the day of the week in the specified date according to universal time. The value returned by getUTCDay is an integer corresponding to the day of the week: 0 for Sunday, 1 for Monday, 2 for Tuesday, and so on.

Syntax

```
Date.getUTCDay ()
```

Return Value

Returns the day of the week in the specified date according to universal time.

Example

```
var dt = new Date( "December 25, 1995 23:15:20" );
console.log("getUTCDay() : " + dt.getUTCDay() );
```

Output

```
getUTCDay() : 1
```

getUTCFullYear()

Javascript date getUTCFullYear() method returns the year in the specified date according to universal time. The value returned by getUTCFullYear is an absolute number that is compliant with year-2000, for example, 2008.

Syntax

```
Date.getUTCFullYear ()
```

Return Value

Returns the year in the specified date according to universal time.

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Example

```
var dt = new Date( "December 25, 1995 23:15:20" );
console.log("getUTCFullYear() : " + dt.getUTCFullYear() );
```

Output

```
getUTCFullYear() : 1995
```

getUTCHours()

Javascript date getUTCHours() method returns the hours in the specified date according to universal time. The value returned by getUTCHours is an integer between 0 and 23.

Syntax

```
Date.getUTCHours ()
```

Return Value

Returns the hours in the specified date according to universal time.

Example

```
var dt = new Date( "December 25, 1995 23:15:20" );
console.log("getUTCHours() : " + dt.getUTCHours() );
```

Output

```
getUTCHours() : 17
```

getUTCMilliseconds()

Javascript date getUTCMilliseconds() method returns the milliseconds in the specified date according to universal time. The value returned by getUTCMilliseconds is an integer between 0 and 999.

Syntax

```
Date.getUTCMilliseconds ()
```

Return Value

Returns the milliseconds in the specified date according to universal time.

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Example

```
var dt = new Date( "December 25, 1995 23:15:20" );
console.log("getUTCMilliseconds() : " + dt.getUTCMilliseconds())
```

Output

```
getUTCMilliseconds() : 0
```

getUTCMinutes()

Javascript date getUTCMinutes() method returns the minutes in the specified date according to universal time. The value returned by getUTCMinutes is an integer between 0 and 59.

Syntax

```
Date.getUTCMinutes ()
```

Return Value

Returns the minutes in the specified date according to universal time.

Example

```
var dt = new Date( "December 25, 1995 23:15:20" );
console.log("getUTCMinutes() : " + dt.getUTCMinutes() );
```

Output

```
getUTCMinutes() : 45
```

getUTCMonth()

Javascript date getUTCMonth() method returns the month in the specified date according to universal time. The value returned by getUTCMonth is an integer between 0 and 11 corresponding to the month. 0 for January, 1 for February, 2 for March, and so on.

Syntax

```
Date.getUTCMonth ()
```

Return Value

Returns the month in the specified date according to universal time.

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Example

```
var dt = new Date( "December 25, 1995 23:15:20" );
console.log("getUTCMonth() : " + dt.getUTCMonth() );
```

Output

```
getUTCMonth() : 11
```

getUTCSeconds()

Javascript date getUTCSeconds() method returns the seconds in the specified date according to universal time. The value returned by getUTCSeconds is an integer between 0 and 59.

Syntax

```
Date.getUTCSeconds ()
```

Return Value

Returns the seconds in the specified date according to universal time.

Example

```
var dt = new Date( "December 25, 1995 23:15:20" );
console.log("getUTCSeconds() : " + dt.getUTCSeconds() );
```

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

```
getUTCSeconds() : 20
```

setDate()

Javascript date setDate() method sets the day of the month for a specified date according to local time.

Syntax

```
Date.setDate( dayValue )
```

Parameter

- **dayValue** – An integer from 1 to 31, representing the day of the month.

Example

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```
var dt = new Date( "Aug 28, 2008 23:30:00" );
dt.setDate( 24 );
console.log( dt )
```

Output

```
Sun Aug 24 2008 23:30:00 GMT+0530 (India Standard Time)
```

setFullYear()

Javascript date setFullYear() method sets the full year for a specified date according to local time.

```
Date.setFullYear(yearValue[, monthValue[, dayValue]])
```

Parameter

- yearValue – An integer specifying the numeric value of the year, for example, 2008.
- monthValue – An integer between 0 and 11 representing the months January through December.
- dayValue – An integer between 1 and 31 representing the day of the month. If you specify the dayValue parameter, you must also specify the monthValue.
- If you do not specify the monthValue and dayValue parameters, the values returned from the getMonth and getDate methods are used.

Example

```
var dt = new Date( "Aug 28, 2008 23:30:00" );
dt.setFullYear( 2000 );
console.log( dt )
```

Output

```
Mon Aug 28 2000 23:30:00 GMT+0530 (India Standard Time)
```

setHours()

Javascript date setHours() method sets the hours for a specified date according to local time..

Syntax

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```
Date.setHours(hoursValue[, minutesValue[, secondsValue[, msValue]]])
```

Parameter

- **hoursValue** – An integer between 0 and 23, representing the hour.
- **minutesValue** – An integer between 0 and 59, representing the minutes.
- **secondsValue** – An integer between 0 and 59, representing the seconds. If you specify the secondsValue parameter, you must also specify the minutesValue.
- **msValue** – A number between 0 and 999, representing the milliseconds. If you specify the msValue parameter, you must also specify the minutesValue and secondsValue.

If you do not specify the minutesValue, secondsValue, and msValue parameters, the values returned from the getUTCMinutes, getUTCSeconds, and getMilliseconds methods are used.

Example

```
var dt = new Date( "Aug 28, 2008 23:30:00" );
dt.setHours(02);
console.log(dt);
```

Output

```
Thu Aug 28 2008 02:30:00 GMT+0000 (UTC)
```

setMilliseconds()

Javascript date setMilliseconds() method sets the milliseconds for a specified date according to local time.

Syntax

```
Date.setMilliseconds(millisecondsValue)
```

Parameter

- **millisecondsValue** – A number between 0 and 999, representing the milliseconds.

If you specify a number outside the expected range, the date information in the Date object is updated accordingly. For example, if you specify 1010, the number of seconds is incremented by 1, and 10 is used for the milliseconds.

Example

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```
var dt = new Date( "Aug 28, 2008 23:30:00" );
dt.setMilliseconds( 1010 );
console.log( dt );
```

Output

```
Thu Aug 28 2008 23:30:01 GMT+0530 (India Standard Time)
```

setMinutes()

Javascript date setMinutes() method sets the minutes for a specified date according to local time.

Syntax

```
Date.setMinutes(minutesValue[, secondsValue[, msValue]])
```

Parameter

- **minutesValue** – An integer between 0 and 59, representing the minutes.
- **secondsValue** – An integer between 0 and 59, representing the seconds. If you specify the secondsValue parameter, you must also specify the minutesValue.
- **msValue** – A number between 0 and 999, representing the milliseconds. If you specify the msValue parameter, you must also specify the minutesValue and secondsValue.

If you do not specify the secondsValue and msValue parameters, the values returned from getSeconds and getMilliseconds methods are used.

Example

```
var dt = new Date( "Aug 28, 2008 23:30:00" );
dt.setMinutes( 45 );
console.log( dt );
```

Output

```
Thu Aug 28 2008 23:45:00 GMT+0530 (India Standard Time)
```

setMonth()

Javascript date setMonth() method sets the month for a specified date according to local time.

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Syntax

```
Date.setMonth(monthValue[, dayValue])
```

Parameter

- **monthValue** – An integer between 0 and 11 (representing the months January through December).
- **dayValue** – An integer from 1 to 31, representing the day of the month.
- **msValue** – A number between 0 and 999, representing the milliseconds. If you specify the msValue parameter, you must also specify the minutesValue and secondsValue.

If you do not specify the dayValue parameter, the value returned from the getDate method is used. If a parameter you specify is outside of the expected range, setMonth attempts to update the date information in the Date object accordingly. For example, if you use 15 for monthValue, the year will be incremented by 1 (year + 1), and 3 will be used for month.

Example

```
var dt = new Date( "Aug 28, 2008 23:30:00" );
dt.setMonth( 2 );
console.log( dt );
```

Output

```
Fri Mar 28 2008 23:30:00 GMT+0530 (India Standard Time)
```

setSeconds()

Javascript date setSeconds() method sets the seconds for a specified date according to local time

Syntax

```
Date.setSeconds(secondsValue[, msValue])
```

Parameter

- **secondsValue** – An integer between 0 and 59.
- **msValue** – A number between 0 and 999, representing the milliseconds..

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If you do not specify the msValue parameter, the value returned from the getMilliseconds method is used. If a parameter you specify is outside of the expected range, setSeconds attempts to update the date information in the Date object accordingly. For example, if you use 100 for secondsValue, the minutes stored in the Date object will be incremented by 1, and 40 will be used for seconds.

Example

```
var dt = new Date( "Aug 28, 2008 23:30:00" );
dt.setSeconds( 80 );
console.log( dt );
```

Output

```
Thu Aug 28 2008 23:31:20 GMT+0530 (India Standard Time)
```

setTime()

Javascript date setTime()method sets the Date object to the time represented by a number of milliseconds since January 1, 1970, 00:00:00 UTC.

Syntax

```
Date.setTime(timeValue)
```

Parameter

- **timeValue** – An integer representing the number of milliseconds since 1 January 1970, 00:00:00 UTC.

Example

```
var dt = new Date( "Aug 28, 2008 23:30:00" );
dt.setTime( 5000000 );
console.log( dt );
```

Output

```
Thu Jan 01 1970 06:53:20 GMT+0530 (India Standard Time)
```


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setUTCDate()

Javascript date setUTCDate() method sets the day of the month for a specified date according to universal time.

Syntax

```
Date.setUTCDate(dayValue)
```

Parameter

- dayValue – An integer from 1 to 31, representing the day of the month.

Example

```
var dt = new Date( "Aug 28, 2008 23:30:00" );
dt.setUTCDate( 20 );
console.log( dt );
```

Output

```
Wed Aug 20 2008 23:30:00 GMT+0530 (India Standard Time)
```

setUTCFullYear()

Javascript date setUTCFullYear() method sets the full year for a specified date according to universal time.

Syntax

```
Date.setUTCFullYear(yearValue[, monthValue[, dayValue]])
```

Parameter

- yearValue – An integer specifying the numeric value of the year, for example, 2008.
- monthValue – An integer between 0 and 11 representing the months January through December.
- dayValue – An integer between 1 and 31 representing the day of the month. If you specify the dayValue parameter, you must also specify the monthValue.

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If you do not specify the monthValue and dayValue parameters, the values returned from the getMonth and getDate methods are used. If a parameter you specify is outside of the expected range, setUTCFullYear attempts to update the other parameters and the date information in the Date object accordingly. For example, if you specify 15 for monthValue, the year is incremented by 1 (year + 1), and 3 is used for the month.

Example

```
var dt = new Date( "Aug 28, 2008 23:30:00" );
dt.setUTCFullYear( 2006 );
console.log( dt );
```

Output

```
Mon Aug 28 2006 23:30:00 GMT+0530 (India Standard Time)
```

setUTCHours()

Javascript date setUTCHours() method sets the hour for a specified date according to local time.

Syntax

```
Date.setUTCHours(hoursValue[, minutesValue[, secondsValue[, msValue]]])
```

Parameter

- **hoursValue** – An integer between 0 and 23, representing the hour.
- **minutesValue** – An integer between 0 and 59, representing the minutes.
- **secondsValue** – An integer between 0 and 59, representing the seconds. If you specify the secondsValue parameter, you must also specify the minutesValue.
- **msValue** – A number between 0 and 999, representing the milliseconds. If you specify the msValue parameter, you must also specify the minutesValue and secondsValue.

If you do not specify the minutesValue, secondsValue, and msValue parameters, the values returned from the getUTCMinutes, getUTCSeconds, and getUTCMilliseconds methods are used.

If a parameter you specify is outside the expected range, setUTCHours attempts to update the date information in the Date object accordingly. For example, if you use 100 for secondsValue, the minutes will be incremented by 1 (min + 1), and 40 will be used for seconds.

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Example

```
var dt = new Date( "Aug 28, 2008 23:30:00" );
dt.setUTCHours( 12);
console.log( dt );
```

Output

```
Thu Aug 28 2008 17:30:00 GMT+0530 (India Standard Time)
```

setUTCMilliseconds()

Javascript date setUTCMilliseconds() method sets the milliseconds for a specified date according to universal time.

Syntax

```
Date.setUTCMilliseconds(millisecondsValue)
```

Parameter

- millisecondsValue – A number between 0 and 999, representing the milliseconds

If a parameter you specify is outside the expected range, setUTCMilliseconds attempts to update the date information in the Date object accordingly. For example, if you use 1100 for millisecondsValue, the seconds stored in the Date object will be incremented by 1, and 100 will be used for milliseconds.

Example

```
var dt = new Date( "Aug 28, 2008 23:30:00" );
dt.setUTCMilliseconds( 1100);
console.log( dt );
```

Output

```
Thu Aug 28 2008 23:30:01 GMT+0530 (India Standard Time)
```

setUTCMinutes()

Javascript date setUTCMinutes() method sets the minutes for a specified date according to universal time.

Syntax

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```
Date.setUTCMinutes(minutesValue[, secondsValue[, msValue]])
```

Parameter

- **minutesValue** – An integer between 0 and 59, representing the minutes.
- **secondsValue** – An integer between 0 and 59, representing the seconds. If you specify the secondsValue parameter, you must also specify the minutesValue.
- **msValue** – A number between 0 and 999, representing the milliseconds. If you specify the msValue parameter, you must also specify the minutesValue and secondsValue.

If you do not specify the secondsValue and msValue parameters, the values returned from getUTCSeconds and getUTCMilliseconds methods are used.

If a parameter you specify is outside of the expected range, setUTCMinutes attempts to update the date information in the Date object accordingly. For example, if you use 100 for secondsValue, the minutes (minutesValue) will be incremented by 1 (minutesValue + 1), and 40 will be used for seconds.

Example

```
var dt = new Date( "Aug 28, 2008 23:30:00" );
dt.setUTCMinutes(65);
console.log( dt );
```

Output

```
Fri Aug 29 2008 00:35:00 GMT+0530 (India Standard Time)
```

setUTCMonth()

Javascript date setUTCMonth() method sets the month for a specified date according to universal time.

Syntax

```
Date.setUTCMonth ( monthvalue )
```

Parameter

- **monthValue** – An integer between 0 and 11, representing the month.

Example

```
var dt = new Date( "Aug 28, 2008 23:30:00" );
```


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```
dt.setUTCMonth(5);
console.log( dt );
```

Output

```
Sat Jun 28 2008 23:30:00 GMT+0530 (India Standard Time)
```

setUTCSeconds()

Javascript date setUTCSeconds() method sets the seconds for a specified date according to universal time.

Syntax

```
Date.setUTCSeconds(secondsValue[, msValue])
```

Parameter

- **secondsValue** – An integer between 0 and 59, representing the seconds.
- **msValue** – A number between 0 and 999, representing the milliseconds.

If you do not specify the msValue parameter, the value returned from the getUTCMilliseconds methods is used.

If a parameter you specify is outside the expected range, setUTCSeconds attempts to update the date information in the Date object accordingly. For example, if you use 100 for secondsValue, the minutes stored in the Date object will be incremented by 1, and 40 will be used for seconds.

Example

```
var dt = new Date( "Aug 28, 2008 23:30:00" );
dt.setUTCSeconds(65);
console.log( dt );
```

Output

```
Thu Aug 28 2008 23:31:05 GMT+0530 (India Standard Time)
```

toDateString()

Javascript date toDateString() method returns the date portion of a Date object in human readable form.

Syntax

```
Date.toDateString()
```

Return Value

Returns the date portion of a Date object in human readable form.

Example

```
var dt = new Date(1993, 6, 28, 14, 39, 7);
console.log( "Formated Date : " + dt.toDateString() )
```

Output

```
Formated Date : Wed Jul 28 1993
```

toLocaleDateString()

Javascript date toLocaleDateString() method converts a date to a string, returning the "date" portion using the operating system's locale's conventions.

Syntax

```
Date.toLocaleString()
```

Return Value

Returns the "date" portion using the operating system's locale's conventions.

Example

```
var dt = new Date(1993, 6, 28, 14, 39, 7);
console.log( "Formated Date : " + dt.toLocaleDateString())
```

Output

```
Formated Date : 7/28/1993
```


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toLocaleString()

Javascript date toLocaleString() method converts a date to a string, using the operating system's local conventions.

The toLocaleString method relies on the underlying operating system in formatting dates. It converts the date to a string using the formatting convention of the operating system where the script is running. For example, in the United States, the month appears before the date (04/15/98), whereas in Germany the date appears before the month (15.04.98).

Syntax

```
Date.toLocaleString ()
```

Return Value

Returns the formatted date in a string format.

Example

```
var dt = new Date(1993, 6, 28, 14, 39, 7);
console.log( "Formated Date : " + dt.toLocaleString() );
```

Output

```
Formated Date : 7/28/1993, 2:39:07 PM
```

toLocaleTimeString()

Javascript date toLocaleTimeString() method converts a date to a string, returning the "date" portion using the current locale's conventions.

The toLocaleTimeString method relies on the underlying operating system in formatting dates. It converts the date to a string using the formatting convention of the operating system where the script is running. For example, in the United States, the month appears before the date (04/15/98), whereas in Germany, the date appears before the month (15.04.98).

Syntax

```
Date.toLocaleTimeString ()
```

Return Value

Returns the formatted date in a string fromat.

Example

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```
var dt = new Date(1993, 6, 28, 14, 39, 7);
console.log( "Formated Date : " + dt.toLocaleTimeString() );
```

Output

```
Formated Date : 2:39:07 PM
```

toString()

This method returns a string representing the specified Date object.

Syntax

```
Date.toString ()
```

Return Value

Returns a string representing the specified Date object.

Example

```
var dateobject = new Date(1993, 6, 28, 14, 39, 7);
stringobj = dateobject.toString();
console.log( "String Object : " + stringobj );
```

Output

```
String Object : Wed Jul 28 1993 14:39:07 GMT+0000 (UTC)
```

toTimeString()

This method returns the time portion of a Date object in human readable form.

Syntax

```
Date.toTimeString ()
```

Return Value

Returns the time portion of a Date object in human readable form.

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Example

```
var dateobject = new Date(1993, 6, 28, 14, 39, 7);
console.log( dateobject.toTimeString() );
```

Output

```
14:39:07 GMT+0530 (India Standard Time)
```

toUTCString()

This method converts a date to a string, using the universal time convention.

Syntax

```
Date.toUTCString ()
```

Return Value

Returns converted date to a string, using the universal time convention.

Example

```
var dateobject = new Date(1993, 6, 28, 14, 39, 7);
console.log( dateobject.toUTCString() );
```

Output

```
Wed, 28 Jul 1993 09:09:07 GMT
```

valueof()

This method returns the primitive value of a Date object as a number data type, the number of milliseconds since midnight 01 January, 1970 UTC.

Syntax

```
Date.valueOf()
```

Return Value

Returns the primitive value of a Date object.

Example

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```
var dateobject = new Date(1993, 6, 28, 14, 39, 7);
console.log( dateobject.valueOf() );
```

Output

```
743850547000
```


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23. 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.

Property	Description
E	Euler's constant and the base of natural logarithms, approximately 2.718
LN2	Natural logarithm of 2, approximately 0.693
LN10	Natural logarithm of 10, approximately 2.302
LOG2E	Base 2 logarithm of E, approximately 1.442
LOG10E	Base 10 logarithm of E, approximately 0.434
PI	Ratio of the circumference of a circle to its diameter, approximately 3.14159
SQRT1_2	Square root of 1/2; equivalently, 1 over the square root of 2, approximately 0.707
SQRT2	Square root of 2, approximately 1.414

Math- E

This is an Euler's constant and the base of natural logarithms, approximately 2.718.

Syntax

```
Math.E
```

Example

```
console.log(Math.E) // the root of the natural logarithm: ~2.718
```

Output

```
2.718281828459045
```

Math- LN2

It returns the natural logarithm of 2 which is approximately 0.693.

Syntax

```
Math.LN2
```

Example

```
console.log(Math.LN2) // the natural logarithm of 2: ~0.693
```

Output

```
0.6931471805599453
```

Math- LN10

Natural logarithm of 10, approximately 2.302

Syntax

```
Math.LN2
```

Example

```
console.log(Math.LN10) // the natural logarithm of 10: ~2.303
```

Output

```
2.302585092994046
```

Math- LOG2E

Base 2 logarithm of E, approximately 1.442

Syntax

```
Math.LOG2E
```

Example

```
console.log(Math.LOG2E) // the base 2 logarithm of Math.E: ~1.433
```

Output

```
1.4426950408889634
```

Math - LOG10E

Base 10 logarithm of E, approximately 0.434.

Syntax

```
Math.LOG10E
```

Example

```
console.log(Math.LOG10E) // the base 10 logarithm of Math.E: 0.434
```

Output

```
0.4342944819032518
```

Math- PI

Ratio of the circumference of a circle to its diameter, approximately 3.14159

Syntax

```
Math.PI
```

Example

```
console.log(Math.PI)
// the ratio of a circle's circumference to its diameter: ~3.142
```

Output

```
3.141592653589793
```

Math- SQRT1_2

Square root of 1/2; equivalently, 1 over the square root of 2, approximately 0.707

Syntax

```
Math.SQRT1_2
```

Example

```
console.log(Math.SQRT1_2)      // the square root of 1/2: ~0.707
```


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Output

```
0.7071067811865476
```

Math - SQRT2

Square root of 2, approximately 1.414

Syntax

```
Math.SQRT2
```

Example

```
console.log(Math.SQRT2)  // the square root of 2: ~1.414
```

Output

```
1.4142135623730951
```

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.

Function	Description
Math.pow(x, y)	Returns **x** raised to the power **y**
Math.sqrt(x)	Returns the square root of the number **x**
ath.cbrt(x)	Returns the cube root of the number **x**
Math.exp(x)	Equivalent to Math.pow(Math.E, x)
Math.expm1(x)	Equivalent to Math.exp(x) – 1
Math.hypot(x1, x2,...)	Returns the square root of the sum of arguments

Pow()

This method returns the base to the exponent power, that is, base to the power exponent.

Syntax

```
Math.pow(x, y)
```

Parameter

- x: represents base
- y: represents the exponent

Return Value

Returns the base to the exponent power.

Example

```
console.log("---Math.pow()---")
console.log("math.pow(2,3) : "+Math.pow(2, 3))
console.log("Math.pow(1.7, 2.3) : "+Math.pow(1.7, 2.3))
```

Output

```
---Math.pow()---
math.pow(2,3) : 8
Math.pow(1.7, 2.3) : 3.388695291147646
```

sqrt()

This method returns the square root of a number. If the value of a number is negative, sqrt returns NaN.

Syntax

```
Math.sqrt ( x );
```

Parameter

- x: represents a number

Return Value

Returns the square root of the number.

Example

```
console.log("---Math.sqrt()---")
console.log("Math.sqrt(16) : "+Math.sqrt(16))
```


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```
console.log("Math.sqrt(15.5) : "+Math.sqrt(15.5))
```

Output

```
---Math.sqrt()---
Math.sqrt(16) : 4
Math.sqrt(15.5) : 3.9370039370059056
```

cbrt()

This method returns the cube root of a number.

Syntax

```
Math.cbrt ( x );
```

Parameter

- x: represents a number

Return Value

Returns the cube root of the number.

Example

```
console.log("---Math.cbrt()---")
console.log("Math.cbrt(27) : "+Math.cbrt(27))
console.log("Math.cbrt(22) : "+Math.cbrt(22))
```

Output

```
---Math.cbrt()---
Math.cbrt(27) : 3
Math.cbrt(22) : 2.802039330655387
```

exp()

Equivalent to Math.pow(Math.E, x)

Syntax

```
Math.exp ( x ) ;
```

Parameter

- x: represents a number

Return Value

Returns the exponential value of the variable x.

Example

```
console.log("---Math.exp()---")
console.log("Math.exp(1) : "+Math.exp(1))
console.log("Math.exp(5.5) : "+Math.exp(5.5))
```

Output

```
---Math.exp()---
Math.exp(1) : 2.718281828459045
Math.exp(5.5) : 244.69193226422036
```

expm1(X)

Equivalent to Math.exp(x) – 1

Syntax

```
Math.expm1( x ) ;
```

Parameter

- x: represents a number

Return Value

Returns the value of Math.exp(x) – 1

Example

```
console.log("---Math.expm1()---")
console.log("Math.expm1(1) : "+Math.expm1(1))
console.log("Math.expm1(5.5) : "+Math.expm1(5.5))
```


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Output

```
---Math.expm1()---
Math.expm1(1) : 1.718281828459045
Math.expm1(5.5) : 243.69193226422038
```

Math.hypot(x1, x2,...)

Returns the square root of the sum of the arguments

Syntax

```
Math.hypot( x1,x2.. ) ;
```

Parameter

- X1 and x2..: represents numbers

Return Value

Returns the square root of the sum of all the numbers passed a argument

Example

```
console.log("---Math.hypot()---")
console.log("Math.hypot(3,4) : "+Math.hypot(3,4))
console.log("Math.hypot(2,3,4) : "+Math.hypot(2,3,4))
```

Output

```
---Math.hypot()---
Math.hypot(3,4) : 5
Math.hypot(2,3,4) : 5.385164807134504
```

Logarithmic Functions

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

Function	Description
Math.log(x)	Natural logarithm of **x**

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Math.log10(x)	Base 10 logarithm of **x**
Math.log2(x)	Base 2 logarithm of **x**
Math.log1p(x)	Natural logarithm of **1 + x**

Math.log(x)

Returns the natural logarithm of X

Syntax

```
Math.log(x)
```

Parameter

- x: represents a number

Example

```
console.log("---Math.log()---")
console.log("Math.log(Math.E): "+Math.log(Math.E))
console.log("Math.log(17.5): "+Math.log(17.5))
```

Output

```
---Math.log()---
Math.log(Math.E): 1
Math.log(17.5): 2.8622008809294686
```

Math.log10(x)

Returns the base 10 logarithm of X

Syntax

```
Math.log10(x)
```

Parameter

- x: represents a number

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Example

```
console.log("---Math.log10()---")
console.log("Math.log10(10): "+Math.log10(10))
console.log("Math.log10(16.7): "+Math.log10(10))
```

Output

```
---Math.log10()---
Math.log10(10): 1
Math.log10(16.7): 1
```

Math.log2(x)

Returns the base 2 logarithm of X

Syntax

```
Math.log2(x)
```

Parameter

- x: represents a number

Example

```
console.log("---Math.log2()---")
console.log("Math.log2(2): "+Math.log2(2))
console.log("Math.log2(5): "+Math.log2(5))
```

Output

```
---Math.log2()---
Math.log2(2): 1
Math.log2(5): 2.321928094887362
```

Math.log1p(x)

Returns the natural logarithm of 1+x

Syntax

```
Math.log1p(x)
```

Parameter

- x: represents a number

Example

```
console.log("---Math.log1p()---")
console.log("Math.log1p(Math.E - 1): "+Math.log1p(Math.E - 1))
console.log("Math.log1p(17.5): "+Math.log1p(17.5))
```

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

```
---Math.log1p()---
Math.log1p(Math.E - 1): 1
Math.log1p(17.5): 2.917770732084279
```

Miscellaneous Algebraic Functions

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

Function	Description
Math.abs(x)	Absolute value of **x**
Math.sign(x)	The sign of x: if x is negative,−1; if x is positive, 1; and if x is 0, 0
Math.ceil(x)	The ceiling of x: the smallest integer greater than or equal to x
Math.floor(x)	The floor of x: the largest integer less than or equal to x
Math.trunc(x)	The integral part of x (all fractional digits are removed)
Math.round(x)	**x** rounded to the nearest integer
Math.min(x1, x2,...)	Returns the minimum argument
Math.max(x1, x2,...)	Returns the maximum argument

Abs()

This method returns the absolute value of a number.

Syntax

```
Math.abs( x ) ;
```

Parameter

- X: represents a number

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Return Value

Returns the absolute value of a number

Example

```
console.log("---Math.abs()---")
console.log("Math.abs(-5.5) : "+Math.abs(-5.5))
console.log("Math.abs(5.5) : "+Math.abs(5.5))
```

Output

```
---Math.abs()---
Math.abs(-5.5) : 5.5
Math.abs(5.5) : 5.5
```

sign()

Returns the sign of x

Syntax

```
Math.sign( x ) ;
```

Parameter

- X: represents a number

Return Value

Returns -1 if x is negative; 1 if x is positive;0 if x is 0.

Example

```
console.log("---Math.sign()---")
console.log("Math.sign(-10.5) : "+Math.sign(-10.5))
console.log("Math.sign(6.77) : "+Math.sign(6.77))
```

Output

```
---Math.sign()---
Math.sign(-10.5) : -1
Math.sign(6.77) : 1
```

round()

It rounds off the number to the nearest integer.

Syntax

```
Math.round( x ) ;
```

Parameter

- X: represents a number

Example

```
console.log("---Math.round()---")
console.log("Math.round(7.2) : "+Math.round(7.2))
console.log("Math.round(-7.7) : "+Math.round(-7.7))
```

Output

```
---Math.round()---
Math.round(7.2) : 7
Math.round(-7.7) : -8
```

trunc()

It returns the integral part of x (all fractional digits are removed).

Syntax

```
Math.trunc( x ) ;
```

Parameter

- X: represents a number

Example

```
console.log("---Math.trunc()---")
console.log("Math.trunc(7.7) : "+Math.trunc(7.7))
console.log("Math.trunc(-5.8) : "+Math.trunc(-5.8))
```

Output

```
---Math.trunc()---
Math.trunc(7.7) : 7
Math.trunc(-5.8) : -5
```

floor()

The floor of x: the largest integer less than or equal to x.

Syntax

```
Math.floor( x ) ;
```

Parameter

- X: represents a number

Example

```
console.log("---Math.floor()---")
console.log("Math.floor(2.8) : "+Math.floor(2.8))
console.log("Math.floor(-3.2) : "+Math.floor(-3.2))
```

Output

```
---Math.floor()---
Math.floor(2.8) : 2
Math.floor(-3.2) : -4
```

ceil()

This method returns the smallest integer greater than or equal to a number.

Syntax

```
Math.ceil ( x ) ;
```

Parameter

- X: represents a number

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Example

```
console.log("---Math.ceil()---")
console.log("Math.ceil(2.2) : "+Math.ceil(2.2))
console.log("Math.ceil(-3.8) : "+Math.ceil(-3.8))
```

Output

```
---Math.ceil()---
Math.ceil(2.2) : 3
Math.ceil(-3.8) : -3
```

min()

This method returns the smallest of zero or more numbers. If no arguments are given, the results is +Infinity.

Syntax

```
Math.min( x1,x2,… ) ;
```

Parameter

- X1,x2,x3..: represents a series of numbers

Example

```
console.log("---Math.min()---")
console.log("Math.min(1, 2) : "+Math.min(1, 2))
console.log("Math.min(3, 0.5, 0.66) : "+Math.min(3, 0.5, 0.66))
console.log("Math.min(3, 0.5, -0.66) : "+Math.min(3, 0.5, -0.66))
```

Output

```
---Math.min()---
Math.min(1, 2) : 1
Math.min(3, 0.5, 0.66) : 0.5
Math.min(3, 0.5, -0.66) : -0.66
```


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max()

This method returns the largest of zero or more numbers. If no arguments are given, the results is –Infinity.

Syntax

```
Math.max(x1,x2,x3..)
```

Parameter

- x1, x2, x3.. : represents a series of numbers

Example

```
console.log("---Math.max()---")
console.log("Math.max(3, 0.5, 0.66) : "+Math.max(3, 0.5, 0.66))
console.log("Math.max(-3, 0.5, -0.66) : "+Math.max(-3, 0.5, -0.66))
```

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

```
---Math.max()---
Math.max(3, 0.5, 0.66) : 3
Math.max(-3, 0.5, -0.66) : 0.5
```

Trigonometric Functions

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

Function	Description
Math.sin(x)	Sine of **x** radians
Math.cos(x)	Cosine of **x** radians
Math.tan(x)	Tangent of **x** radians
Math.asin(x)	Inverse sine (arcsin) of **x** (result in radians)
Math.acos(x)	Inverse cosine (arccos) of **x** (result in radians)

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Math.atan(x)	Inverse tangent (arctan) of **x** (result in radians)
Math.atan2(y, x0)	Counterclockwise angle (in radians) from the x-axis to the point (x, y)

Math.sin(x)

This function returns the sine of x radians.

Syntax

```
Math.sin(x)
```

Parameter

- X : represents a number

Example

```
console.log("---Math.sin()---")
console.log("Math.sin(Math.PI/2): "+Math.sin(Math.PI/2))
console.log("Math.sin(Math.PI/4): "+Math.sin(Math.PI/4))
```

Output

```
---Math.sin()---
Math.sin(Math.PI/2): 1
Math.sin(Math.PI/4): 0.7071067811865475
```

Math.cos(x)

It returns the cosine of x radians.

Syntax

```
Math.cos(x)
```

Parameter

- X : represents a number

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Example

```
console.log("---Math.cos()---")
console.log("Math.cos(Math.PI): "+Math.cos(Math.PI))
console.log("Math.cos(Math.PI/4): "+Math.PI/4)
```

Output

```
---Math.cos()---
Math.cos(Math.PI): -1
Math.cos(Math.PI/4): 0.7853981633974483
```

Math.tan(x)

This function returns the tangent of x.

Syntax

```
Math.tan(x)
```

Parameter

- X : represents a number

Example

```
console.log("---Math.tan()---")
console.log("Math.tan(Math.PI/4): "+Math.tan(Math.PI/4))
console.log("Math.tan(0): "+Math.tan(0))
```

Output

```
---Math.tan()---
Math.tan(Math.PI/4): 0.9999999999999999
Math.tan(0): 0
```

Math.asin(x)

This function returns the inverse sine of x.

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Syntax

```
Math.asin(x)
```

Parameter

- X : represents a number

Example

```
console.log("---Math.asin()---")
console.log("Math.asin(0): "+Math.asin(0))
console.log("Math.asin(Math.SQRT1_2): "+Math.asin(Math.SQRT1_2))
```

Output

```
---Math.asin()---
Math.asin(0): 0
Math.asin(Math.SQRT1_2): 0.7853981633974484
```

Math.acos(x)

This function returns the inverse cosine of x.

Syntax

```
Math.acos(x)
```

Parameter

- X : represents a number

Example

```
console.log("---Math.acos()---")
console.log("Math.acos(0): "+Math.acos(0))
console.log("Math.acos(Math.SQRT1_2): "+Math.acos(Math.SQRT1_2))
```

Output

```
---Math.acos()---
Math.acos(0): 1.5707963267948966
Math.acos(Math.SQRT1_2): 0.7853981633974483
```


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Math.atan(x)

It returns the inverse tangent of x.

Syntax

```
Math.atan(x)
```

Parameter

- X : represents a number

Example

```
console.log("---Math.atan()---")
console.log("Math.atan(0): "+Math.atan(0))
console.log("Math.atan(Math.SQRT1_2): "+Math.atan(Math.SQRT1_2))
```

Output

```
---Math.atan()---
Math.atan(0): 0
Math.atan(Math.SQRT1_2): 0.6154797086703874
```

Math.atan2()

This method returns the arctangent of the quotient of its arguments. The atan2 method returns a numeric value between -pi and pi representing the angle theta of an (x, y) point.

Syntax

```
Math.atan2(x,y)
```

Parameter

- x and y: represent numbers

Example

```
console.log("---Math.atan2()---")
console.log("Math.atan2(0): "+Math.atan2(0,1))
console.log("Math.atan2(Math.SQRT1_2): "+Math.atan2(1,1))
```

Output

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```
---Math.atan2()---
Math.atan2(0): 0
Math.atan2(Math.SQRT1_2): 0.7853981633974483
```

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
```


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24. 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.

Attribute	Description
G	Global match
I	Ignore case
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)
U	Unicode; treat the pattern as a sequence of unicode code points
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.

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Expression	Description
[...]	Any one character between the brackets
[^...]	Any one character not between the brackets
[0-9]	It matches any decimal digit from 0 through 9
[a-z]	It matches any character from lowercase **a** through lowercase **z**
[A-Z]	It matches any character from uppercase **A** through uppercase **Z**
[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.

Expression	Description
p+	It matches any string containing at least one **p**
p*	It matches any string containing zero or more **p's**
p?	It matches any string containing one or more **p's**
p{N}	It matches any string containing a sequence of **N p's**
p{2,3}	It matches any string containing a sequence of two or three **p's**
p{2, }	It matches any string containing a sequence of at least two **p's**
p$	It matches any string with **p** at the end of it

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^p	It matches any string with **p** at the beginning of it
[^a-zA-Z]	It matches any string not containing any of the characters ranging from **a** through **z** and **A** through **Z**
p.p	It matches any string containing **p**, followed by any character, in turn followed by another **p**
^.{2}$	It matches any string containing exactly two characters
(.*)	It matches any string enclosed within **** and ****
p(hp)*	It matches any string containing a **p** followed by zero or more instances of the sequence **hp**

Literal Characters

Character	Description
Alphanumeric	Itself
\0	The NULL character (\u0000)
\t	Tab (\u0009)
\n	Newline (\u000A)
\v	Vertical tab (\u000B)
\f	Form feed (\u000C)
\r	Carriage return (\u000D)
\xnn	The Latin character specified by the hexadecimal number **nn**; for example, \x0A is the same as **\n**
\uxxxx	The Unicode character specified by the hexadecimal number **xxxx**; for example, \u0009 is the same as **\t**

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\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.

Character	Description
.	A single character
\s	A whitespace character (space, tab, newline)
\S	Non-whitespace character
\d	A digit (0-9)
\D	A non-digit
\w	A word character (a-z, A-Z, 0-9, _)
\W	A non-word character
[\b]	A literal backspace (special case)
[aeiou]	Matches a single character in the given set
[^aeiou]	Matches a single character outside the given set
(foo|bar|baz)	Matches any of the alternatives specified

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RegExp Properties

Properties	Description
RegExp.prototype.flags	A string that contains the flags of the RegExp object
RegExp.prototype.global	Whether to test the regular expression against all possible matches in a string, or only against the first
RegExp.prototype.ignoreCase	Whether to ignore case while attempting a match in a string
RegExp.prototype.multiline	Whether or not to search in strings across multiple lines
RegExp.prototype.source	The text of the pattern
RegExp.prototype.sticky	Whether or not the search is sticky

RegExp Constructor

It returns a reference to the array function that created the instance's prototype.

Syntax

```
RegExp.constructor
```

Return Value

Returns the function that created this object's instance.

Example

```
var re = new RegExp( "string" );
console.log("re.constructor is:" + re.constructor);
```

Output

```
re.constructor is:function RegExp() { [native code] }
```


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global

global is a read-only boolean property of RegExp objects. It specifies whether a particular regular expression performs global matching, i.e., whether it was created with the "g" attribute.

Syntax

```
RegExpObject.global
```

Return Value

- Returns "TRUE" if the "g" modifier is set, "FALSE" otherwise.

Example

```
var re = new RegExp( "string" );

if ( re.global )
{
     console.log("Test1 - Global property is set");
}
else
{
     console.log("Test1 - Global property is not set");
}
re = new RegExp( "string", "g" );

if ( re.global ){
     console.log("Test2 - Global property is set");
}
else
{
     console.log("Test2 - Global property is not set");
}
```

Output

```
Test1 - Global property is not set
Test2 - Global property is set
```


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ignoreCase

ignoreCase is a read-only boolean property of RegExp objects. It specifies whether a particular regular expression performs case-insensitive matching, i.e., whether it was created with the "i" attribute.

Syntax

```
RegExpObject.ignoreCase
```

Return Value

- Returns "TRUE" if the "i" modifier is set, "FALSE" otherwise.

Example

```
var re = new RegExp( "string" );

         if ( re.ignoreCase ){
            console.log("Test1-ignoreCase property is set");
         }
         else
         {
           console.log("Test1-ignoreCase property is not set");
         }
         re = new RegExp( "string", "i" );

         if ( re.ignoreCase ){
            console.log("Test2-ignoreCase property is set");
         }
         else
         {
           console.log("Test2-ignoreCase property is not set");
         }
```

Output

```
Test1-ignoreCase property is not set
Test2-ignoreCase property is set
```


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lastIndex

lastIndex a read/write property of RegExp objects. For regular expressions with the "g" attribute set, it contains an integer that specifies the character position immediately following the last match found by the RegExp.exec() and RegExp.test() methods. These methods use this property as the starting point for the next search they conduct.

This property allows you to call those methods repeatedly, to loop through all matches in a string and works only if the "g" modifier is set.

This property is read/write, so you can set it at any time to specify where in the target string, the next search should begin. exec() and test() automatically reset the lastIndex to 0 when they fail to find a match (or another match).

Syntax

```
RegExpObject.lastIndex
```

Return Value

Returns an integer that specifies the character position immediately following the last match.

Example

```
var str = "Javascript is an interesting scripting language";
var re = new RegExp( "script", "g" );
re.test(str);
console.log("Test 1 - Current Index: " +  re.lastIndex);
re.test(str);
console.log("Test 2 - Current Index: " + re.lastIndex)
```

Output

```
Test 1 - Current Index: 10
Test 2 - Current Index: 35
```

multiline

multiline is a read-only boolean property of RegExp objects. It specifies whether a particular regular expression performs multiline matching, i.e., whether it was created with the "m" attribute.

Syntax

```
RegExpObject.multiline
```


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Return Value

- Returns "TRUE" if the "m" modifier is set, "FALSE" otherwise.

Example

```
var re = new RegExp( "string" );
         if ( re.multiline ){
           console.log("Test1-multiline property is set");
         }
         else
         {
           console.log("Test1-multiline property is not set");
         }
         re = new RegExp( "string", "m" );

         if ( re.multiline ){
            console.log("Test2-multiline property is set");
         }
         else
         {
            console.log("Test2-multiline property is not set");
         }
```

Output

```
Test1-multiline property is not set
Test2-multiline property is set
```

source

source is a read-only string property of RegExp objects. It contains the text of the RegExp pattern. This text does not include the delimiting slashes used in regular-expression literals, and it does not include the "g", "i", and "m" attributes.

Syntax

```
RegExpObject.source
```

Return Value

Returns the text used for pattern matching.

Example

```
var str = "Javascript is an interesting scripting language";
var re = new RegExp( "script", "g" );
re.test(str);
console.log("The regular expression is : " +  re.source);
```

Output

```
The regular expression is : script
```

RegExp Methods

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

exec()

The exec method searches string for text that matches regexp. If it finds a match, it returns an array of results; otherwise, it returns null.

Syntax

```
RegExpObject.exec( string );
```


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Parameter Details

- **string** – The string to be searched

Return Value

It returns the matched text if a match is found, and NULL if not.

Example

```
var str = "Javascript is an interesting scripting language";
var re = new RegExp( "script", "g" );
var result = re.exec(str);
console.log("Test 1 - returned value : " +  result);
re = new RegExp( "pushing", "g" );
var result = re.exec(str);
console.log("Test 2 - returned value : " +  result)
```

Output

```
Test 1 - returned value : script
Test 2 - returned value : null
```

test()

The test method searches string for text that matches regexp. If it finds a match, it returns true; otherwise, it returns false.

Syntax

```
RegExpObject.test( string );
```

Parameter Details

- **string** – The string to be searched

Return Value

Returns the matched text if a match is found, and NULL if not.

Example

```
var str = "Javascript is an interesting scripting language";
var re = new RegExp( "script", "g" );
var result = re.test(str);
```


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```
console.log("Test 1 - returned value : " +  result);
re = new RegExp( "pushing", "g" );
var result = re.test(str);
console.log("Test 2 - returned value : " +  result);
```

Output

```
Test 1 - returned value : true
Test 2 - returned value : false
```

match()

This method retrieves the matches.

Syntax

```
str.match(regexp)
```

Parameter Details

- **Regexp**: A regular expression object.

Return Value

Returns an array of matches and null if no matches are found.

Example

```
var str = 'Welcome to ES6.We are learning ES6';
var re = new RegExp("We");
var found = str.match(re);
console.log(found);
```

Output

```
We
```

replace()

This method returns a new string after replacing the matched pattern.

Syntax

```
str.replace(regexp|substr, newSubStr|function)
```


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Parameter Details

- **Regexp**: A regular expression object.
- **Substr**: String to be replaced
- **newSubStr**: The replacement string
- **function**: the function to create a new string

Return Value

A new string after replacing all matches.

Example

```
var str = 'Good Morning';
var newstr = str.replace('Morning', 'Night');
console.log(newstr);
```

Output

```
Good Night
```

search()

This method returns the index where the match was found in the string. If no match is found, it returns -1.

Syntax

```
str.replace(regexp|substr, newSubStr|function)
```

Parameter Details

- **Regexp**: A regular expression object.
- **Substr**: String to be replaced
- **newSubStr**: The replacement string
- **function**: the function to create a new string

Return Value

Returns the index at which the match was found in the string

Example

```
var str = 'Welcome to ES6.We are learning ES6';
var re = new RegExp(/We/);
```


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```
var found = str.search(re);
console.log(found);
```

Output

```
0
```

split()

This method splits a string object on the basis of the separator specified and returns an array of strings.

Syntax

```
str.split([separator[, limit]])
```

Parameter Details

- **separator** : Optional. Specifies the separator character for the string
- **limit**: Optional. Specifies a limit on the number of splits to be found

Return Value

Returns the index at which the match was found in the string

Example

```
var names = 'Monday;Tuesday;Wednesday';

console.log(names);

var re = /\s*;\s*/;
var nameList = names.split(re);

console.log(nameList););
```

Output

```
Monday;Tuesday;Wednesday
Monday,Tuesday,Wednesday
```

toString()

The toStringmethod returns a string representation of a regular expression in the form of a regular-expression literal.

Syntax

```
RegExpObject.toString();
```

Return Value

Returns the string representation of a regular expression.

Example

```
var str = "Javascript is an interesting scripting language";
var re = new RegExp( "script", "g" );
var result = re.toString(str);
console.log("Test 1 - returned value : " +  result);
re = new RegExp( "/", "g" );
var result = re.toString(str);
console.log("Test 2 - returned value : " +  result)
```

Output

```
Test 1 - returned value : /script/g
Test 2 - returned value : /\//g
```


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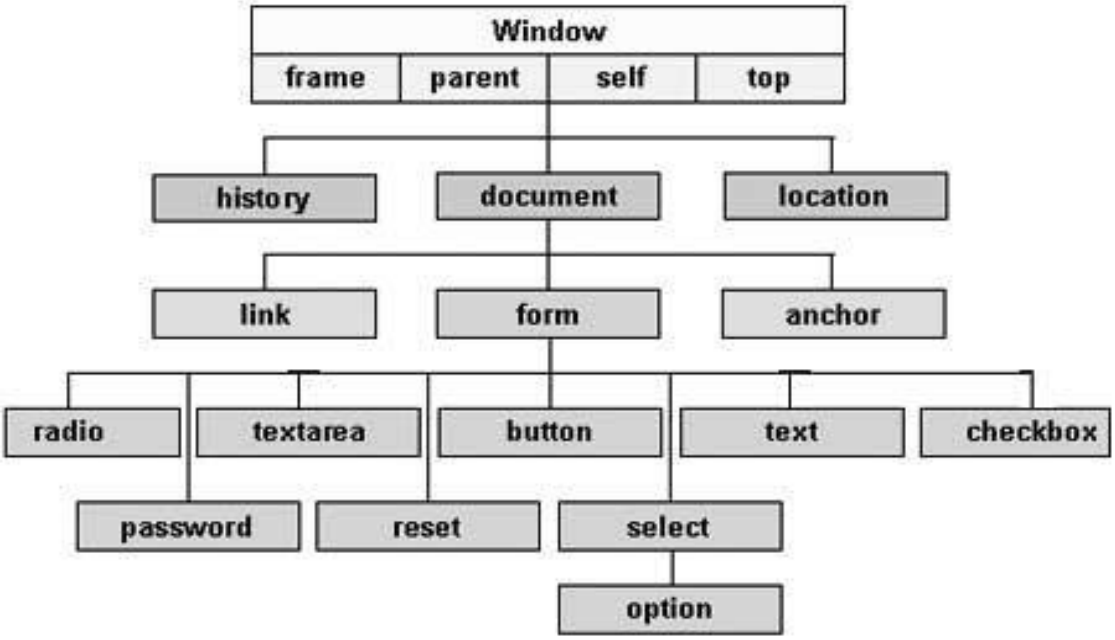
25. ES6 – HTML DOM

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 and 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

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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 image objects, one for each image that is embedded in the document with the HTML <img> tag. **Example**: document.images[0], document.images[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

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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 and 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, ...)

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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.

26. ES6 — Iterator

Introduction to Iterator

Iterator is an object which allows us to access a collection of objects one at a time.

The following built-in types are by default iterable:

- String
- Array
- Map
- Set

An object is considered **iterable**, if the object implements a function whose key is **[Symbol.iterator]** and returns an iterator. A *for...of* loop can be used to iterate a collection.

Example

The following example declares an array, marks, and iterates through it by using a **for..of** loop.

```
 <script>
let marks = [10,20,30]

         //check iterable using for..of
         for(let m of marks){
             console.log(m);
         }

</script>
```

The output of the above code will be as given below:

```
10
20
30
```

Example

The following example declares an array, marks and retrieves an iterator object. The **[Symbol.iterator]()** can be used to retrieve an iterator object. The **next()** method of the iterator returns an object with **'value'** and **'done'** properties . 'done' is Boolean and returns true after reading all items in the collection.

```
<script>
        let marks = [10,20,30]
        let iter = marks[Symbol.iterator]();
        console.log(iter.next())
        console.log(iter.next())
        console.log(iter.next())
        console.log(iter.next())
</script>
```

The output of the above code will be as shown below:

```
{value: 10, done: false}
{value: 20, done: false}
{value: 30, done: false}
{value: undefined, done: true}
```

Custom Iterable

Certain types in JavaScript are iterable (E.g. Array, Map etc.) while others are not (E.g. Class). JavaScript types which are not iterable by default can be iterated by using the iterable protocol.

The following example defines a class named **CustomerList** which stores multiple customer objects as an array. Each customer object has firstName and lastName properties.

To make this class iterable, the class must implement **[Symbol.iterator]()** function. This function returns an iterator object. The iterator object has a function **next** which returns an object **{value:'customer',done:true/false}.**

```
  <script>


         //user defined iterable
        class CustomerList {
               constructor(customers){
                   //adding customer objects to an array
                   this.customers = [].concat(customers)
```


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```
            }

            //implement iterator function
            [Symbol.iterator](){
                let count=0;
                let customers = this.customers
                return {
                    next:function(){
                     //retrieving a customer object from the array
                        let customerVal = customers[count];
                        count+=1;
                        if(count<=customers.length){
                            return {
                                value:customerVal,
                                done:false
                            }
                        }
                        //return true if all customer objects are iterated
                        return {done:true}
                    }
                }
            }
        }

        //create customer objects

        let c1={
            firstName:'Sachin',
            lastName:'Tendulkar'
        }
        let c2={
            firstName:'Rahul',
            lastName:'Dravid'
        }

        //define a customer array and initialize it
```

```
let customers=[c1,c2]

//pass customers to the class' constructor
 let customersObj = new CustomerList(customers);
 //iterating using for..of
 for(let c of customersObj){
    console.log(c)
 }
 //iterating using the next() method
 let iter = customersObj[Symbol.iterator]();
 console.log(iter.next())
 console.log(iter.next())
 console.log(iter.next())
```

The output of the above code will be as follows:

```
{firstName: "Sachin", lastName: "Tendulkar"}
{firstName: "Rahul", lastName: "Dravid"}
{
    done: false
    value: {
    firstName: "Sachin",
    lastName: "Tendulkar"
    }
 }
  {
    done: false
    value: {
    firstName: "Rahul",
    lastName: "Dravid"
    }
 }
 {done: true}
```

Generator

Prior to ES6, functions in JavaScript followed a run-to completion model. ES6 introduces functions known as Generator which can stop midway and then continue from where it stopped.

A generator prefixes the function name with an asterisk * character and contains one or more **yield** statements. The **yield** keyword returns an iterator object.

Syntax

```
function * generator_name()
{
yield value1
    ...
yield valueN
}
```

Example

The example defines a generator function **getMarks** with three yield statements. Unlike normal functions, the **generator function getMarks()**,when invoked, doesn't execute the function but returns an iterator object that helps you to execute code inside the generator function.

On the first call to **markIter.next()** operations in the beginning would run and the yield statement pauses the execution of the generator. Subsequent calls to the **markIter.next()** will resume the generator function until the next **yield** expression.

```
<script>
    //define generator function
 function * getMarks(){
          console.log("Step 1")
          yield 10
          console.log("Step 2")
          yield 20
          console.log("Step 3")
          yield 30
          console.log("End of function")
      }

   //return an iterator object
      let markIter = getMarks()
```

```
    //invoke statements until first yield
       console.log(markIter.next())
    //resume execution after the last yield until second yield expression
       console.log(markIter.next())
    //resume execution after last yield until third yield expression
       console.log(markIter.next())


       console.log(markIter.next()) // iteration is completed;no value is
returned
 </script>
```

The output of the above code will be as mentioned below:

```
Step 1
{value: 10, done: false}
Step 2
{value: 20, done: false}
Step 3
{value: 30, done: false}
End of function
{value: undefined, done: true}
```

Example

The following example creates an infinite sequence of even numbers through

* **evenNumberGenerator** generator function.

We can iterate through all even numbers by using **next()** or using **for of** loop as shown below:

```
 <script>
       function * evenNumberGenerator(){
            let num = 0;


            while(true){
                num+=2
                yield num


            }
```

```
        }

         // display first two elements
        let iter = evenNumberGenerator();

        console.log(iter.next())

        console.log(iter.next())

        //using for of to iterate till 12
        for(let n of evenNumberGenerator()){
            if(n==12)break;
            console.log(n);
        }

</script>
```

The output of the above code will be as follows:

```
{value: 2, done: false}
{value: 4, done: false}

2
4
6
8
10
```

27. 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

Property	Description
Map.prototype.size	This property returns the number of key/value pairs in the Map object.

Syntax

```
Map.size
```

Example

```
var myMap = new Map();
myMap.set("J", "john");
myMap.set("M", "mary");
myMap.set("T", "tom");

console.log(myMap.size);
```

Output

```
3
```


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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
```


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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
```


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Map Methods

Method	Description
Map.prototype.clear()	Removes all key/value pairs from the Map object.
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.
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.
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.
Map.prototype.keys()	Returns a new Iterator object that contains the **keys** for each element in the Map object in insertion order.
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.

clear()

Removes all key/value pairs from the Map object.

Syntax

```
myMap.clear();
```

Parameters: No parameters

Return Value: Undefined

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Example

```
var myMap = new Map();
myMap.set("bar", "baz");
console.log(myMap.size);
myMap.clear();
console.log(myMap.size)
```

Output

```
1
0
```

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.

Syntax

```
myMap.delete(key);
```

Parameters

- **Key** : key of the element to be removed from the Map

Return Value

Returns **true** if the element exited and was removed; else it returns **false**.

Example

```
var myMap = new Map();
myMap.set("id", "admin");
myMap.set("pass", "admin@123");
console.log(myMap.has("id"));
myMap.delete("id");
console.log(myMap.has("id"));
```


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Output

```
true
false
```

entries()

Returns a new Iterator object that contains an array of [key, value] for each element in the Map object in insertion order.

Syntax

```
myMap.entries()
```

Return Value

Returns a new iterator object.

Example

```
var myMap = new Map();
myMap.set("id", "admin");
myMap.set("pass", "admin@123");
var itr = myMap.entries();
console.log(itr.next().value);
console.log(itr.next().value);
```

Output

```
id,admin
pass,admin@123
```

forEach

This function executes the specified function once per each Map entry.

Syntax

```
myMap.forEach(callback[, thisArg])
```

Parameters

- **callback**: Function to execute for each element.
- **thisArg**: Value to use as this when executing callback.

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Return Value

Undefined.

Example

```
function userdetails(key,value) {
    console.log("m[" + key + "] = " + value);
}

var myMap = new Map();
myMap.set("id", "admin");
myMap.set("pass", "admin@123");
myMap.forEach(userdetails);
```

Output

```
m[admin] = id
m[admin@123] = pass
```

keys()

This function returns a new iterator object referring to the keys in the Map.

Syntax

```
myMap.keys()
```

Return Value

Returns an Iterator object

Example

```
var myMap = new Map();
myMap.set("id", "admin");
myMap.set("pass", "admin@123");
var itr=myMap.keys();
console.log(itr.next().value);
console.log(itr.next().value);
```

Output

```
id
pass
```

values()

This function returns a new iterator object referring to the values in the Map.

Syntax

```
myMap.keys()
```

Return Value

Returns an Iterator object.

Example

```
var myMap = new Map();
myMap.set("id", "admin");
myMap.set("pass", "admin@123");
var itr=myMap.values();
console.log(itr.next().value);
console.log(itr.next().value);
```

Output

```
Admin
admin@123
```

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'],
]);
```


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```
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.

```
new Set([iterable]);
```


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Set Properties

Property	Description
Set.prototype.size	Returns the number of values in the Set object

size()

Returns the number of values in the Set object

Syntax

```
Myset.size
```

Example

```
var mySet = new Set('tom','jim','jack');
var tot=mySet.size;
console.log(tot);
```

Output

```
3
```

Set Methods

Method	Description
Set.prototype.add(value)	Appends a new element with the given value to the Set object. Returns the Set object.
Set.prototype.clear()	Removes all the elements from the Set object.
Set.prototype.delete(value)	Removes the element associated to the value.
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.

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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.
Set.prototype.has(value)	Returns a boolean asserting whether an element is present with the given value in the Set object or not.
Set.prototype.values()	Returns a new Iterator object that contains the **values** for each element in the Set object in insertion order.

add()

This method appends a new element with the given value to the Set object.

Syntax

```
mySet.add(value);
```

Parameters

- **Value**: item to add to the list.

Return Value

Set Object.

Example

```
var set = new Set();
set.add(10);
set.add(10); // duplicate not added
set.add(10); // duplicate not added
set.add(20);
set.add(30);
console.log(set.size);
```

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

```
3
```

clear()

This function clears all objects from the Set.

Syntax

```
mySet.clear();
```

Return Value

Undefined

Example

```
var mySet = new Set('tom','jim','jack');
mySet.clear()
var tot=mySet.size;
console.log(tot);
```

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

```
0
```

delete()

This function removes the specified value from the Set.

Syntax

```
myMap.delete(key);
```

Parameters

- Key : key of the element to be removed from the Map

Return Value

Returns **true** if the element exited and was removed; else it returns **false**.

Example

```
var set = new Set();
set.add(10);
set.add(20);
set.add(30);
```


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```
console.log(`Size of Set before delete() :${set.size}`);
console.log(`Set has 10 before delete() :${set.has(10)}`);
set.delete(10)
console.log(`Size of Set after delete() :${set.size}`);
console.log(`Set has 10 after delete() :${set.has(10)}`);
```

Output

```
Size of Set before delete() :3
Set has 10 before delete() :true
Size of Set after delete() :2
Set has 10 after delete() :false
```

entries()

Returns a new Iterator object that contains an array of [value,value] for each element in the Set.

Syntax

```
mySet.entries()
```

Return Value

Returns a new iterator object.

Example

```
var mySet = new Set();
mySet.add("Jim");
mySet.add("Jack");
mySet.add("Jane");
var itr=mySet.entries()
console.log(itr.next().value);
console.log(itr.next().value);
console.log(itr.next().value);
```


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Output

```
Jim,Jim
Jack,Jack
Jane,Jane
```

forEach

This function executes the specified function once per each Map entry.

Syntax

```
myMap.forEach(callback[, thisArg])
```

Parameters

- **callback**: Function to execute for each element.
- **thisArg**: Value to use as this when executing callback.

Return Value

Undefined

Example

```
function userdetails(values) {
    console.log(values);
}

var mySet = new Set();
mySet.add("John");
mySet.add("Jane");
mySet.forEach(userdetails);
```

Output

```
John
Jane
```

has()

Returns a boolean indicating whether an element with the specified value exists in a Set object or not.

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Syntax

```
mySet.has(value);
```

Parameters

- **Value**: The value for which existence check should be done.

Return Value

Returns true if an element with the specified value exists in the Set object; otherwise false.

Example

```
var mySet = new Set();
mySet.add("Jim");

console.log(mySet.has("Jim"));
console.log(mySet.has("Tom"));
```

Output

```
true
false
```

values() and keys()

The values method returns a new Iterator object that contains the values for each element in the Set object. The keys() function too behaves in the same fashion.

Syntax

```
mySet.values();
mySet.keys();
```

Return Value

A new Iterator object containing the values for each element in the given Set.

Example

```
var mySet = new Set();
mySet.add("Jim");
```


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```
mySet.add("Jack");
mySet.add("Jane");
console.log("Printing keys()------------------");

var keyitr=mySet.keys();
console.log(keyitr.next().value);
console.log(keyitr.next().value);
console.log(keyitr.next().value);

console.log("Printing values()------------------");
var valitr=mySet.values();
console.log(valitr.next().value);
console.log(valitr.next().value);
console.log(valitr.next().value);
```

Output

```
Printing keys()------------------
Jim
Jack
Jane
Printing values()------------------
Jim
Jack
Jane
```

Example: Iterating a Set

```
'use strict'
let set = new Set();
 set.add('x');
 set.add('y');
 set.add('z');
  for(let val of set){
  console.log(val);
 }
```

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

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```
x
y
z
```

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 }
```


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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

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```
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}
```

28. 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
{


}
```


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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;
  }
};
```


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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;
```


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```
  }
  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
```

Setters and Getters

Setters

A setter function is invoked when there is an attempt to set the value of a property. The **set keyword** is used to define a setter function. The syntax for defining a setter function is given below:

```
{set prop(val) { . . . }}
{set [expression](val) { . . . }}
```

prop is the name of the property to bind to the given function. **val** is an alias for the variable that holds the value attempted to be assigned to property. **expression** with ES6, can be used as a property name to bind to the given function.

Example

```
<script>
```


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```
class Student {
         constructor(rno,fname,lname){
             this.rno = rno
             this.fname = fname

             this.lname = lname
             console.log('inside constructor')
         }

 set rollno(newRollno){
             console.log("inside setter")
             this.rno = newRollno
         }
     }

let s1 = new Student(101,'Sachin','Tendulkar')
console.log(s1)
//setter is called
s1.rollno = 201
console.log(s1)

</script>
```

The above example defines a class Student with **three properties** namely **rno, fname and lname**. A setter function **rollno()** is used to set the value for the rno property.

The output of the above code will be as shown below:

```
inside constructor
Student {rno: 101, fname: "Sachin", lname: "Tendulkar"}
inside setter
Student {rno: 201, fname: "Sachin", lname: "Tendulkar"}
```

Example

The following example shows how to use an **expression** as a property name with a **setter function**.

```
<script>
let expr = 'name';
```

```
let obj = {
  fname: 'Sachin',
  set [expr](v) { this.fname = v; }
};



console.log(obj.fname);
obj.name = 'John';
console.log(obj.fname);
</script>
```

The output of the above code will be as mentioned below:

```
Sachin
John
```

Getters

A **getter function** is invoked when there is an attempt to fetch the value of a property. The **get keyword** is used to define a getter function. The syntax for defining a getter function is given below:

```
{get prop() { ... } }
{get [expression]() { ... } }
```

prop is the name of the property to bind to the given function.
expression: Starting with ES6, you can also use expressions as a property name to bind to the given function.

Example

```
 <script>
     class Student {
         constructor(rno,fname,lname){
             this.rno = rno
             this.fname = fname
             this.lname = lname
             console.log('inside constructor')
         }

         get fullName(){
```

```
            console.log('inside getter')
           return this.fname + " - "+this.lname
        }
       }

    let s1 = new Student(101,'Sachin','Tendulkar')
    console.log(s1)
    //getter is called
    console.log(s1.fullName)

   </script>
```

The above example defines a class Student with three properties namely **rno, fname and lname**. The getter function **fullName()** concatenates the **fname** and **lname** and returns a new string.

The output of the above code will be as given below:

```
inside constructor
Student {rno: 101, fname: "Sachin", lname: "Tendulkar"}
inside getter
Sachin - Tendulkar
```

Example

The following example shows how to use an expression as a property name with a getter function:

```
<script>
let expr = 'name';
let obj = {
  get [expr]() { return 'Sachin'; }
};
console.log(obj.name);
</script>
```

The output of the above code will be as mentioned below:

```
Sachin
```

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 method
```

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

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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 Car 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.

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```
'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 multi-level 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.

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

29. ES6 — Maps and Sets

ES6 introduces two new data structures: **maps** and **sets**. Let us learn about them in detail.

Maps

A map is an ordered collection of **key-value pairs**. Maps are similar to objects. However, there are some differences between maps and objects. These are listed below:

S. No	Object	Map
1	Keys cannot be Object type	Keys can be any type
2	Keys are not ordered	Keys are ordered
3	not iterable	iterable

Syntax

The syntax for Map is given below:

```
let map= new Map([iterable])
let map= new Map()
```

Example

The following example creates a map using an iterable constructor:

```
<script>
                let andy ={ename:"Andrel"},
                    varun = {ename:"Varun"},
                    prijin={ename:"Prijin"}
               let empJobs = new Map([
               [andy,'Software Architect'],
               [varun,'Developer']]
               );
               console.log(empJobs)
</script>
```

The output of the above code is as shown below:

```
{{…} => "Software Architect", {…} => "Developer"}
```

Checking size of the map

The size property can be used to determine the number of values stored in the map.

Syntax

The syntax for checking the size of the map is given below:

```
map_name.size
```

Example

```
<script>
let daysMap = new Map();
daysMap.set('1', 'Monday');
daysMap.set('2', 'Tuesday');
daysMap.set('3', 'Wednesday');
console.log(daysMap.size);
</script>
```

The output of the above code is mentioned below:

```
3
```

Following are some common methods that can be used to manipulate maps:

S. No	Object	Map
1	set(key,value)	Adds key and value to map
2	get(key)	Returns value if key is matched
3	has(key)	Returns true if an element with the specified key exists; else returns false
4	keys()	Returns an iterator that contains the keys for each element in the map object
5	values()	Returns an iterator that contains the values for each element in the map object

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S. No	Object	Map
6	entries()	Returns an iterator that contains the key-value pairs for each element in the Map
7	delete(key)	Removes the specified element from a Map object

set()

This function adds key and value to map.

Syntax

The syntax for **set()** is given below where, **key** is the key of the element to add to the Map object and **value** is the value of the element to add to the Map object.

```
map_name.set(key, value);
```

Example

```
<script>
        let andy ={ename:"Andrel"},
            varun = {ename:"Varun"},
            prijin={ename:"Prijin"}

       let empJobs = new Map();
       empJobs.set(andy,'Programmer')
       empJobs.set(varun,'Accountant')
       empJobs.set(prijin,'HR')

       console.log(empJobs)
   </script>
```

The output of the above code is as mentioned below:

```
{{…} => "Programmer", {…} => "Accountant", {…} => "HR"}
```

get()

This function returns value if the key is matched or returns **undefined** if the key is not found.

Syntax

The syntax for **get()** is mentioned below, where, **key** is the key of the element to return from the Map object.

```
map_name.get(key)
```

Example

```
<script>
                let andy ={ename:"Andrel"},
                    varun = {ename:"Varun"},
                    prijin={ename:"Prijin"}

               let empJobs = new Map([
               [andy,'Software Architect'],
               [varun,'Developer']]
               );

              let value = empJobs.get(varun)
              console.log(value)

              console.log(empJobs.size)
        </script>
```

The output of the above code is as shown below:

```
Developer
 2
```

has()

This function returns true if an element with the specified key exists; otherwise it returns false.

Syntax

The syntax for **has()** is given below, where, **key** is the key of the element to test for presence.

```
myMap.has(key)
```

Example

```
<script>
                let andy ={ename:"Andrel"},
                    varun = {ename:"Varun"},
                    prijin={ename:"Prijin"}

               let empJobs = new Map([
               [andy,'Software Architect'],
               [varun,'Developer']]
               );

              console.log(empJobs.has(prijin))
              console.log(empJobs.size)
        </script>
```

The output of the above code is as mentioned below:

```
false
2
```

keys()

This function returns an **iterator** that contains the keys for each element in the map object.

Syntax

The syntax for **keys()** is given below:

```
map_name.keys()
```

Example

```
<script>
             let andy ={ename:"Andrel"},
                 varun = {ename:"Varun"},
                 prijin={ename:"Prijin"}

            let empJobs = new Map([
            [andy,'Software Architect'],
            [varun,'Developer']]
            );

           for(let emp of empJobs.keys()){
               console.log(emp.ename)
           }
      </script>
```

The output of the above code is as follows:

```
Andrel
Varun
```

values()

This function returns an iterator that contains the values for each element in the map object.

Syntax

The syntax for **values()** is as follows:

```
map_name.values()
```

Example

```
<script>
        let andy ={ename:"Andrel"},
            varun = {ename:"Varun"},
            prijin={ename:"Prijin"}

       let empJobs = new Map([
       [andy,'Software Architect'],
       [varun,'Developer']]
       );

      for(let role of empJobs.values()){
          console.log(role)
      }
</script>
```

The output of the above code is as mentioned below:

```
Software Architect
Developer
```

entries()

This function returns an **iterator** that contains the key-value pairs for each element in the Map.

Syntax

The syntax for entries() is as given below:

```
map_name.entries()
```

Example

```
<script>
               let andy ={ename:"Andrel"},
                   varun = {ename:"Varun"},
                   prijin={ename:"Prijin"}

              let empJobs = new Map([
              [andy,'Software Architect'],
              [varun,'Developer']]
              );

             for(let row of empJobs.entries()){
                 console.log("key is ",row[0])
                 console.log("value is ",row[1])
             }



       </script>
```

The output of the above code is as shown below:

```
key is  {ename: "Andrel"}
value is  Software Architect
key is  {ename: "Varun"}
value is  Developer
```

delete()

This function is used to remove the specified element from a Map object.

Syntax

The syntax for **delete()** is given below, where, **key** is the key of the element to remove from the map.

```
map_name.delete(key)
where,
```

Example

```
<script>
               let andy ={ename:"Andrel"},
                   varun = {ename:"Varun"},
                   prijin={ename:"Prijin"}

              let empJobs = new Map([
              [andy,'Software Architect'],
              [varun,'Developer']]
              );

              empJobs.delete(andy) //deleting an element
             console.log(empJobs)

       </script>
```

The output of the above code is as given below:

```
{{…} => "Developer"}
```

WeakMap

WeakMap is a small **subset of map**. Keys are weakly referenced, so it can be non-primitive only. If there are no reference to the object keys, it will be subject to garbage collection.

- not iterable
- every key is object type

The WeakMap will allow garbage collection if the key has no reference.

Syntax

The syntax for WeakMap is stated below:

```
new WeakMap([iterable])
```

Example 1.

```
    <script>

        let emp = new WeakMap();
       emp.set(10,'Sachin');// TypeError as keys should be object

    </script>
```

Example 2.

```
    <script>

        let empMap = new WeakMap();
      // emp.set(10,'Sachin');// Error as keys should be object
      let e1= {ename:'Kiran'},
          e2 = {ename:'Kannan'},
          e3 = {ename:'Mohtashim'}

        empMap.set(e1,1001);
        empMap.set(e2,1002);
        empMap.set(e3,1003);

        console.log(empMap)
        console.log(empMap.get(e2))
```


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```
        console.log(empMap.has(e2))
        empMap.delete(e1)
        console.log(empMap)

    </script>
```

The output of the above code is as mentioned below:

```
{{…} => 1002, {…} => 1003, {…} => 1001}
1002
true
{{…} => 1002, {…} => 1003}
```

Set

A set is an unordered collection of unique values. This data structure can contain values of primitive and object types.

Syntax

The syntax for Set is given below:

```
 new Set([iterable])
 new Set()
```

Example

```
<script>
 let names= new Set(['A','B','C','D']);
    console.log(names)
</script>
```

The output of the above code is as given below:

```
{"A", "B", "C", "D"}
```

Checking the size of a set

The size property of the Set object can be used to query the number of elements in the Set.

Syntax

The syntax for checking the size of a set is mentioned below:

```
set.size
```

Example

```
<script>
   let names= new Set(['A','B','C','D']);
   console.log(names.size)


</script>
```

The output of the above code is as shown below:

```
4
```

Iterating a Set

We can use the **forEach** and **for..of** loops to iterate through a Set. This is shown in the example below:

Example

```
<script>


   let names= new Set(['A','B','C','D']);


   //iterate using forEach
  console.log('forEach')
  names.forEach(n=>console.log(n))


  console.log('for of..')


  //iterate using for..of
  for(let n of names){
        console.log(n)
```

```
    }
  </script>
```

The output of the above code is as mentioned below:

```
forEach
A
B
C
D
for of..
A
B
C
D
```

The following methods can be used to manipulate a set**:**

Sr.No	Object	Map
1	add(element)	Adds an element to the Set
2	has(element)	Returns true if element found; else returns false
3	delete(element)	Delete specific element from the Set
4	clear()	Clears all elements from the Set

add()

This function is used to add an element to the set.

Syntax

The below mentioned syntax is for **add()**, where, **value** is the value to add to the Set.

```
set_name.add(value)
```

Example

```
<script>
```

```
let s = new Set([{
            ename:'Smith'
        },{
            ename:'Kannan'
        }])
        console.log(s)

        let students =new Set();
        students.add('Varun');
        students.add('Prijin');
        students.add('Navya');
        students.add('Kannan') //chaining
                .add('Raj')
                .add('Koshy')
                .add('Sudhakaran');
        console.log(students)
    </script>
```

The output of the above code is as given below:

```
{{…}, {…}}
{"Varun", "Prijin", "Navya", "Kannan", "Raj", …}
```

has()

Returns true if element found, otherwise it returns false.

Syntax

Below mentioned is the syntax for **has()**, where, **value** is the value to search for in the Set.

```
set_name.has(value)
```

Example

```
<script>

    let names= new Set(['A','B','C','D']);
```

```
    console.log(names.has('B'))


</script>
```

The output of the above code is as follows:

```
true
```

delete

This function is used to delete a specific element from the Set.

Syntax

The syntax mentioned below is for delete, where, **value** is the value to delete from the Set.

```
set_name.delete(value)
```

Example

```
<script>


    let names= new Set(['A','B','C','D']);
    console.log(names)
    names.delete('A')
    console.log(names)


</script>
```

The output of the above code is as follows:

```
{"A", "B", "C", "D"}
{"B", "C", "D"}
```

clear()

This function clears all elements from the Set.

Syntax

Below mentioned syntax is for **clear().**

```
set_name.clear()
```

Example

```
<script>

   let names= new Set(['A','B','C','D']);
   console.log(names)
   names.clear();
   console.log(names)

</script>
```

The output of the above code is as stated below:

```
 {"A", "B", "C", "D"}
 {}
```

WeakSet

A Weakset holds objects weakly, that means object stored in a WeakSet are subject to garbage collection, if they are not referenced. WeakSets are not iterable and do not have the **get** method.

```
   <script>

let e1 = {ename:'A'}
let e2 ={ename:'B'}
let e3 ={ename:'C'}

let emps = new WeakSet();
emps.add(e1);
emps.add(e2)
    .add(e3);

console.log(emps)
console.log(emps.has(e1))
emps.delete(e1);
console.log(emps)
</script>
```

The output of the above code will be as mentioned below:

```
WeakSet {{…}, {…}, {…}}
 true
WeakSet {{…}, {…}}
```

30. ES6 – Promises

Promise Syntax

The Syntax related to promise is mentioned below where, **p** is the promise object, **resolve** is the function that should be called when the promise executes successfully and **reject** is the function that should be called when the promise encounters an error.

```
let p =new Promise(function(resolve,reject){
    let workDone=true; // some time consuming work
     if(workDone){
         //invoke resolve function passed


         resolve('success promise completed')
     }
     else{
         reject('ERROR , work could not be completed')
     }
})
```

Example

The example given below shows a function **add_positivenos_async()** which adds two numbers asynchronously. The promise is resolved if positive values are passed. The promise is rejected if negative values are passed.

```
<script>


       function add_positivenos_async(n1, n2) {
           let p = new Promise(function (resolve, reject) {
               if (n1 >= 0 && n2 >= 0) {
                   //do some complex time consuming work
                   resolve(n1 + n2)
               }
               else
                   reject('NOT_Postive_Number_Passed')
```

```
            })

            return p;
        }

        add_positivenos_async(10, 20)
            .then(successHandler)  // if promise resolved
            .catch(errorHandler);// if promise rejected

        add_positivenos_async(-10, -20)
            .then(successHandler)  // if promise resolved
            .catch(errorHandler);// if promise rejected



        function errorHandler(err) {
            console.log('Handling error', err)
        }
        function successHandler(result) {
            console.log('Handling success', result)

        }

        console.log('end')
    </script>
```

The output of the above code will be as mentioned below:

```
end
Handling success 30
Handling error NOT_Postive_Number_Passed
```

Promises Chaining

Promises chaining can be used when we have a sequence of **asynchronous tasks** to be done one after another. Promises are chained when a promise depends on the result of another promise. This is shown in the example below:

Example

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In the below example, **add_positivenos_async() function** adds two numbers asynchronously and rejects if negative values are passed. The result from the current asynchronous function call is passed as parameter to the subsequent function calls. Note each **then()** method has a return statement.

```
<script>

        function add_positivenos_async(n1, n2) {
            let p = new Promise(function (resolve, reject) {
                if (n1 >= 0 && n2 >= 0) {
                    //do some complex time consuming work
                    resolve(n1 + n2)
                }
                else
                    reject('NOT_Postive_Number_Passed')

            })

            return p;
        }

       add_positivenos_async(10,20)
        .then(function(result){
            console.log("first result",result)
          return  add_positivenos_async(result,result)
        }).then(function(result){
            console.log("second result",result)
               return add_positivenos_async(result,result)
        }).then(function(result){
            console.log("third result",result)
        })

        console.log('end')
    </script>
```

The output of the above code will be as stated below:

```
end
```

```
first result 30
second result 60
third result 120
```

Some common used methods of the promise object are discussed below in detail:

promise.all()

This method can be useful for aggregating the results of multiple promises.

Syntax

The syntax for the **promise.all()** method is mentioned below, where, **iterable** is an iterable object. E.g. Array.

```
Promise.all(iterable);
```

Example

The example given below executes an array of asynchronous operations **[add_positivenos_async(10,20),add_positivenos_async(30,40),add_positivenos_async(50,60)].** When all the operations are completed, the promise is fully resolved.

```
<script>

                function add_positivenos_async(n1, n2) {
                    let p = new Promise(function (resolve, reject) {
                        if (n1 >= 0 && n2 >= 0) {
                            //do some complex time consuming work
                            resolve(n1 + n2)
                        }
                        else
                            reject('NOT_Postive_Number_Passed')

                    })

                    return p;
                }
               //Promise.all(iterable)
```

```
Promise.all([add_positivenos_async(10,20),add_positivenos_async(30,40),add_posi
tivenos_async(50,60)])
               .then(function(resolveValue){
                  console.log(resolveValue[0])
                  console.log(resolveValue[1])
                  console.log(resolveValue[2])
                  console.log('all add operations done')
               })
               .catch(function(err){
                   console.log('Error',err)
               })
              console.log('end')
 </script>
```

The output of the above code will be as follows:

```
end
30
70
110
all add operations done
```

promise.race()

This function takes an array of promises and returns the first promise that is settled.

Syntax

The syntax for the **promise.race()** function is mentioned below, where, *iterable* is an iterable object. E.g. Array.

```
Promise.race(iterable)
```

Example

The example given below takes an array **[add_positivenos_async(10,20),add_positivenos_async(30,40)]** of asynchronous operations.

The promise is resolved whenever any one of the add operation completes. The promise will not wait for other asynchronous operations to complete.

```
<script>
```

```
function add_positivenos_async(n1, n2) {
                    let p = new Promise(function (resolve, reject) {
                        if (n1 >= 0 && n2 >= 0) {
                            //do some complex time consuming work
                            resolve(n1 + n2)
                        }
                        else
                            reject('NOT_Postive_Number_Passed')

                    })

                    return p;
                }

                      //Promise.race(iterable)

Promise.race([add_positivenos_async(10,20),add_positivenos_async(30,40)])
               .then(function(resolveValue){
                  console.log('one of them is done')
                  console.log(resolveValue)

               }).catch(function(err){
                   console.log("Error",err)
               })
                console.log('end')
            </script>
```

The output of the above code will be as follows:

```
end
one of them is done
30
```

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.

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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
```


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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) {
```


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```
   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.

31. ES6 – Modules

Introduction

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

A module organizes a related set of JavaScript code. A module can contain variables and functions. A module is nothing more than a chunk of JavaScript code written in a file. By default, variables and functions of a module are not available for use. Variables and functions within a module should be exported so that they can be accessed from within other files. Modules in ES6 work only in **strict mode**. This means variables or functions declared in a module will not be accessible globally.

Exporting a Module

The **export** keyword can be used to export components in a module. Exports in a module can be classified as follows:

- Named Exports
- Default Exports

Named Exports

Named exports are distinguished by their names. There can be several named exports in a module. A module can export selected components using the syntax given below:

Syntax 1

```
//using multiple export keyword
export component1
export component2
...
...
export componentN
```

Syntax 2

Alternatively, components in a module can also be exported using a single **export** keyword with **{}** binding syntax as shown below:

```
//using single export keyword


export {component1,component2,....,componentN}
```


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Default Exports

Modules that need to export only a single value can use default exports. There can be only one default export per module.

Syntax

```
export default component_name
```

However, a module can have a default export and multiple named exports at the same time.

Importing a Module

To be able to consume a module, use the **import keyword**. A module can have multiple **import statements**.

Importing Named Exports

While importing named exports, the names of the corresponding components must match.

Syntax

```
import {component1,component2..componentN} from module_name
```

However, while importing named exports, they can be renamed using the **as** keyword. Use the syntax given below:

```
import {original_component_name as new_component_name }
```

All named exports can be imported onto an object by using the asterisk *** operator**.

```
import * as variable_name from module_name
```

Importing Default Exports

Unlike named exports, a default export can be imported with any name.

Syntax

```
import any_variable_name from module_name
```

Example: Named Exports

Step 1: Create a file company1.js and add the following code:

```
let company = "TutorialsPoint"
```


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```
 let getCompany = function(){
    return company.toUpperCase()
}

 let setCompany = function(newValue){
    company = newValue
}

export {company,getCompany,setCompany}
```

Step 2: Create a file company2.js. This file consumes components defined in the company1.js file. Use any of the following approaches to import the module.

Approach 1:

```
 import {company,getCompany} from './company1.js'

console.log(company)
console.log(getCompany())
```

Approach 2:

```
 import {company as x, getCompany as y} from './company1.js'

console.log(x)
console.log(y())
```

Approach 3:

```
import * as myCompany from './company1.js'

console.log(myCompany.getCompany())
console.log(myCompany.company)
```

Step 3: Execute the modules using an HTML file

To execute both the modules we need to make a html file as shown below and run this in live server. Note that we should use the **attribute *type="module"*** in the script tag.

```
<!DOCTYPE html>
<html lang="en">
<head>
```

```
    <meta charset="UTF-8">
    <meta name="viewport" content="width=device-width, initial-scale=1.0">
    <meta http-equiv="X-UA-Compatible" content="ie=edge">
    <title>Document</title>
</head>
<body>
    <script src="./company2.js" type="module"></script>
</body>
</html>
```

The output of the above code will be as stated below:

```
TutorialsPoint
TUTORIALSPOINT
```

Default Export

Step 1: Create a file **company1.js** and add the following code:

```
let name = 'TutorialsPoint'


let company = {
    getName:function(){
        return name
    },
    setName:function(newName){
        name =newName
    }


}


export default company
```

Step 2: Create a file **company2.js**. This file consumes the components defined in the company1.js file.

```
import c from './company1.js'


console.log(c.getName())
```

```
c.setName('Google Inc')
console.log(c.getName())
```

Step 3: Execute the **modules** using an **HTML file**

To execute both the modules we need to make an html file as shown below and run this in live server. Note that we should use the **attribute type="module"** in the script tag.

```
<!DOCTYPE html>
<html lang="en">
<head>
    <meta charset="UTF-8">
    <meta name="viewport" content="width=device-width, initial-scale=1.0">
    <meta http-equiv="X-UA-Compatible" content="ie=edge">
    <title>Document</title>
</head>
<body>
    <script src="./company2.js" type="module"></script>
</body>
</html>
```

The output of the above code will be as mentioned below:

```
TutorialsPoint
Google Inc
```

Example: Combining Default and Named Exports

Step 1: Create a file **company1.js** and add the following code:

```
//named export
export let name = 'TutorialsPoint'


let company = {
    getName:function(){
        return name
    },
    setName:function(newName){
        name =newName
    }
```

```
}

//default export
export default company
```

Step 2: Create a file **company2.js**. This file consumes the components defined in the **company1.js** file. Import the default export first, followed by the named exports.

```
import c, {name} from './company1.js'


console.log(name)
console.log(c.getName())
c.setName("Mohtashim")
console.log(c.getName())
```

Step 3: Execute the modules using an HTML file

```
<!DOCTYPE html>
<html lang="en">
<head>
    <meta charset="UTF-8">
    <meta name="viewport" content="width=device-width, initial-scale=1.0">
    <meta http-equiv="X-UA-Compatible" content="ie=edge">
    <title>Document</title>
</head>
<body>
    <script src="company2.js" type="module"></script>
</body>
</html>
```

The output of the above code will be as shown below:

```
TutorialsPoint
TutorialsPoint
Mohtashim
```

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32. 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.

Error Object	Description
EvalError	Creates an instance representing an error that occurs regarding the global function **eval()**
RangeError	Creates an instance representing an error that occurs when a numeric variable or parameter is outside of its valid range
ReferenceError	Creates an instance representing an error that occurs when de-referencing an invalid reference

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SyntaxError	Creates an instance representing a syntax error that occurs while parsing the code
TypeError	Creates an instance representing an error that occurs when a variable or parameter is not of a valid type
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
```


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```
[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: 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.

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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.

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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
```


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33. ES6 — Object Extensions

String extension

Some popular methods added to the String object in ES6 are:

Sr.No	Method	Description
1	str.startsWith(searchString[, position])	determines whether a string begins with the characters of a specified string. Returns true or false
2	str.endsWith(searchString[, length])	determines whether a string ends with the characters of a specified string. Returns true/false
3	str.includes(searchString[, position])	determines whether one string may be found within another string
4	str.repeat(count)	constructs and returns a new string which contains the specified number of copies of the string on which it was called, concatenated together

String.prototype.startsWith()

It determines whether a string begins with the characters of a specified string. This function returns true or false.

Syntax

The syntax given below is for **String.prototype.startsWith()**, where, **searchString** is the characters to be searched for at the start of this string. **position** is an optional parameter. It represents the position in this string at which to begin searching for **searchString**. The default value is 0.

```
str.startsWith(searchString[, position])
```

Example

```
let company='TutorialsPoint'
console.log(company.startsWith('Tutorial'))
console.log(company.startsWith('orial',3)) // 3 is index
```

The output of the above code will be as shown below:

```
true
true
```

String.prototype.endsWith()

This function determines whether a string ends with the characters of a specified string and returns true or false.

Syntax

The syntax which is mentioned below is for **String.prototype.endsWith()**, where, **searchString** is the characters to be searched for at the end of this string. **length** is an optional parameter. It represents the length of string.

```
str.endsWith(searchString[, length])
```

Example

```
<script>
        let company='TutorialsPoint'
        console.log(company.endsWith('Point'));
        console.log(company.endsWith('Tutor',5))//5 is length of string
</script>
```

The output of the above code will be as mentioned below:

```
true
true
```

String.prototype.includes()

This function determines whether one string may be found within another string.

Syntax

The following syntax is for **String.prototype.includes()**, where, **searchString** is a string to be searched for within this **string position** is an optional parameter. It represents the position in this string at which to begin searching for **searchString**. The default value is 0.

```
str.includes(searchString[, position])
```

Example

```
<script>
let company='TutorialsPoint'
console.log(company.includes('orial'))
console.log(company.includes('orial',4))
</script>
```

The output of the above code will be as follows:

```
true
false
```

String.prototype.repeat()

This function constructs and returns a new string which contains the specified number of copies of the string on which it was called, concatenated together.

Syntax

The below mentioned syntax is for the function **String.prototype.repeat()**, where, **count** indicates the number of times to repeat the string in the newly-created string that is to be returned.

```
str.repeat(count)
```

Example

```
<script>
        let name="Kiran-"
        console.log(name.repeat(3));
```


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```
    </script>
```

The output of the above code will be as shown below:

```
Kiran-Kiran-Kiran-
```

Regex extensions

In a regular expression, for example, **/[A-Z]/g**, the beginning and ending **/** are called **delimiters**. Anything after the closing delimiter is called a **modifier**. ES6 adds a new modifier **/g** where **g** stands for **global**. This match all instances of the pattern in a string, not just one.

Example

The following example searches and returns all upper-case characters in the string.

```
   <script>
   let str = 'JJavascript is  Fun to Work , very Fun '
   let regex = /[A-Z]/g  // g stands for global matches
   let result = str.match(regex);
   console.log(result)

</script>
```

The output of the above code will be as given below:

```
 ["J", "J", "F", "W", "F"]
```

Regular expression searches are case-sensitive. To turn-off case-sensitivity, use the **/i** modifier.

Example

The following example performs a case insensitive global match. The example replaces **fun** with **enjoyable**.

```
<script>

     // /gi global match ignore case

  let str = 'Javascript is  fun to Work , very Fun '
  let regex = /Fun/gi;
  console.log(str.replace(regex,'enjoyable'));
  console.log(str)
  console.log(str.search(regex))
</script>
```

The output of the above code will be as shown below:

```
Javascript is  enjoyable to Work , very enjoyable
Javascript is  fun to Work , very Fun
15
```

Number

Some popular methods added to the **Number object** in ES6 are:

Sr.No	method	description
1	Number.isFinite(value)	method determines whether the passed value is a finite number. Returns true/false.
2	Number.isNaN(value)	returns true if the given value is NaN and its type is Number; otherwise, false.
3	Number.parseFloat(string)	A floating-point number parsed from the given value. If the value cannot be converted to a number, NaN is returned.
4	Number.parseInt(string,[radix])	method parses a string argument and returns an integer of the specified radix or base.

Number.isFinite

Determines whether the passed value is a finite number. Returns true/false.

Syntax

The syntax mentioned below if for **Number.isFinite**, where, **value** has to be tested for finiteness.

```
let res = Number.isFinite(value);
```

Example

```
<script>
console.log(Number.isFinite(Infinity))//false
console.log(Number.isFinite(-Infinity))//false
console.log(Number.isFinite(NaN))//false
console.log(Number.isFinite(123))//true
console.log(Number.isFinite('123')) // evaluates to false
console.log(isFinite('123')) // evaluates to true,global function
</script>
```

The output of the above code will be as follows:

```
false
false
false
true
false
true
```

Number.isNaN

This function **returns true** if the given value is **Not-a-Number (NaN)** and its type is Number; otherwise, it **returns false**.

Syntax

Below mentioned is the syntax for the function **Number.isNaN,** where **value** is the number to determine if it is a NaN.

```
var res = Number.isNaN(value);
```


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Example

```
<script>
console.log(Number.isNaN('123'))//false
console.log(Number.isNaN(NaN))//true
console.log(Number.isNaN(0/0))//true

</script>
```

The output of the above code will be as shown below:

```
false
true
true
```

Number.parseFloat

A floating-point number parsed from the given value. If the value cannot be converted to a number, NaN is returned.

Syntax

The syntax given below is for the function Number.parseFloat, where **string** is the value parse.

```
Number.parseFloat(string)
```

Example

```
<script>
console.log(Number.parseFloat('10.3meters'));
console.log(Number.parseFloat('abc10.3xyz'));
</script>
```

The output of the above code will be as mentioned below:

```
10.3
NaN
```

Number.parseInt

Parses a string argument and returns an integer of the specified radix or base.

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Syntax

Given below is the syntax for the function **Number.parseInt**, where, **string** is the value to parse **radix** is an integer between 2 and 36 that represents the base.

```
Number.parseInt(string,[ radix ])
```

Example

```
<script>
      console.log(Number.parseInt('10meters'))
      console.log(Number.parseInt('abc10meters'))
</script>
```

The output of the above code will be as shown below:

```
10
NaN
```

Math

Some popular methods added to the **Math object** in ES6 are:

Sr.No	method	description
1	Math.sign()	function returns the sign of a number, indicating whether the number is positive, negative or zero.
2	Math.trunc()	function returns the integer part of a number by removing any fractional digits.

Math.sign()

This function returns the sign of a number, indicating whether the number is positive, negative or zero.

Syntax

The syntax mentioned herewith is for the function **Math.sign()**, where, **X** – represents a number.

```
Math.sign( x ) ;
```

Example

```
<script>
```

```
        console.log(Math.sign(-Infinity)) //       console.log(Math.sign(-10))
// -1
        console.log(Math.sign(0)) // 0
        console.log(Math.sign(Infinity)) // 1
        console.log(Math.sign(10)) // 1
        console.log(Math.sign('N')) // NaN

    </script>
```

The output of the above code will be as given below:

```
-1
0
1
1
NaN
```

Math.trunc()

This function returns the integer part of a number by removing any fractional digits.

Syntax

The syntax stated below is for the function **Math.trunc()**, where, **X** – represents a number.

```
Math.trunc( x ) ;
```

Example

```
 <script>
        console.log(Math.trunc(-3.5)) // -3
        console.log(Math.trunc(-3.6)) // -3
        console.log(Math.trunc(3.5)) // 3
        console.log(Math.trunc(3.6)) // 3
    </script>
```

The output of the above code will be as shown below:

```
-3
-3
```

```
3
3
```

Methods of Array in ES6

The table given below highlights the different array methods in ES6 along with the description.

Sr.No	method	Description
1	copyWithin()	shallow copies part of an array to another location in the same array and returns it without modifying its length.
2	entries()	method returns a new Array Iterator object that contains the key/value pairs for each index in the array.
3	find()	method returns the value of the first element in the array that satisfies the provided testing function. Otherwise undefined is returned.
4	fill()	method fills all the elements of an array from a start index to an end index with a static value. It returns the modified array.
5	Array.of()	method creates a new Array instance from a variable number of arguments, regardless of number or type of the arguments.
6	Array.from()	method creates a shallow copy from an array like or iterable object.

Array.copyWithin

This function shallow copies part of an array to another location in the same array and returns it without modifying its length.

Syntax

The syntax stated below is for the array method **".copyWithin()"**, where,

- **target**: Zero-based index at which to copy the sequence to. If negative, target will be counted from the end.
- **start**: This is an optional parameter. Zero-based index at which to start copying elements from. If negative, start will be counted from the end. If start is omitted, **copyWithin** will copy from index 0.

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- **end**: This is an optional parameter. Zero-based index at which to end copying elements from. **copyWithin** copies up to but not including end. If negative, end will be counted from the end. If end is omitted, **copyWithin** will copy until the last index.

```
arr.copyWithin(target[, start[, end]])
```

Example

```
 <script>


      //copy with in
        let marks = [10,20,30,40,50,60]
       console.log(marks.copyWithin(0,2,4)) //destination,source start,source
end(excluding)
       console.log(marks.copyWithin(2,4))//destination,source start,(till
length)
 </script>
```

The output of the above code will be as shown below:

```
 [30, 40, 30, 40, 50, 60]
 [30, 40, 50, 60, 50, 60]
```

Array.entries

This function returns a new Array Iterator object that contains the key/value pairs for each index in the array.

Syntax

The syntax given below is for the array method **entries().**

```
array.entries()
```

Example

```
  <script>


      //enties
      let cgpa_list = [7.5,8.5,6.5,9.5]
```

```
      let iter = cgpa_list.entries()
      for(let cgpa of iter){
          console.log(cgpa[1])
      }

  </script>
```

The output of the above code will be as shown below:

```
7.5
8.5
6.5
9.5
```

Array.find

This function returns the value of the first element in the array that satisfies the provided testing function. Otherwise undefined is returned.

Syntax

Given below is the syntax for the array method **find()**, where, **thisArg** is an optional object to use as this when executing the callback and **callback** is the function to execute on each value in the array, taking three arguments as follows:

- **element:** The current element being processed in the array.
- **index**: This is optional; refers to the index of the current element being processed in the array.
- **array**: This is optional; the array on which find was called.

```
arr.find(callback(element[, index[, array]])[, thisArg])
```

Example

```
  <script>
       //find
      const products = [{name:'Books',quantity:10},
      {name:'Pen',quantity:20},
      {name:"Books",quantity:30}

   ]
     console.log( products.find(p=>p.name=="Books"))
```

```
  </script>
```

The output of the above code will be as mentioned below:

```
{name: "Books", quantity: 10}
```

Array.fill

This function fills all the elements of an array from a start index to an end index with a static value. It returns the modified array.

Syntax

The syntax given herewith is for the array method **fill()**, where,

- **value**: Value to fill an array.
- **start**: This is optional; start index, defaults to 0.
- **end**: This is optional; end index, defaults to this length.

```
arr.fill(value[, start[, end]])
```

Example

```
  <script>
          //fill

      let nosArr = [10,20,30,40]
      console.log(nosArr.fill(0,1,3))// value ,start,end
      //[10,0,0,40]

     console.log(nosArr.fill(0,1)) // [10,0,0,0]
     console.log(nosArr.fill(0))

  </script>
```

The output of the above code will be as shown below:

```
 [10, 0, 0, 40]
[10, 0, 0, 0]
[0, 0, 0, 0]
```

Array.of

This function creates a new array instance from a variable number of arguments, regardless of number or type of the arguments.

Syntax

The syntax mentioned below is for the array method **of()**, where, **elementN** are Elements of which to create the array.

```
Array.of(element0[, element1[, ...[, elementN]]])
```

Example

```
<script>

      //Array.of
      console.log(Array.of(10))
      console.log(Array.of(10,20,30))
     console.log(Array(3))
     console.log(Array(10,20,30))

   </script>
```

The output of the above code will be:

```
[10]
[10, 20, 30]
[empty × 3]
[10, 20, 30]
```

Array.from

This function creates a shallow copy from an array like or iterable object.

Syntax

The syntax mentioned below is for an array method **from()**, where,

- **arrayLike** is an array-like or iterable object to convert to an array.
- **mapFn**: This an optional parameter. Map function to call on every element of the array.
- **thisArg**: this is an optional parameter. Value to use as this when executing mapFn.

```
Array.from(arrayLike[, mapFn[, thisArg]])
```

Example

```
<script>
      //Array.from
        //iterate over an object

        const obj_arr ={
            length:2,
            0:101,
            1:'kannan'
        }
        console.log(obj_arr)
        const arr = Array.from(obj_arr)
        console.log(arr)
        for(const element of arr){
            console.log(element);
        }

        console.log(Array.from('Javascript'))
       let setObj = new Set(['Training',10,20,20,'Training'])
       console.log(Array.from(setObj))

       console.log(Array.from([10,20,30,40],n=>n+1))

   </script>
```

The output of the above code will be as shown below:

```
{0: 101, 1: "kannan", length: 2}
[101, "kannan"]
101
kannan
["J", "a", "v", "a", "s", "c", "r", "i", "p", "t"]
["Training", 10, 20]
```

```
[11, 21, 31, 41]
```

Object

Methods related to Object function are mentioned below in the table along with the respective description.

Sr.No	method	description
1	Object.is()	method determines whether two values are the same value
2	Object.setPrototypeOf()	method sets the prototype of a specified object to another object or null.
3	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.

Object.is

This function determines whether two values are the same value.

Syntax

The syntax which is given below is for an object method **is()**, where,

- **value1**: The first value to compare.
- **value2**: The second value to compare.

```
Object.is(value1, value2);
```

Example

```
<script>

        let emp1 ={ename:'Prijin'}
      let emp2 ={ename:'Prijin'}

      console.log(Object.is(emp1.ename,emp2.ename))
</script>
```

The output of the above code will be as seen below:

```
true
```

Object.setPrototypeOf

With the help of this function, we can set the prototype of a specified object to another object or null.

Syntax

In this syntax, **obj** is the object which is to have its prototype set and **prototype** is the object's new prototype (an object or null).

```
Object.setPrototypeOf(obj, prototype)
```

Example

```
        <script>
        let emp ={name:'A',location:'Mumbai',basic:5000}
        let mgr = {name:'B'}
        console.log(emp.__proto__ == Object.prototype)
        console.log(mgr.__proto__ == Object.prototype)
        console.log(mgr.__proto__ ===emp.__proto__)

        Object.setPrototypeOf(mgr,emp)
        console.log(mgr.__proto__ == Object.prototype) //false
        console.log(mgr.__proto__ === emp)
        console.log(mgr.location,mgr.basic)



    </script>
```

The output of the above code will be as mentioned below:

```
true
true
true
false
true
Mumbai 5000
```

Object.assign

Copy the values of all enumerable own properties from one or more source objects to a target object. It will return the target object.

Syntax

In the syntax given below **target** is the target object and **sources** is the source object(s).

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

Example

```
<script>

        //Object.assign()
        let obj1 ={x:10},
            obj2={y:20},
            obj3={z:30}

        Object.assign(obj1,obj2,obj3)
        console.log("obj 1",obj1)
</script>
```

The output of the above code will be as given below:

```
obj 1 {x: 10, y: 20, z: 30}
```


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34. ES6 — Reflect API

ES6 introduces new features around meta-programming which involves inspecting or modifying the structure of the program, or changing the way things work in the language itself.

Following are the three forms of meta programming:

- **Introspection**: Introspection means a program gathering information about itself. Some examples of JavaScript operators that are used for introspection are **typeof**, **instanceof** etc.

- **Self-modification**: Self-modification refers to modifying the structure of a program at runtime. It involves accessing or creating new properties at runtime. In other words, self-modification is when some code modifies itself.

- **Intercession**: refers to code modifying the default behavior of a programming language. Intercession involves modifying semantics of the programming language or adding new constructs to the program at runtime.

ES6 introduces Reflect Application Programming Interface (Reflect API) and Proxy API that supports meta programming.

Meta Programming with Reflect API

Reflect API in ES6 allows us to inspect, or modify classes, objects, properties, and methods of a program at runtime. The **Reflect** API provides global Reflect object which has static methods that can be used for introspection. These methods are used to discover low level information about the code. The Reflect API can be used to build automation testing frameworks that examine and introspect program at runtime.

Some commonly used methods of the Reflect object are given below:

Sr.No	Name	Description
1	Reflect.apply()	Calls a target function with arguments as specified by the args parameter
2	Reflect.construct()	Equivalent to calling new target(...args) objects of a class

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Sr.No	Name	Description
3	Reflect.get()	A function that returns the value of properties.
4	Reflect.set()	A function that assigns values to properties. Returns a Boolean that is true if the update was successful.
5	Reflect.has()	The in operator as function. Returns a Boolean indicating whether an own or inherited property exists.

Reflect.apply()

This function calls a target function with arguments as specified by the args parameter.

Syntax

The syntax given herewith is for apply(), where,

- **target** represents the target function to call
- **thisArgument** is the value of this provided for the call to target.
- **argumentsList** is an array-like object specifying the arguments with which target should be called.

```
Reflect.apply(target, thisArgument, argumentsList)
```

Example

The following example defines a function that calculates and returns the area of a rectangle.

```
<script>
       const areaOfRectangle = function(width,height){
           return `area is ${width*height} ${this.units}`
       }
      const thisValue = {
          units:'Centimeters'
      }
     const argsList = [10,20]
     const result = Reflect.apply(areaOfRectangle,thisValue,argsList)

     console.log(result)
```

```
</script>
```

The output of the above code will be as mentioned below:

```
area is 200 Centimeters
```

Reflect.construct()

This method acts as the new operator and is equivalent to calling new target(...args).

Syntax

The syntax given below is for the function **construct()**, where,

- **target** is the target function to call.
- **argumentsList** is an array-like object specifying the arguments with which target should be called.
- **newTarget** is the constructor whose prototype should be used. This is an optional parameter. If no value is passed to this parameter, its value is **targetparameter.**

```
Reflect.construct(target, argumentsList[, newTarget])
```

Example

The following example creates a class Student with a property fullName. The constructor of the class takes firstName and lastName as parameters. An object of the class Student is created using reflection as shown below.

```
<script>
     class Student{
         constructor(firstName,lastName){
             this.firstName = firstName
             this.lastName = lastName
         }

         get fullName(){
             return `${this.firstName} : ${this.lastName}`
         }
     }

    const args = ['Mohammad','Mohtashim']
```

```
    const s1 = Reflect.construct(Student,args)


    console.log(s1.fullName)
   </script>
```

The output of the above code will be as follows:

```
Mohammad : Mohtashim
```

Reflect.get()

This is a function that returns the value of properties.

Syntax

The syntax for the function **get()** is given below, where,

- **target** is the target object on which to get the property.
- **propertyKey** is the name of the property to get.
- **Receiver** is the value of this provided for the call to target if a getter is encountered. This is an optional argument.

```
Reflect.get(target, propertyKey[, receiver])
```

Example

The following example creates an instance of the class Student using reflection and fetches the properties of the instance using the **Reflect.get() method**.

```
<script>
     class Student{
         constructor(firstName,lastName){
             this.firstName = firstName
             this.lastName = lastName
         }


         get fullName(){
             return `${this.firstName} : ${this.lastName}`
         }
     }
        const args = ['Tutorials','Point']
    const s1 = Reflect.construct(Student,args)
```

```
    console.log('fullname is ',Reflect.get(s1,'fullName'))


    console.log('firstName is ',Reflect.get(s1,'firstName'))
      </script>
```

The output of the above code will be as shown below:

```
fullname is  Tutorials : Point
firstName is  Tutorials
```

Reflect.set()

This is a function that assign values to properties. It returns a Boolean that is true if the update was successful.

Syntax

The syntax which is mentioned below is for the function **set()**, where,

- **target** is the target object on which to get the property.
- **propertyKey** is the name of the property to get value to set.
- **receiver** is The value of this provided for the call to target if a setter is encountered. This is an optional argument.

```
Reflect.set(target, propertyKey, value[, receiver])
```

Example

The following example creates an instance of the class Student using reflection and sets the value of the instance's properties using the **Reflect.set()** method.

```
<script>
     class Student{
         constructor(firstName,lastName){
             this.firstName = firstName
             this.lastName = lastName
         }
         get fullName(){
             return `${this.firstName} : ${this.lastName}`
         }
     }
```


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```
     const args = ['Tutorials','']
     const s1 = Reflect.construct(Student,args)
    console.log('fullname is ',Reflect.get(s1,'fullName'))
   //setting value
    Reflect.set(s1,'lastName','Point')
    console.log('fullname is ',Reflect.get(s1,'fullName'))
        </script>
```

The output of the above code will be as shown below:

```
fullname is  Tutorials :
fullname is  Tutorials : Point
```

Reflect.has()

This is the in operator as a function which returns a boolean indicating whether an own or inherited property exists.

Syntax

Given below is the syntax for the function **has()**, where,

- **target** is the target object in which to look for the property.
- **propertyKey** is the name of the property to check.

```
Reflect.has(target, propertyKey)
```

Example

The following example creates an instance of the class **Student** using reflection and verifies if the properties exist using the **Reflect.has()** method.

```
<script>
     class Student{
         constructor(firstName,lastName){
             this.firstName = firstName
             this.lastName = lastName
         }
         get fullName(){
             return `${this.firstName} : ${this.lastName}`
         }
     }
```

```
    const args = ['Tutorials','Point']
    const s1 = Reflect.construct(Student,args)
    console.log(Reflect.has(s1,'fullName'))
    console.log(Reflect.has(s1,'firstName'))
    console.log(Reflect.has(s1,'lastname'))
</script>
```

The output of the above code will be as mentioned below:

```
true
true
false
```

35. ES6 — Proxy API

ES6 implements intercession form of meta programming using Proxies. Similar to ReflectAPI, the Proxy API is another way of implementing meta programming in ES6. The Proxy object is used to define custom behavior for fundamental operations. A proxy object performs some operations on behalf of the real object.

The various terminologies related to ES6 proxies are given below:

Sr No	Terminology	Description
1	handler	Placeholder object which contains traps
2	traps	The methods that provide property access. This is analogous to the concept of traps in operating systems
3	target	Object which the proxy virtualizes. It is often used as storage backend for the proxy.

Syntax

The syntax stated below is for the Proxy API, where, **target** can be any sort of object like array, function or another proxy and **handler** is an object whose properties are functions. This defines the behavior of the proxy.

```
const proxy = new Proxy(target,handler)
```


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Handler Methods

The handler object contains traps for Proxy. All traps are optional. If a trap has not been defined, the default behavior is to forward the operation to the target. Some common handler methods are as follows:

Sr No	Method	Description
1	handler.apply()	A trap for a function call.
2	handler.construct()	A trap for the new operator.
3	handler.get()	A trap for getting property values.
4	handler.set()	A trap for setting property values.
5	handler.has()	A trap for the in operator.

Example: handler.apply()

The following example defines a function **rectangleArea**, which takes width and height as parameters and returns the area of the rectangle. The program creates a proxy and defines a handler object for the rectangleArea function. This **handler object** verifies the number of parameters passed to the function before the function is executed. The handler object throws an error if two parameters are not passed to the function.

```
<script>
        function rectangleArea(width,height){
            return width*height;
        }

        const handler = {
            apply:function(target,thisArgs,argsList){
                console.log(argsList);
                //console.log(target)
                if(argsList.length ==2){
                    return Reflect.apply(target,thisArgs,argsList)

                }
```

```
                else throw 'Invalid no of arguments to calculate'
            }
        }

        const proxy = new Proxy(rectangleArea,handler)
        const result = proxy(10,20);
        console.log('area is ',result)
        proxy(10) // Error
    </script>
```

The output of the above code will be as mentioned below:

```
 [10, 20]
area is  200
[10]
Uncaught Invalid no of arguments to calculate
```

Example: handler.construct()

The following example defines a class **Student** with a constructor and a getter method. The constructor takes firstName and lastName as parameters. The program creates a proxy and defines a handler object to intercept the constructor. The handler object verifies the number of parameters passed to the constructor. The handler object throws an error if exactly two parameters are not passed to the constructor.

```
<script>
            class Student{
          constructor(firstName,lastName){
              this.firstName = firstName
              this.lastName = lastName
          }

          get fullName(){
              return `${this.firstName} : ${this.lastName}`
          }
      }

      const handler = {
```

```
        construct:function(target,args){

          if(args.length==2)
          {
              return Reflect.construct(target,args);
          }
              else throw 'Please enter First name and Last name'
        }
    }

  const StudentProxy = new Proxy(Student,handler)
  const s1 = new StudentProxy('kannan','sudhakaran')
  console.log(s1.fullName)
  const s2 = new StudentProxy('Tutorials')
  console.log(s2.fullName)

  </script>
```

The output of the above code will be as follows:

```
kannan : sudhakaran
Uncaught Please enter First name and Last name
```

Example:handler.get()

The following example defines a class **Student** with a constructor and a custom getter method, **fullName**. The custom getter method returns a new string by concatenating the **firstName** and **lastName**. The program creates a proxy and defines a handler object intercepts whenever the properties firstName, lastName and fullName are accessed. The property values will be returned in uppercase.

```
<script>
       class Student{
        constructor(firstName,lastName){
            this.firstName = firstName
            this.lastName = lastName
        }

        get fullName(){
            return `${this.firstName} : ${this.lastName}`
        }
    }

    const handler = {

        get: function(target,property){
           return Reflect.get(target,property).toUpperCase();
        }
    }

     const s1 = new Student("Tutorials","Point")
     const proxy = new Proxy(s1,handler)
     console.log(proxy.fullName)
     console.log(proxy.firstName)
     console.log(proxy.lastName)
  </script>
```

The output of the above code will be as shown below:

```
TUTORIALS : POINT
TUTORIALS
POINT
```

Example:handler.set()

The following example defines a class Student with a constructor and a custom getter method, fullName. The constructor takes firstName and lastName as parameters. The program creates a proxy and defines a handler object which intercepts all set operations on firstName and lastName. The handler object throws an error if the length of the property value is not greater than 2.

```
<script>
         class Student{
          constructor(firstName,lastName){
              this.firstName = firstName
              this.lastName = lastName
          }

          get fullName(){
              return `${this.firstName} : ${this.lastName}`
          }
      }

      const handler = {

          set: function(target,property,value){

              if(value.length>2){
                return Reflect.set(target,property,value);
              }
                else
                { throw 'string length should be greater than 2'
                }
          }
      }
```

```
        const s1 = new Student("Tutorials","Point")
        const proxy = new Proxy(s1,handler)
        console.log(proxy.fullName)
        proxy.firstName="Test"
        console.log(proxy.fullName)
        proxy.lastName="P"

    </script>
```

The output of the above code will be as shown below:

```
Tutorials : Point
Test : Point
Uncaught string length should be greater than 2
```

Example:handler.has()

The following example defines a class Student with a constructor that takes **firstName** and **lastName** as parameters. The program creates a proxy and defines a handler object. The **has() method** of the handler object is called whenever the in operator is used.

```
<script>
         class Student{
          constructor(firstName,lastName){
              this.firstName = firstName
              this.lastName = lastName
          }



      }
      const handler = {



          has: function(target,property){
              console.log('Checking  for '+property+' in the object')
             return Reflect.has(target,property)
```

```
        }
    }

     const s1 = new Student("Tutorials","Point")
     const proxy = new Proxy(s1,handler)
     console.log('firstName' in proxy)
     </script>
```

The output of the above code will be as mentioned below:

```
Checking  for firstName in the object
true
```

36. 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

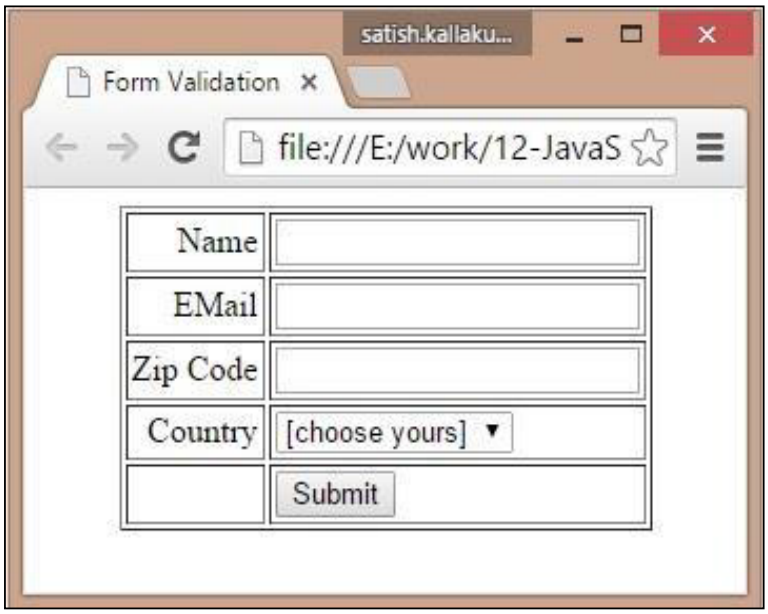
We will take an example to understand the process of validation. Here is a simple form in html format.

```
<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.



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>
```

37. 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>
```

It is not possible to show the result, i.e., the animation in this tutorial.

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>
```

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>
```

38. 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.

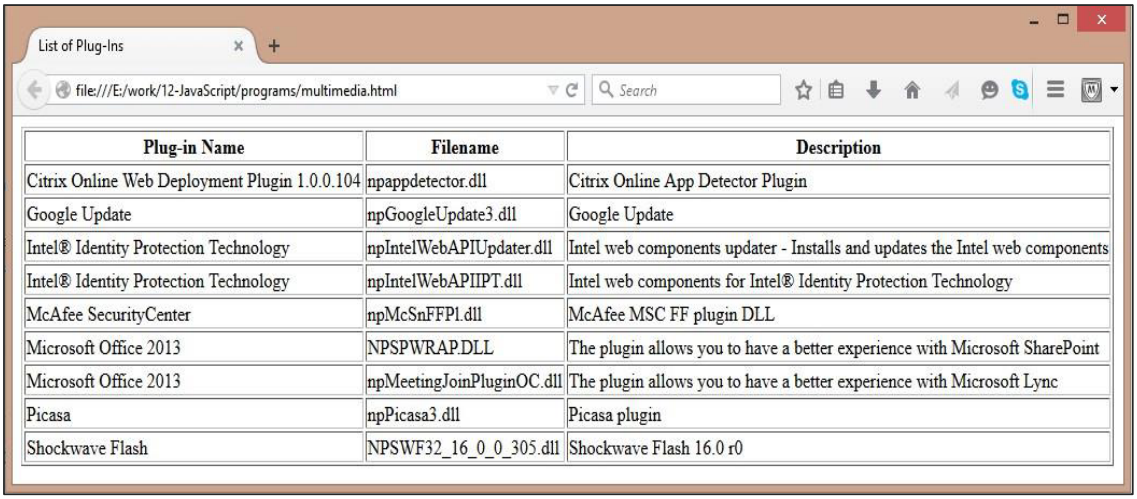
Example

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
Citrix Online Web Deployment Plugin 1.0.0.104	npappdetector.dll	Citrix Online App Detector Plugin
Google Update	npGoogleUpdate3.dll	Google Update
Intel® Identity Protection Technology	npIntelWebAPIUpdater.dll	Intel web components updater - Installs and updates the Intel web components
Intel® Identity Protection Technology	npIntelWebAPIIPT.dll	Intel web components for Intel® Identity Protection Technology
McAfee SecurityCenter	npMcSnFFPl.dll	McAfee MSC FF plugin DLL
Microsoft Office 2013	NPSPWRAP.DLL	The plugin allows you to have a better experience with Microsoft SharePoint
Microsoft Office 2013	npMeetingJoinPluginOC.dll	The plugin allows you to have a better experience with Microsoft Lync
Picasa	npPicasa3.dll	Picasa plugin
Shockwave Flash	NPSWF32_16_0_0_305.dll	Shockwave Flash 16.0 r0

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 plug-in.

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>
```

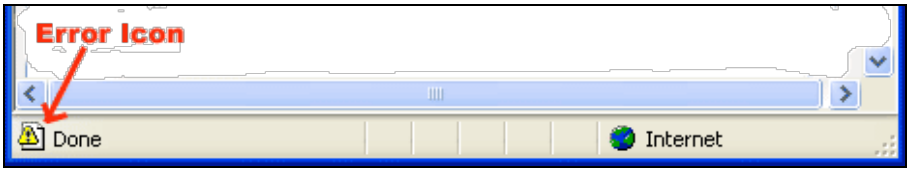
39. ES6 – Debugging

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

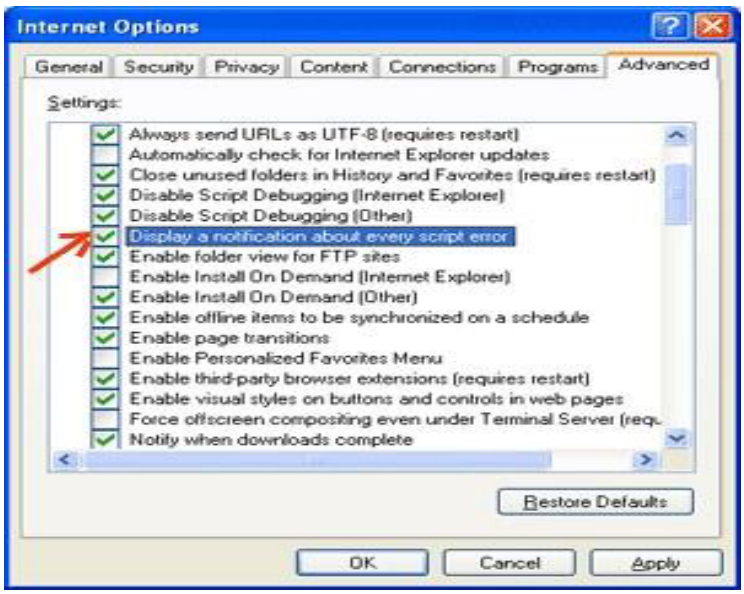
The most basic way to track down errors is by turning on the error information in your browser. By default, the Internet Explorer shows an error icon in the status bar when an error occurs on the page.



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.



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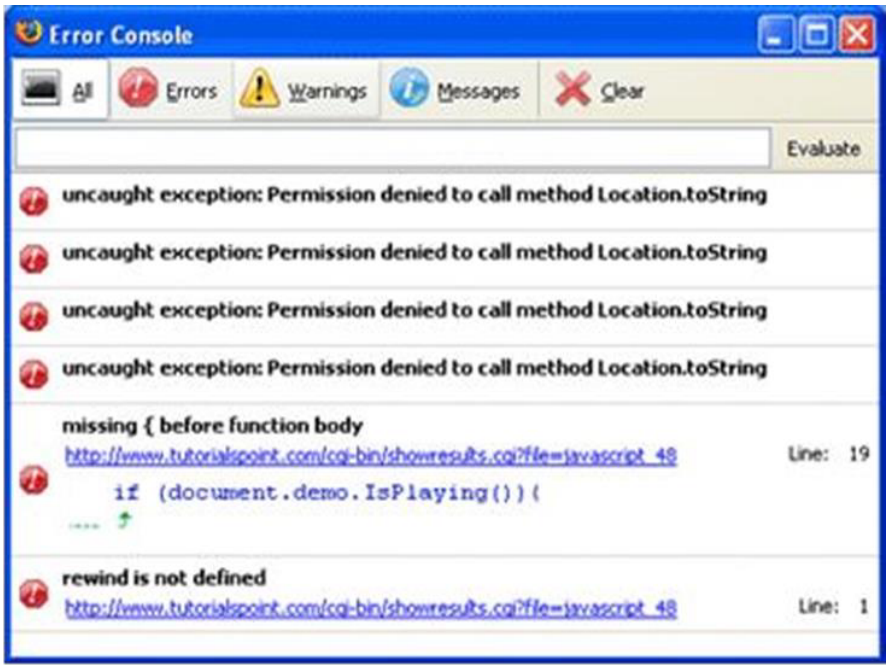
Error Messages in Firefox or Mozilla

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 Programs

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: http://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.

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- 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');
```


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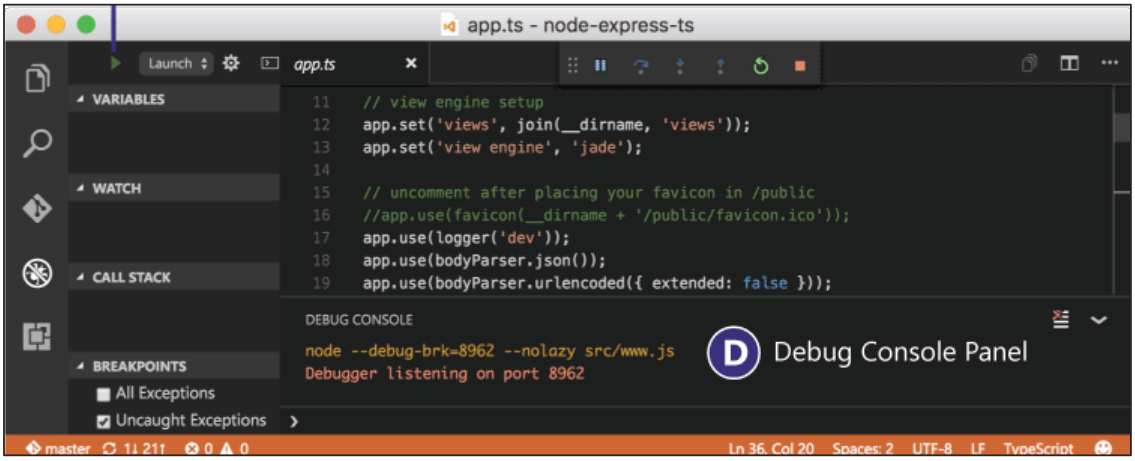
Following is a set of stepping commands that one can use with Node.

Stepping Commands	Description
cont,c	Continue
next,n	Next
step,s	Step in
out,o	Step out
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

40. 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.

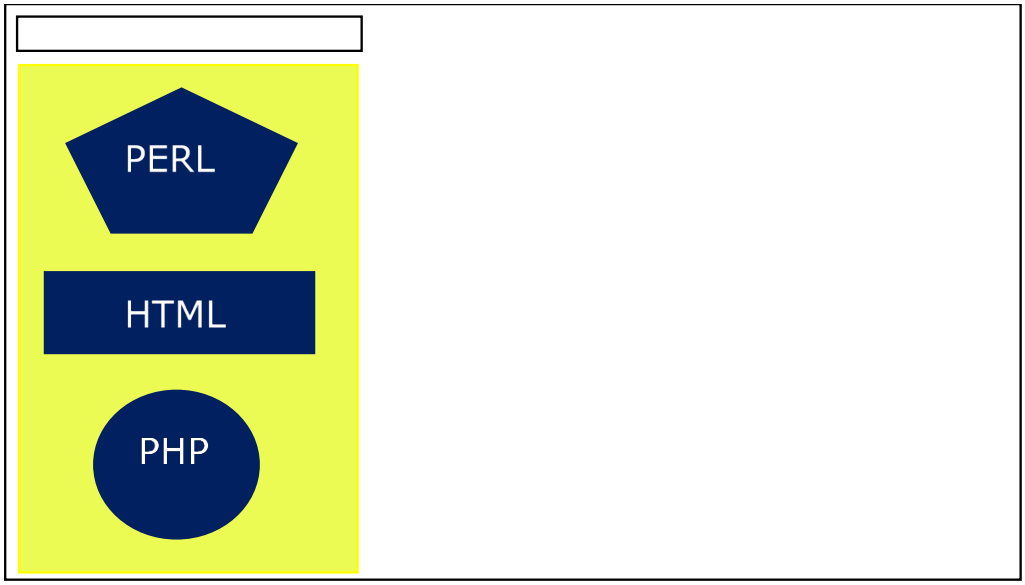
The following code combines imagemaps and JavaScript to produce a message in a text box when the mouse is moved over different parts of an image.

```
<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.



41. 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 and 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

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Navigator Methods

There are several Navigator-specific methods. Here is a list of their names and descriptions.

Sr. No.	Method and 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

42. ES7 — New Features

This chapter provides knowledge about the new features in ES7.

Exponentiation Operator

ES7 introduces a new mathematical operator called exponentiation operator. This operator is similar to using Math.pow() method. Exponentiation operator is represented by a double asterisk **. The operator can be used only with numeric values. The syntax for using the exponentiation operator is given below:

Syntax

The syntax for the exponentiation operator is mentioned below:

```
base_value ** exponent_value
```

Example

The following example calculates the exponent of a number using the **Math.pow() method** and the **exponentiation operator**.

```
<script>
     let base = 2
     let exponent = 3
     console.log('using Math.pow()',Math.pow(base,exponent))
     console.log('using exponentiation operator',base**exponent)

  </script>
```

The output of the above snippet is as given below:

```
using Math.pow() 8
using exponentiation operator 8
```

Array Includes

The Array.includes() method introduced in ES7 helps to check if an element is available in an array. Prior to ES7, the indexof() method of the Array class could be used to verify if a value exists in an array . The indexof() returns the index of the first occurrence of element in the array if the data is found ,else returns -1 if the data doesn't exist.

The Array.includes() method accepts a parameter, checks if the value passed as parameter exists in the array. This method returns true if the value is found, else returns false if the value doesn't exist. The syntax for using the Array.includes() method is given below:

Syntax

```
Array.includes(value)
```

OR

```
Array.includes(value,start_index)
```

The second syntax checks if the value exists from the index specified.

Example

The following example declares an array marks and uses the Array.includes() method to verify if a value is present in the array.

```
<script>


     let marks = [50,60,70,80]
    //check if 50 is included in array
    if(marks.includes(50)){
           console.log('found element in array')
       }else{
           console.log('could not find element')
       }


       // check if 50 is found from index 1
     if(marks.includes(50,1)){ //search from index 1
           console.log('found element in array')
       }else{
           console.log('could not find element')
       }
```

```
 //check Not a Number(NaN) in an array
console.log([NaN].includes(NaN))

//create an object array
let user1 = {name:'kannan'},
 user2 = {name:'varun'},
 user3={name:'prijin'}
 let users = [user1,user2]

 //check object is available in array
 console.log(users.includes(user1))
 console.log(users.includes(user3))


</script>
```

The output of the above code will be as stated below:

```
found element in array
could not find element
true
true
false
```

43. ES8 — New Features

This chapter focusses on the new features in ES8.

Padding a String

ES8 introduces two string handling functions for padding a string. These functions can be used to add space or any desired set of characters to the beginning and end of a string value.

String. padStart()

This function pads the current string with a given input string repeatedly from the start, till the current string reaches the given length. The syntax of the padStart() function is given below:

Syntax

```
string_value.padStart(targetLength [, padString])
```

The padStart() function accepts two parameters which are as follows:

- **targetLength**: A numeric value that represents the target length of the string after padding. If the value of this parameter is lesser than or equal to the existing length of the string, the string value is returned as it is.
- **padString**: This is an optional parameter. This parameter specifies the characters that should be used to pad the string. The string value is padded with spaces if no value is passed to this parameter.

Example

The following example declares a string variable, product_cost. The variable will be padded with zeros from left until the total length of the string is seven. The example also illustrates behaviour of the padStart() function, if no value is passed to the second parameter.

```
<script>

      //pad the String with 0
      let product_cost = '1699'.padStart(7,0)
      console.log(product_cost)
      console.log(product_cost.length)
```


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```
//pad the String with blank spaces
    let product_cost1 = '1699'.padStart(7)
    console.log(product_cost1)
    console.log(product_cost1.length)

  </script>
```

The output of the above code will be as stated below:

```
0001699
7
1699
7
```

String.padEnd()

This function pads the current string with a given input string repeatedly from the end, till the current string reaches the specified length.

The syntax of the padEnd() function is given below:

Syntax

```
string_value.padEnd(targetLength [, padString])
```

The padEnd() function accepts two parameters-

- **targetLength**: A numeric value that represents the target length of the string after padding. If the value of this parameter is lesser than or equal to the existing length of the string, the string value is returned as it is.

- **padString**: This is an optional parameter. This parameter specifies the characters that should be used to pad the string. The string value is padded with spaces if no value is passed to this parameter.

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Example

The following example declares a string variable, product_cost. The variable will be padded with zeros from right until the total length of the string is seven. The example also illustrates behaviour of the padStart() function, if no value is passed to the second parameter.

```
<script>
      //pad the string with x
      let product_cost = '1699'.padEnd(7,'x')
      console.log(product_cost)
      console.log(product_cost.length)

      //pad the string with spaces
      let product_cost1 = '1699'.padEnd(7)
      console.log(product_cost1)
      console.log(product_cost1.length)
</script>
```

The output of the above code will be as mentioned below:

```
1699xxx
7
1699
7
```

Trailing Commas

A trailing comma is simply a comma after the last item in a list. Trailing commas are also known as final commas.

Trailing Commas and Array

Trailing commas in arrays are skipped while using Array.prototype.forEach loop.

Example

The following example iterating an array with trailing commas using foreach loop.

```
<script>
     let marks = [100,90,80,,]
      console.log(marks.length)
      console.log(marks)


        marks.forEach(function(e){ //ignores empty value in array
             console.log(e)
         })
 </script>
```

The output of the above code will be as shown below:

```
4
[100, 90, 80, empty]
100
90
80
```

Trailing commas and function call

Trailing commas, passed as arguments, when defining or invoking a function are ignored by JavaScript runtime engine. However, there are two exceptions:

- Function definitions or invocation that contains only a comma will result in SyntaxError. For example, the following snippet will throw an error-

```
function test(,){} // SyntaxError: missing formal parameter
(,)=>{};  //SyntaxError: expected expression, got ','
test(,) //SyntaxError: expected expression, got ','
```

- Trailing commas cannot be used with rest parameters.

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```
function test(...arg1,){} // SyntaxError: parameter after rest parameter
(...arg1,)=>{} // SyntaxError: expected closing parenthesis, got ','
```

Example

The following example declares a function with trailing commas in the argument list.

```
<script>
    function sumOfMarks(marks,){ // trailing commas are ignored
        let sum=0;
         marks.forEach(function(e){
             sum+=e;
         })
         return sum;
      }

       console.log(sumOfMarks([10,20,30]))
       console.log(sumOfMarks([1,2,3],))// trailing comma is ignored
  </script>
```

The output of the above code is as follows:

```
60
6
```

Object:entries() and values()

ES8 introduces the following new methods to the built-in Object type:

- **Object.entries** : The Object.entries() method can be used to access all the properties of an object.
- **Object.values()**: The Object.values() method can be used to access values of all properties of an object.
- **Object.getOwnPropertyDescriptors()**: This method returns an object containing all own property descriptors of an object. An empty object may be returned if the object doesn't have any properties.

Example

```
<script>
    const student ={
      firstName:'Kannan',
      lastName:'Sudhakaran'
    }
   console.log(Object.entries(student))
    console.log(Object.values(student))


   </script>
```

The output of the above code will be as follows:

```
 [
["firstName", "Kannan"],
["lastName", "Sudhakaran"],
]

["Kannan", "Sudhakaran"]
```

Example

```
<script>
    const marks = [10,20,30,40]
    console.log(Object.entries(marks))
    console.log(Object.values(marks))
  </script>
```


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The output of the above code will be as given below:

```
[ ["0", 10],
["1", 20],
["2", 30],
["3", 40]
]
[10, 20, 30, 40]
```

Example

```
<script>
     const student = {
       firstName : 'Mohtashim',
       lastName: 'Mohammad',
       get fullName(){
        return this.firstName + ':'+ this.lastName
       }
     }
     console.log(Object.getOwnPropertyDescriptors(student))
   </script>
```

The output of the above code will be as mentioned below:

```
{firstName: {value: "Mohtashim", writable: true, enumerable: true,
configurable: true}
fullName: {get: ƒ, set: undefined, enumerable: true, configurable: true}
lastName: {value: "Mohammad", writable: true, enumerable: true, configurable:
true}
}
```

Async and Await

Async/Await is a very important feature in ES8.It is a syntactic sugar for Promises in JavaScript. The await keyword is used with promises. This keyword can be used to pause the execution of a function till a promise is settled. The await keyword returns value of the promise if the promise is resolved while it throws an error if the promise is rejected. The await function can only be used inside functions marked as async. A function that is declared using the async keyword always returns a promise.

Syntax

The syntax of async function with await is given below:

```
async function  function_name(){
        let result_of_functionCall = await longRunningMethod();
}
//invoking async function


function_name().then(()=>{})
              .catch(()=>{})
```

Consider an example that has an asynchronous function that takes two seconds to execute and returns a string value. The function can be invoked in two ways as shown below:

- Using promise.then()
- Using aync/await.

The below code shows invoking the asynchronous function using the traditional ES6 syntax - promise.then()

```
<script>


          function fnTimeConsumingWork(){
             return new Promise((resolve,reject)=>{
               setTimeout(() => {
                 resolve('response is:2 seconds have passed')
               }, 2000);


             })
          }


       fnTimeConsumingWork().then(resp=>{
```


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```
        console.log(resp)
      })

    console.log('end of script')
    </script>
```

The output of the above code will be as follows:

```
end of script
response is:2 seconds have passed
```

The below code shows a cleaner way of invoking the asynchronous function using ES8 syntax - async/await

```
<script>
    function fnTimeConsumingWork(){
              return new Promise((resolve,reject)=>{
                setTimeout(() => {
                  resolve('response is:2 seconds have passed')
                }, 2000);


              })
           }
     async function  my_AsyncFunc(){
      console.log('inside my_AsyncFunc')
      const response = await fnTimeConsumingWork();// clean and readable
      console.log(response)
     }
   my_AsyncFunc();
   console.log("end of script")
  </script>
```

The output of the above code will be as mentioned below:

```
inside my_AsyncFunc
end of script
response is:2 seconds have passed
```

Promise chaining with Async/await

The following example implements promise chaining using the async/await syntax.

In this example, add_**positivenos_async()** function adds two numbers asynchronously and rejects if negative values are passed. The result from the current asynchronous function call is passed as parameter to the subsequent function calls.

```
<script>
    function add_positivenos_async(n1, n2) {
      let p = new Promise(function (resolve, reject) {
        if (n1 >= 0 && n2 >= 0) {
          //do some complex time consuming work
          resolve(n1 + n2)
        }
        else
          reject('NOT_Postive_Number_Passed')

      })

      return p;
    }

    async function addInSequence() {
      let r1 = await add_positivenos_async(10, 20)
      console.log("first result", r1);
      let r2 = await add_positivenos_async(r1, r1);
      console.log("second result", r2)
      let r3 = await add_positivenos_async(r2, r2);
      console.log("third result", r3)
      return "Done Sequence"

    }
    addInSequence().then((r)=>console.log("Async :",r));
    console.log('end')
  </script>
```

The output of the above code will be as given below:

```
end
first result 30
second result 60
third result 120
Async : Done Sequence
```

44. ES9 — New Features

Here, we will learn about the new features in ES9. Let us begin by understanding about the asynchronous generators.

Asynchronous Generators and Iteration

Asynchronous generators can be made asynchronous by using the **async** keyword. The **syntax** for defining an async generator is given below:

```
async function* generator_name()
{
//statements
}
```

Example

Following example shows an async generator which returns Promise on each call to the **next()** method of generator.

```
<script>
     async function* load(){
         yield await Promise.resolve(1);
         yield await Promise.resolve(2);
         yield await Promise.resolve(3);
     }

    let l = load();
    l.next().then(r=>console.log(r))
    l.next().then(r=>console.log(r))
    l.next().then(r=>console.log(r))
    l.next().then(r=>console.log(r))
</script>
```

The output of the above code will be as follows:

```
{value: 1, done: false}
{value: 2, done: false}
```

```
{value: 3, done: false}
{value: undefined, done: true}
```

for await of loop

Asynchronous iterables cannot be iterated using the traditional **for..of loop** syntax as they return promises. ES9 introduces the **for await of loop** to support **asynchronous iteration.**

The syntax for using the **for await of loop** is given below, where,

- On each iteration a value of a different property is assigned to **variable** and a variable may be declared with const, let, or var.
- **iterable:** Object whose iterable properties are to be iterated over.

```
for await (variable of iterable) {
  statement
}
```

Example

The following example shows the use of for await of loop to iterate an async generator.

```
<script>
    async function* load(){
        yield await Promise.resolve(1);
        yield await Promise.resolve(2);
        yield await Promise.resolve(3);
    }

    async function test(){
        for await (const val of load()){
            console.log(val)
        }
    }
   test();
```

```
console.log('end of script')
</script>
```

The output of the above code will be as shown below:

```
end of script
1
2
3
```

Example

The following example iterates an array using the for await of loop.

```
<script>
  async function fntest(){
       for await (const val of [10,20,30,40]){
           console.log(val)
       }
}
fntest();
console.log('end of script')
</script>
```

The output of the above code will be as follows:

```
end of script
10
20
30
40
```

Rest/Spread Properties

ES9 supports the use of Rest and Spread operators with Objects.

Example: Object and Rest Operator

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The following example shows the use of rest operator with an object. The value of age property of student is copied into the age variable while the values of the remaining properties are copied into the other variable using the rest syntax `...`.

```
<script>
      const student = {
          age:10,
          height:5,
          weight:50
      }

      const {age,...other} = student;
     console.log(age)
     console.log(other)



  </script>
```

The output of the above code will be as given below:

```
10
{height: 5, weight: 50}
```

Example: Object and Spread operator

The spread operator can be used to combine multiple objects or cloning objects. This is shown in the following example:

```
<script>
      //spread operator
    const obj1 = {a:10,b:20}
    const obj2={c:30}
 //clone obj1
    const clone_obj={...obj1}
 //combine obj1 and obj2
    const obj3 = {...obj1,...obj2}

    console.log(clone_obj)
    console.log(obj3)

  </script>
```

The output of the above code will be as stated below:

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

Promise: finally()

The **finally()** is executed whenever a promise is settled, regardless of its outcome. This function returns a promise. It can be used to avoid code duplication in both the promise's **then()** and **catch()** handlers.

Syntax

The below mentioned syntax is for the function **finally()**.

```
promise.finally(function() {
   });

promise.finally(()=> {

});
```

Example

The following example declares a async function that returns the square of a positive number after a delay of 3 seconds. The function throws an error if a negative number is passed. The statements in the finally block is executed in either case, whether the promise is rejected or resolved.

```
<script>
let asyncSquareFn = function(n1){


           return new Promise((resolve,reject)=>{
            setTimeout(()=>{
                if(n1>=0){
               resolve(n1*n1)
                }
                else reject('NOT_POSITIVE_NO')
            },3000)
        })
    }
        console.log('Start')

        asyncSquareFn(10)//modify to add -10
        .then(result=>{
            console.log("result is",result)
        }).catch(error=>console.log(error))
        .finally(() =>{
            console.log("inside finally")
            console.log("executes all the time")
        })

        console.log("End");
</script>
```

The output of the above code will be as shown below:

```
Start
 End
 //after 3 seconds
 result is 100
```

```
inside finally
executes all the time
```

Template Literal revision

As of ES7, tagged templates conform to the rules of the following escape sequences:

- Unicode escape sequences are represented using **"\u"**, for example **\u2764\uFE0F**
- Unicode code point escape sequences are represented using **"\u{}"**, for example **\u{2F}**
- Hexadecimal escape sequences are represented using **"\x"**, for example **\xA8**
- Octal literal escape sequences are represented using **""** and followed by one or more digits, for example **\125**

In ES2016 and earlier, if invalid escape sequences are used with tagged functions a Syntax Error will be thrown as shown below:

```
//tagged function with an invalid unicode sequence
myTagFn`\unicode1`
// SyntaxError: malformed Unicode character escape sequence
```

However, unlike the earlier versions, ES9 parses the invalid unicode sequence to undefined and does not throw an error. This is shown in the following example:

```
<script>
  function myTagFn(str) {
    return { "parsed": str[0] }
  }
  let result1 =myTagFn`\unicode1` //invalid unicode character
  console.log(result1)
  let result2 =myTagFn`\u2764\uFE0F`//valid unicode
  console.log(result2)
</script>
```

The output of the above code will be as shown below:

```
{parsed: undefined}
{parsed: "❤"}
```

Raw Strings

ES9 introduces a special property **raw**, available on the first argument to the tag function. This property allows you to access the raw strings as they were entered, without processing the escape sequences.

Example

```
<script>
  function myTagFn(str) {
    return { "Parsed": str[0], "Raw": str.raw[0] }
  }

  let result1 =myTagFn`\unicode`
  console.log(result1)

  let result2 =myTagFn`\u2764\uFE0F`
  console.log(result2)
</script>
```

The output of the above code will be as follows:

```
{Parsed: undefined, Raw: "\unicode"}
{Parsed: "❤", Raw: "\u2764\uFE0F"}
```

Regular Expression feature

In regular expressions, the dot operator or a period is use to match a single character. The **. dot operator** skips line break characters like **\n**, **\r** as shown in the below example:

```
console.log(/Tutorials.Point/.test('Tutorials_Point')); //true
console.log(/Tutorials.Point/.test('Tutorials\nPoint')); //false
console.log(/Tutorials.Point/.test('Tutorials\rPoint')); //false
```

A regular expression pattern is represented as the **/ regular_expression /**. The test() method takes a string parameter and searches for the regex pattern. In the above example, the **test() method** searches for pattern starting with Tutorials, followed by any single character and ending with Point. If we use the **\n** or **\r** in the input string between Tutorials and Point the test() method will return false.

tutorialspoint
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```
true
false
false
```

ES9 introduces a new flag - **DotAllFlag (\s)** that can be used with Regex to match line terminators and emojis. This is shown in the following example:

```
console.log(/Tutorials.Point/s.test('Tutorials\nPoint'));
console.log(/Tutorials.Point/s.test('Tutorials\rPoint'));
```

The output of the above code will be as mentioned below:

```
true
true
```

Named Capture Groups

Prior to ES9, capture groups were accessed by indexes. ES9 allows us to assign names to capture groups. The syntax for the same is given below:

```
(?<Name1>pattern1)
```

Example

```
const birthDatePattern = /(?<myYear>[0-9]{4})-(?<myMonth>[0-9]{2})/;
const birthDate  = birthDatePattern.exec('1999-04');
console.log(birthDate.groups.myYear);
console.log(birthDate.groups.myMonth);
```

The output of the above code is as shown below:

```
1999
04
```