# var, let, and const in JavaScript – the Differences Between These Keywords Explained

In JavaScript, you can declare variables with the var, let and keywords. But what are the differences between them? That's what I'll explain in this tutorial.

I have a [video version of this topic](https://youtu.be/Gd_JG3e1g4A) you can check out as well. 😇

If you're just starting out using JavaScript, a few things you may hear about these keywords are:

* var and let create variables that can be reassigned another value.
* const creates "constant" variables that cannot be reassigned another value.
* developers shouldn't use var anymore. They should use let or const instead.
* if you're not going to change the value of a variable, it is good practice to use const.

The first two points are likely pretty self-explanatory. But what about why we shouldn't use var, or when to use let vs const? As we go through this tutorial, hopefully this will all make sense to you.

## **var** vs **let** vs **const** – What's the Difference?

To analyze the differences between these keywords, I'll be using three factors:

* Scope of variables
* Redeclaration and reassignment
* Hoisting

Let's start by looking at how these factors apply to variables declared with var.

## How to Declare Variables with **var** in JavaScript

### The scope of variables declared with **var**

Variables declared with var can have a **global** or **local** scope. Global scope is for variables declared outside functions, while local scope is for variables declared inside functions.

Let's see some examples, starting from global scope:

var number = 50

function print() {

var square = number \* number

console.log(square)

}

console.log(number) // 50

print() // 2500

The number variable has a global scope – it's declared outside functions in the global space – so you can access it everywhere (inside and outside functions).

Let's see an example of local scope:

function print() {

var number = 50

var square = number \* number

console.log(square)

}

print() // 2500

console.log(number)

// ReferenceError: number is not defined

Here, we declared the number variable in the function print, so it has a local scope. This means that the variable can only be accessed inside that function. Any attempt to access the variable outside the function where it was declared will result in a **variable is not defined** reference error.

### How to redeclare and reassign variables declared with **var**

Variables declared with var can be redeclared and reassigned. I'll explain what I mean with examples.

Here's how to declare a variable with var:

var number = 50

You have the var keyword, the name of the variable number, and an initial value **50**. If an initial value is not provided, the default value will be **undefined**:

var number

console.log(number) // undefined

The var keyword allows for redeclaration. Here's an example:

var number = 50

console.log(number) // 50

var number = 100

console.log(number) // 100

As you can see, we have redeclared the variable number using the var keyword and an initial value of **100**.

The var keyword also allows for reassignment. In the code var number = 50, we assigned the **50** value to number. We can reassign another value anywhere in the code since it was declared with var. Here's what I mean:

var number = 50

console.log(number) // 50

number = 100

console.log(number) // 100

number = 200

console.log(number) // 200

Here, we're not redeclaring – rather, we're reassigning. After declaring the first time with an initial value of **50**, we reassign a new value of **100** and later on with a new value of **200**.

### How to hoist variables declared with **var**

Variables declared with var are hoisted to the top of their global or local scope, which makes them accessible before the line they are declared. Here's an example:

console.log(number) // undefined

var number = 50

console.log(number) // 50

The number variable here has a global scope. Since it is declared with var, the variable is hoisted. This means that we can access the variable before the line where it was declared without errors.

But the variable is hoisted with a default value of **undefined**. So that's the value returned from the variable (until the line where the variable is declared with an initial value gets executed).

Let's see a local scope example:

function print() {

var square1 = number \* number

console.log(square1)

var number = 50

var square2 = number \* number

console.log(square2)

}

print()

// NaN

// 2500

In the print function, number has a local scope. Due to hoisting, we can access the number variable before the line of declaration.

As we see in square1, we assign **number \* number**. Since number is hoisted with a default value of **undefined**, square1 will be **undefined \* undefined** which results in **NaN**.

After the line of declaration with an initial value is executed, number will have a value of **50**. So in square2, **number \* number** will be **50 \* 50** which results in **2500**.

## **How to Declare Variables with let in JavaScript**

### The scope of variables declared with **let**

Variables declared with let can have a **global**, **local**, or **block scope**. Block scope is for variables declared in a block. A block in JavaScript involves opening and closing curly braces:

{

// a block

}

You can find blocks in ***if, loop, switch, and a couple of other statements***. Any variables declared in such blocks with the let keyword will have a block scope. Also, you can't access these variables outside the block.

Here's an example showing a global, local, and block scope:

let number = 50

function print() {

let square = number \* number

if (number < 60) {

var largerNumber = 80

let anotherLargerNumber = 100

console.log(square)

}

console.log(largerNumber)

console.log(anotherLargerNumber)

}

print()

// 2500

// 80

// ReferenceError: anotherLargerNumber is not defined

In this example, we have a global scope variable number and a local scope variable square. There's also block scope variable anotherLargerNumber because it is declared with let in a block.

largerNumber, on the other hand – though declared in a block – does not have a block scope because it is declared with var. So largerNumber has a local scope as it is declared in the function print.

We can access number everywhere. We can only access square and largerNumber in the function because they have local scope. But accessing anotherLargerNumber outside the block throws an **anotherLargerNumber is not defined** error.

### **How to redeclare and reassign variables declared with let**

Just like var, variables declared with let can be reassigned to other values, but they cannot be redeclared. Let's see a reassignment example:

let number = 50

console.log(number) // 50

number = 100

console.log(number) // 100

Here, we reassigned another value **100** after the initial declaration of **50**.

But redeclaring a variable with let will throw an error:

let number = 50

let number = 100// SyntaxError: Identifier 'number' has already been declared

You see we get a syntax error: **Identifier 'number' has already been declared**.

### How to hoist variables declared with **let**

Variables declared with let are hoisted to the top of their global, local, or block scope, but their hoisting is a little different from the one with var.

var variables are hoisted with a default value of **undefined**, which makes them accessible before their line of declaration (as we've seen above).

But, let variables are hoisted without a default initialization. So when you try to access such variables, instead of getting **undefined**, or **variable is not defined** error, you get **cannot access variable before initialization**.

Let's see an example:

console.log(number) // ReferenceError: Cannot access 'number' before initialization

let number = 50

Here, we have a global variable, number declared with let. By trying to access this variable before the line of declaration, we get **ReferenceError: Cannot access 'number' before initialization**.

Here's another example with a local scope variable:

function print() {

let square = number \* number

let number = 50

}

print() // ReferenceError: Cannot access 'number' before initialization

Here we have a local scope variable, number, declared with let. By accessing it before the line of declaration again, we get the **cannot access 'number' before initialization** reference error

## **How to Declare Variables with const in JavaScript**

### The scope of variables declared with **const**

Variables declared with const are similar to let in regards to **scope**. Such variables can have a **global**, **local**, or **block** scope.

Here is an example:

const number = 50

function print() {

const square = number \* number

if (number < 60) {

var largerNumber = 80

const anotherLargerNumber = 100

console.log(square)

}

console.log(largerNumber)

console.log(anotherLargerNumber)

}

print()

// 2500

// 80

// ReferenceError: anotherLargerNumber is not defined

This is from our previous example, but I've replaced let with const. As you can see here, the number variable has a global scope, square has a local scope (declared in the print function), and anotherLargeNumber has a block scope (declared with const).

There's also largeNumber, declared in a block. But because it is with var, the variable only has a local scope. Therefore, it can be accessed outside the block.

Because anotherLargeNumber has a block scope, accessing it outside the block throws an **anotherLargerNumber is not defined**.

### How to redeclare and reassign variables declared with **const**

In this regard, const is different from var and let. const is used for declaring **constant** variables – which are variables with values that cannot be changed. So such variables cannot be redeclared, and neither can they be reassigned to other values. Attempting such would throw an error.

Let's see an example with redeclaration:

const number = 50

const number = 100 // SyntaxError: Identifier 'number' has already been declared

Here, you can see the **Identifier has already been declared** syntax error.

Now, let's see an example with reassignment:

const number = 50

number = 100 // TypeError: Assignment to constant variable

Here, you can see the **Assignment to constant variable** type error.

### How to hoist variables declared with **const**

Variables declared with const, just like let, are hoisted to the top of their global, local, or block scope – but without a default initialization.

var variables, as you've seen earlier, are hoisted with a default value of **undefined** so they can be accessed before declaration without errors. Accessing a variable declared with const before the line of declaration will throw a **cannot access variable before initialization** error.

Let's see an example:

console.log(number) // ReferenceError: Cannot access 'number' before initialization

const number = 50

Here, number is a globally scoped variable declared with const. By trying to access this variable before the line of declaration, we get **ReferenceError: Cannot access 'number' before initialization**. The same will occur if it was a locally scoped variable.

Here's an article to learn more about [Hoisting in JavaScript with let and const – and How it Differs from var](https://www.freecodecamp.org/news/javascript-let-and-const-hoisting/).

## Wrap up

Here's a table summary showing the differences between these keywords:

|  |  |  |  |
| --- | --- | --- | --- |
| KEYWORD | SCOPE | REDECLARATION & REASSIGNMENT | HOISTING |
| var | Global, Local | yes & yes | yes, with default value |
| let | Global, Local, Block | no & yes | yes, without default value |
| const | Global, Local, Block | no & no | yes, without default value |

These factors I've explained, play a role in determining how you declare variables in JavaScript.

If you never want a variable to change, const is the keyword to use.

If you want to reassign values:

* and you want the hoisting behavior, var is the keyword to use
* if you don't want it, let is the keyword for you

The hoisting behavior can cause unexpected bugs in your application. That's why developers are generally advised to avoid var and stick to let and cost.

# When (and why) you should use ES6 arrow functions — and when you shouldn’t

Arrow functions (also called “fat arrow functions”) are undoubtedly one of the more popular features of ES6. They introduced a

new way of writing concise functions.

Here is a function written in ES5 syntax:

function timesTwo(params) {

return params \* 2

}

timesTwo(4); // 8

Now, here is the same function expressed as an arrow function:

var timesTwo = params => params \* 2

timesTwo(4); // 8

It’s much shorter! We are able to omit(to not include) the curly braces and the return statement due to implicit returns (but only if there is no block — more on this below).

It is important to understand how the arrow function behaves differently compared to the regular ES5 functions.

### Variations

One thing you will quickly notice is the variety of syntaxes available in arrow functions. Let’s run through some of the common ones:

#### 1. No parameters

If there are no parameters, you can place an empty parentheses before =&gt;.

( ) => 42

In fact, you don’t even need the parentheses!

\_ => 42

#### 2. Single parameter

With these functions, parentheses are optional:

x => 42 || (x) => 42

#### **3. Multiple parameters**

Parentheses are required for these functions:

(x, y) => 42

#### **4. Statements (as opposed to expressions)**

In its most basic form, a function expression produces a value, while a function statement performs an action.

With the arrow function, it is important to remember that statements need to have curly braces. Once the curly braces are present, you always need to write return as well.

Here is an example of the arrow function used with an if statement:

var feedTheCat = (cat) => {

if (cat === 'hungry') {

return 'Feed the cat';

} else {

return 'Do not feed the cat';

}

}

#### **5. “Block body”**

If your function is in a block, you must also use the explicit return statement:

var addValues = (x, y) => {

return x + y

}

#### **6. Object literals**

If you are returning an object literal, it needs to be wrapped in parentheses. This forces the interpreter to evaluate what is inside the parentheses, and the object literal is returned.

x =>({ y: x })

### Syntactically anonymous

It is important to note that arrow functions are anonymous, which means that they are not named.

This anonymity creates some issues:

1. Harder to debug

When you get an error, you will not be able to trace the name of the function or the exact line number where it occurred.

2. No self-referencing

If your function needs to have a self-reference at any point (e.g. recursion, event handler that needs to unbind), it will not work.

### Main benefit: No binding of ‘this’

In classic function expressions, the this keyword is bound to different values based on the context in which it is called. With arrow functions however, this is lexically bound. It means that it uses this from the code that contains the arrow function.

For example, look at the setTimeout function below:

// ES5

var obj = {

id: 42,

counter: function counter() {

setTimeout(function() {

console.log(this.id);

}.bind(this), 1000);

}

};

In the ES5 example, .bind(this) is required to help pass the this context into the function. Otherwise, by default this would be undefined.

// ES6

var obj = {

id: 42,

counter: function counter() {

setTimeout(() => {

console.log(this.id);

}, 1000);

}

};

ES6 arrow functions can’t be bound to a this keyword, so it will lexically go up a scope, and use the value of this in the scope in which it was defined.

### When you should not use Arrow Functions

After learning a little more about arrow functions, I hope you understand that they do not replace regular functions.

Here are some instances where you probably wouldn’t want to use them:

1. Object methods

When you call cat.jumps, the number of lives does not decrease. It is because this is not bound to anything, and will inherit the value of this from its parent scope.

var cat = {

lives: 9,

jumps: () => {

this.lives--;

}

}

2. Callback functions with dynamic context

If you need your context to be dynamic, arrow functions are not the right choice. Take a look at this event handler below:

var button = document.getElementById('press');

button.addEventListener('click', () => {

this.classList.toggle('on');

});

If we click the button, we would get a TypeError. It is because this is not bound to the button, but instead bound to its parent scope.

3. When it makes your code less readable

It is worth taking into consideration the variety of syntax we covered earlier. With regular functions, people know what to expect. With arrow functions, it may be hard to decipher what you are looking at straightaway.

### When you should use them

Arrow functions shine best with anything that requires this to be bound to the context, and not the function itself.

Despite the fact that they are anonymous, I also like using them with methods such as map and reduce, because I think it makes my code more readable. To me, the pros outweigh the cons.

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JavaScript Array Methods

|  |  |
| --- | --- |
| Array length Array toString() Array pop() Array push() Array shift() Array unshift() | Array join() Array delete() Array concat() Array flat() Array splice() Array slice() |
| The methods are listed in the order they appear in this tutorial page | |

## **1] JavaScript Array length**

The length property returns the length (size) of an array:

const fruits = ["Banana", "Orange", "Apple", "Mango"];

let size = fruits.length;

## **2] JavaScript Array toString()**

The JavaScript method toString() converts an array to a string of (comma separated) array values.

const fruits = ["Banana", "Orange", "Apple", "Mango"];

console.log(fruits.toString()); // Banana,Orange,Apple,Mango

## **3] JavaScript Array join()**

The **join()** method also joins all array elements into a string.

It behaves just like toString(), but in addition you can specify the separator:

const fruits = ["Banana", "Orange", "Apple", "Mango"];

console.log(fruits.join(" \* ")); // Banana \* Orange \* Apple \* Mango

console.log(fruits.join(" - ")); // Banana - Orange - Apple - Mango

## **Popping and Pushing**

When you work with arrays, it is easy to remove elements and add new elements.

This is what popping and pushing is:

Popping items **out** of an array, or pushing items **into** an array.

## **4] JavaScript Array pop()**

The pop() method removes the last element from an array:

const fruits = ["Banana", "Orange", "Apple", "Mango"];

fruits.pop();

The pop() method returns the value that was "popped out":

const fruits = ["Banana", "Orange", "Apple", "Mango"];

let fruit = fruits.pop();

console.log(fruit); //Mango

## **5] JavaScript Array push()**

The push() method adds a new element to an array (at the end):

const fruits = ["Banana", "Orange", "Apple", "Mango"];  
fruits.push("Kiwi");

The push() method returns the new array length:

const fruits = ["Banana", "Orange", "Apple", "Mango"];  
let length = fruits.push("Kiwi"); //5

## **6] JavaScript Array shift()**

The shift() method removes the first array element and "shifts" all other elements to a lower index.

const fruits = ["Banana", "Orange", "Apple", "Mango"];  
fruits.shift();

The shift() method returns the value that was "shifted out":

const fruits = ["Banana", "Orange", "Apple", "Mango"];  
let fruit = fruits.shift();

## **7] JavaScript Array unshift()**

The unshift() method adds a new element to an array (at the beginning), and "unshifts" older elements:

const fruits = ["Banana", "Orange", "Apple", "Mango"];  
fruits.unshift("Lemon");

The unshift() method returns the new array length:

const fruits = ["Banana", "Orange", "Apple", "Mango"];  
fruits.unshift("Lemon");

## **8] Changing Elements**

Array elements are accessed using their **index number**:

Array **indexes** start with 0:

[0] is the first array element  
[1] is the second  
[2] is the third ...

const fruits = ["Banana", "Orange", "Apple", "Mango"];  
fruits[0] = "Kiwi";

## **9] JavaScript Array length**

The length property provides an easy way to append a new element to an array:

const fruits = ["Banana", "Orange", "Apple", "Mango"];  
fruits[fruits.length] = "Kiwi";

## **10] JavaScript Array delete()**

### **Warning !**

Array elements can be deleted using the JavaScript operator delete.

Using delete leaves undefined holes in the array.

Use pop() or shift() instead.

const fruits = ["Banana", "Orange", "Apple", "Mango"];  
delete fruits[0];

## **11] Merging (Concatenating) Arrays**

The concat() method creates a new array by merging (concatenating) existing arrays:

Merging two arrays

const myGirls = ["Cecilie", "Lone"];  
const myBoys = ["Emil", "Tobias", "Linus"];  
  
const myChildren = myGirls.concat(myBoys);

The concat() method does not change the existing arrays. It always returns a new array.

The concat() method can take any number of array arguments:

### **(Merging Three Arrays)**

const arr1 = ["Cecilie", "Lone"];  
const arr2 = ["Emil", "Tobias", "Linus"];  
const arr3 = ["Robin", "Morgan"];  
const myChildren = arr1.concat(arr2, arr3);

The concat() method can also take strings as arguments:

### **Merging an Array with Values**

const arr1 = ["Emil", "Tobias", "Linus"];  
const myChildren = arr1.concat("Peter");

## **12] Flattening an Array**

Flattening an array is the process of reducing the dimensionality of an array.

The flat() method creates a new array with sub-array elements concatenated to a specified depth.

const myArr = [[1,2],[3,4],[5,6]];  
const newArr = myArr.flat();

console.log(newArr) // [1, 2, 3, 4, 5, 6]

## **Slicing and Splicing Arrays**

The slice() method slices out a piece of an array.

The splice() method adds new items to an array.

## **13] JavaScript Array slice()**

The slice() method slices out a piece of an array into a new array.

This example slices out a part of an array starting from array element 1 ("Orange"):

## const fruits = ["Banana", "Orange", "Lemon", "Apple", "Mango"]; const citrus = fruits.slice(1); // ['Orange', 'Lemon', 'Apple', 'Mango']

## **Note**

The slice() method creates a new array.

The slice() method does not remove any elements from the source array.

The slice() method can take two arguments like slice(1, 3).

The method then selects elements from the start argument, and up to (but not including) the end argument.

const fruits = ["Banana", "Orange", "Lemon", "Apple", "Mango"];  
const citrus = fruits.slice(1, 3); // ['Orange', 'Lemon']

const citrus = fruits.slice(0, -2); // ['Banana', 'Orange', 'Lemon']

const citrus = fruits.slice(-1); // ['Mango']

const citrus = fruits.slice(-2); // ['Apple', 'Mango']

## **14] JavaScript Array splice()**

The splice() method can be used to add new items to an array:

const fruits = ["Banana", "Orange", "Apple", "Mango"];  
fruits.splice(2, 0, "Lemon", "Kiwi");

The first parameter (2) defines the position **where** new elements should be **added** (spliced in).

The second parameter (0) defines **how many** elements should be **removed**.

The rest of the parameters ("Lemon", "Kiwi") define the new elements to be **added**.

The splice() method returns an array with the deleted items:

*const* fruits = ["Banana", "Orange", "Apple", "Mango"];

console.log("Original Array:\n" + fruits); // Banana,Orange,Apple,Mango

*let* removed = fruits.splice(2, 2, "Lemon", "Kiwi");

console.log("New Array:\n" + fruits); // Banana,Orange,Apple,Mango

console.log("Removed Items:\n" + removed); // Apple,Mango

## **Using splice() to Remove Elements**

With clever parameter setting, you can use splice() to remove elements without leaving "holes" in the array:

*const* fruits = ["Banana", "Orange", "Apple", "Mango"];

console.log(fruits.splice(0, 1)); *// ['Banana']*

The first parameter (0) defines the position where new elements should be **added** (spliced in).

The second parameter (1) defines **how many** elements should be **removed**.

The rest of the parameters are omitted. No new elements will be added.

Visit this link for more Array Methods

<https://www.programiz.com/javascript/library/array>

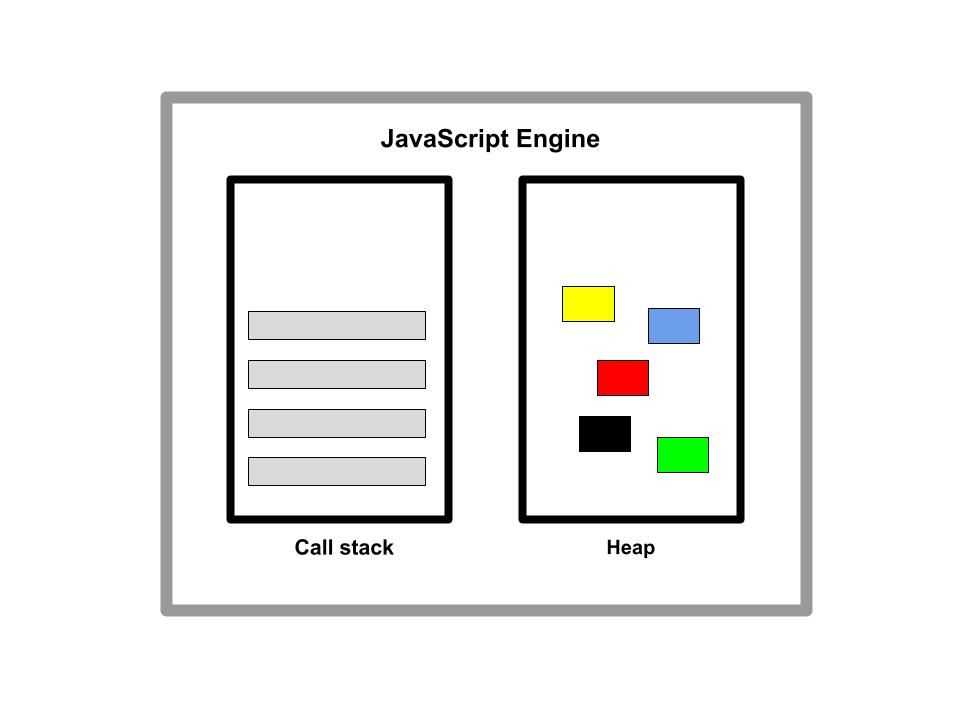
# Object Methods in JavaScript

<https://www.digitalocean.com/community/tutorials/how-to-use-object-methods-in-javascript>

<https://medium.com/geekculture/8-javascript-object-methods-every-developer-should-know-46838e6dc879>

# How Does JavaScript Work Behind the Scenes? JS Engine and Runtime Explained

## **The JavaScript Engine**



JavaScript Engine showing the Call stack and the Heap

The JavaScript engine is simply a computer program that interprets JavaScript code. The engine is responsible for executing the code.

Every major browser has a JavaScript engine that executes JavaScript code. The most popular one is the Google Chrome [V8](https://en.wikipedia.org/wiki/JavaScript_engine) engine. Google’s V8 powers Google Chrome and [Node.js](https://nodejs.org/en/docs), a back-end JavaScript runtime environment used to build server-side applications.

Other major browser engines include:

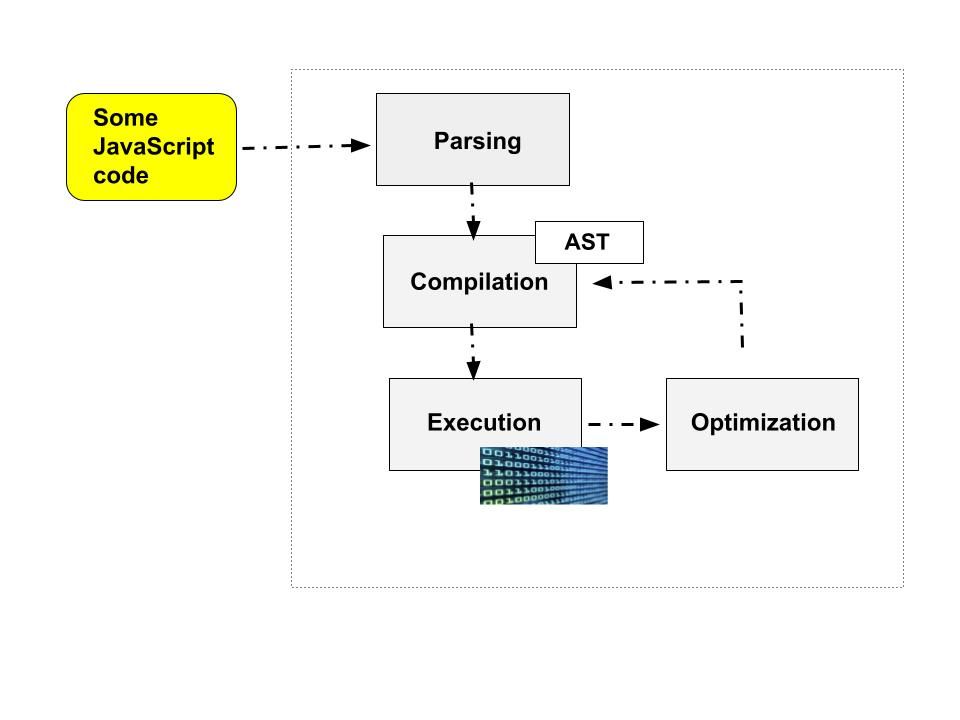
* SpiderMonkey developed by Mozilla for Firefox
* JavaScriptCore which powers the Safari browser
* Chakra which powers Internet Explorer

Any JavaScript engine typically contains a call stack and a heap. The call stack is where the code is executed. The heap is an unstructured memory pool that stores all the objects needed for the application.

Since the computer’s processor only understands binary, 0’s and 1’s, the code has to be translated to 0’s and 1’s.

When a code snippet passes into the engine, the code is initially parsed, that is read. The code is subsequently parsed to a data structure called the abstract syntax tree (AST). The resulting tree is then used to create machine codes.

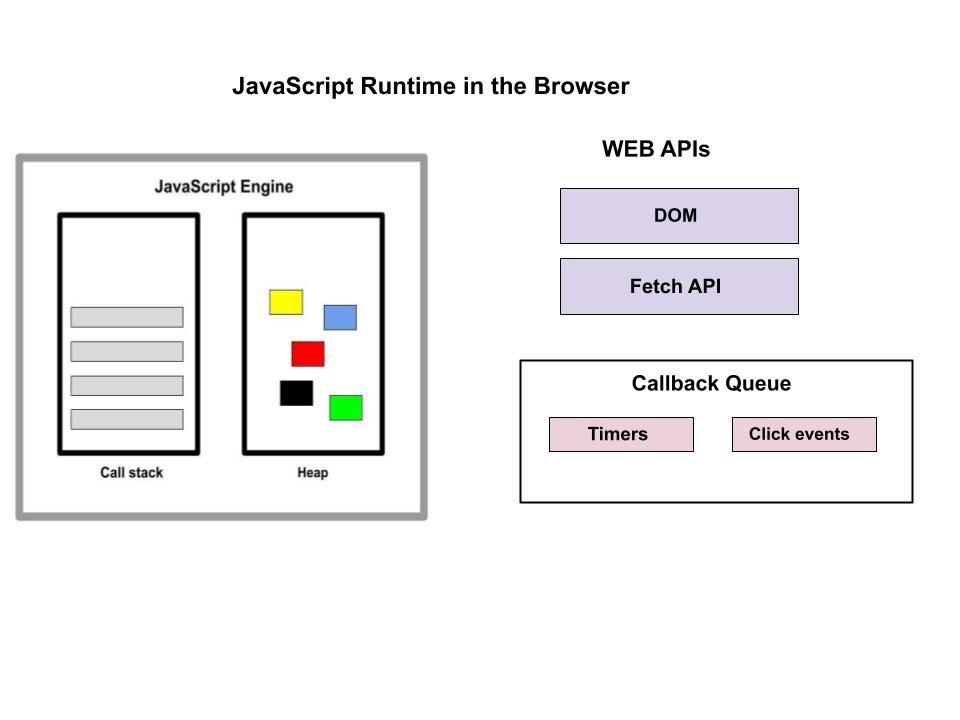
Execution happens in the JavaScript engine call stack using the execution context. This is the environment where JavaScript code is executed.

A diagram illustration showing the JavaScript execution process

## **The JavaScript Runtime**

Think of the JavaScript runtime as the house that encompasses all the components needed to run JavaScript. This house comprises the JavaScript engine, Web APIs, and the callback queue.

Web APIs are functionalities that are provided to the engine but are not part of the JavaScript language. They are accessible to the engine through the browser and help access data or enhance browser functionality. Examples are the Document Object Model (DOM) and Fetch APIs.



A diagram of JavaScript Runtime in the Browser containing the JavaScript Engine, WEB APIs, and the Callback Queue

The callback queue includes callback functions that are ready to be executed. The callback queue ensures that callbacks are executed in the First-In-First-Out (FIFO) method and they get passed into the stack when it’s empty.

The browser runtime and Node.js are examples of runtime environments.

When JavaScript executes within a web browser it is operating within the browser’s runtime environment. The browser runtime environment provides access to the DOM which enables interaction with web page elements, handling events, and manipulating the page structure.

Node.js provides a server-side runtime environment for executing JavaScript outside the browser. Because it executes JavaScript outside the browser, it does not have access to the web APIs. Instead, the Node.js runtime environment replaces it with something called C++ bindings and the thread pool.

## **JavaScript Optimization Strategies**

Modern JavaScript engines have some optimization strategies put in place to enhance the performance of code execution. These optimizations occur dynamically during the execution process. Let's look at some of these strategies.