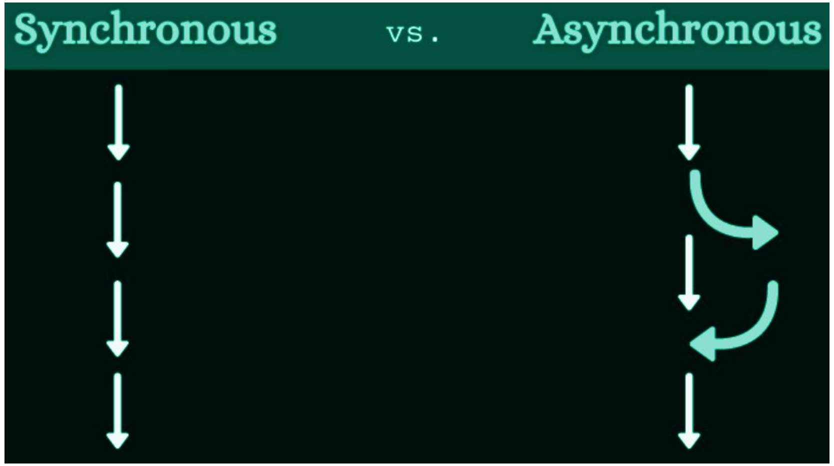
Asynchronous JS & Synchronous JS



Synchronous JavaScript

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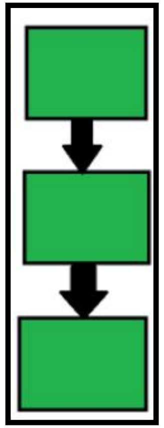
- Every statement in a **code** is **executed** in a **sequence,** one after the other.
- Every statement will **wait** for one statement to **complete executing**.
- JavaScript is a **single threaded synchronous programming language**.
- The JavaScript code **does not** run in **parallel, but** it can only **run one at a time**.



Synchronous JavaScript

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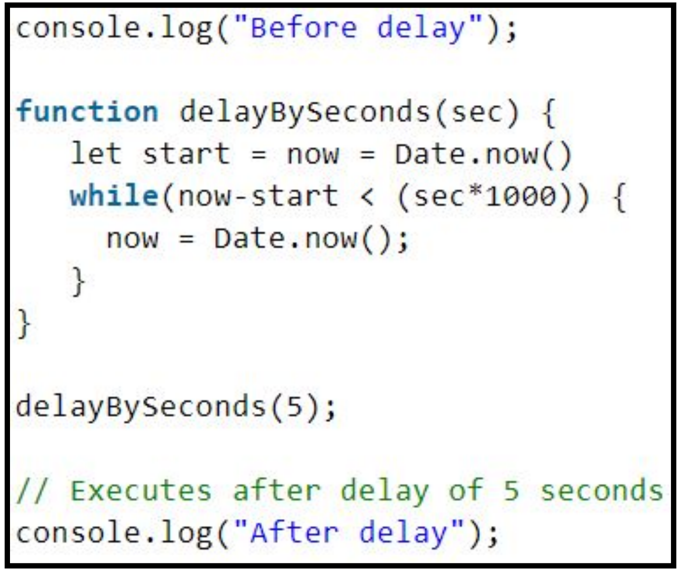


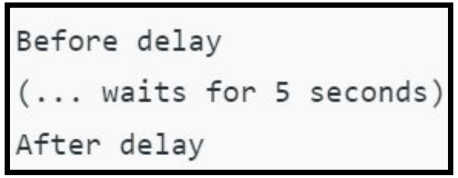
```
console.log("Before delay");

function delayBySeconds(sec) {
   let start = now = Date.now()
   while(now-start < (sec*1000)) {
     now = Date.now();
   }
}

delayBySeconds(5);

// Executes after delay of 5 seconds
console.log("After delay");
```

OUTPUT



```
Before delay
(... waits for 5 seconds)
After delay
```

Synchronous JS

Asynchronous JS

Memory Allocation

Function Call stack

Event Loop

Callback Hell

Asynchronous JavaScript

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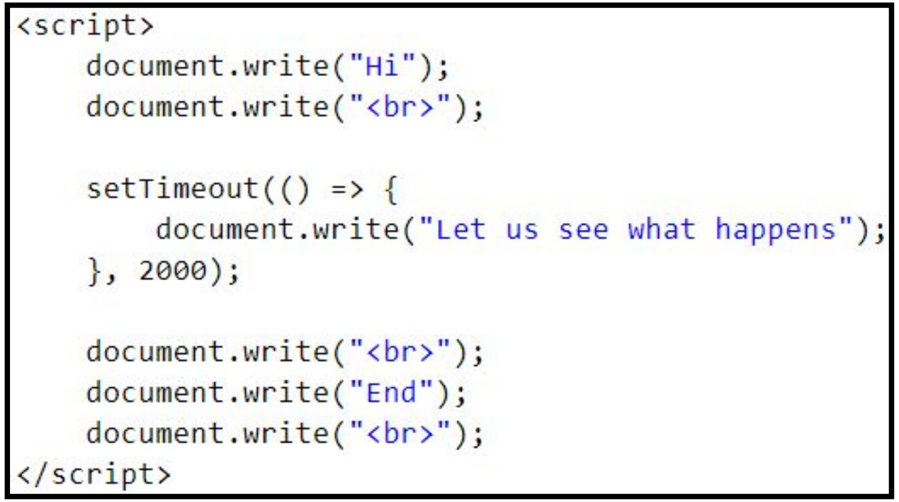
- The program will be executed **immediately** in **asynchronous code**.
- Many operations can be performed simultaneously in **AJAX**.

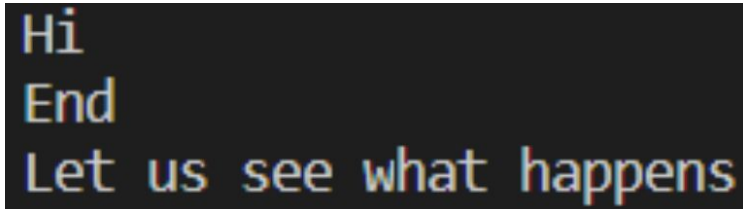


```
<script>
    document.write("Hi");
    document.write("<br>");

    setTimeout(() => {
        document.write("Let us see what happens");
    }, 2000);

    document.write("<br>");
    document.write("End");
    document.write("<br>");
</script>
```

OUTPUT



```
Hi
End
Let us see what happens
```

Synchronous JS | **Asynchronous JS** | Memory Allocation | Function Call stack | Event Loop | Callback Hell

Asynchronous JavaScript

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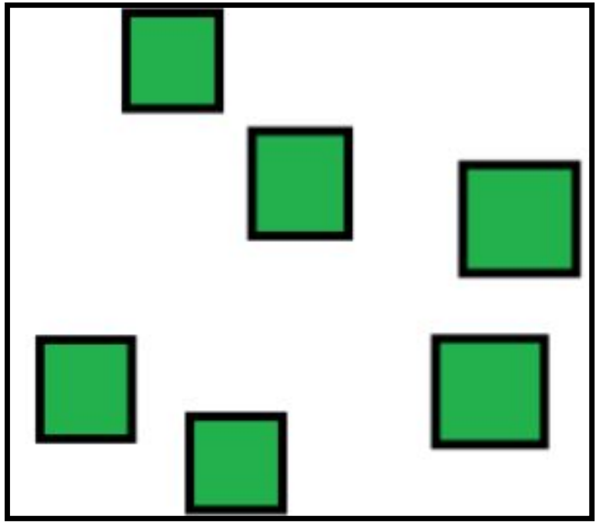
- At first, **Hi statement** will get logged.
- Then, JavaScript passes **setTimeout function to web API** and **rest of the code** will be **executed**.
- **After executing** all the code, the **setTimeout function** is pushed to the **call stack** and finally gets **executed**.

Memory Allocation

Heap Memory

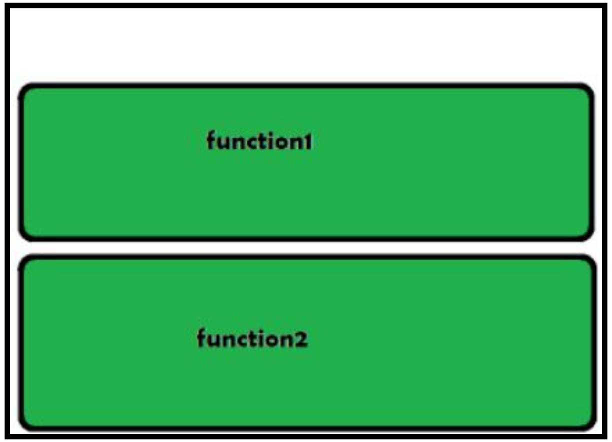
- The **data** will be **stored randomly** and **memory** is also allocated in the same manner.



Memory Allocation

Stack Memory

- The **memory** will be allocated in the **form of a stack**. In case of **functions, stack memory** is used.



Function Call Stack

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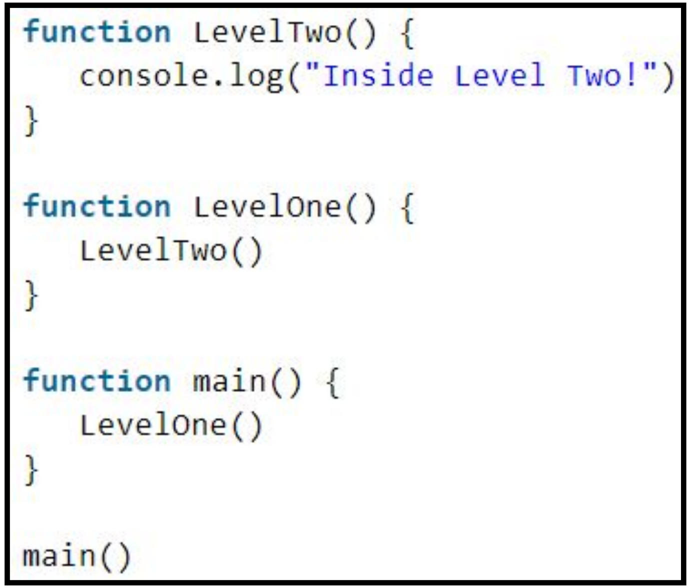
- The **function stack** is a **function** which **keeps track of all the functions** that are executed during the **run time**.
- When an **error** is occurred, we can see a **function stack** being printed at that time.



```
function LevelTwo() {
    console.log("Inside Level Two!")
}

function LevelOne() {
    LevelTwo()
}

function main() {
    LevelOne()
}

main()
```

Function Call Stack

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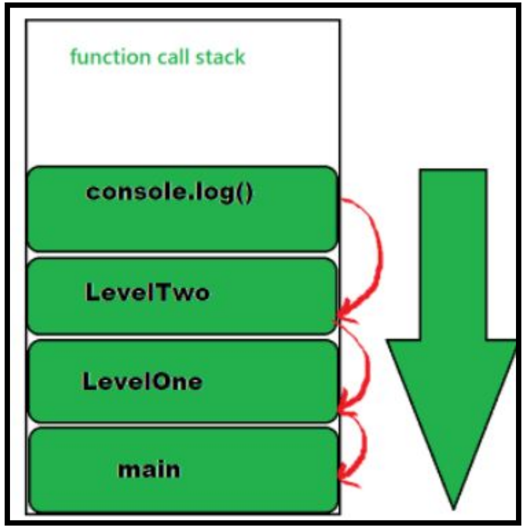
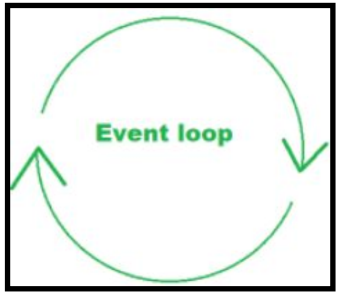
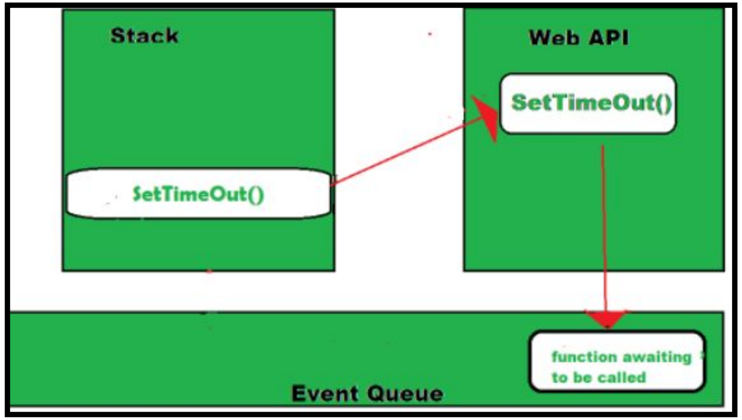
- The function gets **popped out of stack** after the function’s purpose gets over.



Event Loop

- Whenever a **function stack** is **empty**, the **event loop** pulls the stuff **out of queue** and places it over the **function stack**.
- The event loop gives the illusion of **multithreaded**.





Event Loop

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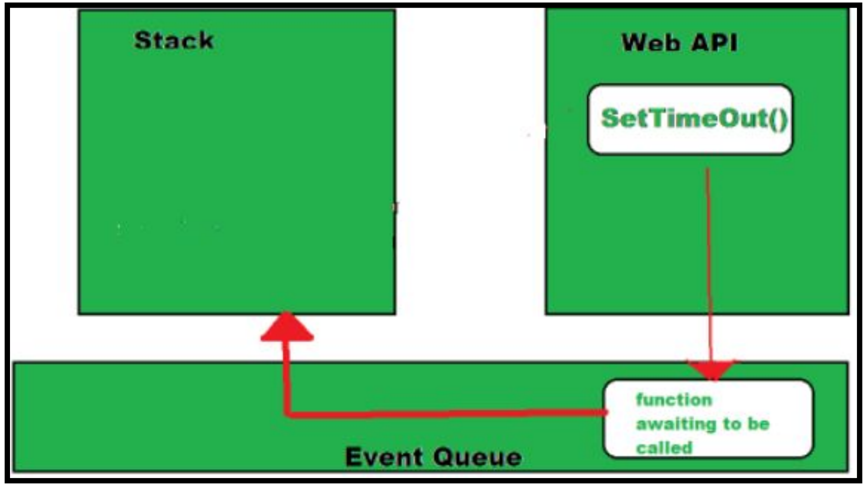
- The **callback** is in the **event queue** is **waiting** for its turn in the stack to run when **setTimeout()** is being **executed**. When the **function stack** becomes **empty**, it is **loaded** to the **stack**.



Event Loop

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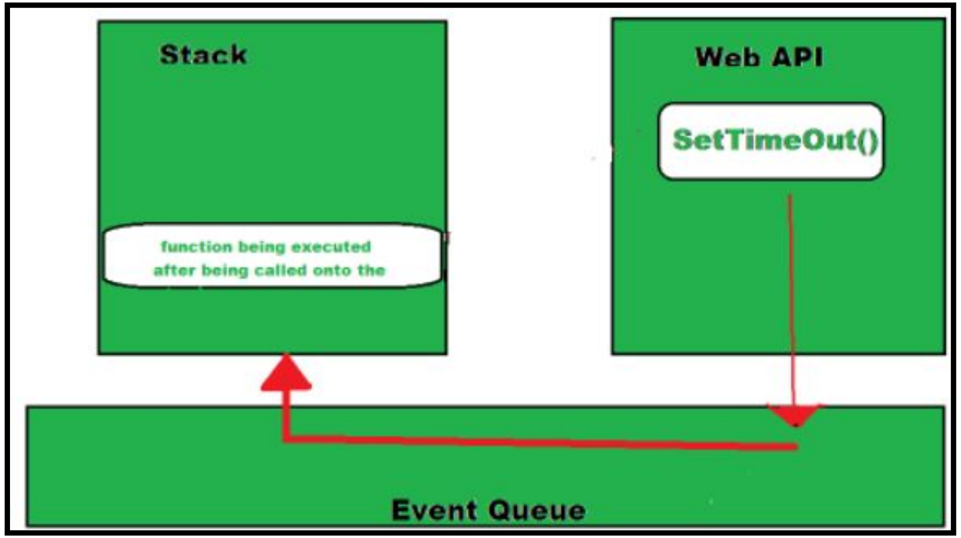
- The **first event** from the event queue is now being placed on the **stack**. This cycle is called **event loop** and this is how JavaScript handles **events**.



Callback Hell

- The code with **complex nested callbacks** will cause a **big issue** called **Callback Hell**.
- The **result** of the **previous callback** is taken up by the **upcoming callbacks**.
- The **code structure** will look like a **pyramid**.
- It is **difficult** to **read** and **maintain**.
- If anyone **function** has an **error**, it will **affect** all the **other function**.

Callback Hell

How to avoid callback hell?

- In JavaScript, **event queue** and **promises** help to **escape** from a **callback hell**.
- Any **asynchronous function** will **return an object** called **promise**. A **callback method** can be added to a **promise**.
- **.then()** method is used by **promises** to **call async callbacks**. As many callbacks can be chained together. The **order** of the callbacks is also **strictly maintained**.
- Promise uses
  - **.fetch()** method to **fetch an object** from the network.
  - **.catch()** method to **catch any exception** when any block fails.

Callback Hell

- The subsequent JS code **doesn't block** if these **promises** are put in **event queue**. The event queue finishes its operations once the results are returned.
- The keywords and methods like **async, wait, settimeout()** are used to **simplify** and make **callbacks used better**.