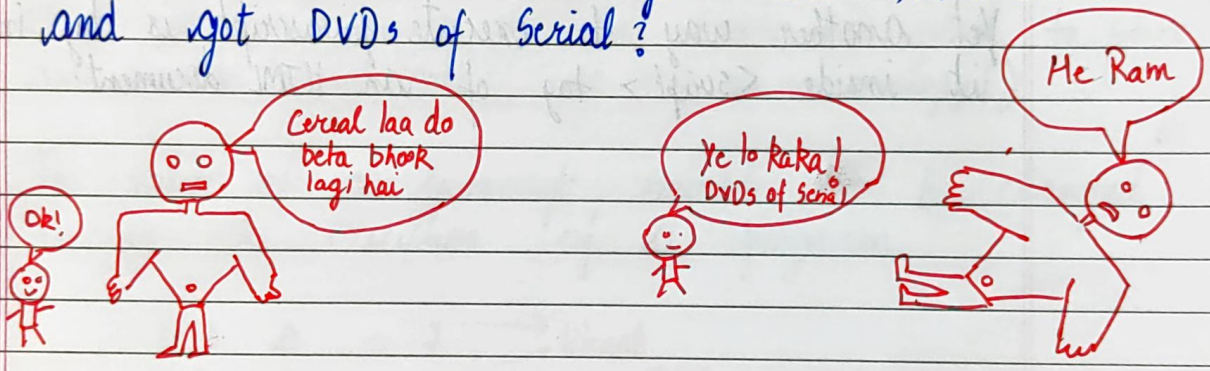
Introduction to programming

Programming is a way to talk to computers.
A language like Hindi, English or Bengali can be used to talk to a human but for computers we need straightforward instructions

Computer is Dumb!
When was the last time you ordered some cereal and got DVDs of Serial?



Programming is the act of constructing a program, a set of precise instructions telling a computer what to do.

What is Ecmascript?
ECMAScript is a standard on which Javascript is based!
It was created to ensure that different documents on javascript are actually talking about the same language.

JavaScript & ECMAScript can almost always be used interchangably
JavaScript is very liberal in what it allows.

How to execute JavaScript?

JavaScript can be executed right inside one's browser. You can open the javascript console and start writing javascript there

Another way to execute javascript is a runtime like Node.js which can be installed and used to run javascript code.

Yet another way to execute javascript is by inserting it inside <script> tag of an HTML document.

Chapter 1 - Variables & Data

Just like we follow some rules while speaking english (the grammar), we have some rules to follow while writing a javascript program. The set of these rules is called Syntax in javascript.

What is a Variable?

A Variable is a container that stores a value. This is very similar to the containers used to store rice, water and oats (Treat this as an analogy!)

The value of a javascript variable can be changed during the execution of a program

```
var a = 7;   → literal
let a = 7;   ⇒ Declaring Variables
    ↑   ↑
Identifier  assignment operator
```

Rules for choosing variable names

→ Letters, digits, underscores & $ sign allowed.
→ Must begin with a $, _ or a letter.
→ JavaScript reserved words cannot be used as a variable name
→ Harry & haRRy are different variable (case sensitive)

Var vs let in JavaScript

1. Var is globally scoped while let & const are block scoped
2. Var can be updated & re-declared within its scope
3. let can be updated but not re-declared
4. const can neither be updated nor be re-declared.

5. var variables are initialized with undefined whereas let and const variables are not initialized.
6. const must be initialized during declaration unlike let and var

Primitive Data Types & Objects
Primitive data types are a set of basic data types in javascript
Object is a non primitive datatype in javascript

These are the 7 primitive datatypes in javascript

- Null
- Undefined
- Number
- Boolean
- String
- BigInt
- Symbol

Object
An object in JavaScript can be created as follows.

```
const item = {
    name : "Led Bulb",
    price : "150"
}
```

key ← name, price ; value → "Led Bulb", "150"

Quick Quiz: Write a JavaScript program to store name, phone number and marks of a student using objects.

Chapter 2 - Expressions & Conditionals

A fragment of code that produces a value is called an expression. Every value written literally is an expression. for ex: 77 or "Harry"

Operators in JavaScript

1. Arithmetic operators

+	Addition
-	Subtraction
*	Multiplication
**	Exponentiation
/	Division
%	Modulus
++	Increment
--	Decrement

2. Assignment Operators

=	x = y
+=	x = x + y
-=	x = x - y
*=	x = x * y
/=	x = x / y
%=	x = x % y
**=	x = x ** y

3. Comparison Operators

==	equal to
!=	not equal
===	equal value and type
!==	not equal value or not equal type
>	greater than
<	less than
>=	greater than or equal to
<=	less than or equal to
?	ternary operator

4. Logical Operators

&&	logical and
||	logical or
!	logical not

Apart from these, we also have type and bitwise operators. Bitwise operators perform bit by bit operations on numbers.

operands

7 + 8 = 15 → Result

↳ operator

Comments in JavaScript

Sometimes we want our programs to contain a text which is not executed by the JS Engine

Such a text is called comment in Javascript

A comment in Javascript can be written as follows :

```
let a = 2; // this is a single line comment
```
→ Single line Comment

```
/*
  I am a
multiline comment
*/
```
} Multiline comment

Sometimes comments are used to prevent the execution of some lines of code

```
let switch = true;
// switch = false
```
→ Commented line wont execute

Conditional Statements

Sometimes we might have to execute a block of code based off some condition.
For example a prompt might ask for the age of the user and if its greater than 18, display a special message.

In JavaScript we have three forms of if ... else statement.

1. if statement
2. if ... else statement
3. if ... else if ... else statement

If statement

The if statement in JavaScript looks like this:

```
if (condition) {
    // execute this code
    }
```

The if statement evaluates the condition inside the ( ). If the condition is evaluated to true, the code inside the body of if is executed else the code is not executed.

if- else statement

The if statement can have an optional else clause. The syntax looks something like this

```
if (condition) {
    // block of code if condition true
    }
else {
    // block of code if condition false
    }
```

If the condition is true, code inside if is executed else code inside else block is executed

if - else if statement

Sometimes we might want to keep rechecking a set of conditions one by one until one matches. We use if else if for achieving this.

Syntax of if...else if looks like this

```
if (age > 0) {
    console.log("A valid age");
}
else if (age > 10 && age < 15) {
    console.log("but you are a kid");
}
else if (age > 18) {
    console.log("not a kid");
}
else {
    console.log("Invalid Age")
}
```

JavaScript ternary Operator
Evaluates a condition and executes a block of code based on the condition

Condition ? exp1 : exp2

Example Syntax of ternary operator looks like this:

(marks > 10) ? 'yes' : 'No'

↳ if marks are greater than 10, you are passed else not

Chapter 3 - Loops & functions

We use loops to perform repeated actions. For example - If you are assigned a task of printing numbers from 1 to 100, it will be very hectic to do it manually, Loops help us automate such tasks

Types of loops in JavaScript

for loop → loop a block of code no of times
for in loop → loops through the keys of an Object
for of loop → loops through the values of an object
while loop → loops a block based on a specific condition
do-while loop → while loop variant which runs atleast once

The for loop

The syntax of a for loop looks something like this

```
for ( statement 1 ; statement 2; statement 3) {
  // code to be executed
}
```

→ statement 1 is executed one time
→ Statement 2 is the condition base on which the loop runs (loop body is executed)
→ statement 3 is executed everytime the loop body is executed

Quick Quiz : Write a sample for loop of your choice.

The for-in loop
The syntax of for-in loop looks like this

```
for (key in object) {
  // code to be executed
}
```

Quick Quiz: Write a sample program demonstrating for-in loop

Note - for-in loops also work with arrays which will be discussed in the later videos.

The for-of loop
The syntax of for-of loop looks like this

```
for (variable of iterable) {
  // code
}
```

↳ For every iteration
↳ Iterable data structure like Arrays, Strings etc.

Quick Quiz: Write a sample program demonstrating for-of loops

The while loop
The syntax of while loop looks like this:

```
while (condition) {
  // code to be executed
}
```

Note: If the condition never becomes false, the loop will never end and this might crash the runtime.

Quick Quiz: Write a sample program demonstrating while loop.

The do-while loop

The do while loop's syntax looks like this:

```
do {
  // code to be executed  => Executed at least once
}
while (condition)
```

Quick Quiz: Write a sample program demonstrating do while loop

Functions in Java Script

A JavaScript function is a block of code designed to perform a particular task.

Syntax of a function looks something like this:

```
function myFunc () {
    // code
}

function bindFunc (parameter 1, parameter 2) {
    // code
}
```

↳ Function with parameters

↓ Here the parameters behave as local variables

binod func (7, 8) ⟹ Function Invocation

Function invocation is a way to use the code inside the function

A function can also return a value. The value is "returned" back to the caller

```
Const sum =(a,b) => {
                      let c = a+b;
                      return c;
                    }
```

↓ Another way to create & use the function ↑

⟹ Returns the sum

```
let y = sum (1, 3)
console.log(y)
```

→ Prints 4

Chapter 4 - Strings

Strings are used to store and manipulate text.
String can be created using the following syntax:

```
let name = "Harry" → Creates a string
name.length
    ↳ This property prints length of the string
```

Strings can also be created using single quotes

```
let name = 'Harry'
```

Template Literals
Template literals use backtics instead of quotes to define a string

```
let name = `Harry`
```

With template literals, it is possible to use both single as well as double quotes inside a string

```
let Sentence = `The name "is" Harry's`
               ↓ backtic   ↓ double quote   ↓ Single quote
```

We can insert variable directly in template literal. This is called string interpolation

```
let a = `This is ${name}` → Prints 'This is a Harry'
                 name is a variable
```

Escape Sequence Characters

If you try to print the following string, JavaScript will misunderstand it

```
let name = 'Adam D'Angelo'
```

We can use single quote escape sequence to solve the problem

```
let name = 'Adam D\'Angelo'
```

Similarly we can use \" inside a string with double quotes

Other escape sequence characters are as follows

- \n → Newline
- \t → Tab
- \r → Carriage Return

String properties and Methods

1. `let name = "Harry"`
   `name.length` → prints 5

2. `let name = "Harry"`
   `name.toUpperCase()` → prints HARRY

3. `let name = "Harry"`
   `name.toLowerCase()` → prints harry

4) let name = "Harry"
(0, 1, 2, 3, 4)
name.slice(2, 4) → prints rr
(from 2 to 4, 4 not included)

5) let name = "Harry"
name.slice(2) → prints rry
(from 2 to end)

6) let name = "Harry Bhai"
let newName = name.replace("Bhai", "Bhau")

7) let name1 = "Harry"
let name2 = "Naman"
let name3 = name1.concat(name2, "Yes")
↳ We can even use + operator

8) let name = " Harry "
let newName = name.trim()
↳ Removes whitespaces

Strings are immutable. Inorder to access the character at an index we use the following syntax

let name = "Harry"
name[0] → Prints H
name[1] → Prints a

Chapter 5 - Arrays

Arrays are variables which can hold more than one value.

```
const fruits = ["banana", "apple", "grapes"]

const a1 = [7, "Harry", false]
```
↳ can be different types

Accessing Values

```
let numbers = [1, 2, 7, 9]

numbers[0] → 1
numbers[1] → 2
```

Finding the length

```
let numbers = [1, 7, 9, 21]
              ↙0  ↓1  ↓2  ↘3

numbers[0] → 1
numbers.length → 4
```

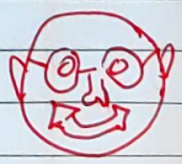
Changing the values

```
let numbers = [7, 2, 40, 9]

numbers[2] = 8
```
↳ "numbers" now becomes [7, 2, 8, 9]

Arrays are mutable

Arrays can be changed



In JavaScript, arrays are objects. The typeof operator on arrays returns object

```
Const n = [1, 7, 9]

typeof n → returns "object"
```

Arrays can hold many values under a single name

Array methods

There are some important array methods in JavaScript. Some of them are as follows:

1. toString() → Converts an array to a string of comma separated values

```
let n = [1, 7, 9]
n.toString() → 1, 7, 9
```

2. join() → joins all the array elements using a separator

```
let n = [7, 9, 13]
n.join("-") → 7-9-13
```

3. pop() → removes last element from the array

```
let n = [1, 2, 4]
n.pop() → updates the original array
          returns the popped value
```

4. push() → Adds a new element at the end of the array

```
let a = [7, 1, 2, 8]
a.push(9) → modifies the original array
          ↳ returns the new array length
```

5. shift() → Removes first element and returns it

6. unshift() → Adds element to the beginning. Returns new array length

7. delete → Array elements can be deleted using the delete operator

```
let d = [7, 8, 9, 10]
delete d[1]        → delete is an operator
```

8. Concat() → Used to join arrays to the given array

```
let a1 = [1, 2, 3]
let a2 = [4, 5, 6]
let a3 = [9, 8, 7]

a1.concat(a2, a3) → Returns [1, 2, 3, 4, 5, 6, 9, 8, 7]
```

↓
Returns a new array
Does not change existing arrays

9> Sort() → sort() method is used to sort an array alphabetically.

```
let a = [7, 9, 8]
a.sort()
```

↳ a changes to [7, 8, 9]
[modifies the original array]

Sort() takes an optional compare function. If this function is provided as the first argument, the sort() function will consider these values (the values returned from the compare function) as the basis of sorting.

10> splice() → splice can be used to add new items to an array

```
Const numbers = [1, 2, 3, 4, 5]
numbers.splice(2, 1, 23, 24)
```

Returns deleted items, modifies the Array
position to add
No of elements to remove
Elements to be added

11> slice() → slices out a piece from an array. It creates a new array

```
Const num = [1, 2, 3, 4]
num.slice(2)    → [3, 4]
num.slice(1, 3) → [2, 3]
```

12. reverse() → Reverses the elements in the source array.

Looping through Arrays
Arrays can be looped through using the classical JavaScript for loop or through some other methods discussed below

1. forEach loop → Calls a function, once for each array element

```
Const a = [1, 2, 3]
a.forEach ((value, index, array) => {
    // function logic
});
```

2. map() → Creates a new array by performing some operation on each array element.

```
Const a = [1, 2, 3]
a.map ((value, index, array) => {
    return value * value;
})
```

3. filter() → Filters ran array with values that passes a test. Creates a new array

```
Const a = [1, 2, 3, 4, 5]
a.filter (greater_than_5)
```

4. reduce method → Reduces an array to a single value

```
Const n = [1, 8, 7, 11]
let sum = numbers.reduce(add)
```

↳ A function

1+8+7+11

5. Array.from → Used to create an array from any other object

```
Array.from("Harry")
```

6. for... of → For-of loop can be used to get the values from an array

7. for ... in → for-in loop can be used to get the keys from an array.

Chapter 6 - JavaScript in the browser

JavaScript was initially created to make web pages alive. JS can be written right in a web page's HTML to make it interactive

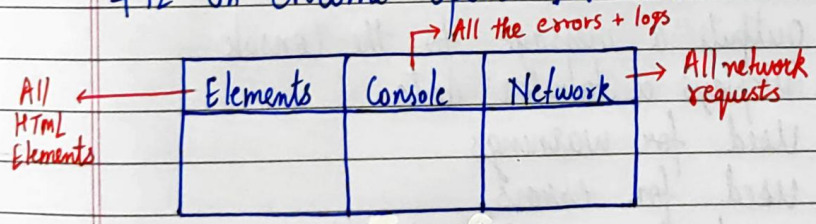
The browser has an embedded engine called the JavaScript engine or the Javascript runtime.

JavaScript's ability in the browser is very limited to protect the user's safety. For example a webpage on http://goofle.com cannot access http://codeswear.com and steal information from there.

Developer tools

Every browser has some developer tools which makes a developer's life a lot easier.

F12 on chrome opens Dev tools



We can also write JavaScript commands in the Console

The script tag

The script tag is used to insert JavaScript into an HTML page

The script tag can be used to insert external or internal scripts

```
<Script>
  alert("Hello")
</Script>
// or...
<Script Src="/js/thisone.js"></Script>
```

The benefit of a separate javascript file is that the browser will download it and store it in its cache

Console object methods
The console object has several methods, log being one of them. Some of them are as follows:

assert() → used to assert a condition
clear() → clears the console
log() → Outputs a message to the console
table() → Displays a tabular data
warn() → Used for warnings
error() → used for errors
info() → Used for special information

You will naturally remember some or all of these with time
Comprehensive list can be looked up on MDN

Interaction : alert, prompt and confirm

alert : Used to invoke a mini window with a msg.

```
alert("hello")
```

prompt : Used to take user input as string

```
inp = prompt("Hi", "No")
```

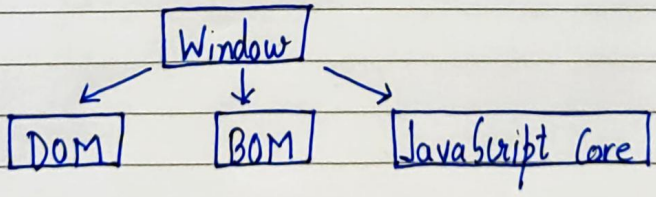
↳ optional default value

Confirm : shows a message and waits for the user to press ok or cancel. Returns true for ok and false for cancel.

The exact location & look is determined by the browser which is a limitation

Window object, BOM & DOM

We have the following when JavaScript runs in a browser



Window object represents browser window and provides methods to control it. It is a global object

Document Object Model (DOM)

Dom represents the page content as HTML

```
document.body  → Page body as Js object

document.body.style.background = "green"
  ↳ changes page background to green
```

Browser Object Model (BOM)

The Browser Object Model (BOM) represents additional objects provided by the browser (host environment) for working with everything except the document.

The functions alert / confirm / prompt are also a part of the BOM

```
location.href = "https://codewithharry.com"
  ↳ Redirect to another URL
```

Chapter 7 - Walking the DOM

DOM tree refers to the HTML page where all the nodes are objects. There can be 3 main types of nodes in the DOM tree :

1) text nodes
2) element nodes
3) comment nodes

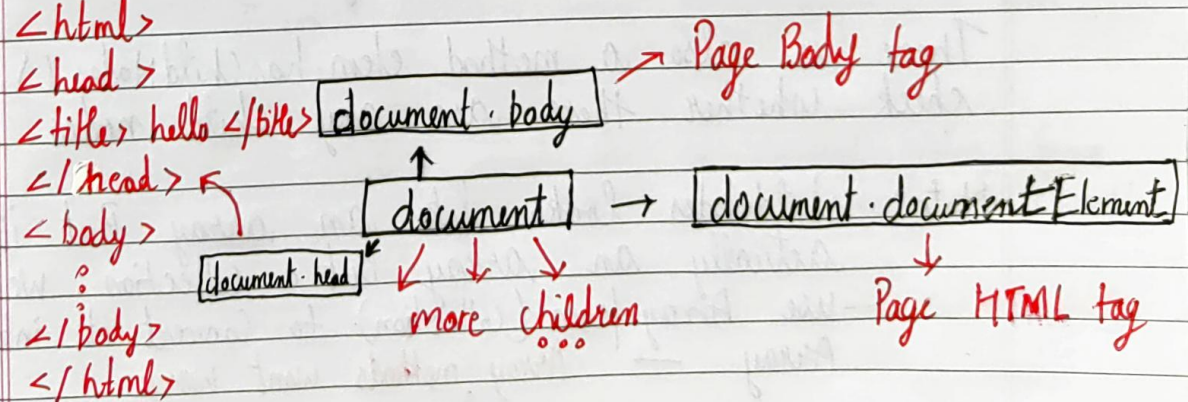
In an HTML page, <html> is at the root and <head> and <body> are its children, etc.

A text node is always a leaf of the tree

Auto Correction

If an erroneous HTML is encountered by the browser, it tends to correct it for example, if we put something after the body, it is automatically moved inside the body. Another example is <table> tag which must contain <tbody>

Walking the DOM



Note : document.body can sometimes be null if the javascript is written before the body tag.

Children of an element
Direct as well as deeply nested elements of an element are called its children

Child nodes → Elements that are direct children
For example head & body are children of <html>

Descendant nodes → All nested elements, children, their children and so on ...

firstChild, lastChild & childNodes

element.firstChild → first child element
element.lastChild → last child element
element.childNodes → All child nodes

Following is always true :

elem.childNodes[0] === elem.firstChild
elem.childNodes[elem.childNodes.length - 1] === elem.lastChild

There is also a method elem.hasChildNodes() to check whether there are any child nodes.

Note : childNodes looks like an array. But its not actually an array but a collection. We can use Array.from(collection) to convert it into an Array. → Array methods went work

Notes on DOM collections

→ They are read-only
→ They are live. elem.childNodes variable (reference) will automatically update if childNodes of elem is changed.
→ They are iterable using for... of loop

Siblings and the parent

Siblings are nodes that are children of the same parent.

→ For example: <head> and <body> are siblings. Siblings have same parent. In the above example its html

→ <body> is said to be the "next" or "right" sibling of <head>, <head> is said to be the "previous" ore "left" sibling of <body>

→ The next sibling is in nextSibling property, and the previous one in previousSibling.
The parent is available as parentNode.

```
alert( document.documentElement.parentNode ); //document
alert( document.documentElement.parentElement ); // null
```

Element only Navigation

Sometimes, we dont want text or comment nodes. Some links only take Element nodes into account. For example

document.previousElementSibling → Previous sibling which is an Element

document.nextElementSibling → next sibling (Element)

document.firstElementChild → first Element child

document.lastElementChild → last Element child.

Table links

Certain DOM elements may provide additional properties specific to their type for convenience.

Table element supports the following properties:

table.rows → collection of tr elements
table.caption → reference to <caption>
table.tHead → reference to <thead>
table.tFoot → reference to <tfoot>
table.tBodies → collection of <tbody> elements
tbody.rows → collection of <tr> inside

tr.cells → collection of td and th
tr.sectionRowIndex → index of tr inside enclosing element
tr.rowIndex → Row number starting from 0

td.cellIndex → no of cells inside enclosing <tr>

Quick Quiz: Print typeof document and typeof window in the console & see what it prints

Searching the DOM

DOM navigation properties are helpful when the elements are close to each other. If they are not close to each other, we have some more methods to search the DOM

→ **document.getElementById**
This method is used to get the element with a given "id" attribute

```
let span = document.getElementById('span')
span.style.color = "red"
```

→ **document.querySelectorAll**
Returns all elements inside an element matching the given CSS selector

→ **document.querySelector**
Returns the first element for the given CSS Selector.
A efficient version of elem.querySelectorAll(css)[0]

→ **document.getElementsByTagName**
Returns elements with the given tag name

→ **document.getElementsByClassName**
Returns elements that have the given CSS class

↳ Dont forget the "s" letter

→ **document.getElementsByName**
Searches elements by the name attribute.

matches, closest & contains methods

There are three important methods to search the DOM

1> elem.matches(css) → To check if element matches the given CSS selector

2> elem.closest(css) → To look for the nearest ancestor that matches the given CSS-selector. The elem itself is also checked

3> elemA.contains(elemB) → Returns true if elemB is inside elemA (a descendant of elemA) or when elemA == elemB

Chapter 8 - Events & other DOM properties

Console.dir function
Console.log shows the element DOM tree
Console.dir shows the element as an object with its properties

tagName / nodeName
Used to read tag name of an element
tagName → only exists for Element nodes
nodeName → defined for any node (text, comment etc.)

innerHTML and outerHTML
The innerHTML property allows to get the HTML inside the element as a string.
↳ Valid for element nodes only

The outerHTML property contains the full HTML. innerHTML + the element itself.

innerHTML is valid only for element nodes. For other node types we can use nodeValue or data.

textContent
Provides access to the text inside the element: only text, minus all tags.

The hidden property
The "hidden" attribute and the DOM property specifies whether the element is visible or not.

```
<div hidden> I am hidden </div>

<div id = "element"> I can be hidden </div>

<script>
element.hidden = true;
</script>
```

Attribute methods

1. elem.hasAttribute(name) → Method to check for existence of an attribute
2. elem.getAttribute(name) → Method used to get the value of an attribute
3. elem.setAttribute(name, value) → Method used to set the value of an attribute.
4. elem.removeAttribute(name) → Method to remove the attribute from elem.
5. elem.attributes → Method to get the collection of all attributes

data-* attributes

We can always create custom attributes but the ones starting with "data-" are reserved for programmers use. They are available in a property named dataset.

If an element has an attribute named "data-one", its available as element.dataset.one

Insertion methods

We looked at some ways to insert elements in the DOM. Here is another way:

```
let div = document.createElement('div') // create
div.className = "alert"                 // set class
div.innerHTML = "<span>hello</span>
document.body.append(div)
```

Here are some more insertion methods:

1. node.append(e) → append at the end of node
2. node.prepend(e) → Insert at the beginning of node
3. node.before(e) → Insert before node
4. node.after(e) → Insert after node
5. node.replaceWith(e) → replaces node with the given node.

Quick Quiz: Try out all these methods with your own webpage.

insert Adjacent HTML / Text / Element

This method is used to insert HTML. The first parameter is a code word, specifying where to insert. Must be one of the following:

1. "beforebegin" - Insert HTML immediately before element
2. "afterbegin" - Insert HTML into element at the beginning
3. "beforeend" - Insert HTML into element at the end.
4. "afterend" - Insert HTML immediately after element.

The second parameter is an HTML String

Example:

```
<div id = "div"> </div>
<script>
  div.insertAdjacentHTML('beforebegin', '<p> Hello </p>');
  div.insertAdjacentHTML('afterend', '<p> Bye </p>');
</script>
```

The output would be:

```
<p> Hello </p>
<div id = "div"> </div>
<p> Bye </p>
```

Node removal

To remove a node, there's a method node.remove()

```
let id1 = document.getElementById("id1")

id1.remove()
```

ClassName and classList

If we assign something to elem.className, it replaces the whole string of classes.

Often we want to add/remove/toggle a single class.

1) elem.classList.add/remove("class") - Adds/removes a class

2) elem.classList.toggle("class") - Adds the class if it doesnt exist, otherwise removes it.

3) elem.classList.contains("class") - Checks for the given class, returns true/false

SetTimeout and setInterval

SetTimeout allows us to run a function once after the interval of time.

Syntax of setTimeout is as follows:

```
let timerId = setTimeout(function, <delay>, <arg1>, <arg2>)
```

timerId ↓ returns a timer Id

<delay> ↓ in ms

clearTimeout is used to cancel the execution (in case we change our mind). For example:

```
let timerId = setTimeout(() => alert("never"), 1000);

clearTimeout(timerId)
```

↳ cancel the execution

setInterval method has a similar syntax as setTimeout:

```
let timerId = setInterval(function, <delay>, <arg1>, <arg2>)
```

All arguments have the same meaning. But unlike setTimeout, it runs the function not only once, but regularly after the given interval of time.

To stop further calls, we can use clearInterval(timerId)

Browser Events

An event is a signal that something has happened. All the DOM nodes generate such signals.

Some important DOM events are:

Mouse events: click, contextmenu (right click), mouseover/mouseout, mousedown/mouseup, mousemove

Keyboard events: keydown and keyup

form element events : submit, focus etc.

Document events : DOMContentLoaded

Handling Events

Events can be handled through HTML attributes

```
<input value = "Hey" onclick = "alert('hey')" type = "button">
```

↳ can be another JS function

Events can also be handled through the onclick property

```
elem.onclick = function() {
                 alert("yes")
                 };
```

Note : Adding a handler with JavaScript overwrites the existing handler

addEventListener and removeEventListener

addEventListener is used to assign multiple handlers to an event.

```
element.addEventListener(event, handler)

element.removeEventListener(event, handler)
```

↳ handler must be the same function object for this to work

The Event Object

When an event happens, the browser creates an event object, puts details into it and passes it as an argument to the handler

```
elem.onclick = function (event) {
    ...
}
```

event.type : Event type
event.currentTarget : Element that handled the event
event.clientX / event.clientY : Coordinates of the cursor

Chapter 9 - Callbacks, promises & async/await

Asynchronous actions are the actions that we initiate now and they finish later. eg. setTimeout
Synchronous actions are the actions that initiate and finish one-by-one

Callback functions

A callback function is a function passed into another function as an argument, which is then invoked inside the outer function to complete an action.

Here is an example of a callback:

```
function loadScript (src, callback) {
    let script = document.createElement ('script')
    script.src = src
    script.onload = () => callback (script)
    document.head.append (script)
}
```

Now we can do something like this:

```
loadScript ('https://cdn.harry.com', (script) => {
    alert ('script is loaded')
    alert (script.src)
});
```

This is called "callback-based" style of async programming. A function that does something asynchronously should provide a callback argument where we put the function to run after it's complete

Handling errors
We can handle callback errors by supplying error argument like this:

```
function loadScript (src, callback) {
  ...
  ...
  script.onload = () => callback (null, script);
  script.onerror = () => callback (new Error ('failed'));
  ...
}
```

Then inside of loadScript call:

```
loadScript ('cdn/harry', function (error, script) {
  ...
  if (error) {
    // handle error
    }
  else {
    // script loaded
    }
  });
```

Pyramid of Doom

When we have callback inside callbacks, the code gets difficult to manage

```
loadScript((...) {

    loadScript ..        ← Pyramid of Doom

        loadScript ...

            loadScript
                ...
```

As calls become more nested, the code becomes deeper and increasingly more difficult to manage, especially if we have real code instead of ...

This is sometimes called "callback hell" or "pyramid of doom"

The "pyramid" of these calls grows towards the right with every asynchronous action. Soon it spirals out of control. So this way of coding isn't very good!

Introduction to Promises

The solution to the callback hell is promises. A promise is a "promise of code execution". The code either executes or fails, in both the cases the subscriber will be notified.

The syntax of a Promise looks like this:

```
let promise = new Promise( function (resolve, reject) {
    // executor
});
```

(predefined in JS engine)

resolve and reject are two callbacks provided by javascript itself. They are called like this:

resolve (value) → If the job is finished successfully
reject (error) → If the job fails

The promise object returned by the new Promise constructor has these properties

1. State: Initially pending, then changes to either "fulfilled" when resolve is called or "rejected" when reject is called

2. result: Initially undefined, then changes to value if resolved (resolve(value)) or error when rejected (reject(error))

Consumers: then & catch
The consuming code can receive the final result of a promise through then & catch

The most fundamental one is then

```
promise.then( function (result) { /* handle */ },
              function (error) { /* handle error */ }
            );
```

If we are interested only in successful completions, we can provide only one function argument to .then():

```
let promise = new Promise (resolve => {
    setTimeout (() => resolve ("done"), 1000);
    });

promise.then (alert);
```

If we are interested only in errors, we can use null as the first argument: .then(null, f) or we can use .catch:

```
promise.catch (alert)
```

promise.finally (() => {}) is used to perform general cleanups

Quick Quiz: Rewrite the loadScript function we wrote in the beginning of this chapter using promises.

Promises Chaining

We can chain promises and make them pass the resolved values to one another like this

```
p.then (function (result) => {          // p is a promise
    alert (result); return 2;
    }).then ...
```

The idea is to pass the result through the chain of .then handlers.

Here is the flow of execution

1. The initial promise resolves in 1 seconds (Assumption)
2. The next .then() handler is then called, which returns a new promise (resolved with 2 value)
3. The next .then() gets the result of previous one and this keeps on going

Every call to .then() returns a new promise whose value is passed to the next one and so on. We can even create custom promises inside .then()

Attaching multiple handlers

We can attach multiple handlers to one promise. They dont pass the result to each other; instead they process it independently.

Let p is a promise

p.then(handler1) →

p.then(handler2) → Runs Independently

p.then(handler3) →

Promise API

There are 6 static methodes of Promise class:

1) Promise.all(promises) → Waits for all promises to resolve and returns the array of their results. If any one fails, it becomes the error & all other results are ignored

2) Promise.allSettled(promises) → Waits for all the promises to settle and returns their results as an array of objects with status and value.

3) Promise.race(promises) → Waits for the first promise to settle and its result/error becomes the outcome.

4) Promise.any(promises) → Waits for the first promise to fulfill (& not rejected), and its result becomes the outcome. Throws AggregateError if all the promises are rejected.

5) Promise.resolve(value) → Makes a resolved promise with the given value.

6) Promise.reject(error) → Makes a rejected promise with the given error.

Quick Quiz : Try all these promise APIs on your custom promises.

Async / Await

There is a special syntax to work with promises in javascript

A function can be made async by using async keyword like this :

```
async function harry(){
    return 7;
}
```

An async function always returns a promise. Other values are wrapped in a promise automatically

We can do something like this :

```
harry().then(alert)
```

So, async ensures that the function returns a promise and wraps non promises in it.

The await keyword

There is another keyword called await that works only inside async functions

```
let value = await promise;
```

The await keyword makes javascript wait until the promise settles and returns its value.

Its just a more elegant syntax of getting the promise result than promise.then + its easier to read & write

Error Handling

We all make mistakes. Also sometimes our script can have errors. Usually a program halts when an error occurs.

The try ... catch syntax allows us to catch errors so that the script instead of dying can do some thing more reasonable

The try ... catch Syntax

The try catch syntax has two main blocks: try and then catch

```
try {
  // try the code

} catch (err) {
  // error handling
  }
```

⇒ The err variable contains an error object

It works like this

1. first the code in try is executed
2. If there is no error, catch is ignored else catch is executed

try catch works synchronously
If an exception happens in scheduled code, like in setTimeout, then try... catch wont catch it :

```
try {
    setTimeout ( function () {
            // error code
        }
catch ...
```

→ Script dies and catch wont work

Thats because the function itself is executed later, when the engine has already left the try ... catch construct.

The error object
For all the built in errors, the error object has two main properties :

```
try {
  hey; // error variable not defined
  } catch (err) {
        alert (err.name)
        alert (err.message)
        alert (err.stack)
    }
```

Throwing Custom Error

We can throw our own error by using the throw syntax

```
if (age > 180) {
    throw new Error("Invalid Age")
    ...
```

We can also throw a particular error by using the built in constructor for standard errors:

```
let error = new SyntaxError(message)
            or
            new ReferenceError(message)
```

The finally clause

The try ... catch construct may have one more code clause: finally

If it exists it runs in all cases:

after try if there were no errors
after catch if there were errors

If there is a return in try, finally is executed just before the control returns to the outer code.

Chapter 10 - Network Requests & Storing Data

JavaScript can be used to send and retrieve information from the network when needed (AJAX)

Fetch API

fetch is used to get data over the network

```
let promise = fetch(url, [options])
```

↳ without options, a get request is sent

Getting a response is a 2-stage process

1. An object of Response class containing "status" & "ok" properties

   status - The http status code, eg. 200
   ok - boolean, true if the HTTP status code is 200 - 299

2. After that we need to call another method to access the body in different formats:

   response.text() → Read & return the text
   response.json() → parse the response as JSON

   Other methods include response.formData(), response.blob(), response.arrayBuffer() etc.

Note - We can use only one body reading method. example if we have already got the response with response.text() then response.json() wont work

Response headers

The response headers are available in response.headers

Request headers

To set a request header in fetch, we can use the headers option.

```
let res = fetch(url, {
            headers: {
              Authentication: 'secret'
            }
          });
```

POST requests

To make a POST request, we need to use fetch options

1) method → HTTP-method, e.g. POST
2) body → the request body

```
let response = await fetch('/url', {
                 method: 'POST',
                 headers: {
                   'Content Type': 'application/json'
                 },
                 body: '{"a": "harry"}'
               });
let result = await response.json()
```

JavaScript Cookies

Cookies are small strings of data stored directly in the browser.
In JavaScript, document.cookie provides access to cookies.

Cookies are set by a web server using the Set-Cookie HTTP-header. Next time when the request is sent to the same domain, the browser sends the cookie using the Cookie HTTP-header. That way the server knows who sent the request

We can also access cookies using document.cookie property:

```
alert ( document.cookie)
```

↳ Contains key=value pairs delimited by a ;

Writing to Cookie

An assignment to document.cookie is treated specially in a way that a write operation doesn't touch other cookies

```
document.cookie = "user=Harry"
```

↳ updates only cookie named user to Harry

Quick Quiz: Print all the cookies on twitter.com

encode URI Component

This function helps keep the valid formatting. It is used like this:

```
document.cookie = encodeURIComponent(name) + '=' +
                  encodeURIComponent(value)
```

This way, the special characters are encoded

Cookie options

Cookies have several options which can be provided after key=value to a set call like this:

```
document.cookie = "user=John; path=/a; expires=
                  Tue, 29 March 2041 03:18:22 GMT"
```

path option makes the cookie visible at /a, /a/b etc.
expires sets the cookie expiration time

Note:

1. The name=value pair, after encodeURIComponent, should not exceed 4KB
2. Total no of cookies per domain is limited to around 20+ (Exact number is browser dependent)

localStorage

localStorage is a web storage object which are not sent to server with each request
This data survives a full page refresh and even a full browser restart

These are the methods provided by localStorage

1. setItem(key, value) → store key/value pair
2. getItem(key) → get the value by key
3. removeItem(key) → remove the key with its value.
4. clear() → delete everything
5. key(index) - get the key on a given position.
6. length - the number of stored items

We can get and set values like an object

```
localStorage.one = 1

alert(localStorage.one)

delete localStorage.one
```

Important Note

1. Both key and values must be strings
2. We can use the two JSON methods to store objects in localStorage:

```
JSON.stringify(object) → Converts objects to JSON strings
JSON.parse(string) → Converts string to objects
                     (must be a valid JSON)
```

Session Storage

Used less often than localStorage. Properties and methods are same as localStorage but:

1. The sessionStorage exists only within the current browser tab. Another tab with same page will have a different storage.
2. The data survives page refresh, but not closing/opening the tab.

Storage Event

When the data gets updated in localStorage or sessionStorage, storage event triggers with these properties:

1. key → The key
2. oldValue → Previous value
3. newValue → New value
4. url → Page URL
5. storageArea → local or sessionStorage

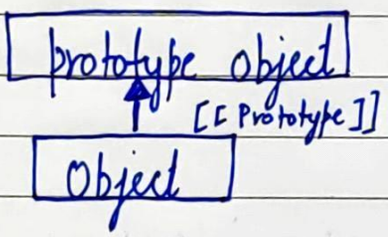
We can listen the onstorage event of window which is triggered when updates are made to the same storage from other documents.

Chapter 11 - Object Oriented Programming

In programming we often take something and then extend it. for example we might want to create a user object and "admin" and "guest" will be slightly modified variants of it

[[Prototype]]

JavaScript objects have a special property called prototype that is either null or references another object



When we try to read a property from a prototype and its missing, JavaScript automatically takes it from the prototype. This is called "prototypal inheritance"

Setting Prototype

We can set prototype by setting __proto__

Now if we read a property from the object which is not in object and is present in the prototype, JavaScript will take it from prototype

If we have a method in object, it will be called from the object. If its missing in object and present in prototype, its called from the prototype

Classes and Objects

In object-oriented programming, a class is an extensible program-code template for creating objects, providing initial values for state (member variables) and implementation of behavior (member functions)

The basic syntax for writing a class is :

```
Class MyClass {
    // class methods
    constructor() { ... }
    method1() { ... }
    method2() { ... }
    }
```

We can then use new MyClass() to create a new object with all the listed methods

The Constructor method

The Constructor() method is called automatically by new, so we can initialize the object there

Quick Quiz : Create a class user and create a few methods along with a constructor.

Class Inheritance

Class Inheritance is a way for one class to extend another class. This is done by using the extends keyword.

The extends keyword

extends keyword is used to extend another class.

```
class Child extends Parent
```

We can create a class Monkey that inherits from Animal

```
class Monkey extends Animal {
    hide() {
        alert(`${this.name} hides!`);
    }
}

let monkey = new Monkey("Monu")
monkey.run(7); // From Animal
monkey.hide();
```

Method Overriding

If we create our own implementation of run, it will not be taken from the Animal class. This is called Method Overriding

super keyword

When we override a method, we dont want the method of the previous class to go in vain. We can execute it using super keyword.

```
super(a, b)
```

→ call parent constructor

```
run () {
    super. run ( )
    this. hide ( )
    }
```

Overriding Constructor

With a constructor, things are a bit tricky / different According to the specification, if a class extends another class and has no constructor, then the following empty constructor is generated

```
Class Monkey extends Animal {
    // auto generated
    Constructor (... args) {
        super (... args);
    }
}
```

=> Happens if we dont write our own Constructor

Constructors in inheriting classes must call super (...) and do it before using this.

We can also use super. method ( ) in a Child method to call Parent Method

Static method

Static methods are used to implement functions that belong to a class as a whole and not to any particular object

We can assign a static method as follows:

```
Class Employee {
    static sMethod () {
        alert ("Hey");
    }
}
Employee.sMethod()
```

Static methods arent available for individual objects

Getters and Setters
Classes may include getters and setters to get & set the computed properties

Example:

```
class Person {
    ...
    get (name) {
        return this._name;
    }
    set name (newName) {
        this._name = newName;
    }
```

First the name property is changed to _name to avoid the name collision with the getter & setter. Then the getter uses the get keyword as shown above

instanceof Operator

The instanceof operator allows to check whether an object belongs to a certain class

The syntax is :

<obj> instanceof <class>

It returns true if obj belongs to the Class or any other class inheriting from it

Chapter 12 - Advanced JavaScript

There are some JavaScript concepts which make the life of a developer extremely simple. We will discuss some of those in this chapter

IIFE

IIFE is a JavaScript function that runs as soon as it is defined.

```
( function () {
    ...
    ...
  } )();
```

⇒ IIFE Syntax

It is used to avoid polluting the global namespace, execute an async-await, etc.

Destructuring

Destructuring assignment is used to unpack values from an Array, or properties from objects, into distinct variables

```
let [x, y] = [7, 20]
```

x will be assigned 7 and y, 20

```
[10, x, ...rest] = [10, 80, 7, 11, 21, 88]
```

x will be 80 rest will be [7, 11, 21, 88]

Similarly we can destructure objects on the left hand side of the assignment

```
Const obj = { a: 1, b: 2 }
const {a, b} = obj;
```

Some more examples can be found on MDN docs.

Spread Syntax

Spread syntax allows an iterable such as an array or string to be expanded in places where zero or more arguments are expected. In an object literal, the spread syntax enumerates the properties of an object and adds the key-value pairs to the object being created.

Example:

①
```
Const arr = [1, 7, 11]
Const obj = { ...arr }; // { 0: 1, 1: 7, 2: 11 }
```

②
```
Const nums = [1, 2, 7]
Console.log (Sum (...nums)) // 10
```

Other examples can be found on MDN docs

Quick Quiz: Output of the following ??

```
Const a = "the", b = "no"
Const c = { a, b }
Console.log (c)
```

Date
Page

local, global & block scopes

JavaScript has three types of scopes:

1. Block scope
2. Function Scope
3. Global Scope

let & const provide block level scope which means that the variables declared inside a { } cannot be accessed from outside the block

```
{
  let a = 27;
}
// a is not available here
```

Variables declared within a JavaScript function, become local to the function

A variable declared outside a function, becomes global

Hoisting

Hoisting refers to the process whereby the interpreter appears to move the declarations to the top of the code before execution

Variables can thus be referenced before they are declared in JavaScript

hello("Harry")

function hello(name) {
...
}

⇒ Works!

Important Note: JavaScript only hoists declarations, not initializations. The variable will be undefined until the line where its initialized is reached.

Hoisting with let and var
With let and var hoisting is different

console.log(num) → Error if let or const
let num = 6; → with var undefined is printed

function expressions and class expressions are not hoisted