JAVASCRIPT

❖ **Introduction:**
- JavaScript is a high-level, Object-oriented, Multi-paradigm programming language.
- JavaScript allows us to add dynamic effects in pages.
- And it is also use for building entire web applications in the browser.

❖ **Inline JavaScript:**
- Inline JavaScript means the JavaScript written in HTML file.

❖ **External JavaScript:**
- There is separate JavaScript file with all logic having .js extension and attach in html file with script tag.
- This file make code modular and clear.
- Syntax: <script src=" filename.js"></script>

❖ **Values and Variable:**
- Values are an information or data.
- Variable are block whose store this value or information or data.
- Variable name should be camelCase
- Variable only contains letters, numbers, underscore '_' , $ sign.
- Variable should not start with numbers. Eg: 3name = 'hii'; ❌
- Variable may start with Underscore and dollar $
- For constant variable write variable in UPPERCASE. Eg: PI = 3.14 ✅

❖ **Data Types:**
- JavaScript has a dynamic typing -> We do not have manually define the data type of the value stored in a variable. Instead, data types are determined automatically.
- To check data type of variable we use **typeof** operator. Eg: **typeof** name

1. **Primitive Data Types:**
   I. **Numbers:** Floating point numbers -> Used for decimals and integers. Eg: let age = 23;
   II. **String:** Sequence of characters -> Used for text. Eg: let name = "js";
   III. **Boolean:** Logical type that can only be true or false -> Used for decision taking. Eg: let isLogin = true;
   IV. **Undefined:** Value taken by a variable that is not yet defined ('empty value') Eg: let children;
      - If we only declare variable the value and type both are undefined.
   V. **Null:** Also means 'empty value'.

1. **NOTE:** Null in JavaScript has a typeof **object,** but it is a biggest bug in JavaScript language.

VI. **Symbol:** Value that is unique and cannot be changed.

VII. **BigInt:** Larger integer than the Number type can told.

2. **Non – Primitive Data Types:**

- **Dynamic typing:**

```
let lastName = "Jangale";
console.log(typeof lastName);  //String
lastName = 100;
console.log(typeof lastName); //number
```

- String can be converted to number dynamically.

❖ **Let, const and var:**

1. Var:

- Var is oldest keyword in JavaScript for declaring a variable.
- It has a global scoped or function scope that means variable defined outside a function can be accessed globally and variable defined inside a particular function can be accessed within the function.
- Eg:

```
var a = 10
function f() {
    var b = 20
    console.log(a, b)
}
f();
console.log(a);
```

- We can re-declare a variable with same name in the same scope using var keyword, which give no error in case of var keyword

Eg:

```
var a = 10


var a = 8


a = 7
console.log(a);
```

2. **Let:**

- The let keyword is an improved version of the var keyword.
- It is introduced in ES6 or ECMAScript 2015.
- These variables have the block scope. It can't be accessible outside the particular code block.

Eg:

```
let a = 10;
function f() {
    let b = 9
    console.log(b);
    console.log(a);
}
f();
```

- Redeclaration in same scope of let variables is not allowed in JavaScript and it is the biggest advantages of let variables over var variables.

```
let a = 10

// It is not allowed
let a = 10

// It is allowed
a = 10
```

- But redeclaration in different scope is allowed in JavaScript.

Eg.

```
let a = 10
if (true) {
    let a = 9
    console.log(a) // It prints 9
}
console.log(a) // It prints 10
```

- We can modify the let value after declaring the value.

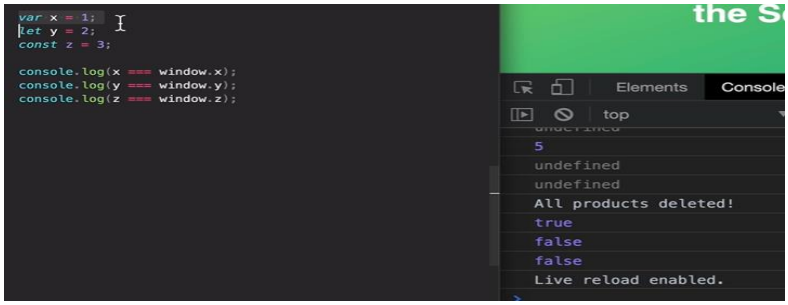
3. **Const keyword:**
    - Const has all the properties that are the same as the let keyword, except the user cannot update it and must assign it with a value at the time of declaration.
    - These variables also have the block scope.
    - It is mainly used to create constant variables whose values cannot be changed once they are initialized with a value like value of PI.

Eg:

```
const a = 10;
function f() {
    a = 9
    console.log(a)
}
f();
```

It gives TypeError: Assignment to constant variables.

Note : var variable creates properties in window object but **let and const** variables is not create properties in window object.



❖ **Difference between let, var and const variables:**

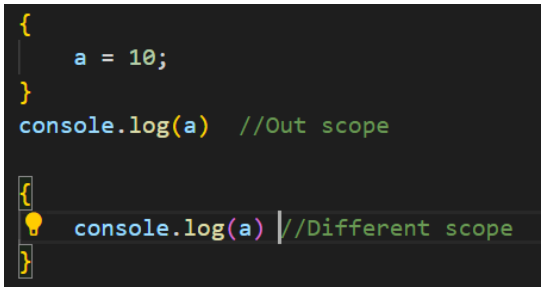
var	let	const
Scope is functional or global	Scope is block scope only.	Scope is block scope only.
It can be updated and re-declared in the same scopes. (Mutable)	It can be updated but cannot be re-declared in the same scope. (Mutable)	It cannot be updated or re-declared in any scope. (Immutable)
It can be declared without initialization.	It can be declared without initialization.	It cannot be declared without initialization.
It can be accessed without initialization as its default value is “undefined”.	It cannot be accessed without initialization otherwise it will give ‘referenceError’	It cannot be accessed without initialization, as it cannot be declared without initialization.
These variables are hoisted.	These variables are hoisted but stay in the temporal dead zone until the initialization.	These variables are hoisted but stays in the temporal dead zone until the initialization.

- **NOTE:** Don’t use var keyword for declaring variable because var is outdated variable and it is not safe because it has a global scope. And there is no error occurs when we redeclare var variables with same name.

❖ **Global Variable:**

- If we declare variable without using var, let and const this variable consider as a global scope variable. We can access this variable from out off the scope and also inside the other scope.

Eg:



- But you should not create variable without var, let and const keyword until and unless any requirement available.

❖ **Template Literals:**

- If we want to insert variable in string, we use backticks (` `) and pass variable in ${}.

- Template literals allowing us for multi-line string or string interpolation with embedded expressions.

  Eg:

```
const firstName = "Lokesh";
const lastName = "Jangale";
const job = "Junior Software Engineer";
const company = "Smart Stream Technology";
const year = 2024;

const details = `Hii, My name is ${firstName} ${lastName}
I am ${year - 2002} years old
I work as ${job} in ${company}`;

console.log(details)
```

  Output:

```
PS C:\Users\LJangale\Desktop\SST-Learning\JavaScript\01-Fundamentals-Part-1> node .\TemplateLiterals.js
Hii, My name is Lokesh Jangale
I am 22 years old
I work as Junior Software Engineer in Smart Stream Technology
```

❖ **Type Conversion:**

- JavaScript provide a way to convert data type manually.

1. **String to Number:**
   - Syntax: Number(value)
   - If we contain a string having number and we want to convert this string to number we use these syntax.

   Eg:

   let value = “23”;

   console.log (Number(value)) //output: 23→number
   - If variable contain string as a word the conversion output is NaN (Not a Number)

   Eg:

   let value = “Lokesh”;

   console.log (Number(value)) //output: NaN -> number
2. **Number to String:**
   - Syntax: String(value);
   - I we want to convert number to string then we use above syntax.

❖ **Type coercion:**

- Type coercion refers to the process of automatic or implicit conversion of value from one data type to another data type.

- This includes conversion from Number to String, String to Number, Boolean to number etc.
- For String if we use '+' then numberString is concatenated but if we use '-' then string is converted to number.

  Eg:

```
console.log(5 + '5')
console.log(5 - '5')
console.log('5' - 5)
console.log(5 * '5')
console.log(5 / '5')
console.log(5 ** '5')
console.log('5' * 5)
```

```
PS C:\Users\L
55
0
0
25
1
3125
25
```

Falsy value:

- In JavaScript there are 5 falsy values are available [0, undefined, ' ' , NaN, null].
- These 5 falsy values are used for false conditions.

❖ **Equality Operator == vs ===:**

1. **=== or Strict Equality operator:**
   - It is checking value and also data type of value are equal or not.
   - It does not perform type coercion.

   Eg:

```
console.log(18 === 18)  //true
console.log ('18' === 18) //false
```

2. **== or Loose Equality Operator:**
   - It is checking value but not check data type of value.
   - It performs type coercion.
   - That's why sometime bugs found

   Eg:

```
console.log (18 == 18) //true
console.log ('18' == 18) //true
```

Note: Always use strict equality operator (===) to check equality for value until and unless if any particular requirement are not present for ==.

❖ **Ternary Operator (?):**

- It is a conditional operator which is used to check conditions true or false.
- It works as a single line if – else statement.

- Syntax:

  Condition ? true statement : false statement;
- We call it a ternary operator because it has a tree main type condition, true statement and false statement.
- We can use ternary operators in template literals but we cannot use if-else statement in template literals.

  Eg:

```
let age = 15;
console.log(`I like to drink ${age >= 18 ? "wine 🍷" : "water 💧"}`)
```

❖ **Strict Mode:**

- Being a scripting language, sometimes the JavaScript code displays the code displays the correct result even it has some errors. Hence this is cause a bug In a program. To overcome this problem we can use the JavaScript strict mode.
- JavaScript provides "**use strict**"; expression to enable the strict mode. If there is any silent error or mistake in the code, it throws an error.
- We can write more safe code using strict mode.
- By using strict mode we can perform strict type checking in code. And it avoid global variable declaration
- The purpose of "use strict" is to indicate that the code should be executed in "strict mode".
- With strict mode, you cannot use undeclared variables or we cannot declare variable without let, const and var.

  Eg:

```
//Code without using strict mode
/*
let hasDrivingLicence = false
const passTest = true

if (passTest) hasDrivinLicence = true
if (hasDrivingLicence) console.log("I can drive now");
*/

//Above code is not giving error when i was assign value to wrong variable thats why it cause a bug in
our program
'use strict'
let hasDrivingLicence = false;
const passTest = true;

if (passTest) hasDrivinLicence = true;
if (hasDrivingLicence) console.log("I can drive now");

//This code give us a error message about hasDrivinLicence variable is not defined
```

❖ **Function:**

- Function is a piece of code which we can use repeatedly by just calling that function.

- We can also pass arguments to function, and function can also return some value.
- This is also called as function declaration.
- Functions allow us to write more maintainable code.
    - Syntax:
      function funcName(**param**){} //Function Declaration

      funcName(val); //Function Calling

    Eg:

```
//Normal Function
function calAge1(param) {
    return 2024 - param;
}
console.log(calAge1(2002))
```

❖ **Types of Function:**

1. **Anonymous Function:**
    - Function without name is called Anonymous Function.
    - This function is declaring as variable declaration
    - This is also called as function expression.
    - Syntax:

      const funcName = **function (param){}**

      Eg:

```
const calAge = function (param) {
    return 2024 - param;
}
const age = calAge(2002);
console.log(age);
```

Note: The main difference between function declaration and function expression is in function declaration we can call function before declaration but in function expression we cannot call function before declaration.

a) **Function Declaration:**

```
//Function declaration
console.log(calAge1(2002))
function calAge1(param) {
    return 2024 - param;
}
```

Output:

```
PS C:\Users\LJangale\Desktop\SST-L
Hii I am lokesh
5 0
Juice of 5 apples and 0 oranges
0 5
Juice of 0 apples and 5 oranges
22
22
```

- This function can execute before declaration
- We cannot use function declaration for callback function.

b) **Function Expression**:

```
//Function expression
const age = calAge(2002);
console.log(age);
const calAge = function (param) {
    return 2024 - param;
}
```

Output:

```
ReferenceError: Cannot access 'calAge' before initialization
    at Object.<anonymous> (C:\Users\LJangale\Desktop\SST-Learning\Jav
    at Module._compile (node:internal/modules/cjs/loader:1358:14)
```

- This function is not execute before declaration
- We can use function expression for callback function.

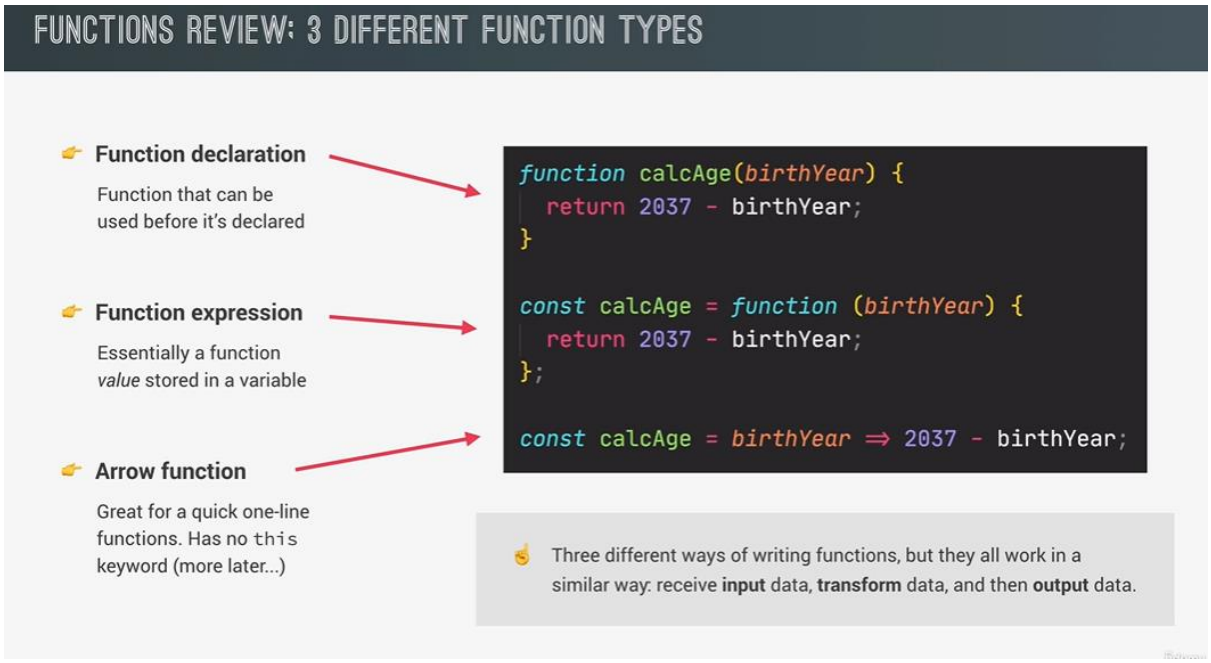
2. **Arrow Function:**
    - It is concise way of writing JavaScript functions in shorter way.
    - They make our code is more structured and readable.

- Arrow function is anonymous function that is function without a name but they are often assigned to any variable.
- They are also called as **Lambda function.**
- Syntax:
  const funcName = () => {}
- The return statement and function brackets are optional for single-line functions.

Eg:

```
//Arrow function

const yearsUntilRetirement = (birthYear, firstName) => {  //Arrow Function declaration
    let age = 2024 - birthYear;
    const retirement = 60 - age;
    return `${firstName} is retires in ${retirement} years`;
}
console.log(yearsUntilRetirement(2002, "Lokesh"))  //Arrow Function Calling
```

❖ **All Function type in one image:** 👇



❖ **Array:**

- An array is a group of similar elements or a data item of the same type collected at contiguous memory locations.
- Syntax:
  `const array_name = [item1, item2, ...];`
  Or

const array_name = **new Array(**item1, item2, ...**);**

Eg:

```
const friends = ["Lokesh", "Yeshwant", "Vishal"];
console.log(friends);

//Another way to declare array by using new keyword
const year = new Array(2001, 2002, 2003, 2004);
console.log(year);

//Find the length of array
console.log(friends.length);

//Find the last element of array
console.log(friends[friends.length - 1])

//Change the last element of array
friends[friends.length - 1] = "Karan";
console.log(friends);
```

- **Note:** If array is declared as a **const** we can modify the element of array but we cannot assign new array to that variable

Eg:

```
friends[1] = "Vikram";  //allowed
console.log(friends)
friends = ["Lukky"]  //not allowed
```

Output:

```
[ 'Lokesh', 'Yeshwant', 'Karan' ]
[ 'Lokesh', 'Vikram', 'Karan' ]
C:\Users\LJangale\Desktop\SST-Learning\JavaScript\
friends = ["Lukky"]  //not allowed
        ^

TypeError: Assignment to constant variable.
```

❖ **Object:**

- Object is a most important data type in JavaScript.
- Objects are store value as like array but in unique way.
- Array can store value in the form of index but object can store value is in the form of key-value pair.
- We can access element of array using index but we can access element of object by there keys.

- Object is like container in JavaScript which can hold multiple value in it. These value are store as a properties of object with it own key
- Syntax:

```
const object_name = {
        Key : value,
        ....
}
```

- We can access key by using dot (.) or square brackets (**['Key']**)

```
Eg:

console.log(lokesh.firstName);

console.log(lokesh['firstName'])
```

- The main difference in between dot and square brackets we can pass the expression in brackets, but we can't pass expression in dot.
  Eg:

```
const nameKey = "Name";
console.log(lokesh."first" + nameKey)  //Not allowed
console.log(lokesh['first' + nameKey])  //Allowed
```

- If we want to find value through any expression then only use bracket notation otherwise use dot notation it give more cleaner and simple code
- We can also pass function as a property in object
  Eg:

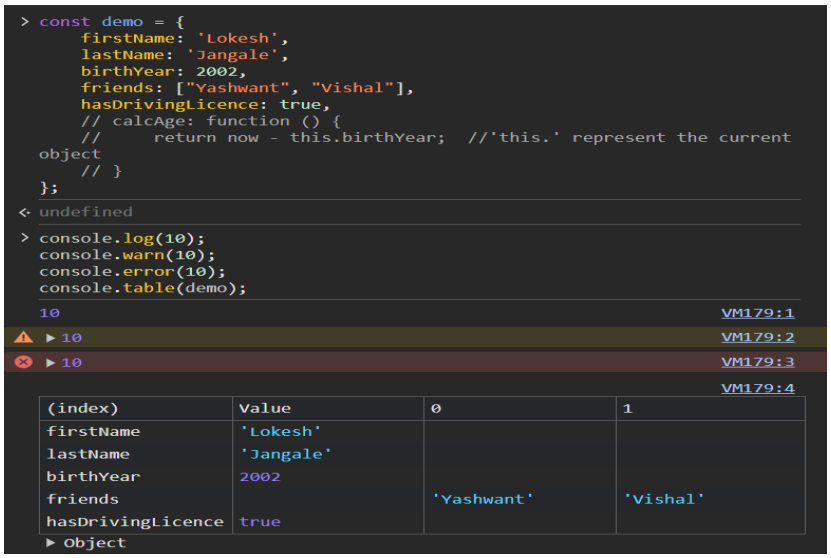
```
//We can also pass function in object
const demo = {
    firstName: 'Lokesh',
    lastName: 'Jangale',
    birthYear: 2002,
    friends: ["Yashwant", "Vishal"],
    hasDrivingLicence: true,
    calcAge: function () {
        return now - this.birthYear;
    }
};

console.log(demo.calcAge())
```

Note: this. Represent current object.

❖ **Type of console. :**

1. **console.log();** -> Generate log value
2. **console.warn();** -> use to generate warning in console.
3. **console.error();** -> use to generate error in console.
4. **console.table();** -> log value display in table format.

   Eg:

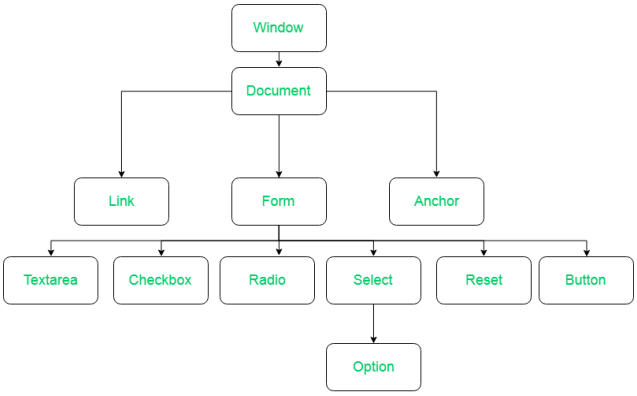


❖ **Software Bug:**

- Defect or problem in a computer program.
- Basically, any unexpected or unintended behaviour of a computer program is a software bug.

❖ **Document Object Model (DOM):**

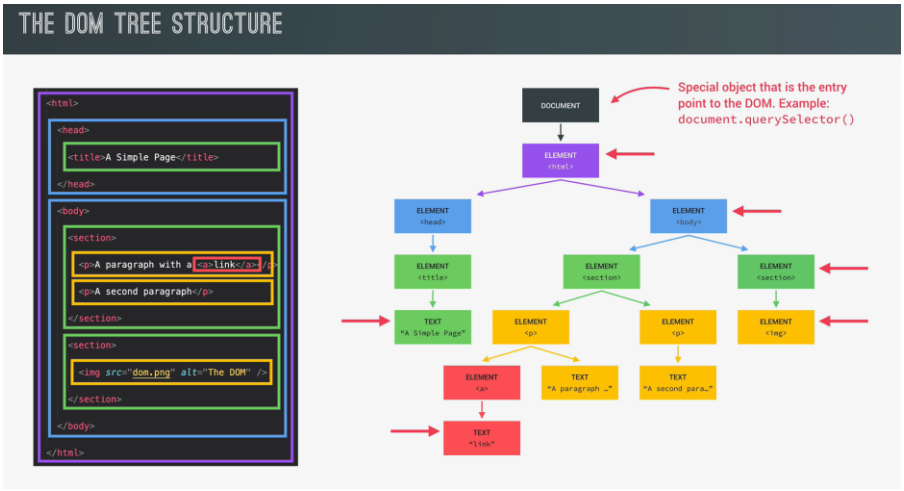
- DOM is a structured representation of HTML or XML documents in tree format.
- It allows JavaScript to access HTML elements and style to manipulate them.
- So basically, DOM is an API that represents and interacts with HTML or XML documents.
- We can also say that DOM is a connection point between JavaScript code and Html code.
- It is generated by browser when any HTML page is load in browser and it demonstrate HTML element in tree like structure.



- **Window Object:**
    - Window object is object of the browser which is always at top of the hierarchy. It is like an API that is used to set and access all the properties and method of the browser.
    - It is automatically created by browser.

- **Why is DOM Required?**
    - HTML is used to structure the web pages and JavaScript is used to add behaviour to our web pages.
    - When an HTML file loaded into the browser, the JavaScript cannot understand the Html document directly. So, it interprets and interact with DOM. Which is created by the browser based on the HTML documents.

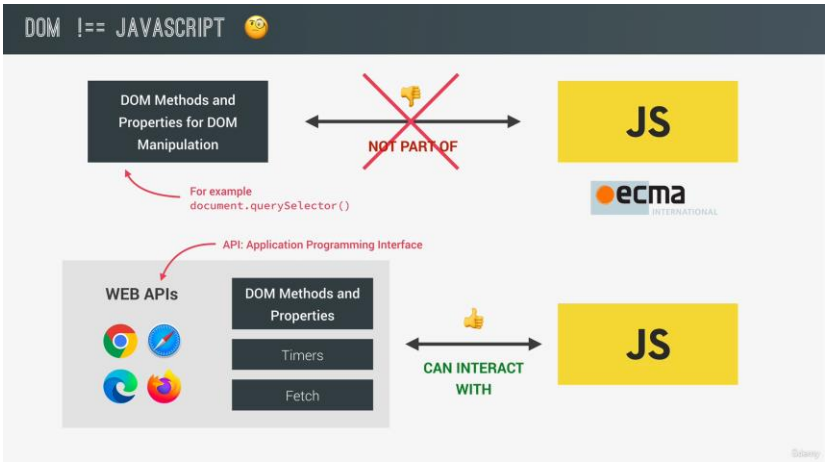
- **The DOM Tree structure:**



- This type of structure is generated by browser

❖ **DOM!== JavaScript:**

- DOM is not a part of JavaScript language it is a part of WEB APIs.
- WEB APIs is a library that browsers implement which we can access using JavaScript code.
- That is a reason DOM manipulation is work a same in all browsers.



- There are various other APIs present in WEB APIs just like Times, Fetch etc.

❖ **DOM Manipulation:**

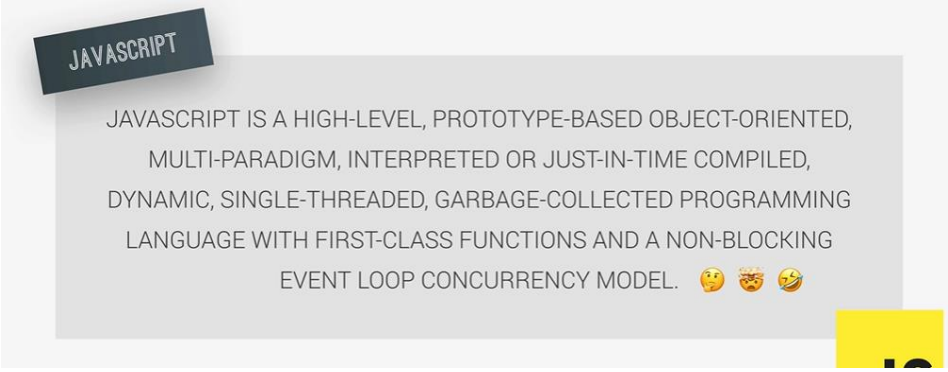
1) document.querySelector(“”);

- It is used to select any HTML element by using ID, className, tagName etc.
- We can perform various manipulation using this like text printing, Modifying that text.

Eg:

```
> document.querySelector(".message").textContent
'Start guessing...'
> document.querySelector(".message").textContent = "Hello world"
'Hello world'
>
```

❖ **High Level Overview of JavaScript Language:**



1. High Level:

- There are certain low-level languages like C where we need to manually managed resources such as Memory, RAM etc.
- But in High-Level Language Developer does not have to worry about resources it managed automatically.

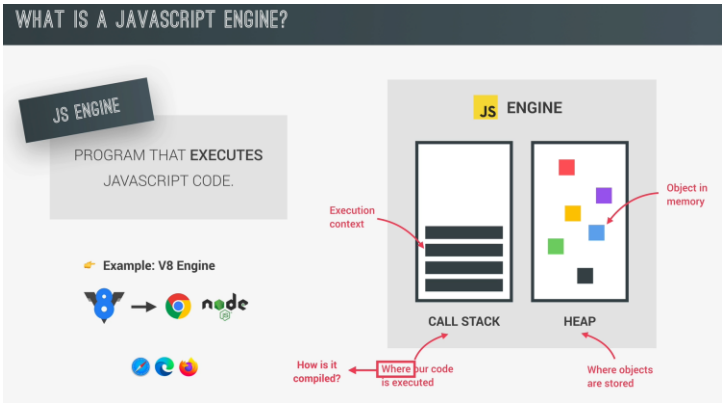
- It can make developer to write code easily, but disadvantages of high-level language are it is slower than low-level language like C.

2. **Garbage Collector:**
    - All Stubs for memory management for JavaScript is done by GC.
    - GC can remove unnecessary managed resource from memory and reclaim this memory.
    - It works as a cleaner in JavaScript.
3. **Interpreted or just-in-time compiler:**
    - JavaScript interpreter can compiler JavaScript code in Machine code.
    - Because computer is not understanding JavaScript code directly, it only understands binary code.
    - This can be done in JavaScript Engine.
4. **Multi-paradigm:**
    - **Paradigm:** An approach and mindset of structuring code, which will direct your coding style and technique.
    - There are 3 types of paradigm present in JavaScript.
    a. Procedural Programming
    b. Object-Oriented Programming (OOP)
    c. Functional Programming (FP)
5. **Prototype-based object-oriented:**
    - Almost everything in JavaScript is object except primitive value.
6. **Dynamic:**
    - JavaScript is dynamically type language means when we declare variable we never mention datatype we only mention "**Let, const, var"**
    - Type of variable becomes known at runtime based on value.
    - If we create variable with string value and then in next line, we mention number in same variable then datatype is automatically convert from string to number.
7. **First Class Function:**
    - In a language with first-class function, functions are simply treated as variables. We can pass them into other functions and return them from functions.

8. **Single-threaded:**
    - **Concurrency model:** How the JavaScript engine handles multiple tasks happening at a same time.
    - Because of JavaScript runs in on single thread, so it can only do one thing at a time.
9. **Non-blocking event loop:**
    - JavaScript is single threaded language so it can't easily handle long-running task.
    - We can achieve that using an **event loop:** Takes long running tasks, executes them in the "background", and puts them back in the main thread once they are finished.

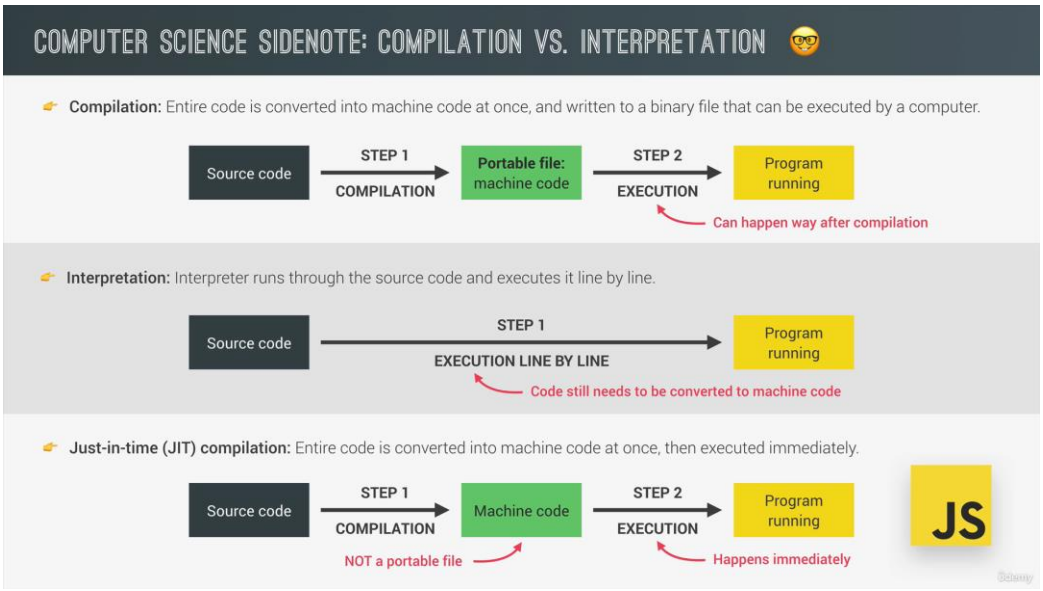
❖ **JavaScript Engine:**

- JavaScript Engine is simply a computer program that execute JavaScript code.
- JavaScript is a scripting language and is not directly understood by computer, but the browsers have inbuilt JavaScript engine which help them to understand and interpret JavaScript codes.
- These engine help to convert out JavaScript program into computer-understandable language.
- Every browser contains separate JavaScript engine but the most famous engine in **Google v8 Engine.** It is run on chrome as well as node js.

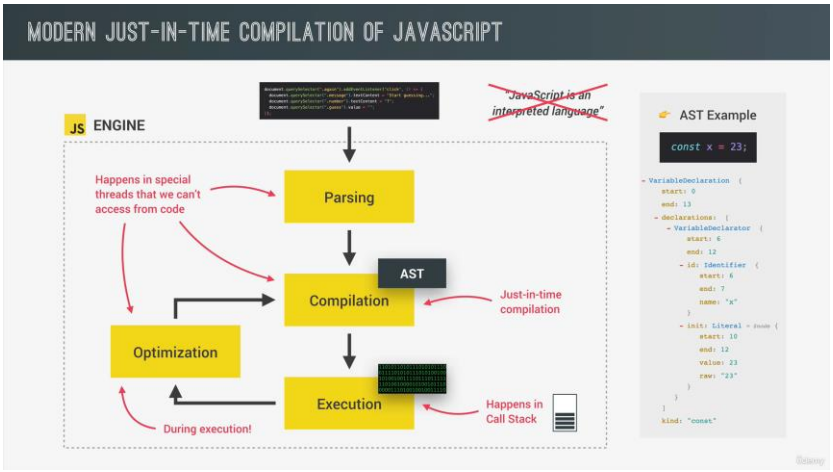


- **Call Stack:** Where our code is executed stack wise.
- **Heap:** Where all objects are stored.

- **Compilation vs Interpretation:**



1. We can say that old JavaScript are interpreted language, but interpretation makes JavaScript slower than other language
2. So, our modern JavaScript is **Just-in-time (JIT) compilation.**

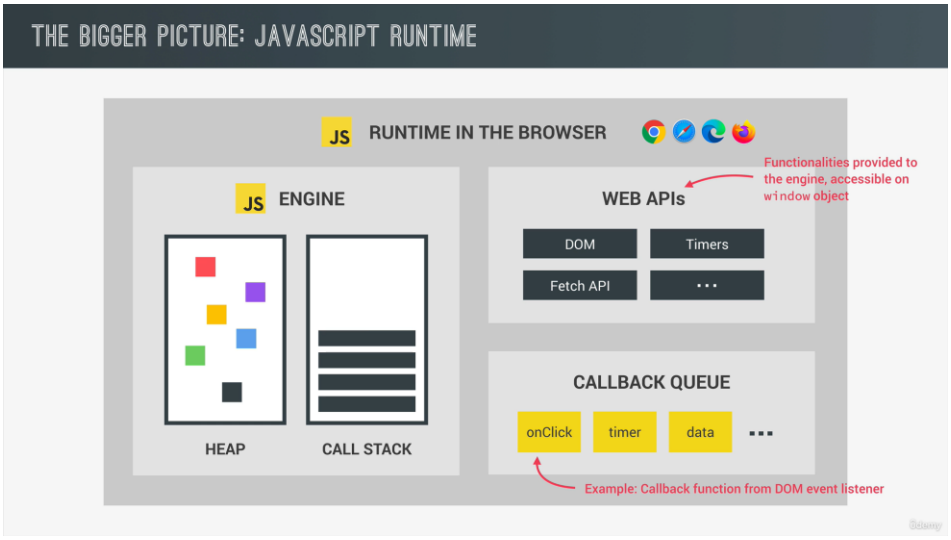


3. **AST:** Abstract Syntax Tree.

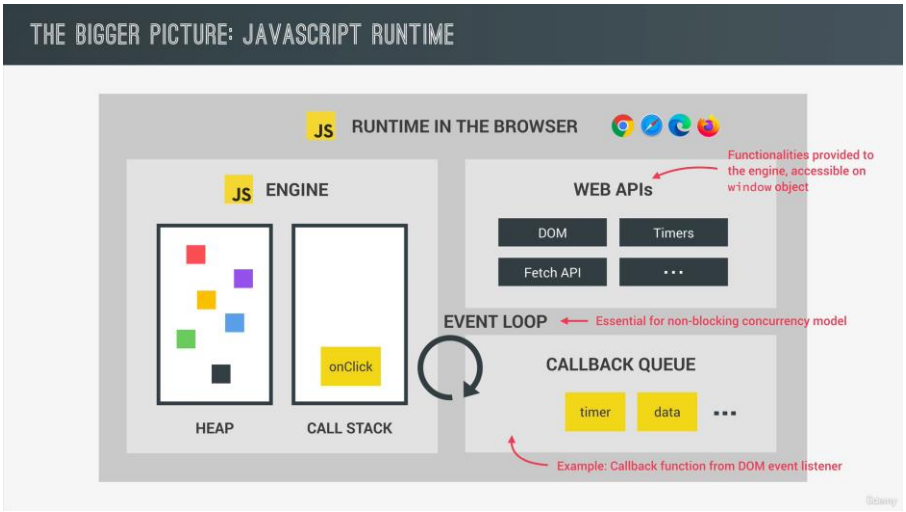
- **Different JavaScript Engines:**

Browser	Name of Javascript Engine
Google Chrome	V8
Edge (Internet Explorer)	Chakra
Mozilla Firefox	Spider Monkey
Safari	Javascript Core Webkit

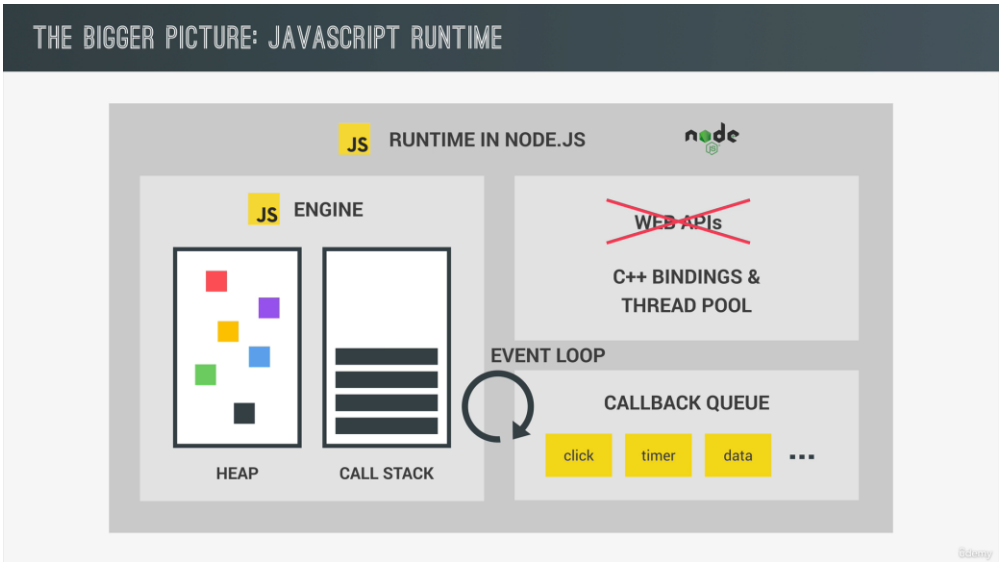
❖ **JavaScript Runtime on Web Browser:**



- All callback function is present in **callback queue.** When any event occurs or want to execute, function is loaded in **call stack** by using **event loop.**
- This process is executed in loop.



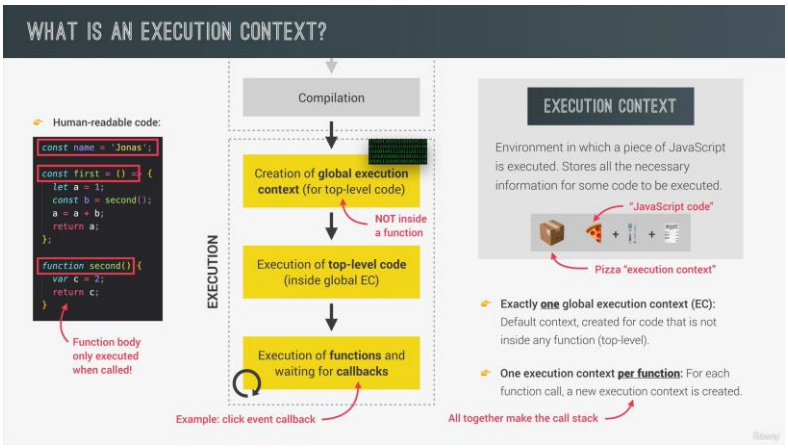
❖ **JavaScript Runtime on Node/Outside the browser:**



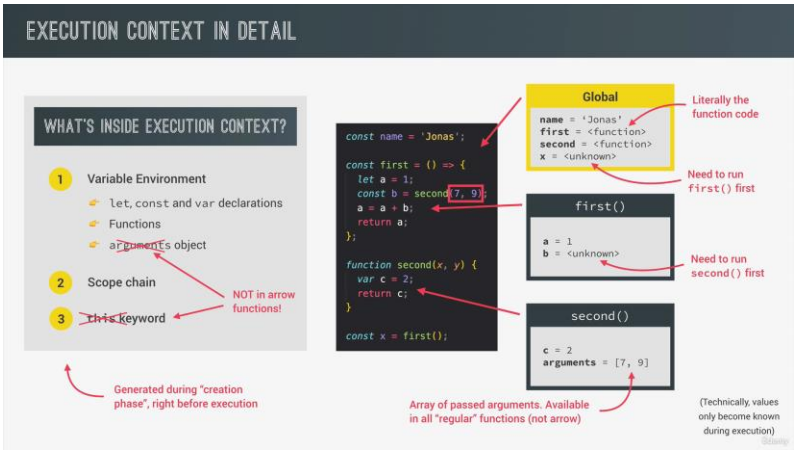
- As node is outside browser environment so **web APIs** are not available for node runtime instead of this **C++ Bindings and Thread Pool** are available.
- Execution of **callback event** are same as browser runtime environment.

❖ **Execution Context:**

- When the JavaScript engine scans a script file, it makes an environment called the **Execution Context** that handle the entire transformation and execution of the code.
- During the context runtime, the parser parse the source code and allocates memory for the variables and functions. The source code is generated and gets executed.
- There are two types of execution context : **global** and **function.**
- The **global** execution context is created when a JavaScript first starts to run, and it represent global scope.
- A **function** execution context is created whenever a function is called, representing the function's local scope.

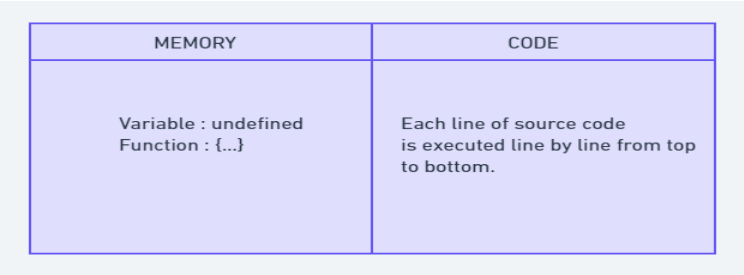


❖ **Execution context in detail:**

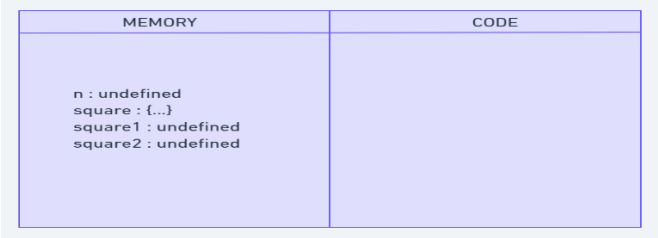


❖ [Phases of the JavaScript Execution Context]:

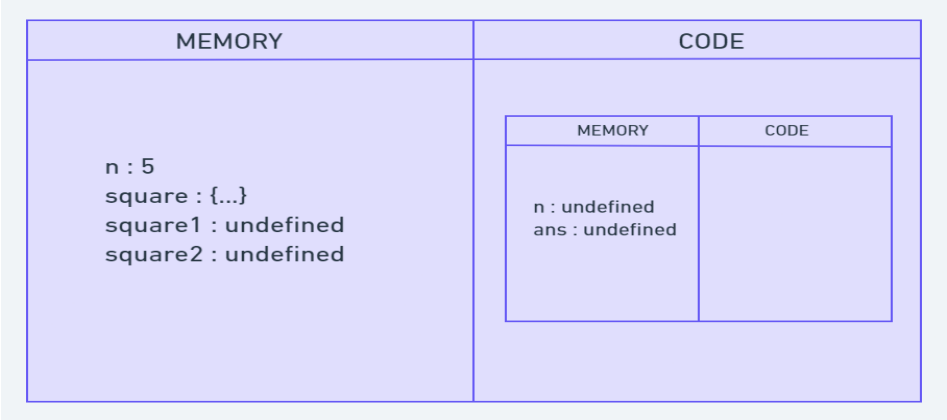
1. **Creation Phase:** In this phase, The JavaScript engine creates the execution context and sets up the script's environment. It determines the value of variables and functions and sets up the scope chain for the execution context.



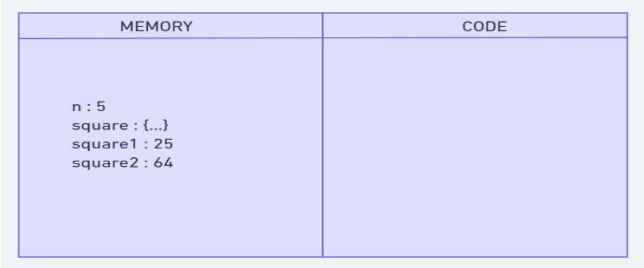
   - In creation phase only variable is created without, but value is not assign. The default value is **undefined**.
   - For function also same work only function name is defined like 👇



2. **Execution Phase:**
   - In this phase, the JavaScript engine executes the code in the execution context. It processes any statements or expressions in the script and evaluates any functions calls.
   - In this phase, it starts going through entire code line by line from top to bottom. And assign the value to every variable which define in creation phase. Until now, the value of variables was undefined by default.
   - For every function invoke in execution phase new function execution context is created where both creation and execution phase happen. 👇

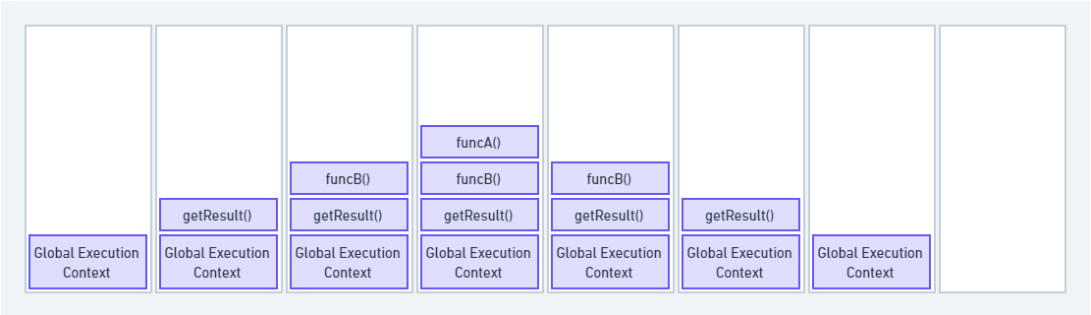


- Then function return the value and **function execution context** will be destroyed.



❖ **Call Stack:**

- For call stack description click on **call stack.**
- To keep the track of all the contexts, including global and functional, the JavaScript engine used **call stack.**
- A call stack also known as an "**Execution Context Stack**", **"Runtime Stack"** or "**Machine Stack**".
- It uses the **LIFO** principle. When the engine first starts executing the script, it crates global context and pushes it on the stack.
- Whenever function is invoked, similarly, the JS engine crate function stack context for the function and pushes it to the top of the call stack and starts executing it.
- When the execution of current function is complete, then the JavaScript engine will automatically remove the context from the call stack, and it goes back to its parent.



Note: JavaScript only work on single thread that's why only one function can executed at a time in call stack.

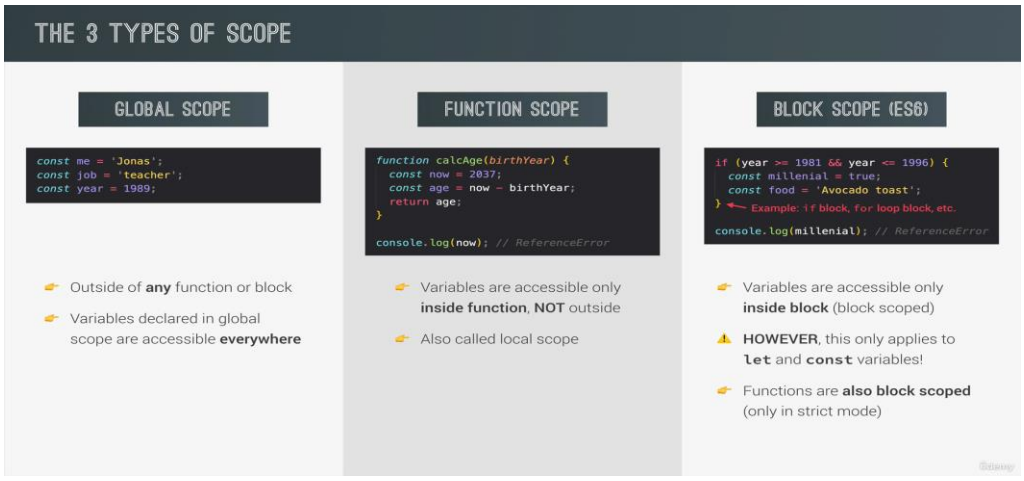
❖ **Scoping and Scope Chain in JavaScript:**

- **Scoping:** How our program's variables are organized and accessed. "Where do variables live?" or "Where can we access a certain variable, and where not?".
- **Lexical Scoping:** Scoping is controlled by placement of functions and blocks in the code.

- **Scope:** Space or environment or place in which a certain variable is declared (variable environment in case of functions). There is **global** scope, **function** scope and **block** scope.
- **Scope of a variables:** Region of our code where a certain variable can be **accessed.**

❖ **The 3 types of scope:**

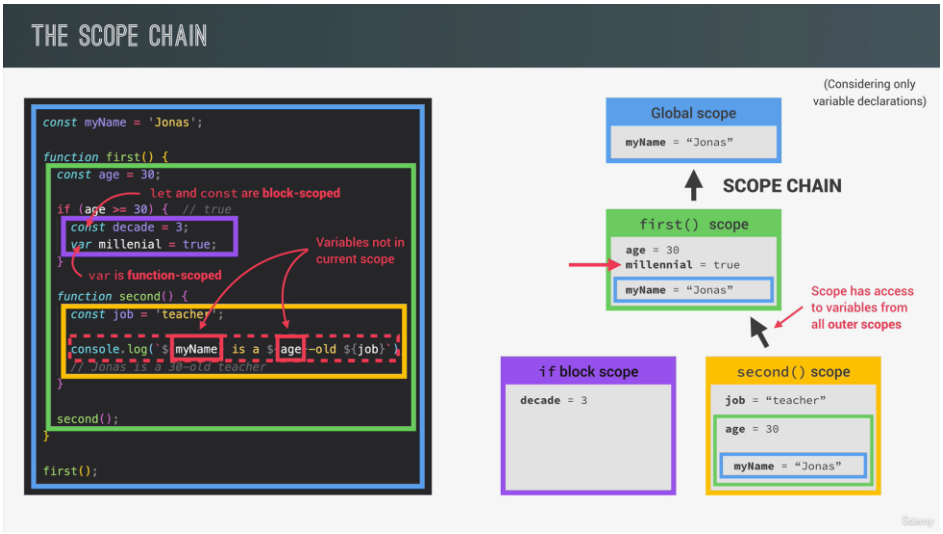
1. **Global Scope:**
    - Variable declare **outside** of any function or block is called global scope.
    - Variable declared in global scope are accessible everywhere.
2. **Function Scope:**
    - Variables are accessible only **inside function, Not Outside** function.
    - It is also called local scope.
    - If we try to access variable **outside** function which declared inside in function, we can get **Reference Error.**
3. **Block Scope:**
    - Block scope introduce in **ES6**.
    - Variables are accessible only **inside block scope** or **Curly braces {}.**
    - However, this only applies to **let** and **const** variables. It is not applying on **var** variables.
    - In **strict mode** function are also block scoped.

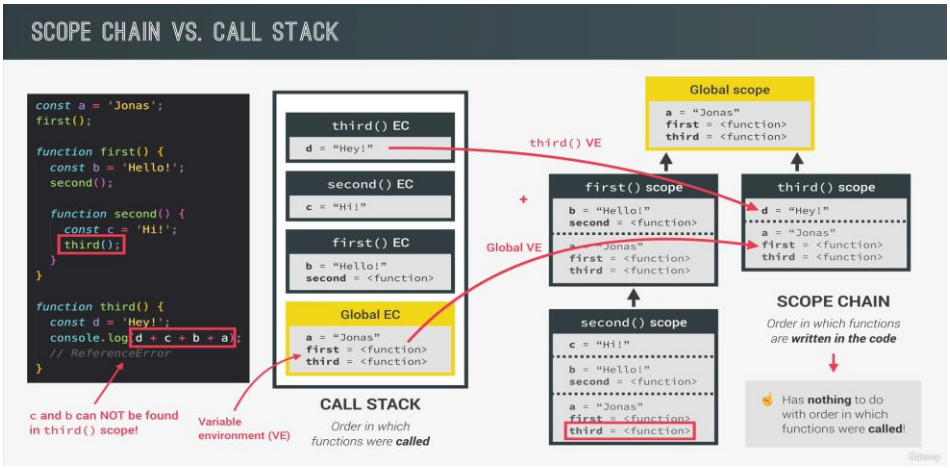


- **Note: let** and **const** are block scope but **var** is function scope. We can access var variable outside the block scope but we can't access var variable outside function.

- **Function** is a block scope only in **strict** mode. If we remove **use strict** then we can access function outside a block also.

❖ **The Scope chain:**





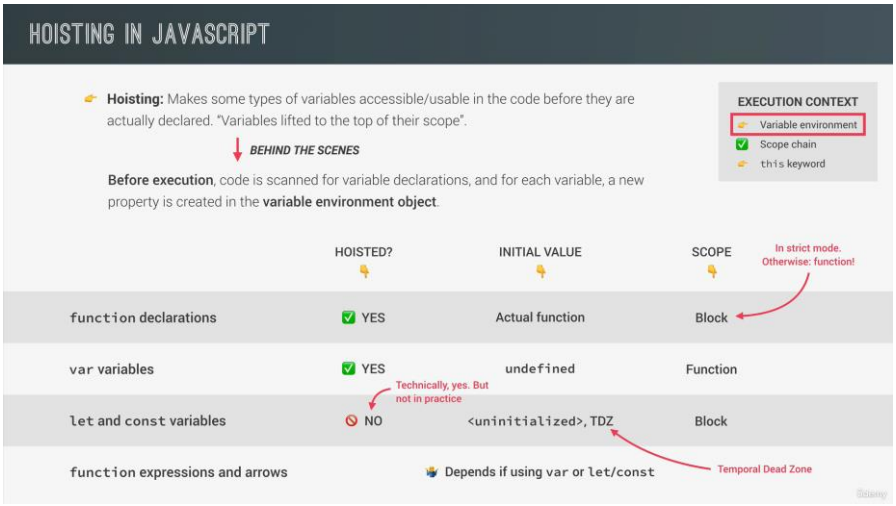
❖ **Scoping Summary:**

- Scoping asks the question “Where do variables live?” or “Where can we access a certain variable, and where not?”.
- There are 3 types of scope in JavaScript: **global scope, function scope and block scope.**
- Only **let** and **const** variables are block-scoped. Variable declared with **var** end up in the closest function scope.
- In JavaScript, we have lexical scoping, so the rules of where we can access variables are based on exactly where in the code functions and blocks are written.

- Every scope always has access to all the variables from all its outer scopes. This is the scope chain!
- When a variable is not in the current scope, the engine looks up in the scope chain until it finds the variable it's looking for. This is called variable lookup.
- The scope chain is a one-way street: a scope will never, ever have access to the variables of an inner scope.
- The scope chain in certain scope is equal to adding together all the variable environments of the all-parent scopes.
- The scope chain has nothing to do with the order in which functions were called. It does not affect the scope chain at all!

❖ **Hoisting in JavaScript:**

- Makes some types of variables accessible/usable in the code before they are actually declared. "Variables lifted to the top of their scope".
- **Before execution,** code is scanned for variable declarations, and for each variable, a new property is created in the **variable environment object.**



- Hoisting is the default behaviour in JavaScript where declarations of variables and functions are moved to the top of their respective scopes during the compilation phase.
- This is that regardless of where variables and functions are declared within a scope, they are accessible throughout that scope.
- JavaScript only hoist declarations, not initializations.
- Hoisting is allow calling function before their declarations.

❖ **Temporal Dead Zone (TDZ):**

- For a particular variable Temporal dead zone is area starts from the beginning of current scope to that variable declared.
- TDZ are use for: It makes easier to avoid and catch errors which is accessing variable before declaration is bad practice and it should be avoided.

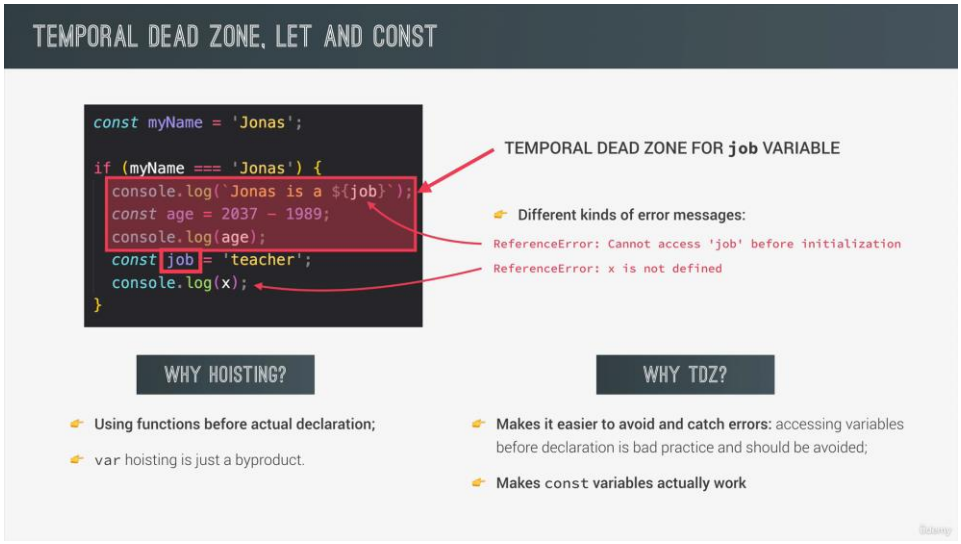
- It also makes **const** variable actually work, we know that **const** variable have one time declaration and initialization property so if we use **const** before declaring or initializing then it considers as a bad practice. That's why **TDZ** help us to avoid this mistake.

❖ **Why Hoisting?**

- Developer adds hoisting functionality in JavaScript to use function declaration before they are actual define.

```
// Function declaration
sayHello();

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

- But it only works with function declaration type it can't work with function expression or arrow function.



☞ **Hoisting for variable:**

- **var** variable can access before declaration but it gives **undefined** value.
- **let and const** variable cannot access before declaration it gives **ReferenceError.**

  Eg:

```
//=====Hoisting for variables=============
console.log(myName);  //undefined
console.log(age);     //ReferenceError: Cannot access 'age' before initialization
console.log(gender);  //ReferenceError: Cannot access 'gender' before initialization

var myName = "lokesh";
let age = 23;
const gender = "Male";
```

☞ **Hoisting for function:**

- For function declaration type hoisting of function is work fine.
- But for function expression type or arrow function hoisting is not work it give **ReferenceError.**

  Eg:

```
//=====Hoisting for Function===============
console.log(addDecl(2, 3)); //5
console.log(addExpr(2, 3)); //ReferenceError: Cannot access 'addExpr' before initialization
console.log(addArrow(2, 3)); //ReferenceError: Cannot access 'addArrow' before initialization

function addDecl(a, b) {return a + b;}

const addExpr = function (a, b) { return a + b;}

const addArrow = (a, b) => a + b;
```

- But if we create function with **var** variable it will give **TypeError**

  Eg:

```
//=====Hoisting for Function===============
console.log(addDecl(2, 3)); //5
console.log(addExpr(2, 3)); //TypeError: addExpr is not a function
console.log(addArrow(2, 3)); //ReferenceError: Cannot access 'addArrow' before initialization

function addDecl(a, b) { return a + b; }

var addExpr = function (a, b) { return a + b; }

const addArrow = (a, b) => a + b;
```

☞ **Hoisting with scope:**

```
const x = 2;
{
    console.log(x);  //ReferenceError: Cannot access 'x' before initialization
    let x = 3;
}
```

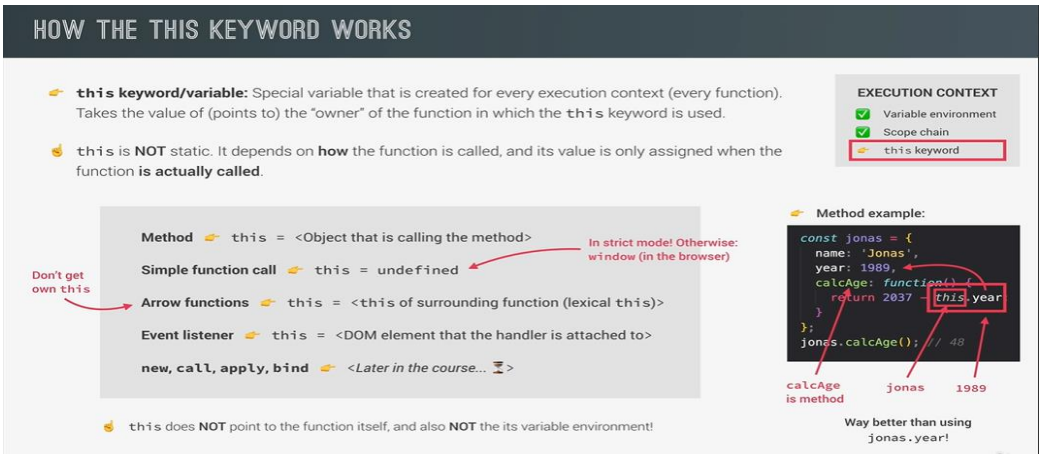
- It can first check **x** variable in current scope then if found but it is declared after calling that variable that's why it gives ReferenceError.

Note: Always remember that in the background the JavaScript is first declaring the variable and then initializing them. It is also good to know that variable declaration are processed before any code executed.

❖ **'this' keyword/variable:**

- It is a special variable that is created for every execution context (every function).
- It takes the value of the 'owner' of the function in which the keyword is used.
- **this** is not static. It depends on how the function is called, and its value is only assigned when the function is actually called.
- **this** keyword refers to the current context or scope or object within which code is executing.
- **Arrow function** doesn't get its own **this** variable. Although it uses **this** variable from there surrounding function (lexical this).

- Without strict mode **this** keyword in function refers global **window** function and contain all the properties of window function. But with strict mode **this** keyword in function give result as undefined.
- But for **arrow function** it refers surrounding function or window function with or without strict mode.



- In object **this** variable refers to the current object. If we create a function in object, in that function if we want to access property of that object then we use **this** keyword which is denote that this is a property of current object.
  Eg:

```
const lokesh = {
    name: "lokesh",
    year: 2002,
    calAge: function () {
        console.log(2024 - this.year);
    }
}
```

  By using **this.year** we can access year property of Lokesh object.

❖ **Regular function vs Arrow function regarding this keyword:**

- Arrow function does not contain **this** keyword. It inherits **this** from its parent function.

```
const lokesh = {
    firstName: 'Lokesh',
    year: 2002,
    calcAge: () => {
        console.log(this);    //{}
        console.log(2024 - this.year);  //NaN
    }
}

lokesh.calcAge();
```

- Parent function of **calcAge** function is window function and window function does not contain any **year** property.
- That's why use of arrow function as a function is bad practice instead of use any regular function like function expression or function declaration.

```
const lokesh = {
    firstName: 'Lokesh',
    year: 2002,
    calcAge: function () {
        console.log(this);   //{ firstName: 'Lokesh', year: 2002, calcAg
        console.log(2024 - this.year);  //22
    }
}

lokesh.calcAge();
```

- By using regular function, we can use all property of that object because regular functions contain **this** keyword.
- So, where we use arrow function let's see below example,

```
const lokesh = {
    firstName: 'Lokesh',
    year: 2002,
    calcAge: function () {
        console.log(this);   //{ firstName: 'Lokesh', year: 2002, calcAge: [Function: calcAge] }
        console.log(2024 - this.year);  //22
        const isEligible = function () {
            console.log(this);  //undefined
            console.log((2024 - this.year) > 18); //TypeError: Cannot read properties of undefin
        }
        isEligible();
    }
}

lokesh.calcAge();
```

  - As we saw **this** keyword is undefined because **isEligible**() function call is a just regular function call and the rule says that for every regular function call **this** keyword is set to undefined.
  - To make this workable we have two options:
    - Create a variable, assign it with this, and use it as this keyword

      Eg.

```
const lokesh = {
    firstName: 'Lokesh',
    year: 2002,
    calcAge: function () {
        console.log(this);   //{ firstName: 'Lokesh', year: 2002, calcAge: [Func
        console.log(2024 - this.year);  //22
        const self = this;
        const isEligible = function () {
            console.log(self);  //{ firstName: 'Lokesh', year: 2002, calcAge: [F
            console.log((2024 - self.year) > 18); //true
        }
        isEligible();
    }
}

lokesh.calcAge();
```

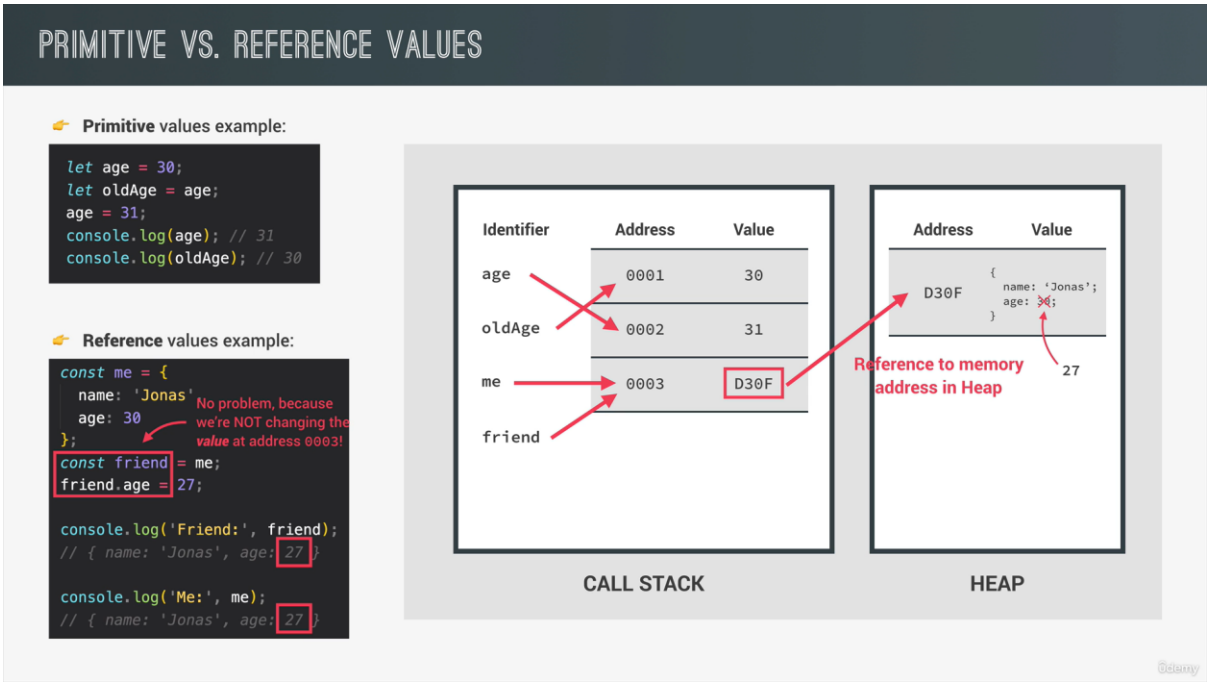
    - Use arrow function instead regular function, because arrow function inherits **this** keyword from parent function so it can access all property of that function.

      Eg.

```
const lokesh = {
    firstName: 'Lokesh',
    year: 2002,
    calcAge: function () {
        console.log(this);   //{ firstName: 'Lokesh', year: 2002, cal
        console.log(2024 - this.year);  //22

        const isEligible = () => {
            console.log(this);  //{ firstName: 'Lokesh', year: 2002,
            console.log((2024 - this.year) > 18); //true
        }
        isEligible();
    }
}
lokesh.calcAge();
```

- Regular functions have access of **arguments keyword,** but arrow function does not have access of **arguments** keyword.

❖ **Reference vs Primitive value:**



❖ Data Structure and Modern Operators:

1. **Array:**
   - **Destructuring of array:**
     - We can do these two ways:

```
//Destructuring of array
const arr = [1, 2, 3];
const a = arr[0];
const b = arr[1];
const c = arr[2];

console.log(a, b, c); //a=1,b=2,c=3

const [x, y, z] = arr;
console.log(x, y, z); //x=1,b=2,c=3
```

     - If we want to add third value of array to second element, we just pass nothing and separate it by comma.

```
const [first, , second] = restaurant.categories;
console.log(first, second); //O/P: Italian Vegetarian
```

- **Swapping/Switching a variable in array without using third variable:**

```
[first, second] = [second, first]; //--> Swapping without third variable
console.log(first, second); //o/p: Vegetarian Italian
```

- **Receive two return value from a function:**

```
const [starter, mainCourse] = restaurant.order(2, 0);
console.log(starter, mainCourse);   //Garlic Bread Pizza
```

- **Destructuring nested array:**

```
//Destructuring nested array
const nested = [2, 4, [5, 6]];
const [i, , [j, k]] = nested;
console.log(i, j, k); //2,5,6
```

- **Swap value of 2 variable using array destructuring.**

```
//Swapping value of 2 variable using array destruturing
let o = 12;
let m = 13;
[m, o] = [o, m];
console.log(o, m);
```

3. **Object:**

- **Destructing object:**
  - For destructing object, we need to mention the variable name as same as name of property in object
  - In object order is not important so if we want to skip some element then we don't need to mention blank element instead we just mention required property.

```
//Destructuring the object
const { name, openingHours, categories } = restaurant;
console.log(name, openingHours, categories);
```

O/P:

```
Classico Italiano {
  thu: { open: 12, close: 22 },
  fri: { open: 11, close: 23 },
  sal: { open: 0, close: 24 }
} [ 'Italian', 'Pizzeria', 'Vegetarian', 'Organic' ]
```

- If want to give our own name to the variable, we use below syntax:
  Property : variableName

```
const {
  name: restaurantName, //Classico Italiano
  openingHours: hours, //{thu: { open: 12, close: 22 },    fri: { oper
  categories: tags, // [ 'Italian', 'Pizzeria', 'Vegetarian', 'Organi
} = restaurant;
console.log(restaurantName, hours, tags);
```

- **For Default value:**

```
const { menu = [], starterMenu: starters = [] } = restaurant;
console.log(menu, starters); //[] [ 'Focaccia', 'Bruschetta', 'Garlic Bread', 'Caprese Salad' ]
```

Without default value we can get **undefined** if property is not present in object.

- **Mutating Variables/Alter variables:**
  - If we want to mutate existing variable value with object variable value
  - Syntax:
    ({existing_variables = object})

```
//Mutating variables
let a = 111;
let b = 999;
const obj = { a: 23, b: 7, c: 14 };
({ a, b } = obj);
console.log(a, b);  //a=23,b=7
```

- **Nested Object:**

```
//Nested Objects
const {
  fri: { open, close },
} = restaurant.openingHours;
console.log(open, close);  //11 23
```

❖ **Spread Operator(...):**

- The spread operator helps us **expand an iterable** such as an array where multiple arguments are needed, it also helps to expand the object expressions. In cases where we require all the elements of an iterable or object to help us achieve a task, we use as spread operator.
- Spread Operator is a key feature in JavaScript that enables an iterable to expand whenever zero or more arguments are required.
- Its primary use case is with arrays, especially when expecting multiple values.

- This operator provides the convenience of easily extracting a list of parameters from an array, making our code more versatile and readable.
- **Syntax:**

  let variableName = [...iterable];

  Eg:

```
// spread operator doing the concat job or merge element
let arr = [1, 2, 3];
let arr2 = [4, 5];

arr = [...arr, ...arr2];
console.log(arr); // [ 1, 2, 3, 4, 5 ]
```

- Whenever we need a individual element in array we use spread operator(...).
  Eg:

```
console.log(...arr); //1 2 3 4 5
```

- Difference between destructing array and spread operator is spread operator can takes all the element from array and it doesn't create new variable, however in destructing of array we can takes only required element in array and we can also store that element in variables.
- **Spread operator with string**

```
//working with string
const str = 'Lokesh';
const letter = [...str, ' ', 'J.'];
console.log(letter); //['L', 'o',  'k','e', 's',  'h',' ',
'J.' ]
```

Spread operator does not work with template literals because for template literals only one value is required one arguments but spread operator returns multiple value.

```
console.log(`${...str}`);
```

- **Working with function:**

```
//Working with function
function display(name1, name2, name3) {
  console.log(name1, name2, name3);
}
const nameArr = ['lokesh', 'Yashwant', 'Vikram'];
display(...nameArr); //lokesh Yashwant Vikram
```

- **Working with Objects:**

```
//Objects
const newRestaurant = { foundedIn: 1998, ...restaurant,
founder: 'Lokesh' };
console.log(newRestaurant);
```

- **Shallow copy of object**

```
//Shallow copy of object
const restaurantCopy = { ...restaurant };
restaurantCopy.name = 'Ristorante Roma';
console.log(restaurantCopy.name); //Ristorante Roma
console.log(restaurant.name);  //Classico Italiano
```

- **Rest Parameter(...parameterName):**
    - Rest parameter is **converse** to the spread operator.
    - While spread operator expands of an iterable, the rest parameter compresses them. It collects several elements.
    - Rest parameter is an improved way to handle function parameters, allowing us to more easily handle various input as parameters in a function.
    - The rest parameter syntax allows us to represent an indefinite number of arguments as an array.
    - With the help of rest parameter, a function can be called with any number of arguments, no matter how it was defined.
    - It is also used to collect multiple elements and composed it in array

```
//REST, because on LEFT side of =
const [a, b, ...others] = [1, 2, 3, 4, 5];
console.log(a, b, others); //1 2 [ 3, 4, 5 ]
```

    - **Rest operator** is use left side of assignment (=) operator. However, **spread operator** are use right side of assignment (=) operator.

```
//SPREAD OPERATOR
const arr = [1, 2, ...[3, 4]];
console.log(arr); //[ 1, 2, 3, 4 ]

//REST, because on LEFT side of =
const [a, b, ...others] = [1, 2, 3, 4, 5];
console.log(a, b, others); //1 2 [ 3, 4, 5 ]
```

    - Rest parameter should always last parameter.

```
const [a, b, ...others,e] = [1, 2, 3, 4, 5];  //SyntaxError: Rest element must be last element
console.log(a, b, others); //1 2 [ 3, 4, 5 ]
```

- **Working with function:**

```
//function
const display = function (...numbers) {
  console.log(numbers);
};
display(2, 3); //[2,3]
display(2, 3, 4, 5); //[2,3,4,5]
```

- **Working with objects:**

```
//Objects
const { sat, ...weekDays } = restaurant.openingHours;
console.log(weekDays);
```

```
{ thu: { open: 12, close: 22 }, fri: { open: 11, close: 23 } }
```

- **Short-circuiting:**
  - Short-circuiting is a behaviour exhibited by logical operator (&&, ||) where the evaluation of the second operand is skipped if the outcome can be determined by evaluating the first operand alone.
  - There are 3 different properties of logical operator:
    - It uses ANY Data Type
    - It returns ANY Data Type
    - Short-circuiting

```
console.log(3 || 'lokesh'); //3
console.log('' || 'Lokesh'); //Lokesh
console.log(true || 0); //true
console.log(undefined || null); //null
console.log(undefined || 0 || '' || 'Hello' || 23 ||
null); //Hello
```

- **Returning default value in multiple way**

If we want to return some value in case not any value is present, we can do like this.

```
//return default value if no value present in object using
ternary and short-cirtuit
//using ternary operator
restaurant.newGuest = 100;
const guest1 = restaurant.newGuest ? restaurant.newGuest :
10;
console.log(guest1); //10 --> if no value present then it
return 10 otherwise return value of restaurant.newGuest

//using short-circuting
const guest2 = restaurant.newGuest || 20;
console.log(guest2);
```

But it is not work with falsy value mean If restaurant.newGuest = 0 then it return default value

To Fix this in ES2020 new concept is introduces **Nullish Value**

❖ **Nullish Value:**

- Nullish value are **null** and **undefined** only it is not contain other falsy value like **0,' ', NaN.**
- It is fix that error

```
restaurant.newGuest = 0;
const guestCorrect = restaurant.newGuest ?? 20;
console.log(guestCorrect);   //0
```

Note: Or operator return first truthy value or return last falsy value and **And** operator return first falsy value or return last truthy value.

```
console.log('--- AND ---');
console.log(0 && 'Lokesh');//0
console.log(7 && 'Lokesh');//lokesh --> return last truthy
value
console.log('Hello' && 23 && null && 'lokesh'); //null
```

- Looping:
  - **For-of loop:**
    - For-of is used to iterate over the array or other iterables.

      Syntax:

      for(const/let variable **of** iterable) {};

      Eg:

```
//For-of loop
const menu = [...restaurant.starterMenu, ...restaurant.mainMenu];
for (const item of menu) {
  console.log(item);
}
```

- If we want to print value with their index use **.entries()** method

```
//If we want to print item with index value use .entries() method
for (const item of menu.entries()) {
  console.log(item);
}
```

```
[ 0, 'Focaccia' ]
[ 1, 'Bruschetta' ]
[ 2, 'Garlic Bread' ]
[ 3, 'Caprese Salad' ]
```

- Array indexing with different ways

```
//Print value with index using array indexing
console.log('-------Array indexing-----------');
for (const item of menu.entries()) {
  console.log(`${item[0]}: ${item[1]}`);
}

//Print value with index using array destructuring
console.log('-------Array Destructuring----------');
for (const [i, item] of menu.entries()) {
  console.log(`${i}: ${item}`);
}
```

- **Optional Chaining(?.):**
  - The optional chaining is an error-proof way to access nested object properties, even if an intermediate property doesn't exist.
  - It is similar to **chaining '.'** Except that it does not report the error, instead it returns a value which is **undefined**.
  - It also works with a function call when we try to make a call to a method which may not exist.
  - When we want to check a value of the property which is deep inside a tree-like structure, we often must perform check whether intermediate nodes exist.

```
//Optional Chaining
// console.log(restaurantNewUi.openingHours.mon.open); //TypeError: Cannot read prope
'open')
console.log(restaurantNewUi.openingHours.mon?.open); //undefined

const days = ['mon', 'tue', 'wed', 'thu', 'fri', 'sat', 'sun'];
for (const day of days) {
  const open = restaurantNewUi.openingHours[day]?.open ?? 'Closed';
  console.log(`On ${day} we open at ${open}`);
}
```

- It is also work on method, it checks method exists or not if exist then it execute that method or return undefined.

```
//Optional chaining on methods checking method exist or not
console.log(restaurantNewUi.order?.(0, 1) ?? 'Method does
not exists');
console.log(restaurantNewUi.orderRissoto?.(0, 1) ??
'Method does not exists'); //undefined or 'Method not
exist'
```

- Optional Chaining with array

```
//Optional chaining with array
// const user = [{ name: 'Lokesh', email: 'lokesh@gmail.
com' }];
const user = [];
console.log(user[0]?.name ?? 'User arry is Empty');
```

4. **Sets**:
   - Set is a collection of unique values, meaning no duplicate are allowed.
   - Set provide efficient ways to store and manage distinct elements.
   - Set is storing all type of iterable.
   - Set support operation like adding, deleting and checking presence of items, enhancing performance for tasks requiring uniqueness.
   - **Syntax:**

     const variableName = new Set([iterables**]);**

     Eg:

```
const orderSet = new Set([
  'Pizza',
  'Pasta',
  'Pizza',
  'Risotto',
  'pizza',
  'Pasta',
]);
console.log(orderSet);  //Set(4) { 'Pizza', 'Pasta',
'Risotto', 'pizza' }
```

   - If the parameter is not specified or null is passed, then a new set created is empty set.

- **.has()** method: Checking value/element present in Set or not

```
//checking element present in the Set or not
//.has()  -->true/false
console.log(orderSet.has('Pizza')); //true
console.log(orderSet.has('Bread')); //false
```

Note: If we want to work with unique value and order of element is not important then go with **Set** but if duplicates are allowed and order of element is important than go with **Array**.

5. **Maps**:
   - Collection of elements in key and values pair
   - It is not similar to **objects** because there is certain difference available in **objects** and **maps.**
   - In map **keys** can have any type but in object **keys** are only **string** type.
   - On iterating a map object returns the key, and value pair in the same order as inserted.
   - Map() constructor is used to create a map.
   - Syntax:

     const varName = new Map([key, value**]);**

     Eg:

```
// Creating a Map for product prices
const prices = new Map([
    ["Laptop", 1000],
    ["Smartphone", 800],
    ["Tablet", 400]
]);
```

   - **Map.set():** set() method is use to add element in map.

```
const rest = new Map();
rest.set('name', 'Classico Italiano'); //Key with string dat
rest.set(1, 'Firenze,Italy'); //Key with integer data types
```

Map.set() method also return a map

```
//Set method also return map
console.log(rest.set(2, 'Lisbon,Portugal'));
```

```
Map(8) {
  'name' => 'Classico Italiano',
  1 => 'Firenze,Italy',
  2 => 'Lisbon,Portugal',
  'categories' => [ 'Italian', 'Pizzaria', 'Vegetarian', 'Organic' ],
  'open' => 11,
  'close' => 23,
  true => 'we are open :)',
  false => 'We are close'
}
```

We can also use chaining with set method to add multiple elements in Map.

```
rest
  .set('categories', ['Italian', 'Pizzaria', 'Vegetarian',
  .set('open', 11)
  .set('close', 23)
  .set(true, 'we are open :)')
  .set(false, 'We are close');
console.log(rest);
```

- **Convert object to map**

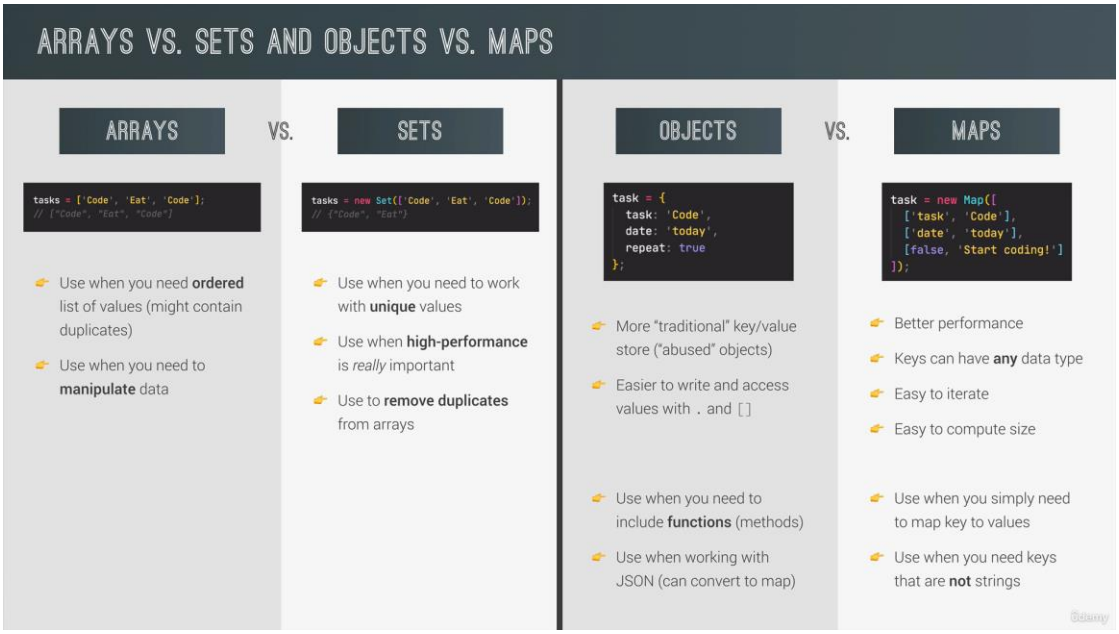
```
//Convert object to map
const data = { name: 'Lokesh', age: '23' };
console.log(Object.entries(data)); //[ [ 'name',
'Lokesh' ], [ 'age', '23' ] ]
const mapData = new Map(Object.entries(data));
console.log(mapData); //Map(2) { 'name' => 'Lokesh', 'age'
=> '23' }
```

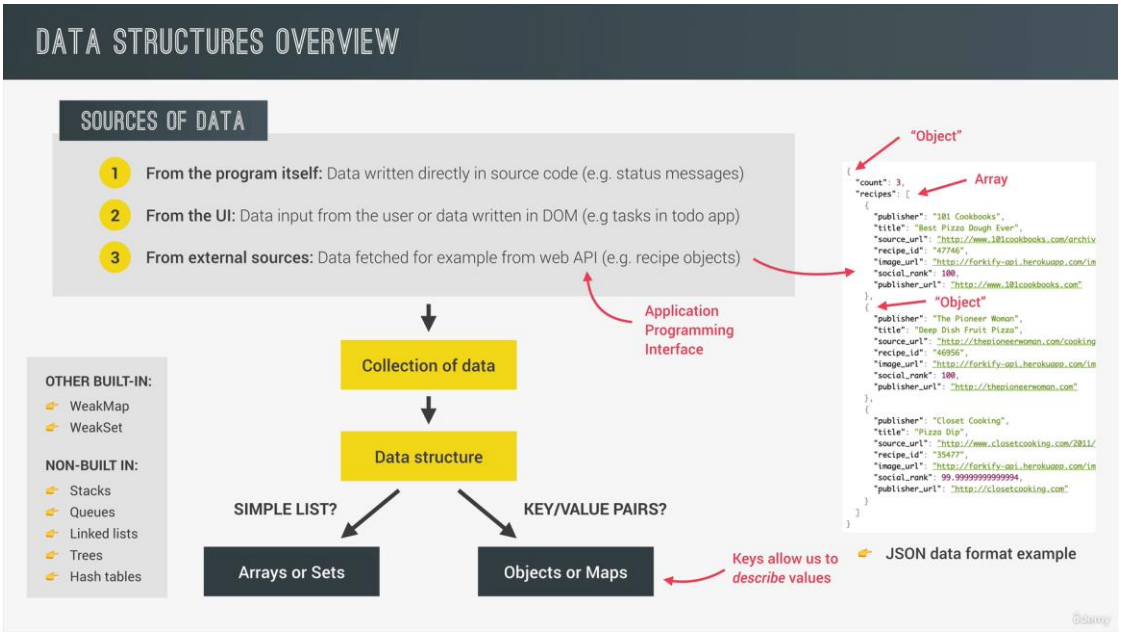
- **Convert map to array:**

```
//Convert map to aray
const mapToArray = [...question]
console.log(mapToArray);
```

- **When to use which data structure:**
    - In JavaScript there are 4 Data Structures are available array, object, set, map

1. **Array:**
    - If we want data in simple list and data may be duplicate and order of element is important then use array.
    - Use when you need to manipulate data because there is lots of useful method in array.
2. **Set:**
    - If we want data in simple list but data is unique, and order of element is not important than use set.
    - Use when **high-performance** is important.
    - Use to remove duplicates from arrays.
3. **Object:**
    - More “traditional” key/value store
    - Easier to write and access value with **. and []**
    - Use when you need to include **functions** (methods) in object
    - Use when working with **JSON** (can convert to map)
4. **Map:**
    - It gives Better perform than object
    - Key can have **any** data type
    - Easy to iterate because Map comes from iterable family.
    - Easy to compute size.
    - Use when you simply need to map key to values
    - Use when you need keys that are **not** strings.





❖ **String**:

- Collection array of character.
- To find length of string use **string.length** property.

```
//To find length of string
console.log(airline.length); //16
console.log('B339'.length); //4
```

- To find first found index of character or word use **.indexOf()** method.

```
//indexOf() method -->find first found index of letter
console.log(airline.indexOf('r')); //6
console.log(airline.indexOf('Air')); //4
```

- To find last found index of character/word use **.lastIndexOf()** method.

```
//lastIndexOf() method --> find last found index of letter
console.log(airline.lastIndexOf('r')); //10
```

- **.slice():** It is use to extract string from original string

```
//slice() method --> it extract string from given index
//It always return a new string which is substring of
original string and slice() is not modify original string
console.log(airline.slice(4)); //Air Portugal

console.log(airline.slice(4, 7)); //Air--> start and end
index

//Extract first and last word dynamically from string
console.log(airline.slice(0, airline.indexOf(' '))); //TAP
console.log(airline.slice(airline.lastIndexOf(' ') +
1)); //Portugal

//use slice with negative value
console.log(airline.slice(-2)); //al
console.log(airline.slice(1, -1)); //AP Air Portuga-->
print remaining letter after removing 1 letter
```

- **.trim() method:** Remove start and end spaces from string

```
//trim() methods -->Remove spaces from start and end of
string
const str = ' Lokesh Jangale ';
console.log(str.trim());
console.log(str.trimStart()); //Remove spaces from start
console.log(str.trimEnd()); //Remove spaces form end
```

- **Split() method:** It divide a string into multiple part from given character and store in array

```
//Split() --> Divide a string in multiple part from given
character and store in array
console.log('a+very+nice+string'.split('+')); //[ 'a',
'very', 'nice', 'string' ]
console.log('Lokesh Jangale'.split(' ')); //[ 'Lokesh',
'Jangale' ]
const [firstName, lastName] = 'Lokesh Jangale'.split(' ');
console.log(firstName, lastName);
```

- **Join() method:** Join splited string in single string

  Compress multiple string in single string

```
//Join() --> Compress multiple string in single string
const newName = ['Mr.', firstName, lastName.toUpperCase()].
join(' ');
console.log(newName);//Mr. Lokesh JANGALE
```

❖ Default Parameter:

```
const bookings = [];
const createBooking = function (
  flightNum,
  numPassenger = 1, //Default value if not any value/undefined is pass
  price = 1000 * numPassenger //Perform calculation as default value
) {
  const booking = {
    flightNum,
    numPassenger,
    price,
  };
  console.log(booking);
  bookings.push(booking);
};

createBooking('LH123'); //{ flightNum: 'LH123', numPassenger: 1, price: 1000 }
createBooking('LH123', 2); //{ flightNum: 'LH123', numPassenger: 2, price: 2000 }
createBooking('LH123', 3, 1500); //{ flightNum: 'LH123', numPassenger: 3, price: 1500 }
//skip parameter to get default value
createBooking('LH123', undefined, 3000); //{ flightNum: 'LH123', numPassenger: 1, price: 3000 }
```

❖ Primitive vs Reference type in function parameter:

Note: JavaScript is pass by value

- When we pass a primitive type variable in function it will create copy of that variable but when we pass reference type variable like objects it will pass reference of that object because reference type is store in heap and in call stack reference type variable access by there heap memory reference.

```
const flight = 'LH204';
const lokesh = {
  name: 'Lokesh Jangale',
  passport: 322456483683,
};

const checkIn = function (flightNum, passenger) {
  flightNum = 'LH323';
  passenger.name = 'Mr. ' + passenger.name;
  if (passenger.passport === 322456483683) {
    console.log('Checked in');
  } else {
    console.log('Wrong Passport!');
  }
  console.log(passenger);
};
checkIn(flight, lokesh); //{ name: 'Mr. Lokesh Jangale', passport: 322456483683 }
// checkIn(flight, { ...lokesh }); //{ name: 'Lokesh Jangale', passport: 322456483683 }
console.log(flight); //LH204
console.log(lokesh); // name: 'Mr. Lokesh Jangale', passport: 322456483683 } --> It is reference type so the
reference is pass to the function and function can manipuate reference type to avoid this we can pass shallow copy
of object --> checkIn(flight, { ...lokesh });
```

- To avoid this, we pass shallow copy of object by using spread operator

Syntax:

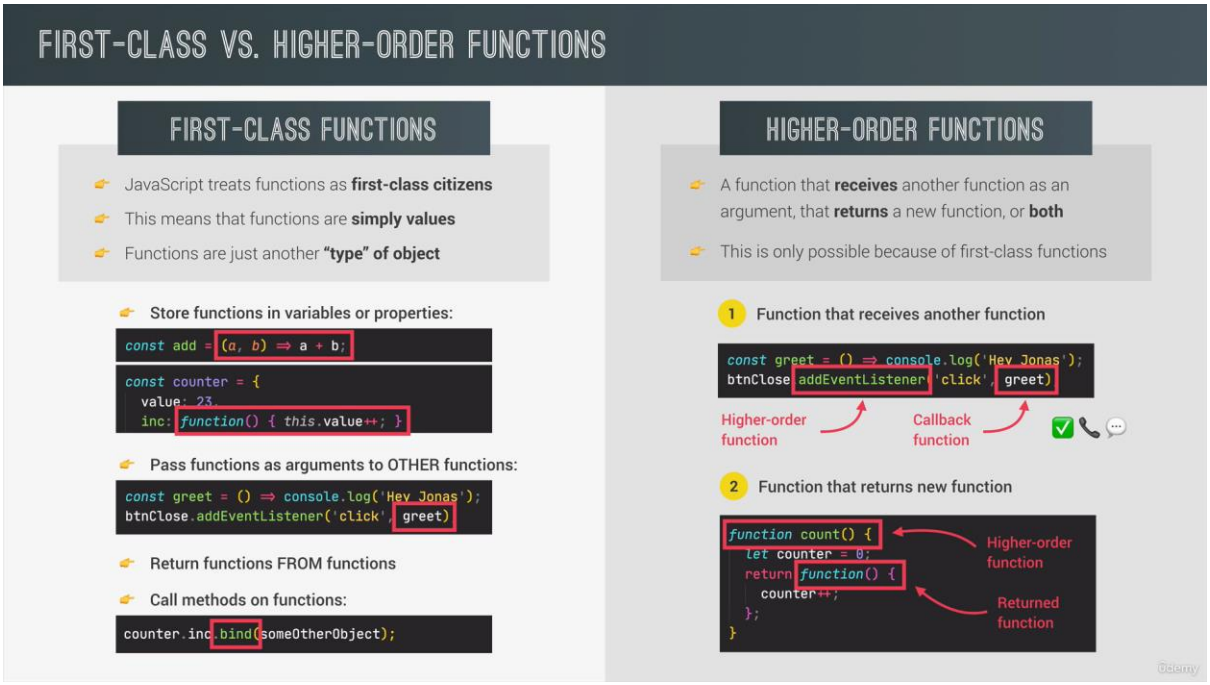
funcName({...objectName});

```
checkIn(flight, { ...lokesh }); //{ name: 'Lokesh Jangale', passport: 322456483683 }
```

It will pass copy of object not reference of object so if anyone try to make changes then it will not reflect in original object.

```
//This function try to change passport number
//original object: { name: 'Mr. Lokesh Jangale', passport:
322456483683 }
const changePassport = function (passenger) {
  passenger.passport = Math.trunc(Math.random() *
  100000000);
};
// changePassport(lokesh); //{ name: 'Mr. Lokesh Jangale',
passport: 86093387 }

changePassport({ ...lokesh });
console.log(lokesh); //{ name: 'Mr. Lokesh Jangale',
passport: 322456483683 }
```

❖ **First-class function vs Higher order function:**



- We can say that first – class function is a simply value or a function which is declare in object.
- We can also First – class function as an arguments to another function or return first – class function as a return type.
- However, Higer – order function is a function which receive argument of first-class function. We can simply say that it is a parent function
- Also function that return function is called Higer-order function.

❖ Callback Function: 🔗

- A callback function is a function passed as an argument to another function, which gets invoked after the main function completes its execution.
- You can pass the main function as an argument, and once the main function finishes its task, it calls the callback function to deliver a result.
- After making any function which can take callback function as a arguments so we made this function to perform in more generic way. So we can use that function for multiple logic

  Eg:

```
function isOdd(number) {
  return number % 2 != 0;
}
function isEven(number) {
  return number % 2 == 0;
}

function filter(numbers, fn) {
  let results = [];
  for (const number of numbers) {
    if (fn(number)) {
      results.push(number);
    }
  }
  return results;
}
let numbers = [1, 2, 4, 7, 3, 5, 6];

console.log(filter(numbers, isOdd));
console.log(filter(numbers, isEven));
```

  The above filter() function behave like generic function and take a callback function as a arguments. So this function perform in both cases like isOdd or isEven case.

- A callback function can be an anonymous function, which is a function without a name:

```
function filter(numbers, callback) {
  let results = [];
  for (const number of numbers) {
    if (callback(number)) {
      results.push(number);
    }
  }
  return results;
}

let numbers = [1, 2, 4, 7, 3, 5, 6];

let oddNumbers = filter(numbers, function (number) {
  return number % 2 != 0;
});

console.log(oddNumbers);
```

❖ **Function returning another function:**

```
//Function which return another function
const greet = function (greeting) {
  return function (name) {
    console.log(`${greeting} ${name}`);
  };
};

const greeterHey = greet('Hey,');
console.log(greeterHey); //[Function (anonymous)]
greeterHey('Lokesh'); //Hey, Lokesh

greet('Hello')('Yeshwant');//Hello, Yeshwant
```

❖ **Call() and apply() method:**

- If we want to explicitly define object to the '**this**' keyword we use call() and apply() method.
- Whereas both methods contain there first element is '**this**' keyword which we will pass.
- But second argument of both keywords are different:
    - Call() method takes normal parameter like whatever parameter we use in function.
    - But apply() method compulsory takes second parameter as array.

Eg

```
'use strict';
//Manipulate this keyword of different objcet
const lufthansa = {
  airline: 'Lufthansa',
  iataCode: 'LH',
  bookings: [],
  //book: function{}
  book(flightNum, name) {
    `${name} booked a seat on ${this.airline} flight ${this.iataCode}${flightNum}`;
    this.bookings.push({ flight: `${this.iataCode}${flightNum}`, name });
  },
};
lufthansa.book(239, 'Lokesh Jangale');
lufthansa.book(834, 'Yashwant Patil');
console.log(lufthansa);
const eurowings = {
  name: 'Eurowings',
  iataCode: 'EW',
  bookings: [],
};
const book = lufthansa.book;
// book(23, 'Sarah Williams');//undefined because it is only normal function and for every normal functioncall this keyword is undefined
book.call(eurowings, 232, 'Sarah Williams'); //this keyword points eurowings object
//.call() function have first parameter is 'this' object which is use to point which object should point
console.log(eurowings);
book.call(lufthansa, 439, 'Sagrika sinha');
console.log(lufthansa);

//Apply method --> apply() method take second argument array
book.apply(eurowings, [564, 'Vishal Patil']);
console.log(eurowings);
```

- By using these two methods we can manually set **this** keyword to function.

❖ bind() function:

- bind() function does not immediately call the function instead it return new function where **this** keyword is bound so it set to whatever value which we will pass to bind() function.
- bind() function does not call the function instead it bind function with given object and return that function with **this** keyword.

  Eg:

```
//bind() function
const bookEW = book.bind(eurowings);
bookEW(343, 'Vikram Patil');
console.log(eurowings);
```

  bind() function just return function with **this** keyword as a value and **bookEW** store that function as a function expression and then it is call like normal function expression is call.

❖ Immediately invoke function expression(IIFE) :

```
// IIFE
(function () {
  console.log('This will never run again');
  const isPrivate = 23;
})();

// console.log(isPrivate);

(() => console.log('This will ALSO never run again'))
();
```

- If we want to create a function which will execute only once than we can do like this
- The main reason for IIFE is to create a scope for variables.
- But this technique/pattern are no more use because we can easily create scope with jus curly braces {}.
- Only one advantage of IIFE is we can declare **var** variable which has a function scope we cannot access it outside the function but if we create scope using curly braces which is block scope **var** variable can also accessible outside scope

```
(function () {
  console.log('IIFE code');
  var isPrivate = true;
})();
// console.log(isPrivate); //Reference error

{
  console.log('Block Scope');
  var isPrivate = true;
}
console.log(isPrivate);//true
```

❖ Closures:

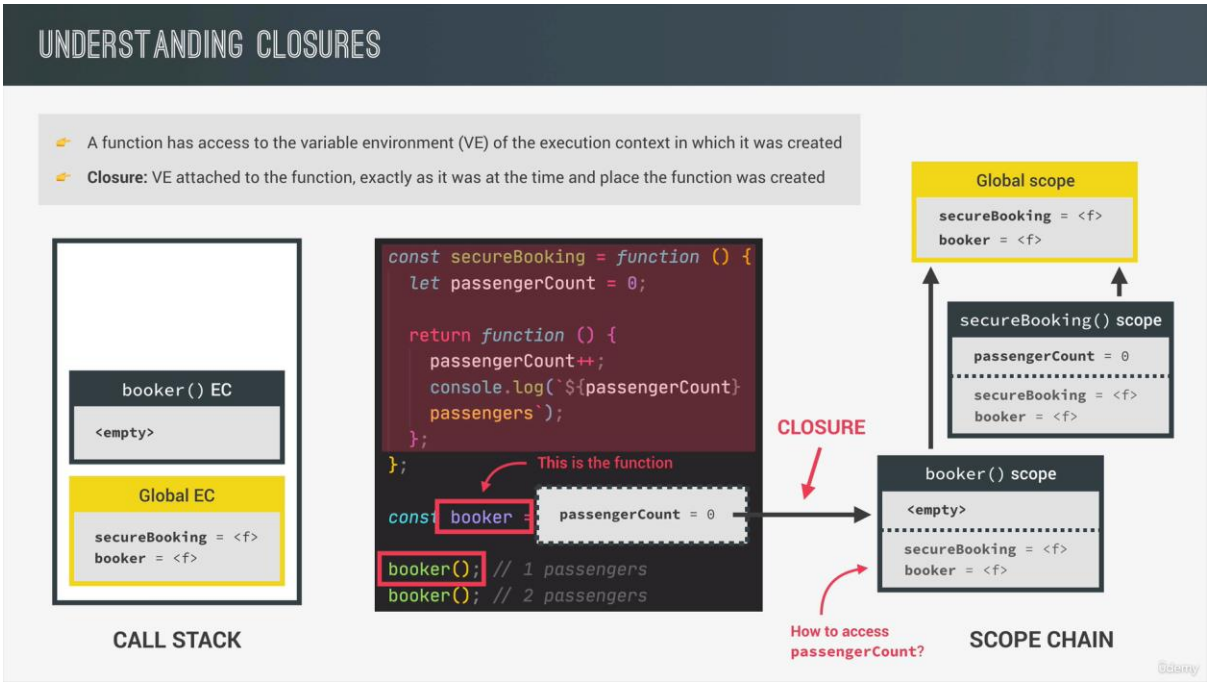
- A closure is a function that reference variables in the outer scope from its inner scope. The closure preserves the outer scope inside its inner scope.
- Closure is function that can remember all variables that existing in parent function which will use in child function or that function which return by Higher-order function, that's why we can access the variable even after the function execution is over in child function.
- This variable may be remove from scope chain but it will present in closure memory.

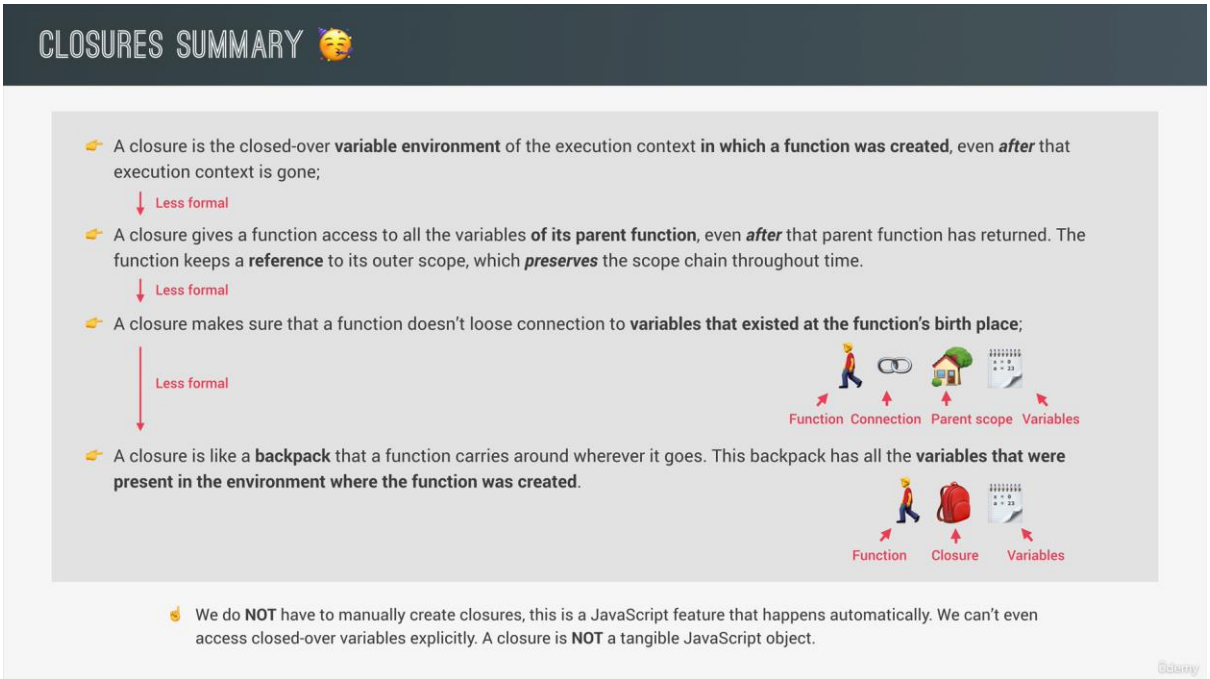
  Eg:

```
const secureBooking = function () {
  let passangerCount = 0;
  let count = 1;
  return function () {
    passangerCount++;
    count++;
    console.log(`${passangerCount} passengers`);
  };
};

const booker = secureBooking();
booker(); //1 passengers
booker();//2 passengers
booker();//3 passengers
console.dir(booker);
```

  - In above example booker function can also access variable **count** and **passangerCount** even after execution of **secureBooking()** function is over.
  - Because **secureBooking** function return a function which execute by **booker()** and have a access of both variables. Hence js engine directly return the variable environment of **secureBooking** function in **booker** variable and make connection between two execution contexts, this connection is called as **closure**. That's why booker() function can access variable of secureBooking() function even after execution of secureBooking function is over.

- Closure has more priority over the scope chain.





❖ Array Methods:

1. slice():

- slice method is used to extract sub-array from original array.

```
//slice() method--> extract sub-array without changing
original array
console.log(arr.slice(2)); //[ 'c', 'd', 'e' ]
console.log(arr.slice(2, 4)); //[ 'c', 'd' ]
console.log(arr.slice(-2)); //[ 'd', 'e' ]
console.log(arr.slice(-1)); //[ 'e' ]
console.log(arr.slice(1, -2)); //[ 'b', 'c' ]
```

- We can also use slice() method to create shallosw copy of array.

```
//slice() method is also use to create shallow copy of any
array
const newArrCpy = arr.slice(); //create shallow copy of
original array
console.log(newArrCpy); //[ 'a', 'b', 'c', 'd', 'e' ]
```

2. **splice():**
   - It work similar like **slice()** method but main difference is slice() method does not modify original array but splice() method modify original array.

     Eg:

```
//splice() method: --> same as slice() but it mutate
original array
console.log(arr.splice(2)); //[ 'c', 'd', 'e', 3 ]
console.log(arr); //[ 'a', 'b' ]
```

     Here when we use splice() it return array with element but it not return new array it modify original array and return it.

     Than it remove all element in original array
   - The main use of splice method to remove multiple element in array.
   - Remove element from given index

```
//remove element from given range
arr.splice(1, 3); //[ 'a','e', 3 ] --> it remove element
from given range and how many element is delete (index,
count)
```

     First parameter is index -> from removal is start

     Second parameter is total element-> how many element you want to remove.

3. **reverse():**
   - It used to reverse array element.
   - But reverse method is modifying original array.

```
//Reverse method --> mutate original array
arr = ['a', 'b', 'c', 'd', 'e'];
const arr2 = ['j', 'i', 'h', 'g', 'f'];
console.log(arr2.reverse()); //[ 'f', 'g', 'h', 'i', 'j' ]
console.log(arr2); ////[ 'f', 'g', 'h', 'i', 'j' ]
```

4. **concat():**
    - This method is used to concat two array in single array
    - This method does not modify original arrays

```
//Concat method --> concatinate two array
const letters = arr.concat(arr2);
console.log(letters); //['a', 'b', 'c', 'd','e', 'f', 'g',
'h','i', 'j' ]
```

5. **join():**
    - This method is used to join element of array with each other with some separator which we will pass as an argument or join function.
    - The default separator is **‘,’ comma.**
    - This method does not modify original array

```
//Join() method
console.log(letters.join('-')); //a-b-c-d-e-f-g-h-i-j
```

6. **at():**
    - This method is used to find element in array using index
    - It is simpler way to access last element in array

```
//at() method: --> use to find value at index
const array = [23, 11, 64];
console.log(array[0]); //23
console.log(array.at(0)); //23
console.log(array.at(-1)); //64 -->getting last array
element
```

    - **At()** method also work on string.

```
//at() method with string
console.log('Lokesh'.at(0)); //L
console.log('Lokesh'.at(-1)); //h
```

7. **forEach():**
    - forEach() method is use to iterate/looping over the array

```
//Loop over an array using forEach() method;
const foreachArray = [1, 2, 3, 4, 5, 6, 7, 9, 10];
foreachArray.forEach(function (e) {
  console.log(e);
});
```

    - forEach() method takes a parameter as callback function

- forEach() with index

```
//forEach with index
foreachArray.forEach(function (element, index) {
    console.log(`${index}: ${element}`);
});
```

- The disadvantages of forEach() loop is we cannot use **break** and **continue** statement in forEach() loop. For that condition we compulsory need to use normal for loop or forOf loop.
- ForEach method with map:

```
//ForEach on map
console.log('----- FOREACH WITH MAP -----');
const currencies = new Map([
  ['USD', 'United States dollar'],
  ['EUR', 'Euro'],
  ['GBP', 'Pound sterling'],
]);

currencies.forEach((value, key) => {
  console.log(`${key}: ${value}`);
});
```

- ForEach method with set:

```
//ForEach with set
console.log('----- FOREACH WITH SET -----');
const currenciesUnique = new Set(['USD', 'GBP', 'USD',
'EUR', 'EUR']);
currenciesUnique.forEach(function (value) {
  console.log(value);
});
```

8. map():

- It is similar like forEach method to iterate/looping over the array
- But the main difference is that map returns a new array containing the results of applying operation on all original array elements where as forEach not return new array.

```
//array.map() method
const movements = [200, 450, -400, 3000];

const movementsUSD = movements.map(function (mov) {
  return mov * 1.1;
});
console.log(movements); //[ 200, 450, -400, 3000 ]
console.log(movementsUSD); //[ 220.00000000000003, 495.
00000000000006,-440.00000000000006, 3300.0000000000005]
```

Original array is not modified and map function return new array.

- Map with index

```
//map method with index
const nameArr = ['lokesh', 'Yashwant', 'Sagrika',
'Vikram'];
const indexMap = nameArr.map((name, i) => {
  return `${i}: ${name}`;
});

console.log(indexMap); //[ '0: lokesh', '1: Yashwant', '2:
Sagrika', '3: Vikram' ]
```

9. filter():

- Filter method is use to check elements of array with some given condition.
- Filter() method returns a new array containing the array elements that passed a specified test condition.

```
//array.filter() method
const movementsFilter = [200, 450, -400, 3000, -650, -130,
70, 1300];
const deposits = movementsFilter.filter(function (mov,
index) {
  return mov > 0;
});
console.log(deposits); //[ 200, 450, 3000, 70, 1300 ]
```

10. reduce():

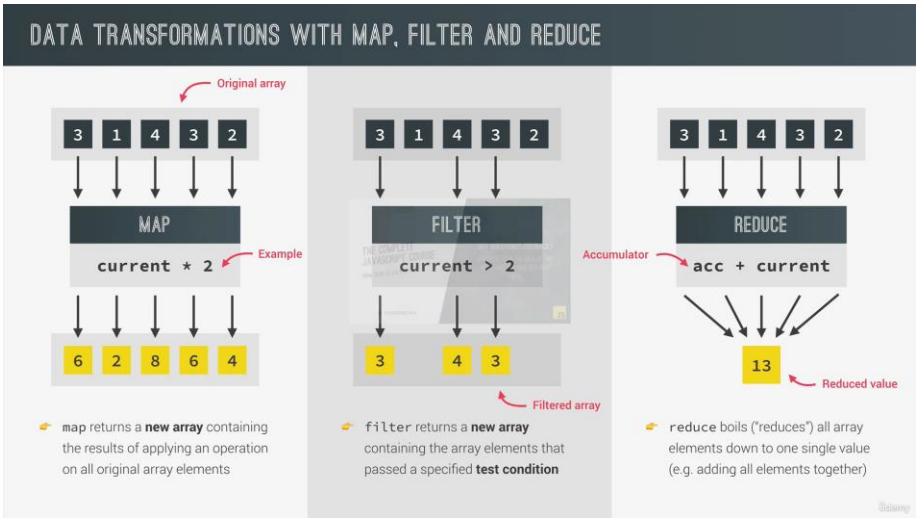
- reduce boils (‘reduces’) all array elements down to one single value

```
//array.reduce() method
const movementsReduce = [200, 450, -400, 3000, -650, -130,
70, 1300];

const balance = movementsReduce.reduce(function (acc, cur,
i, arr) {
  console.log(`Iteration ${i}: ${acc}`);
  return acc + cur;
}, 0);
console.log(balance); //3840
```

- reduce() method is executes a reducer function for each array element, returning a single accumulated value.
- It skips empty array elements and doesn’t modify the original array, making it useful for concise data aggregation
- Syntax:

```
array.reduce(function(total, currentValue,
currentIndex, arr),
initialValue )
```

Parameter Name	Description	Required/Optional
total	Specifies the initial value or previously returned value of the function	Required
currentValue	Specifies the value of the current element	Required
currentIndex	Specifies the array index of the current element	Optional
arr	Specifies the array object the current element belongs to	Optional



11. find():

- find() method is used to find/retrieve one element from array based on the condition which is given.
- It is return first founded element based on condition.

```
//find() method: -> to retrieve one element from array based on condition
const movements = [200, 450, -400, 3000, -650, -130, 70, 1300];
const withdrawal = movements.find(mov => mov < 0);
console.log(withdrawal); //-400
```

- if not any element match to given condition find method return **undefined**.

12. findIndex():

- It is used to find index of element present in array or object

```
const movements = [200, 450, -400, 3000, -650, -130, 70, 1300];
//findIndex() method: -> is used to find index of value
console.log(movements.findIndex(param => param === 70)); //6
```

- It return the index of first element which satisfied the given condition.
- This method is seems like similar to **.indexOf()** method but there is minor difference is by using **findIndex()** method we can simply find index through expression however in **indexOf()** method we need to pass value.

13. some():

- some() method is used to find value based on the given condition.
- It return true/false if value present
- It is same as **includes()** method but a difference is includes() method only return result based on equality check while we can pass some condition to **some()** function and it will return answer based on condition.

```
//some() method: -> It will return true by finding any
value in array based on the given condition
//Equality
// console.log(movements.includes(-130)); //true

//Condition
console.log(movements.some(mov => mov === -130)); //true
const anyDeposits = movements.some(mov => mov > 0);
console.log(anyDeposits); //true
```

- It take argument as a callback function and check condition and then return result based on satisfaction on this condition.

14. every():

- every() method only return true if all elements in array satisfy the given condition.
- It work similar as **some()** array but the difference is it is return true only if all elements satisfied condition

```
//Every() method:-> It only return true if all element in
array satisfy the given conditoin
console.log(movements.every(mov => mov > 0)); //false
console.log(movements.every(mov => mov % 10 == 0)); //true
```

15. flat():

- flat() method is used to merge all nested array into one big, array.

```
const arrr = [[1, 2, 3, 4], [5, 6], 7, 8];
console.log(arrr.flat()); //[1, 2, 3, 4, 5, 6, 7, 8]
```

- But it only work with only one level of nesting.

```
const arrDeep = [[[1, 2], 3, 4], [5, 6], 7, 8];
console.log(arrDeep.flat()); //[[1, 2 ], 3, 4, 5, 6, 7, 8 ]
```

- To avoid this we can simply pass level of nested array, Default level is **1**.

```
console.log(arrDeep.flat(2)); //[1, 2, 3, 4, 5, 6, 7, 8]
```

Parameter **2** is denoted of two level of nesting

16. sort():

- sort() method is used for sorting a element in array
- This method can modify the original array
- To sort string we just need to mention sort function.

Eg.

```
//sort() method :-> Sorting arrays
const owner = ['Jonas', 'Zach', 'Adam', 'Martha'];
console.log(owner.sort()); //[ 'Adam', 'Jonas', 'Martha',
'Zach' ]
```

- But for number we need to pass some callback function because default sorting of array work as a string so it sorts based on string character by default and it will produce a bug in our program to solve it, we pass some condition through callback function.

Eg:

```
//sort numbers in array
const num = [1, 3, 4, 2, 5, 6, 9, 8, 7];
//accending order
console.log(
  num.sort((a, b) => a - b)
); //[1, 2, 3, 4, 5,6, 7, 8, 9]

//sortin array in descending order
console.log(
  num.sort((a, b) => b - a)
); //[9, 8, 7, 6, 5, 4, 3, 2, 1]
```

17. fill():

- fill() method is used to fill the element in array based on given range

```
//fill() method: -> it fill element in array
x.fill(1);
console.log(x);//[1, 1, 1, 1, 1, 1, 1];
```

fill whole array with 1

```
x.fill(1, 3);
console.log(x); //[ <3 empty items>, 1, 1, 1, 1 ]

x.fill(1, 3, 5);
console.log(x); //[ <3 empty items>, 1, 1, <2 empty items> ]
```

Fill array in given range where first parameter is value , second parameter is start index, third parameter is end index

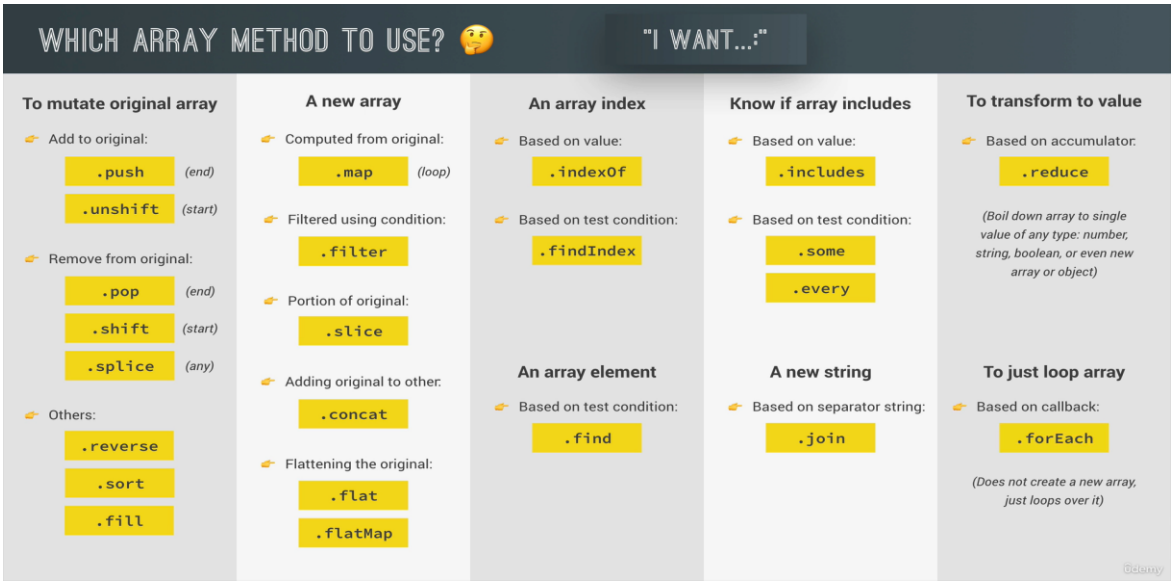
18. Array.from():

- Array.from() method is used to create new array based on the array like structure.

```
//Array.from
const y = Array.from({ length: 7 }, () => 1);
console.log(y); //[1, 1, 1, 1, 1, 1, 1];

const z = Array.from({ length: 8 }, (_, i) => i + 1);
console.log(z); //[1, 2, 3, 4, 5, 6, 7, 8]
```

it is used to generate array based on condition.

- It is also used create array from different iterables and objects.



❖ **Number:**

- JavaScript has a float-based number system

```
console.log(23 === 23.0); //true
```

Both are same

- There is certain method to manipulating a number like:

1. **Type conversion:**

    - We can do type conversion in 2 ways

```
//type conversion
console.log(Number('23')); //
//Automatic type coersion
console.log(+'23'); //23
```

2. **Parsing:**

    - Parse string to int

    - parse string to float

```
//Parse number from string
console.log(Number.parseInt('30px', 10)); //30 --> js try
to remove spring 'px' from string and return only number
console.log(Number.parseInt('e30', 10)); //NaN--> string
should start by number

console.log(Number.parseInt('2.4rem')); //2
console.log(Number.parseFloat('2.4rem')); //2.4
```

    - It will also remove ending string part of value

3. **isNaN():**

    - it will check given value is number or not a number

```
//.isNaN() --> check given value is  not a number or it is
number
console.log(Number.isNaN(23)); //false
console.log(Number.isNaN('23')); //false
console.log(Number.isNaN(+'23x')); //true
console.log(Number.isNaN(10 / 0)); //false
```

4. **isFinite():**

- it work same as isNaN() function but more efficient way

```
//.isFinite() :--> checking a value is a number
console.log(Number.isFinite(20)); //true
console.log(Number.isFinite('20')); //false
console.log(Number.isFinite(+'20s')); //false
console.log(Number.isFinite(10 / 0)); //false
```

5. **isInteger():**

- this method is check given value is integer or not

```
//.isInteger() :--> checking value is integer or not
console.log(Number.isInteger(23)); //true
console.log(Number.isInteger(23.0)); //true
console.log(Number.isInteger(23 / 0)); //false
console.log(Number.isInteger('20')); //false
console.log(Number.isInteger(+'20s')); //false
```

❖ **Numeric Separator: (_):**

```
//Numeric separator: (_)
const diameter = 287_460_000_000;
console.log(diameter); //287460000000
console.log(1_0 + 20); //30
```

- It is use for reading purpose we can easily read this number which is separated by underscore and this underscore is not counted while performing any operation in JavaScript
- But it is not working with conversion of string to number

```
console.log(Number('234_343')); //NaN
```

❖ **BigInt:**

- bigInt is used to store number which is greater than "9007199254740991" length.

  Eg.

```
//BigInt
console.log(21212232243242423425242425345355
3); //2.1212232243242423e+32
console.log(21212232243242423425242425345355
3n); //212122322432424234252424253453553n
```

- bigInt number is end by '**n**'
- But there is some exception occurs with bigInt numbers

- We cannot easily add normal number and bigInt number it will through error we need to convert normal number to bigInt

```
const bigNum = 34324259849823893902424723n;
const normalNum = 23;
// console.log(bigNum * normalNum); //TypeError: Cannot mix
BigInt and other types, use explicit conversions
console.log(bigNum * BigInt(normalNum)); //
789457976545949559755768629n
```

- **Math()** functions not work with bigInt.

❖ **Dates:**

- **Date()** class is used to perform date related operation in JavaScript.

  Eg:

```
//Create a date
const now = new Date();
console.log(now); //Mon Jun 17 2024 18:27:59 GMT+0530
(India Standard Time)
console.log(now.toDateString()); //Mon Jun 17 2024
console.log(new Date('Mon Jun 17 2024 ')); //Mon Jun 17
2024 18:27:59 GMT+0530 (India Standard Time)
console.log(new Date('Augest 12, 2024')); //Mon Aug 12 2024
00:00:00
console.log(new Date(2024, 5, 18, 15, 23, 5)); //Thu Jul 18
2024 15:23:05
console.log(new Date(2024, 7, 32, 15, 23, 5).toDateString
()); //Sun Sep 01 2024
```

  .toDateString() function return date in string format

- **Representation of Date:**

1. **Day():**
   - Day of week start from Sunday to Saturday by 0-6
   - Where 0 for Sunday and 6 for Saturday
   - For Monday **.getDay()** function return **1**

     Eg

```
console.log(now.getDay()); //1
```

2. **Month():**
   - Month of year start from January to December and it denoted by 0 – 11
   - Where 0 for January and 11 for December.
   - For June **.getMonth()** function return **5.**

     Eg:

```
console.log(now.getMonth());//5
```

3. **Year():**

- We can represent year in two way either we represent by describing full year (1970) or we just mention last two digit (70)
- **.getFullYear()** function can easily identify the year

Eg:

```
console.log(new Date('July,7,69').getFullYear()); //1969
```

❖ Formatting international dates and Numbers:

- To get international dates and numbers JavaScript has inbuilt **Intl** library/Api
- Internationalizing dates 👇

```
//International dates API
let newDate = new Intl.DateTimeFormat('en-IN').format(now); //18/6/2024
console.log(newDate);

const options = {
  hour: 'numeric',
  minute: 'numeric',
  day: 'numeric',
  month: 'long', //2-digit: 08, numeric: 8
  year: 'numeric', //2-digit: 24
  weekday: 'long',
};
// newDate = new Intl.DateTimeFormat('mr-IN', options).format(now); //मंगळवार, १८ जून, २०२४ रोजी ११:१७ AM

newDate = new Intl.DateTimeFormat('en-IN', options).format(now); //Tuesday 18 June, 2024 at 11:16 am
console.log(newDate);

// const locals = navigator.language; //--> to identify local time-zone using browser
// newDate = new Intl.DateTimeFormat(locals, options).format(now); //Tuesday 18 June, 2024 at 11:16 am
// console.log(newDate);
```

- Internationalizing Numbers 👇

```
//International Number Formator
const num = 3884764.23;
console.log('US      : ', new Intl.NumberFormat('en-US').format(num)); //US      :  3,884,764.23
console.log('Germany: ', new Intl.NumberFormat('en-DE').format(num)); //Germany:  3.884.764,23
console.log('INDIA  : ', new Intl.NumberFormat('en-IN').format(num)); //INDIA   :  38,84,764.23
console.log('Marathi: ', new Intl.NumberFormat('mr-IN').format(num)); //Marathi:  ३८,८४,७६४.२३

const numOptions = {
  style: 'unit', //unit,percent,currency
  unit: 'mile-per-hour', //mile-per-hour,celcius
  currency: 'EUR', //INDIA  :  €38,84,764.23
  //   useGrouping: false, //3884764.23 --> Number will printed without separator
};
console.log('US      : ',new Intl.NumberFormat('en-US', numOptions).format(num)); //US      :  3,884,764.23 mph
console.log('Germany: ',new Intl.NumberFormat('en-DE', numOptions).format(num)); //Germany:  3.884.764,23 mph
console.log('INDIA  : ',new Intl.NumberFormat('en-IN', numOptions).format(num)); //INDIA   :  38,84,764.23 mph
console.log('Marathi: ',new Intl.NumberFormat('mr-IN', numOptions).format(num)); //Marathi:  ३८,८४,७६४.२३ मैप्रता
```

❖ Timers:

- There are two type of timers in JavaScript
- **.setTimeout()** -> we can set time to stop
- **.setIntervalTimer()** -> keep running until we stop
- When we used setTimeout() function JavaScript simply registered that function and count given timer and execute next line of code until timer is completed asynchronously, as soon as timer end .setTimeout() callback function is executed

  Eg:

```
setTimeout(() => console.log('Here is your Pizza 🍕'), 3000);
console.log('Waiting....');
```

```
Waiting....
Here is your Pizza 🍕
```

  Waiting.... Message was printed before pizza method because of 3sec timer
- We cannot easily pass arguments to callback function of setTimeout() method because setTimeout() method is automatically called by JavaScript, So there is not any scope to pass arguments in callback function
- But there is some solution which is we can simply pass arguments from third parameter

```
setTimeout(
  (ing1, ing2) => console.log(`Here is your Pizza with $
  {ing1} and ${ing2} 🍕`),
  3000,
  'olives',
  'spinach'
); //Here is your Pizza with olives and spinach 🍕
```

- **.setInterval()** function contain two parameter first is callback function and second is interval in millisecond.

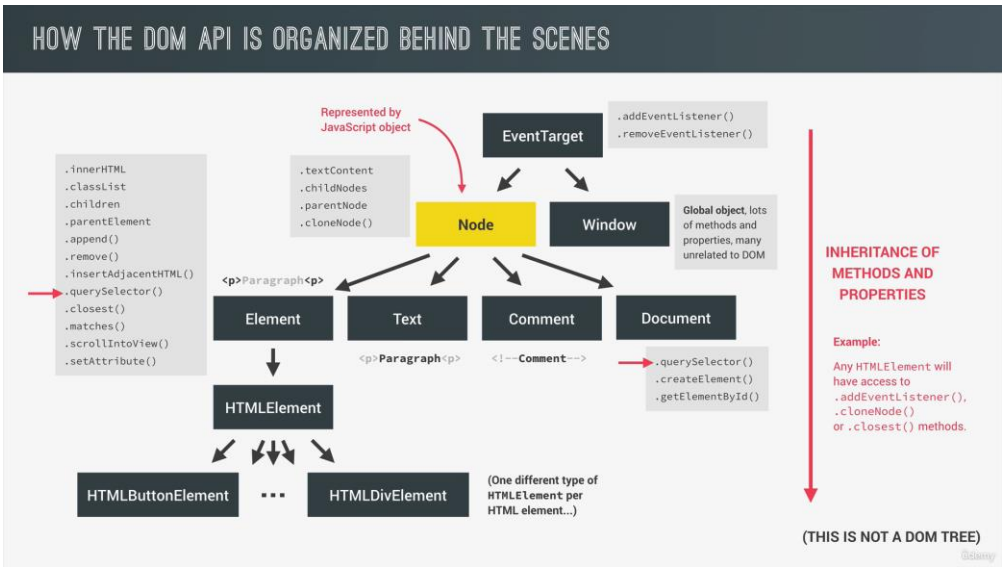
```
//setInterval() function
let time = 10;
setInterval(function () {
    //print time on console
    console.log(time);
    //stop timmer
    if (time === 0) clearInterval(this);
    time--;
}, 1000);
```

- Combine use of .setTimeout() and .setInterval() function

```
//Print interval after 3000 second
setTimeout(function () {
  setInterval(function () {
    //print time on console
    console.log(time);
    //stop timmer on 0
    if (time === 0) clearInterval(this);
    time--;
  }, 1000);
}, 3000);
```

This start printing timer after 3 second

❖ **How the DOM API is organized behind the scenes**



- **EventTarget** is a root element of DOM hierarchy which contain two main methods **.addEventListner()** and **.removeEventListner().**
- Dom are work as a inheritance means element is access properties of parent element/node that's why all node can easily access methods of **EventTarget**.

❖ **Event and Types of events:**

- There are various types of events available in JavaScript

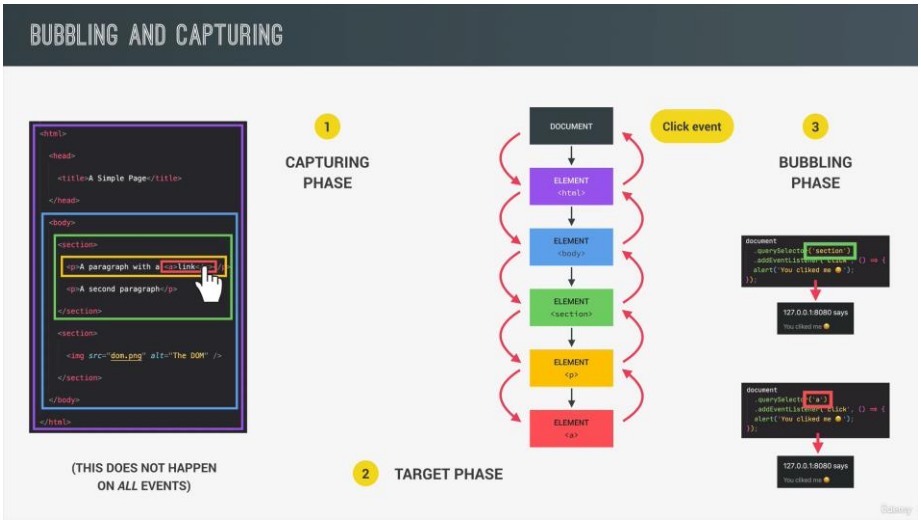
Common HTML Events

Here is a list of some common HTML events:

Event	Description
onchange	An HTML element has been changed
onclick	The user clicks an HTML element
onmouseover	The user moves the mouse over an HTML element
onmouseout	The user moves the mouse away from an HTML element
onkeydown	The user pushes a keyboard key
onload	The browser has finished loading the page

- We can handle this events using .addEventListner() or .removeEventListner() method of EventTarget.

❖ **Event Propagation: Bubbling and Capturing:**



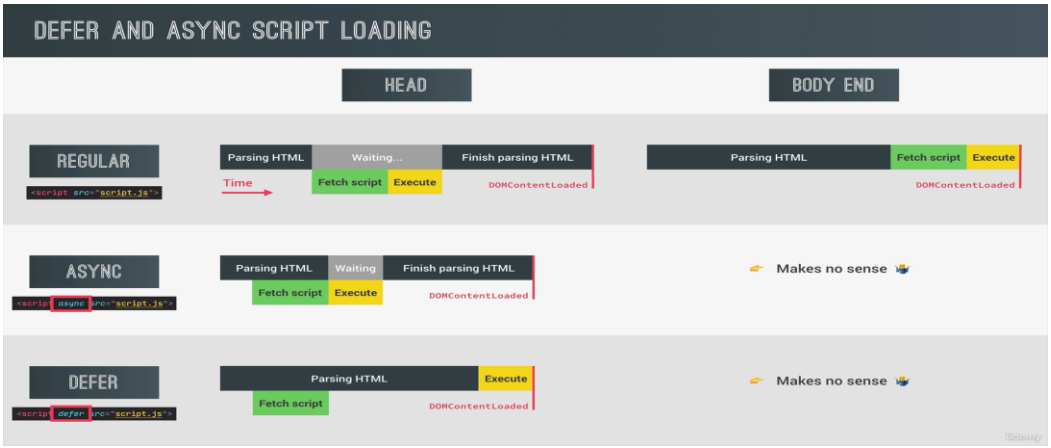
- When any event occurs root element (document node) start capturing that particular element where event has occurred. Then this phase is called **capturing phase**
- After that when event reached to that target element this phase is called as **Target phase**
- Then to execute this target element event need to getback to root node(document) node. Then this phase is called as **Bubbling phase.**
- **Note:** Not all event can perform capturing and bubbling phase because some event is generated directly at on target element.

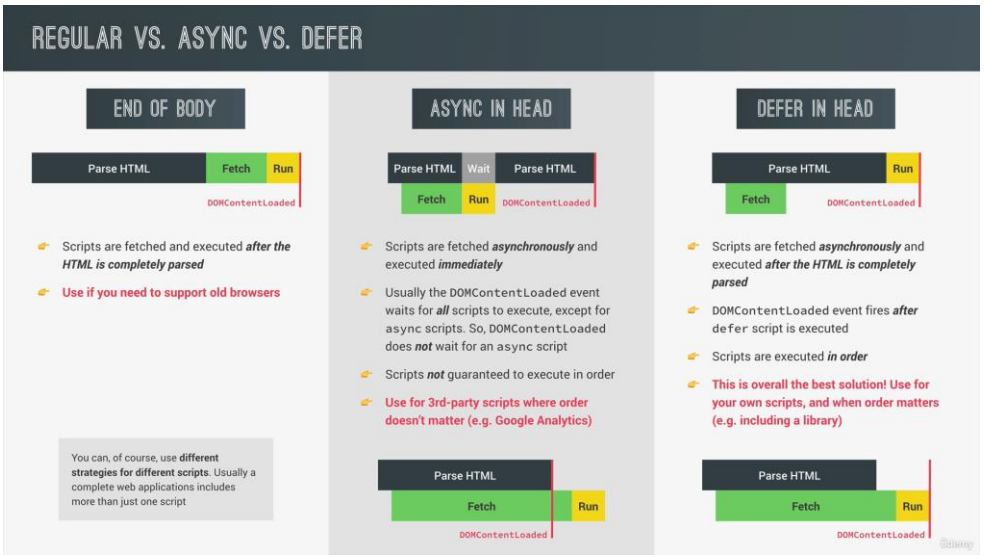
❖ **Lifecycle Dom Events:**

```
document.addEventListener('DOMContentLoaded',
function (e) {
  console.log('HTML parsed and DOM tree built!', e);
});

window.addEventListener('load', function (e) {
  console.log('Page fully loaded', e);
});

// window.addEventListener('beforeunload', function
(e) {
//   e.preventDefault();
//   console.log(e);
//   e.returnValue = '';
// });
```

- **DOMContentLoaded** event gets executed once the basic HTML document is loaded and its parsing has taken place. This event doesn't wait for the completion of the loading of add-ons such as stylesheets, sub-frames and images/pictures.
- **load** event gets completed once all the components i.e. DOM hierarchy along with associated features of a webpage such as CSS file, JavaScript files, images/picture and external links are loaded. So basically, the **load** event helps in knowing when the page has fully-loaded.
- **beforeunload** event occurs when you click a text link or picture link or any kind of link which will bring you to a new page. This event will display a confirmation dialog box to inform the user whether the user wants to stay on the page or leave the current page and move on to the next linked page. The message in the dialog box cannot be removed.

❖ **Efficient way to load script file:**





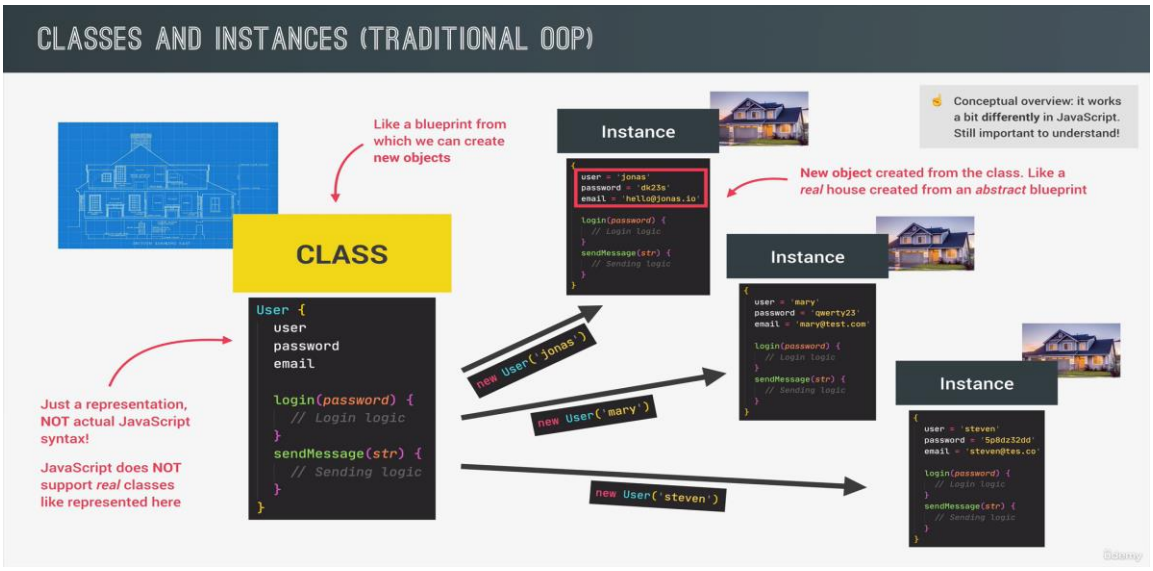
❖ **Object Oriented Programming (OOPs):**

- Object-oriented programming is a programming paradigm based on the concept of objects
- **Paradigm**: Style of code, 'how' we write and organize code
- We use objects to **model** (describe) real-world or abstract features (Html component or data structure).
- Object may contain data (properties) and code (method). By using objects, we pack **data and corresponding behavior** into one block.
- In OOP, objects are **self-contained** pieces/blocks or code.
- Objects are building blocks of applications and interact with one another.

- Interaction happens through a **public interface (API):** interface is bunch of methods that the code outside of the object can access and use to communicate with the object.
- **OOP** was developed with the goal of **organizing** code, to make it more **flexible** and **easier to maintain** to avoid complexity.
- OOP is also used for reusability of code.

❖ **Classes:**

- **Classes** are a blueprint from which we can create new objects.
- **Instance** is a new object created from the class. Like a real house created from and abstract blueprint.
- Beauty of classes is we can use this class to create many more instance based on our requirement.



- **How do we actually design classes?:** There are 4 fundamental principle which is actually guide us to design classes

1. **Abstraction:**
   - Ignoring or hiding details that **don't matter**, allowing us to get an overview perspective of the thing we're implementing, instead of messing with details that don't really matter to our implementation.
2. **Encapsulation:**
   - **Keeping** properties and method **private** inside the class, so they are **not accessible from outside the class.** Some methods be exposed as a public interface (API).
   - **Private** keyword doesn't exist in JavaScript
3. **Inheritance:**

- Making all properties and methods of a certain class **available to a child class,** forming a hierarchical relationship between classes. This allow us to **reuse common logic** and to model real-world relationship.

4. **Polymorphism:**
   - A child class can **overwrite** a method it inherited from a parent class

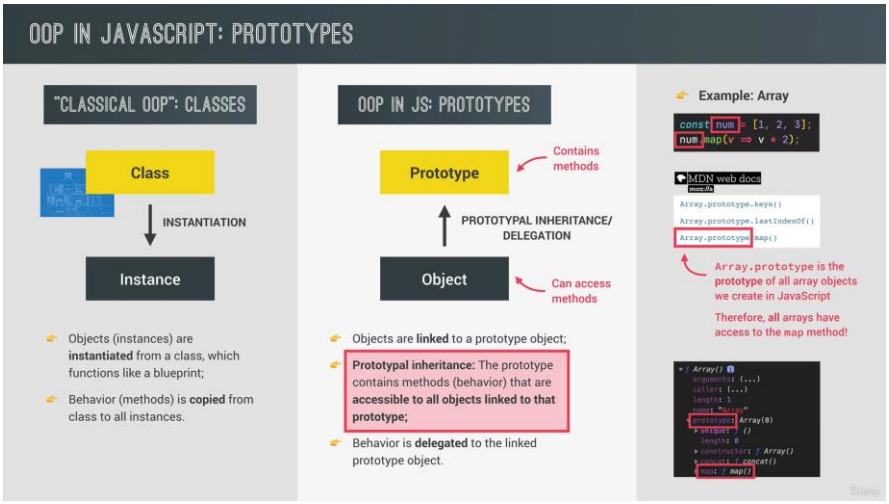
❖ **OOP in JavaScript:**

➢ **Prototype:**

- Every object in JavaScript has a build-in property, which is called its prototype **__proto__**.
- The prototype itself an object, so the prototype will have its own prototype, making what's called prototype chain.
- The chain ends when we reach a prototype that has null for its own prototype.
- JavaScript contains the concept of **prototype** instead a **class**.
- Where prototype contain methods and **objects** are linked to a prototype object
- The prototype contains methods (behavior) that are accessible to all objects linked to prototype is called **prototypal inheritance.**
- Prototypal inheritance is different from old original inheritance which this can inherit properties form parent class, but in JavaScript Prototypal inheritance, basically the instance inheriting from a class.

  Eg:

  Array.prototype.map() is a prototype of all array object we create in JavaScript. Than we can easily access **map()** method through our own defined array like **num.map().** Here num -> Array.prototype.



Note:

- The prototype property is only present for functions and is a property that's set only if you're using **'new'** keyword when creating objects with this (constructor) function

```
const house = {
  color: 'brown',
  size: 'huge',
};

console.log(house.prototype); //undefined
```

- The __proto__ is an object within every object that points out (reference) the prototype that has been set for that object. __proto__ is the actual object that is used in the lookup chain to resolve methods, etc.

- **How do we actually create prototype?**

  There are 3 different ways to implement prototype in JavaScript

  1. **Constructor Functions:**
     - It is a technique to create objects form a function.

- This is how built-in objects like Arrays, Maps or Sets are actually implemented.
- The constructor function is same as a normal function but only difference with constructor function is we use **new** operator during calling of constructor function.
- Naming convention of constructor function which start from **capital letter.**
- Only function expression and function declaration work for creation of constructor function, Arrow function does not work because arrow function doesn't contain **this** keyword
- When we call function with **new** keyword it work behind like this 👇
    i. First New {} empty object is created
    ii. Function is called and **this** is set to that empty object {}
    iii. This newly created object is linked to **prototype**
    iv. Function automatically return empty **object** until we not defined properties

```
//Constructor function
const Person = function (firstName, birthYear) {
  console.log(this); //Person {}
  this.firstName = firstName;
  this.birthYear = birthYear;
  console.log(this); //Person { firstName: 'Lokesh',
  birthYear: 2001 }
};
new Person('Lokesh', 2001);
```

- Now constructor function create new prototype/blueprint by using this we can create as many object as we want.

- We can also create functions in constructor function, but it is a bad practice, we should avoid that because for every constructor call there is new copy is created so it

will increase the length of function.

```
//Constructor function
const Person = function (firstName, birthYear) {
  console.log(this); //Person {}
  //Instance Properties
  this.firstName = firstName;
  this.birthYear = birthYear;
  console.log(this); //Person { firstName: 'Lokesh',
  birthYear: 2001 }

  //Adding method --> you should never create method in
  constructor function. because every constructor call new
  copy will be created
  //   this.calcAge = function () {
  //     console.log(2024 - this.birthYear);
  //   };
};
```

- We can have another option like prototypal inheritance / prototype chaining to add methods.

```
//Adding method through prototype property
Person.prototype.calcAge = function () {
  console.log(2024 - this.birthYear);
};
lokesh.calcAge(); //23
```

By using this there is only one copy is created and all object which create using **Person** (constructor function) can use this function.

- We can see all prototype by using **object.__proto__** property

```
console.log(lokesh.__proto__); //{ calcAge: [Function (anonymous)] }
```

- Set property using prototype

```
//set property using prototype
Person.prototype.species = 'Home Sapiens';
console.log(lokesh.species, yashwant.species);
```

But it is not Person's constructor property it is inherited from prototype. Only own property of Person is which is created when we call it using **new.**

2. **ES6 Classes:**
   - Modern alternative to constructor function syntax
   - 'Syntactic sugar': behind the scenes, ES6 classes work exactly like constructor functions.

- ES6 classes do not behave like classes in 'classical OOP'.
- It is just a layer of abstraction over a constructor function.

```
//Class expression
// const Person = class{}

//Class declaration
class Person {
  constructor(firstName, birthYear) {
    console.log(this); //Person {}
    this.firstName = firstName;
    this.birthYear = birthYear;
    console.log(this); //Person { firstName: 'Lokesh', birthYear: 2002 }
  }
  calcAge() {
    console.log(2024 - this.birthYear);
  }
}
const lokesh = new Person('Lokesh', 2002);
console.log(lokesh); //Person { firstName: 'Lokesh', birthYear: 2002 }
lokesh.calcAge(); //22
```

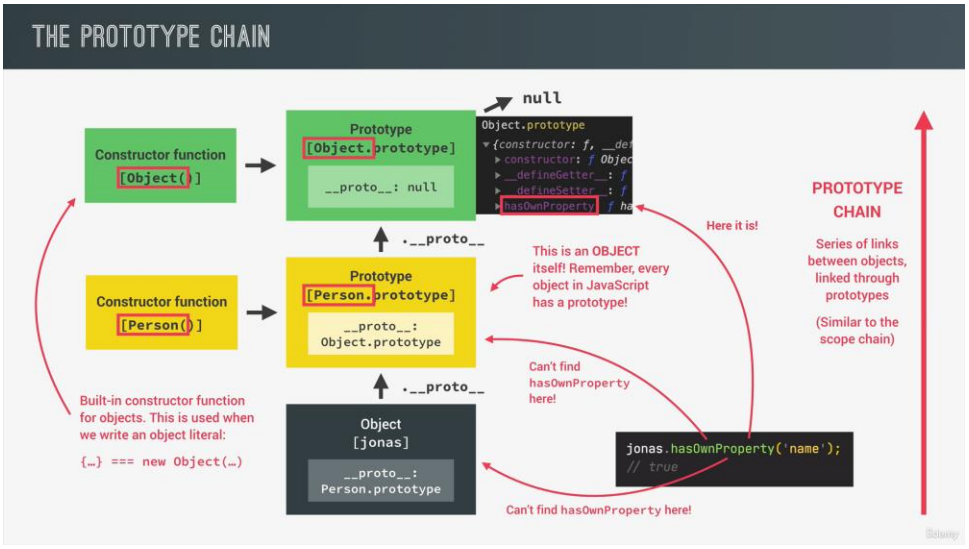
- When we create a function in class this function is created in **prototype** it is not created through constructor i.e. only one copy will create only when first time Person object is created
- Classes are **not hoisted.**
- Classes are also **first-class citizen** that means we can pass as function
- Classes are executed in strict mode.

3. **Object.create():**
   - The easiest and most straightforward way of linking an object to a prototype object.

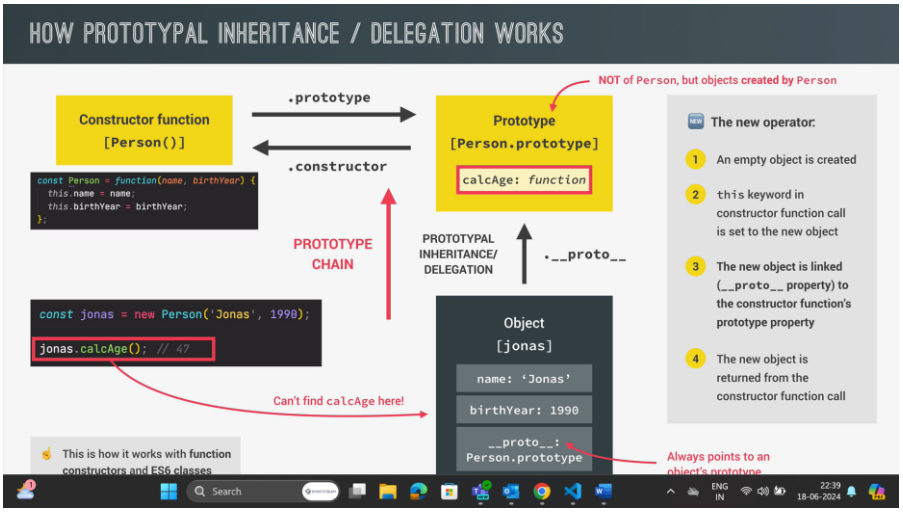
```
const PersonProto = {
  calcAge() {
    console.log(2024 - this.birthYear);
  },
};

const lokesh = Object.create(PersonProto);
console.log(lokesh.__proto__); //{ calcAge: [Function:
calcAge] }
```

   - Object.create() method create new object and the prototype of that object which we pass in.

➢ **Prototype Chain:**



- As we know every object in JavaScript has inbuilt prototype property.
- In the chaining of prototype **Object.prototype** is a top of all the prototype, and this is assigned by **null.** Which is denoted no other prototype above it.



- If any method/function call happen it will first check recent prototype object if method available execute it else, it will check in parent prototype object.

➢ **Getters and setters:**

- Every object in JavaScript has getter and setter properties
- We can also call this as **Accessor property** however for normal property we call as **Data Property.**
- It is function that get and set value.
- To declare property as a getter property we simply used below syntax

get functionName() { return value};

Eg:

```
const account = {
  owner: 'lokesh',
  movements: [200, 530, 120, 300],
  get latest() {
    return this.movements.slice(-1).pop();
  },
};

console.log(account.latest); //33
```

- To declare setter property

  Set functionName(param) {}

  Eg:

```
  set latest(mov) {
    this.movements.push(mov);
  },
};
account.latest = 50;
console.log(account.movements); //[ 200, 530, 120, 300, 50 ]
```

- For calling both getter and setter method we need to call like property. Because JavaScript doesn't create function it creates property

➢ **Static Methos:**

- The JavaScript allows static method that belong to the class rather than an instance of that class. Hence, as instance is not needed to call such static methods.
- Static method is call on class directly.
- Static method is not available in prototype hence child classes/objects are not able to call this method we need to call that method by using that own class/object.
- Declare static method in constructor function

```
//Static method declaration
Person.hey = function () {
  console.log('Hey there 👋');
};
Person.hey(); //Hey there 👋
lokesh.hey(); //TypeError: lokesh.hey is not a function
```

- Declare static method in ES6 class

```
//Static method declareation in ES6 class
static hey() {
  console.log('Hey there 👋`'); //Hey there 👋
}
```

- This static method only belongs to that Class.

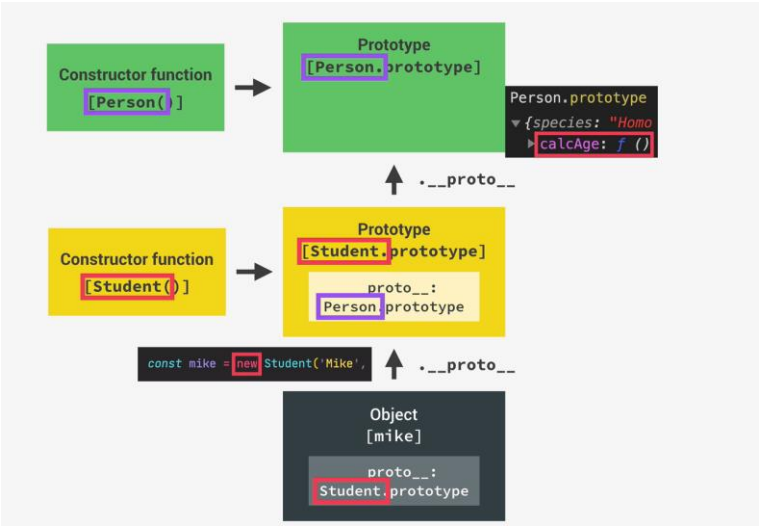
- This static method is not available on instances.
- We cannot access not static field in static method.

❖ **Inheritance Between Classes:**

1. **Through Constructor function:**

```
//Stundent constructor function
const Stundent = function (firstName, birthYear, course) {
  Person.call(this, firstName, birthYear);
  this.course = course;
};
```

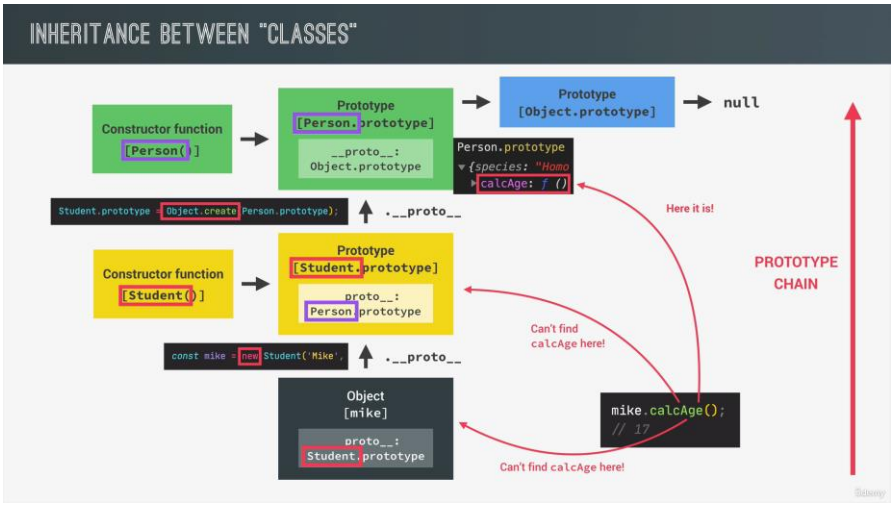
- We need to call and bind **this** keyword to parent Person object to achieve inheritance.



- To link student prototype with person prototype we use

```
//To link student prototype to person prototype
Student.prototype = Object.create(Person.prototype);
```

Now we are able to access calcAge() function from Person prototype.



3. **Through ES6 Classes:**

```
class Student extends Person {
  constructor(fullName, birthYear, course) {
    super(fullName, birthYear);
    this.course = course;
  }
```

- ES6 classes simply use **extends** and **super** keyword to perform inheritance.
- It is simplest way to doing inheritance.

4. **Through Object.create():**

```
const StudentProto = Object.create(PersonProto);
StudentProto.init = function(firstName,birthYear,course){
    PersonProto.init.call(this, firstName, birthYear)
    this.course = course;
}
```

❖ **Encapsulation:**

- Keep some property and method private to achieve abstraction.
- JavaScript does not contain Access specifier like private, public, protected.
- All method or property by default public in JavaScript.
- To achieve encapsulation in JavaScript there is some naming convention

```
//Protected Property
this._pin = pin;
this._movements = [];
```

This is not making that property private but this is a naming convention for all developers is this method is for private purpose don't try to access.

- To achieve full encapsulation and make all properties private then declare this property outside a constructor using **#** variable where **#** is denote for private field in JavaScript. This field is called as **instance field**

```
class Account1 {
  //public field
  owner;
  currency;
  //private field
  #pin;
  #movements = [];
  constructor(owner, currency, pin) {
    this.owner = owner;
    this.currency = currency;
    //Protected Property
    this.#pin = pin;
    console.log(`Thanks for opening an account, ${owner}`);
}
```

Like this

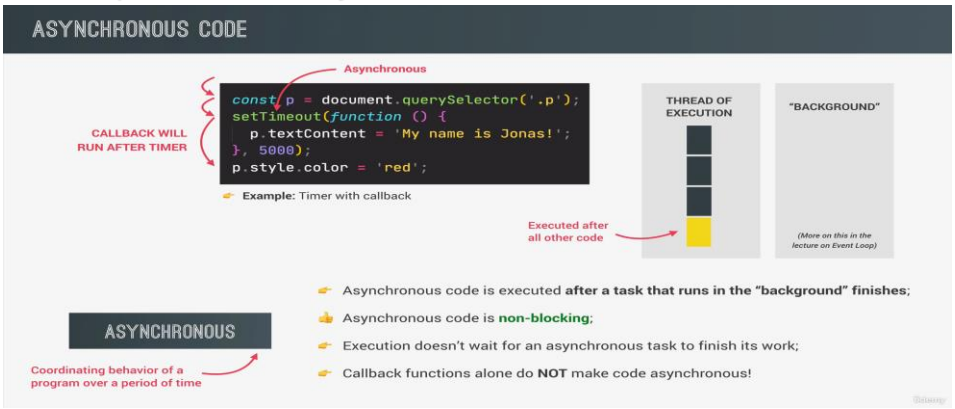
- The if we want to access that field/method outside the it gives error

```
Private identifiers are not allowed outside class
bodies. ts(18016)
View Problem (Alt+F8)    No quick fixes available
console.log(#pin);
```

Note: Private field and private method does not present in prototype it is instance field.

❖ **Asynchronous JavaScript:**

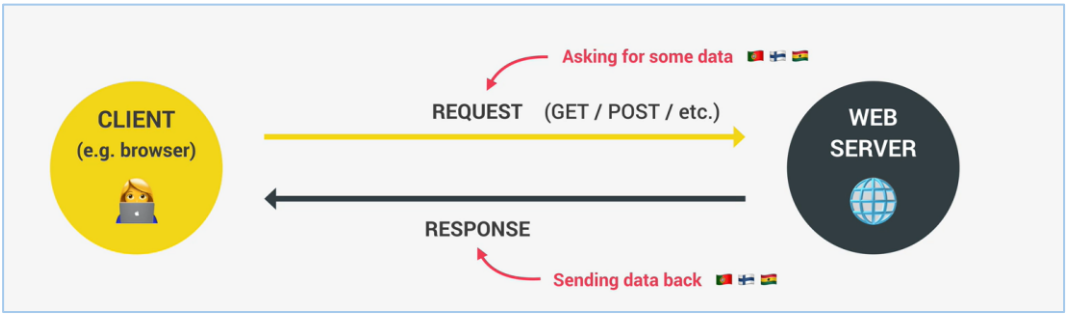
- JavaScript is by default single threaded application means JavaScript execute most of the code **synchronously.**
- Synchronous code is executed line by line.
- Each line of code waits for previous line to finish.
- That's why long running operation block code execution.
- To solve that issue of synchronous programming JavaScript has option of **Asynchronous programming.**
- In this main thread give task to background thread to execute and go forward until background thread complete their task.
- After completion of task by background thread result is handover to main thread and then main thread present that result.
- Asynchronous code is executed after a task that runs in the 'background' finishes.
- Asynchronous code is **non-blocking.**
- Execution doesn't wait for an asynchronous task to finish its work.
- Callback function is alone do **NOT** making code asynchronous. It just help JavaScript to become asynchronous.



- Eg: Geolocation API or AJAX call

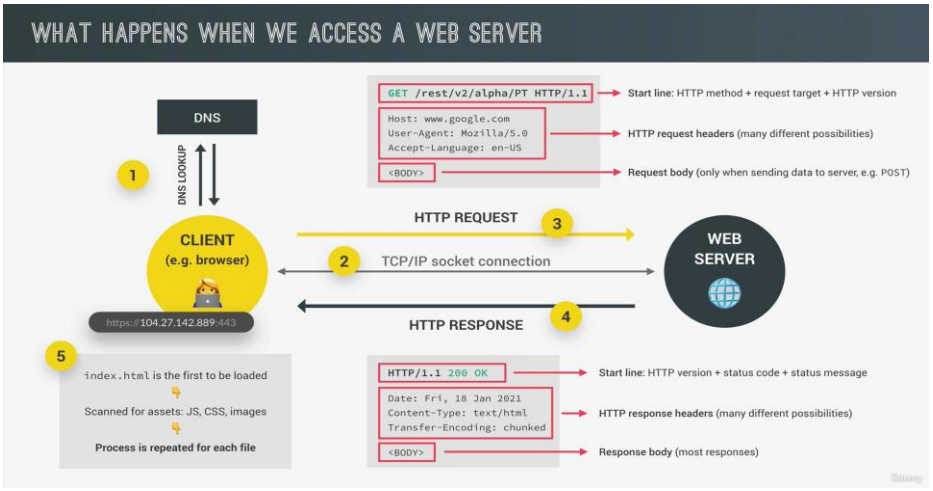
❖ **AJAX – Asynchronous JavaScript And XML:**

- Allow us to communicate with remote web servers in an **asynchronous way.**
- With AJAX calls, we can request data from web servers dynamically.



➢ **API:**

- **Application Programming Interface:** Piece of software that can be used by another piece of software, in order to allow applications to talk to each other
- There are many types of APIs in web development like **DOM API, Geolocation API, Own Class API, Online API**.
- **Online API:** Application running on a server, that receives requests for data, and sends data back as response.
- We can build our own web API or use 3rd-party APIs like weather API, movie API, Google Maps API



➢ **Promise:**

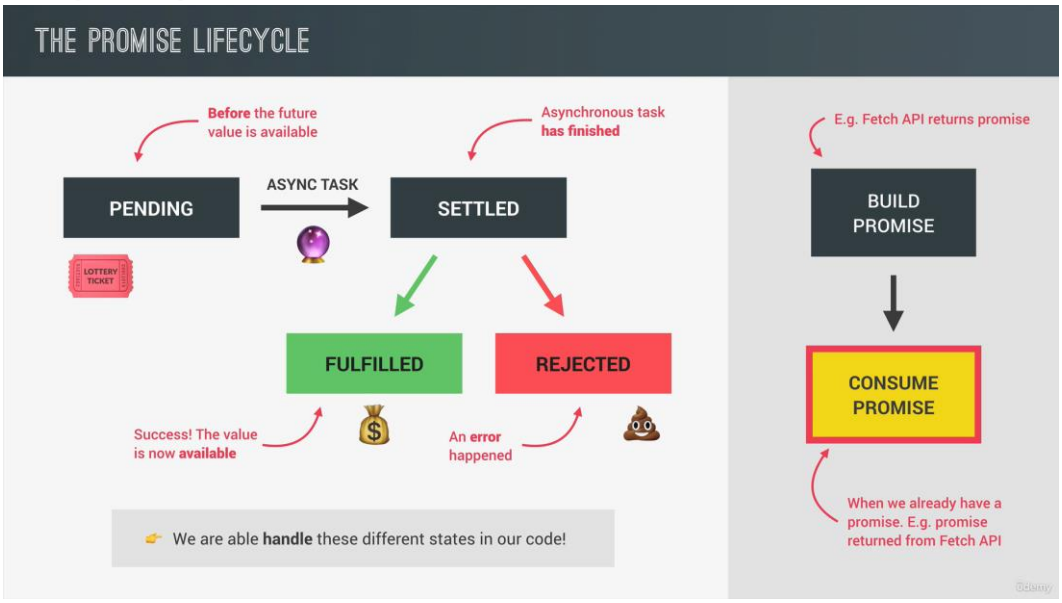
- An object that is used as a **placeholder** for the future result of an asynchronous operation.
- Promise is a container for an asynchronously delivered value.
- Promise is a container for a future value (Response coming from APIs).
- We no longer need to rely on events and callbacks passed into asynchronous function to handle asynchronous results.
- Instead of nesting callbacks, we can **chain promises** for a sequence of asynchronous operations: **escaping callback hell**

```
const getCountryData = function (country) {
  fetch(`https://restcountries.com/v3.1/name/${country}`)
    .then(response => response.json())
    .then(data => renderCountry(data[0]));
};

getCountryData('portugal');
```

To perform promises **.then()** function is used with his major component like **.catch()** or **.finally()**

```
fetch(`https://restcountries.com/v3.1/name/${country}`)
  .then(response => {
    if (!response.ok)
      throw new Error(`Country not founde ${response.status}`);
    return response.json();
  })
  .catch(err => {···
  })
  .finally(() => {···
  });
```

- **Lifecycle of promise:**



- **Build your own promise:**

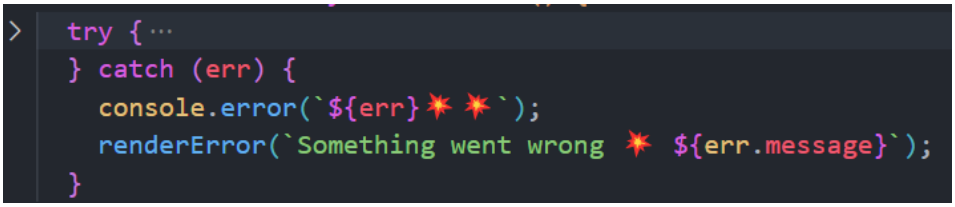
```
const lotteryPromise = new Promise(function (resolve,
reject) {
  console.log('Lottery draw is happening 🔮');
  setTimeout(() => {
    if (Math.random() >= 0.5) {
      resolve('You WIN!!');
    } else {
      reject(new Error('You LOST your money!!! 💩'));
    }
  }, 2000);
});

lotteryPromise.then(res => console.log(res)).catch(err =>
console.error(err));
```

❖ **Async-Await:**

- It is a syntactical sugar for then method.
- In background it is use as promises only.
- There are two main keyword is used in this **async**:- to execute function or statement asynchronously
  await:- to block main thread execution until child thread return the response.
- This are used to handle asynchronous operation with promises.
- **Async** function implicitly return promise, while **await** pauses the execution until the promise is resolved.
- This makes a code simplifies and it enhance readability by making it appear synchronous.
- **Async()** function is always return **promise{}**.

```
const whereAmI = async function (country) {
  const res = await fetch(`https://restcountries.com/v3.1/
  name/${country}`);
  console.log(res);
};

whereAmI('portugal');
console.log('First');
```

❖ **Try-Catch Exception Handling:**



```
try {···
} catch (err) {
  console.error(`${err}💥💥`);
  renderError(`Something went wrong 💥 ${err.message}`);
}
```