# JavaScript for Full Stack Assignment

## 1. JavaScript Introduction

## Theory Assignment

### Question 1: What is JavaScript? Explain the role of JavaScript in web development?

Answer : **JavaScript** is a high-level, interpreted programming language that is one of the core technologies of the web, alongside **HTML** and **CSS**. It was initially developed to make web pages interactive and dynamic.

**Role of JavaScript in Web Development:**

1. **Client-Side Interactivity**:
   JavaScript runs in the browser and allows developers to create interactive features such as image sliders, form validation, dropdown menus, modal windows, and dynamic content updates without reloading the page.
2. **DOM Manipulation**:
   JavaScript can access and manipulate the **Document Object Model (DOM)**, enabling developers to dynamically change the content, structure, and style of a webpage in response to user actions.
3. **Event Handling**:
   JavaScript allows developers to respond to user actions like clicks,

keyboard inputs, and mouse movements, making the website responsive and engaging.

4. **Asynchronous Communication (AJAX)**:
   JavaScript supports asynchronous data fetching, allowing web pages to request and load data from a server without refreshing. This is commonly used in modern web apps to enhance performance and user experience.
5. **Backend Development**:
   With environments like **Node.js**, JavaScript is also used on the server side, enabling full-stack development using a single programming language.
6. **Frameworks and Libraries**:
   JavaScript powers popular frameworks (e.g., React, Angular, Vue) and libraries (e.g., jQuery), which streamline development and provide powerful tools for building complex applications.

**• Question 2: How is JavaScript different from other programming languages like Python or Java ?**

Answer : JavaScript differs from programming languages like **Python** and **Java** in several key ways, especially in terms of execution environment, syntax, and use cases. Here's a comparison:

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**1. Execution Environment**

- **JavaScript**: Primarily runs in web browsers (client-side), but can also run on servers using **Node.js**.

- **Python**: Runs on the server side or locally for scripting, data analysis, AI, and web development (using frameworks like Django or Flask).
- **Java**: Compiled language that runs on the **Java Virtual Machine (JVM)**. Used for enterprise applications, Android development, and more.

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**2. Syntax and Typing**

- **JavaScript**: Dynamically typed, interpreted language. Variables are declared using var, let, or const, and types are determined at runtime.

javascript

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let x = 10; // number

x = "Hello"; // now a string

- **Python**: Dynamically typed, but emphasizes readability and simplicity.

python

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x = 10

x = "Hello"

- **Java**: Statically typed, compiled language. Variables must be declared with a specific type.

java

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```
int x = 10;

x = "Hello"; // Error: type mismatch
```

---

**3. Use Cases**

- **JavaScript**: Mainly used for web development (front-end and back-end).
- **Python**: Used in data science, AI/ML, automation, backend web development, and scripting.
- **Java**: Popular in large-scale systems, Android apps, and enterprise-level applications.

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**4. Compilation and Interpretation**

- **JavaScript**: Interpreted (JIT compiled in modern engines like V8).
- **Python**: Interpreted (runs via Python interpreter).
- **Java**: Compiled into bytecode, then executed by the JVM.

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**5. Concurrency**

- **JavaScript**: Uses an event-driven, non-blocking **single-threaded** model with asynchronous behavior via **callbacks**, **promises**, and **async/await**.

- **Python**: Traditionally synchronous, but supports async features using asyncio.
- **Java**: Multithreaded concurrency is a core feature, with strong built-in support.

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**Summary Table:**

| Feature | JavaScript | Python | Java |
|---|---|---|---|
| Typing | Dynamic | Dynamic | Static |
| Primary Use | Web development | General-purpose | Enterprise, Android |
| Execution | Browser / Node.js | Interpreter | JVM (compiled) |
| Syntax Complexity | Moderate | Easy, readable | Verbose |
| Concurrency Model | Event loop (async) | asyncio/threading | Multithreading |

Question 3: Discuss the use of <script> tag in HTML. How can you link an external JavaScript file to an HTML document?

Answer : **Use of the <script> Tag in HTML**

The <script> tag in HTML is used to embed or reference JavaScript code within a webpage. It enables browsers to execute scripts that

control the behavior of the page—like handling user input, modifying content, or adding interactivity.

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**Ways to Use the <script> Tag**

**1. Inline JavaScript**

You can write JavaScript code directly inside the HTML document using the <script> tag:

html

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```
<!DOCTYPE html>
<html>
<head>
  <title>Inline JavaScript</title>
</head>
<body>
  <script>
    alert("Hello, world!");
  </script>
</body>
</html>
```

**2. Linking to an External JavaScript File**

To separate HTML and JavaScript for better readability and maintenance, you can link to an external .js file using the src attribute:

html

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```
<!DOCTYPE html>
<html>
<head>
  <title>External JavaScript</title>
  <script src="script.js"></script> <!-- Linking external file -->
</head>
<body>
  <h1>Welcome</h1>
</body>
</html>
```

Here, script.js should be located in the same directory or provide a correct path (e.g., js/script.js).

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**Best Practices**

- Place <script src="..."> tags at the **end of the body** or use defer in the <head> to prevent blocking page rendering:

html

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<script src="script.js" defer></script>

- Avoid mixing HTML and JavaScript logic (inline scripts) to keep code modular and maintainable.

2. Variable and Data types

Question 1: What are variables in JavaScript? How do you declare a variable using var, let, and const?

Answer: **What Are Variables in JavaScript?**

Variables in JavaScript are used to **store data values** that can be referenced and manipulated in a program. They act as containers for information such as numbers, strings, objects, or any data type.

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**Declaring Variables in JavaScript**

JavaScript provides **three keywords** to declare variables: var, let, and const. Each behaves differently in terms of **scope**, **hoisting**, and **reassignment**.

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**1. var – Old Way (Function-Scoped)**

- **Scope**: Function-scoped
- **Can be Reassigned?** Yes
- **Hoisted?** Yes (initialized as undefined)

javascript

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```
var name = "Alice";
name = "Bob"; // allowed
```

---

**2. let – Modern Way (Block-Scoped)**

- **Scope**: Block-scoped (inside {})
- **Can be Reassigned?** Yes
- **Hoisted?** Yes, but not initialized (cannot use before declaration)

javascript

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```
let age = 25;
age = 30; // allowed
```

---

**3. const – For Constants (Block-Scoped)**

- **Scope**: Block-scoped
- **Can be Reassigned?** No (value must remain constant)
- **Hoisted?** Yes, but not initialized

javascript

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```
const pi = 3.14;
```

// pi = 3.15; // Error: Assignment to constant variable

Note: If a const holds an object or array, the contents **can** be modified, but you **can't reassign** the whole variable.

javascript

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const person = { name: "Alice" };

person.name = "Bob"; // Allowed

// person = { name: "Charlie" }; // Error

---

**Summary Table**

| **Keyword** | **Scope** | **Reassignable** | **Hoisting Behavior** | **Use Case** |
|---|---|---|---|---|
| var | Function | Yes | Hoisted with undefined | Legacy code |
| let | Block | Yes | Hoisted but not initialized | General use |
| const | Block | No | Hoisted but not initialized | Constants (fixed references) |

**Question 2: Explain the different data types in JavaScript. Provide examples for each ?**

Answer : **Different Data Types in JavaScript**

JavaScript has two main categories of data types:

1. **Primitive Data Types**
2. **Non-Primitive (Reference) Data Types**

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**1. Primitive Data Types**

Primitive types hold **single values** and are **immutable**.

| Data Type | Description | Example |
|---|---|---|
| **String** | A sequence of characters | "Hello" or 'World' |
| **Number** | Any numeric value (integer or floating-point) | 42, 3.14 |
| **Boolean** | Logical value: true or false | true, false |

| Data Type | Description | Example |
| --- | --- | --- |
| **Undefined** | A variable declared but not assigned a value | let x; → x is undefined |
| **Null** | Represents "no value" or "empty" | let y = null; |
| **BigInt** | For large integers beyond 2^53 - 1 | const big = 1234567890123456789012345678 90n; |
| **Symbol** | Unique and immutable value, often used as object keys | const sym = Symbol('id'); |

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**Examples:**

javascript

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```
let name = "Alice";       // String
let age = 30;             // Number
```

```
let isStudent = true;      // Boolean
let address;               // Undefined
let salary = null;         // Null
let bigNum = 9007199254740991n; // BigInt
let id = Symbol("id");     // Symbol
```

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**2. Non-Primitive (Reference) Data Types**

These types hold **collections of values** and are **mutable**.

| Data Type | Description | Example |
|---|---|---|
| **Object** | A collection of key-value pairs | { name: "Alice", age: 25 } |
| **Array** | Ordered list of values | [1, 2, 3, "hello"] |
| **Function** | A block of reusable code | function greet() { ... } |

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**Examples:**

javascript

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```
let person = { name: "Bob", age: 40 };    // Object
let numbers = [10, 20, 30];               // Array
function greet() {
```

```
  console.log("Hello!");
}                                   // Function
```

---

**Summary Table:**

| Type | Category | Example |
|---|---|---|
| String | Primitive | "JavaScript" |
| Number | Primitive | 123, 4.56 |
| Boolean | Primitive | true, false |
| Undefined | Primitive | let x; |
| Null | Primitive | let y = null; |
| BigInt | Primitive | 123456789012345678901n |
| Symbol | Primitive | Symbol('key') |
| Object | Non-Primitive | { key: "value" } |
| Array | Non-Primitive | [1, 2, 3] |
| Function | Non-Primitive | function() { ... } |

**Question 3: What is the difference between undefined and null in JavaScript?**

Answer : **Difference Between undefined and null in JavaScript**

Both undefined and null represent **absence of a value**, but they are used in **different contexts** and have **distinct meanings**.

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### ✅ 1. undefined

- **Meaning**: A variable has been **declared** but **not assigned** a value.
- **Set by**: JavaScript **automatically**.
- **Type**: undefined (primitive type)

**Example**:

javascript

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let a;

console.log(a); // Output: undefined

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### ✅ 2. null

- **Meaning**: A value that explicitly represents **"no value"** or **"empty value"**.
- **Set by**: **Developer manually**
- **Type**: object (this is a known quirk in JavaScript)

**Example**:

javascript

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```
let b = null;
console.log(b); // Output: null
```

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🔍 **Key Differences Table**

| Feature | undefined | null |
|---|---|---|
| Set by | JavaScript (default) | Developer (manual assignment) |
| Meaning | Variable declared but not set | Intentional absence of value |
| Type | undefined | object |
| Use Case | Uninitialized variables | Resetting or clearing a value |
| Example | let x; | let y = null; |

3. **JavaScript Operators**

**• Question 1: What are the different types of operators in JavaScript? Explain with examples. o Arithmetic operators o Assignment operators o Comparison operators o Logical operators ?**

Answer : **Different Types of Operators in JavaScript**

Operators in JavaScript are symbols used to perform operations on variables and values. Here are the major types with examples:

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## 🔢 1. Arithmetic Operators

Used to perform mathematical operations.

| Operator | Description | Example | Result |
|---|---|---|---|
| + | Addition | 5 + 2 | 7 |
| - | Subtraction | 5 - 2 | 3 |
| * | Multiplication | 5 * 2 | 10 |
| / | Division | 5 / 2 | 2.5 |
| % | Modulus (Remainder) | 5 % 2 | 1 |
| ** | Exponentiation | 2 ** 3 | 8 |
| ++ | Increment | x++ | Increases x by 1 |
| -- | Decrement | x-- | Decreases x by 1 |

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## 📝 2. Assignment Operators

Used to assign values to variables.

| Operator | Example | Meaning |
|---|---|---|
| = | x = 5 | Assign 5 to x |
| += | x += 3 | x = x + 3 |
| -= | x -= 2 | x = x - 2 |
| *= | x *= 4 | x = x * 4 |

| Operator | Example | Meaning |
|---|---|---|
| /= | x /= 2 | x = x / 2 |
| %= | x %= 3 | x = x % 3 |

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### ⚖️ 3. Comparison Operators

Used to compare two values and return a boolean (true or false).

| Operator | Description | Example | Result |
|---|---|---|---|
| == | Equal to | 5 == "5" | true |
| === | Strict equal (type + value) | 5 === "5" | false |
| != | Not equal | 5 != 4 | true |
| !== | Strict not equal | 5 !== "5" | true |
| > | Greater than | 5 > 3 | true |
| < | Less than | 3 < 5 | true |
| >= | Greater than or equal | 5 >= 5 | true |
| <= | Less than or equal | 4 <= 5 | true |

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### 🔗 4. Logical Operators

Used to combine multiple conditions.

| Operator | Description | Example | Result |
| --- | --- | --- | --- |
| && | Logical AND | true && false | false |
| ` | | ` | Logical OR |
| ! | Logical NOT | !true | false |

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✅ **Example Use Case:**

javascript

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```
let age = 20;
let isStudent = true;

// Logical operator + comparison + assignment
if (age >= 18 && isStudent) {
  console.log("Eligible for student discount");
}
```

• **Question 2: What is the difference between == and === in JavaScript?**

Answer : **Difference Between == and === in JavaScript**

Both == and === are **comparison operators**, but they behave differently in how they compare values.

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✅ **== (Loose Equality)**

- Compares **values only**, **not types**.
- Performs **type coercion** if the types are different.

**Example:**

javascript

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```
5 == "5"       // true (number and string are coerced to the same type)
0 == false     // true
null == undefined // true
```

---

✅ **=== (Strict Equality)**

- Compares **both value and type**.
- **No type coercion** – values must be of the **same type** to be equal.

**Example:**

javascript

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```
5 === "5"      // false (different types: number vs. string)
0 === false    // false
null === undefined // false
5 === 5        // true
```

---

🔍 **Summary Table**

| Operator | Name | Checks Value | Checks Type | Type Coercion |
|---|---|---|---|---|
| == | Loose Equality | ✅ Yes | ❌ No | ✅ Yes |
| === | Strict Equality | ✅ Yes | ✅ Yes | ❌ No |

4. Control Flow (If-Else, Switch)

• Question 1: What is control flow in JavaScript? Explain how if-else statements work with an example.

Answer : **What is Control Flow in JavaScript?**

**Control flow** in JavaScript refers to the **order in which the code is executed**. By default, JavaScript runs code **from top to bottom**, but you can control that flow using decision-making structures like:

- if, else if, else
- switch
- loops (for, while, etc.)
- functions and early return statements

These allow your program to **make decisions** and **execute different blocks of code** based on conditions.

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## ✅ How if-else Statements Work

The if-else statement lets you execute different code blocks **depending on whether a condition is true or false**.

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**Syntax:**

javascript

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```
if (condition) {
  // Code runs if condition is true
} else {
  // Code runs if condition is false
}
```

You can also use else if for multiple conditions:

javascript

CopyEdit

```
if (condition1) {
  // Executes if condition1 is true
} else if (condition2) {
```

```
  // Executes if condition2 is true
} else {
  // Executes if none of the above conditions are true
}
```

---

**Example:**

javascript

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```
let age = 18;

if (age < 13) {
  console.log("You are a child.");
} else if (age < 20) {
  console.log("You are a teenager.");
} else {
  console.log("You are an adult.");
}
```

**Output:**

You are a teenager.

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**Question 2: Describe how switch statements work in JavaScript. When should you use a switch statement instead of if-else?**

Answer : **How switch Statements Work in JavaScript**

A switch statement is used to execute **one block of code** out of many possible options, based on the **value of an expression**. It's a cleaner alternative to writing multiple if-else if statements when comparing the **same variable** to different values.

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✅ **Syntax:**

javascript

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```
switch (expression) {
  case value1:
    // Code block
    break;
  case value2:
    // Code block
    break;
  default:
    // Code block if no case matches
}
```

- expression is evaluated once.

- case values are compared **strictly** (===) to the expression.
- break stops execution from falling through to the next case.
- default runs if no case matches (like an else block).

---

✅ **Example:**

javascript

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```
let day = "Monday";

switch (day) {
  case "Monday":
    console.log("Start of the work week.");
    break;
  case "Friday":
    console.log("End of the work week.");
    break;
  case "Saturday":
  case "Sunday":
    console.log("Weekend!");
    break;
  default:
```

```
    console.log("Midweek day.");
}
```

**Output:**
Start of the work week.

---

🤔 **When to Use switch Instead of if-else:**

| **Use switch when...** | **Use if-else when...** |
| --- | --- |
| You're comparing **one variable** to **many exact values** | You have **complex conditions or ranges** |
| There are **multiple clear cases** | You need **logical or relational operators** (e.g., >, <, &&) |
| You want **cleaner, more readable code** | You have **few conditions or simple logic** |

5. **<u>Loops (For, While, Do-While)</u>**

**<u>Question 1: Explain the different types of loops in JavaScript (for, while, do-while). Provide a basic example of each</u>**.

Answer : **Different Types of Loops in JavaScript**

Loops allow you to run a block of code **multiple times** until a certain condition is met. JavaScript provides different types of loops, each with different use cases:

1. **for Loop**
2. **while Loop**
3. **do-while Loop**

Let's go through each one and provide basic examples.

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## ✅ 1. for Loop

A for loop is used when you know the **number of iterations** in advance. It consists of three parts: initialization, condition, and increment/decrement.

**Syntax:**

javascript

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```
for (initialization; condition; increment/decrement) {
  // Code to be executed
}
```

**Example:**

javascript

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```
for (let i = 0; i < 5; i++) {
```

```
  console.log(i);  // Prints numbers 0 to 4
}
```

**Output:**

```
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0
1
2
3
4
```

---

### ✅ 2. while Loop

A while loop is used when you want to run a block of code **as long as a condition is true**. The condition is checked before the code is executed.

**Syntax:**

```
javascript
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while (condition) {
  // Code to be executed
}
```

**Example:**

javascript

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```
let i = 0;
while (i < 5) {
  console.log(i);  // Prints numbers 0 to 4
  i++;
}
```

**Output:**

CopyEdit

0

1

2

3

4

---

### ✅ 3. do-while Loop

A do-while loop is similar to a while loop, but the condition is checked **after** the code block is executed. This guarantees that the code will run at least once.

**Syntax:**

javascript

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```
do {
  // Code to be executed
} while (condition);
```

**Example:**

javascript

CopyEdit

```
let i = 0;
do {
  console.log(i);  // Prints numbers 0 to 4
  i++;
} while (i < 5);
```

**Output:**

CopyEdit

0

1

2

3

4

---

📝 **Key Differences:**

| Loop Type | Condition Check | When to Use |
|---|---|---|
| for | Before loop | When you know the **number of iterations** ahead of time. |
| while | Before loop | When you want to loop **while a condition is true** and may not know the number of iterations. |
| do-while | After loop | When you want the loop to run **at least once**, regardless of the condition. |

**Question 2: What is the difference between a while loop and a do-while loop?**

Answer : **Difference Between a while Loop and a do-while Loop in JavaScript**

Both while and do-while loops are used to execute a block of code repeatedly as long as a condition is true, but they differ in when they check the condition.

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✅ **1. while Loop**

- **Condition Check**: The condition is checked **before** the loop body executes.

- **Execution**: If the condition is false initially, the code inside the loop will **not execute at all**.

**Syntax:**

javascript

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

**Example:**

javascript

CopyEdit

```
let i = 5;
while (i < 5) {
  console.log(i);  // This will NOT execute because the condition is false initially
  i++;
}
```

**Output:** (Nothing will be printed)

---

### ✅ 2. do-while Loop

- **Condition Check**: The condition is checked **after** the loop body executes.

- **Execution**: The loop will **always execute at least once**, even if the condition is false initially.

**Syntax:**

javascript

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```
do {
  // Code to be executed
} while (condition);
```

**Example:**

javascript

CopyEdit

```
let i = 5;
do {
  console.log(i);  // This will execute once even though the condition is false initially
  i++;
} while (i < 5);
```

**Output:**

CopyEdit

5

---

📝 **Key Difference:**

| Feature | while Loop | do-while Loop |
|---|---|---|
| **Condition Check** | Before entering the loop | After executing the loop body once |
| **Guarantee of Execution** | **May not run** if the condition is false initially | **Always runs at least once**, even if the condition is false initially |
| **Best Used When** | You are uncertain if the loop will run, and want to check the condition first | You need the loop to run **at least once**, even if the condition is false at first |

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6. **Functions**

**Question 1: What are functions in JavaScript? Explain the syntax for declaring and calling a function.**

Answer : **What are Functions in JavaScript?**

In JavaScript, a **function** is a **reusable block of code** that performs a specific task. Functions help in organizing code, making it modular, and enabling **reusability**. Functions can take **input parameters** (arguments), process them, and then **return** a result.

Functions allow you to:

- **Encapsulate** logic into a single unit.

- **Reuse** code without repeating it.
- Improve **readability** and **maintainability**.

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### ✅ Syntax for Declaring a Function

A function is declared using the function keyword, followed by the function name, a list of parameters (optional), and a block of code enclosed in curly braces {}.

**Basic Syntax:**

javascript

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```
function functionName(parameter1, parameter2, ...) {
  // Code to be executed
  return result;  // Optional, returns a value
}
```

**Example:**

javascript

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```
function greet(name) {
  console.log("Hello, " + name + "!");
}
```

In this example, the greet function takes one parameter (name) and logs a greeting message to the console.

---

## ✅ Syntax for Calling a Function

To call or **invoke** a function, you simply use its name followed by parentheses () containing the arguments (if any).

**Calling the function:**

javascript

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```
greet("Alice");  // Output: "Hello, Alice!"
```

---

## ✅ Example: A Function with Parameters and Return Value

Here's an example of a function that **takes two parameters** and **returns a value**:

**Syntax:**

javascript

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```
function add(a, b) {
  return a + b;
}
```

**Calling the function:**

javascript

CopyEdit

```
let sum = add(3, 4);  // sum is 7
console.log(sum);      // Output: 7
```

---

✅ **Different Ways to Declare Functions in JavaScript**

1. **Function Declaration** (Traditional way):

javascript

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```
function multiply(a, b) {
  return a * b;
}
```

2. **Function Expression** (Anonymous function):

javascript

CopyEdit

```
const multiply = function(a, b) {
  return a * b;
};
```

3. **Arrow Function** (Shorter syntax):

javascript

CopyEdit

```
const multiply = (a, b) => a * b;
```

---

✅ **Function Scope**

- Variables declared inside a function are **local** to that function and cannot be accessed outside of it (i.e., **function scope**).
- Parameters are **local** to the function and only accessible within it.

**Example:**

javascript

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```
function example() {
  let localVar = "I'm inside the function";
  console.log(localVar);  // This works inside the function
}

example();
console.log(localVar);  // Error: localVar is not defined (outside function)
```

**Question 2: What is the difference between a function declaration and a function expression?**

Answer : **Difference Between a Function Declaration and a Function Expression in JavaScript**

In JavaScript, both **function declarations** and **function expressions** are ways to define functions, but they behave differently in terms of **hoisting**, **syntax**, and **usage**.

---

## ✅ 1. Function Declaration

A **function declaration** is the traditional way of defining a function. It defines the function with a name and allows you to invoke the function before its actual definition (due to **hoisting**).

**Syntax:**

javascript

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```
function functionName(parameters) {
  // Code to be executed
}
```

**Example:**

javascript

CopyEdit

```
function greet(name) {
  console.log("Hello, " + name + "!");
}


greet("Alice");  // Output: "Hello, Alice!"
```

**Key Points:**

- The function has a **name** (e.g., greet).

- **Hoisted**: Function declarations are **hoisted** to the top of their scope, meaning they can be called before they appear in the code.

**Example of Hoisting:**

javascript

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```
greet("Alice");  // Works fine even before the function declaration


function greet(name) {
  console.log("Hello, " + name + "!");
}
```

**Output:**

CopyEdit

Hello, Alice!

---

### ✅ 2. Function Expression

A **function expression** is when a function is defined **within an expression** and often assigned to a variable. It can be either named or anonymous. Unlike function declarations, function expressions are **not hoisted**.

**Syntax:**

javascript

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```
const functionName = function(parameters) {
  // Code to be executed
};
```

**Example (Anonymous Function Expression):**

javascript

CopyEdit

```
const greet = function(name) {
  console.log("Hello, " + name + "!");
};

greet("Bob");  // Output: "Hello, Bob!"
```

**Example (Named Function Expression):**

javascript

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```
const greet = function greetFunction(name) {
  console.log("Hello, " + name + "!");
};

greet("Charlie");  // Output: "Hello, Charlie!"
```

**Key Points:**

- **Anonymous**: The function can be **unnamed** or **named**.

- **Not Hoisted**: Function expressions are **not hoisted**, meaning the function cannot be called before the expression is defined.

**Example of Not Hoisted:**

javascript

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greet("Alice");  // Error: greet is not a function (cannot call before definition)

const greet = function(name) {

  console.log("Hello, " + name + "!");

};

Question 3: Discuss the concept of parameters and return values in functions.

Answer : **Concept of Parameters and Return Values in Functions**

In JavaScript, **parameters** and **return values** are two fundamental concepts when working with functions. Understanding these concepts is essential for making functions more flexible and useful.

---

✅ **1. Parameters in Functions**

**Parameters** are variables listed in the **function definition**. They allow you to pass **values** (arguments) into a function, making it **dynamic** and **reusable**.

**Syntax:**

javascript

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```
function functionName(parameter1, parameter2, ...) {
  // Function body
}
```

- **Parameters** are placeholders inside the function definition.
- When the function is called, **arguments** (real values) are passed to these parameters.

**Example:**

javascript

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```
function greet(name) {
  console.log("Hello, " + name + "!");
}
```

In the function greet, name is the **parameter**. It will hold the value passed during the function call.

---

## ✅ 2. Calling a Function with Arguments

When you call a function, you **pass values** to the parameters. These values are called **arguments**.

**Example:**

javascript

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```
greet("Alice");  // "Hello, Alice!"
greet("Bob");    // "Hello, Bob!"
```

In these examples, "Alice" and "Bob" are **arguments** passed to the name parameter.

---

### ✅ 3. Return Values in Functions

A **return value** is the value that a function **produces** and sends back to the calling code. This is done using the return keyword. The return value can be any type of data, such as a number, string, array, object, or even another function.

- A function can **return a value**, or it can **not return anything** (in which case it returns undefined by default).

**Syntax:**

javascript

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```
function functionName(parameters) {
  return value;  // The value to return
}
```

- Once the return statement is executed, the function **stops executing** further, and the return value is sent back to the caller.

**Example with Return Value:**

javascript

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```
function add(a, b) {
  return a + b;
}


let result = add(3, 4);  // result is 7
console.log(result);      // Output: 7
```

In this example, the function add takes two parameters (a and b), adds them together, and returns the sum.

---

### ✅ 4. Functions Without Return Values (void)

If a function does not explicitly return a value, it is considered to **not return** anything. In this case, the function implicitly returns undefined.

**Example (No Return Value):**

javascript

CopyEdit

```
function greet(name) {
```

```
  console.log("Hello, " + name + "!");
}

let result = greet("Alice");  // "Hello, Alice!"
console.log(result);          // Output: undefined
```

Here, greet doesn't return anything, so result is undefined.

---

### ✅ 5. Default Parameters

JavaScript also allows you to set **default values** for parameters. If no argument is passed for a parameter, the default value is used.

**Syntax:**

```
javascript
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function functionName(parameter = defaultValue) {
  // Code
}
```

**Example with Default Parameters:**

```
javascript
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function greet(name = "Guest") {
  console.log("Hello, " + name + "!");
```

```
}

greet("Alice");  // Output: "Hello, Alice!"
greet();         // Output: "Hello, Guest!"
```

Here, if no argument is passed, name defaults to "Guest".

---

### ✅ 6. Rest Parameters (Handling Multiple Arguments)

In JavaScript, **rest parameters** allow you to pass an arbitrary number of arguments to a function.

**Syntax:**

```
javascript
CopyEdit
function functionName(...parameters) {
  // Code
}
```

The ... syntax collects all remaining arguments into an array.

**Example with Rest Parameters:**

```
javascript
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function sum(...numbers) {
  return numbers.reduce((total, num) => total + num, 0);
```

```
}


console.log(sum(1, 2, 3, 4));  // Output: 10
console.log(sum(5, 10));       // Output: 15
```

Here, the function sum can accept any number of arguments, and the numbers array will contain all the arguments passed to it.

---

📝 **Key Points to Remember:**

| Concept | Description |
|---|---|
| **Parameters** | Variables that hold the values passed to a function when it is called. |
| **Arguments** | The actual values passed to the function's parameters during the function call. |
| **Return Value** | The value that a function sends back to the caller, using the return statement. |
| **Default Parameters** | Parameters that are assigned a default value if no argument is provided. |
| **Rest Parameters** | Allows a function to accept an indefinite number of arguments as an array. |

7. **Arrays**

**Question 1: What is an array in JavaScript? How do you declare and initialize an array?**

Answer : **What is an Array in JavaScript?**

An **array** in JavaScript is a **special type of object** used to store a **collection of values**. These values can be of any data type, such as numbers, strings, booleans, objects, or even other arrays. Arrays allow you to store and manipulate multiple values in a single variable, making it easier to work with lists or collections of data.

**Key Characteristics of Arrays:**

- Arrays are **indexed**, meaning each element in the array has a specific **index** (starting from 0).
- Arrays are **ordered** collections, meaning the elements maintain their order.
- JavaScript arrays are **dynamic**, meaning their size can change during runtime.

---

✅ **How to Declare and Initialize an Array in JavaScript**

**1. Array Declaration**

You can declare an array using either the Array constructor or the array literal syntax (most common and recommended).

---

**Array Declaration Using Array Literal Syntax:**

The most common and recommended way to declare and initialize an array is by using **square brackets** [].

**Syntax:**

javascript

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let arrayName = [element1, element2, element3, ...];

**Example:**

javascript

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let fruits = ["Apple", "Banana", "Orange"];

console.log(fruits);  // Output: ["Apple", "Banana", "Orange"]

Here, fruits is an array containing three string elements: "Apple", "Banana", and "Orange".

---

**Array Declaration Using the Array Constructor:**

You can also declare an array using the **Array constructor**. This method is less common but still valid.

**Syntax:**

javascript

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let arrayName = new Array(element1, element2, element3, ...);

**Example:**

javascript

CopyEdit

let numbers = new Array(1, 2, 3, 4);

console.log(numbers);  // Output: [1, 2, 3, 4]

Here, numbers is an array initialized with the elements 1, 2, 3, 4.

---

✅ **Empty Array Declaration:**

You can also declare an empty array, which can later be populated with values.

**Example:**

javascript

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let emptyArray = [];

console.log(emptyArray);  // Output: []

Or using the Array constructor:

javascript

CopyEdit

let emptyArray = new Array();

console.log(emptyArray);  // Output: []

---

✅ **Initializing an Array with a Specific Length:**

You can create an array with a specific length by passing the length as an argument to the Array constructor. The array will be empty but have the specified number of slots.

**Example:**

javascript

CopyEdit

```
let emptySlots = new Array(5);

console.log(emptySlots);  // Output: [ <5 empty items> ]
```

This creates an array with 5 empty slots. It does not initialize the elements with values.

---

✅ **Accessing Array Elements:**

You can access elements in an array using their index (position) in the array, starting from 0.

**Example:**

javascript

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```
let colors = ["Red", "Green", "Blue"];

console.log(colors[0]);  // Output: "Red"

console.log(colors[1]);  // Output: "Green"

console.log(colors[2]);  // Output: "Blue"
```

---

✅ **Array Length:**

You can get the number of elements in an array using the .length property.

**Example:**

javascript

CopyEdit

```
let numbers = [10, 20, 30];

console.log(numbers.length);  // Output: 3
```

**<u>Question 2: Explain the methods push(), pop(), shift(), and unshift() used in arrays.</u>**

Answer : **Array Methods in JavaScript: push(), pop(), shift(), and unshift()**

In JavaScript, arrays come with a set of built-in methods that allow you to **add** or **remove** elements from the array. Four commonly used methods for modifying arrays are push(), pop(), shift(), and unshift(). These methods directly manipulate the array by modifying its length and content.

---

### ✅ 1. push() Method

The push() method is used to **add one or more elements to the end** of an array. It **returns the new length** of the array after the elements are added.

**Syntax:**

javascript

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array.push(element1, element2, ..., elementN);

**Example:**

javascript

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let fruits = ["Apple", "Banana"];

fruits.push("Orange", "Grapes");

console.log(fruits);  // Output: ["Apple", "Banana", "Orange", "Grapes"]

In this example, the push() method adds "Orange" and "Grapes" to the end of the fruits array.

---

### ✅ 2. pop() Method

The pop() method is used to **remove the last element** from an array. It modifies the original array and **returns the removed element**.

**Syntax:**

javascript

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let removedElement = array.pop();

**Example:**

javascript

CopyEdit

```
let fruits = ["Apple", "Banana", "Orange"];
let lastFruit = fruits.pop();

console.log(fruits);       // Output: ["Apple", "Banana"]
console.log(lastFruit);    // Output: "Orange"
```

In this example, pop() removes the last element ("Orange") from the fruits array and assigns it to the variable lastFruit.

---

### ✅ 3. shift() Method

The shift() method is used to **remove the first element** from an array. It modifies the original array and **returns the removed element**. It shifts all the other elements one position towards the start of the array.

**Syntax:**

```
javascript
CopyEdit
let removedElement = array.shift();
```

**Example:**

```
javascript
CopyEdit
let fruits = ["Apple", "Banana", "Orange"];
let firstFruit = fruits.shift();
```

console.log(fruits);  // Output: ["Banana", "Orange"]

console.log(firstFruit);  // Output: "Apple"

In this example, shift() removes the first element ("Apple") from the fruits array and assigns it to the variable firstFruit.

---

### ✅ 4. unshift() Method

The unshift() method is used to **add one or more elements to the beginning** of an array. It **returns the new length** of the array after the elements are added.

**Syntax:**

javascript

CopyEdit

array.unshift(element1, element2, ..., elementN);

**Example:**

javascript

CopyEdit

let fruits = ["Banana", "Orange"];

fruits.unshift("Apple", "Grapes");

console.log(fruits);  // Output: ["Apple", "Grapes", "Banana", "Orange"]

In this example, unshift() adds "Apple" and "Grapes" to the beginning of the fruits array.

---

📝 **Summary of Methods:**

| Method | Action | Affects Array | Return Value |
|---|---|---|---|
| push() | Adds elements to the end of array | Modifies array | **New length** of array |
| pop() | Removes the last element of array | Modifies array | **Removed element** |
| shift() | Removes the first element of array | Modifies array | **Removed element** |
| unshift() | Adds elements to the beginning of array | Modifies array | **New length** of array |

8. **Objects Theory Assignment**

**• Question 1: What is an object in JavaScript? How are objects different from arrays?**

Answer : **What is an Object in JavaScript?**

An **object** in JavaScript is a collection of key-value pairs, where each key (also known as a **property**) is a string (or symbol), and the value can be any data type, such as a string, number, array, function, or even another object. Objects are used to represent **structured data**

and are the foundation for storing and organizing more complex data in JavaScript.

---

## ✅ Object Syntax

**Creating an Object:**

Objects are typically created using **curly braces** {} and are initialized with key-value pairs.

**Example:**

javascript

CopyEdit

```
let person = {
  name: "Alice",
  age: 25,
  job: "Developer"
};
```

In this example:

- name, age, and job are the **keys** (or properties).
- "Alice", 25, and "Developer" are the corresponding **values**.

**Accessing Object Properties:**

You can access the properties of an object using either **dot notation** or **bracket notation**.

- **Dot Notation**:

javascript

CopyEdit

console.log(person.name);  // Output: "Alice"

- **Bracket Notation**:

javascript

CopyEdit

console.log(person["age"]);  // Output: 25

---

## ✅ Objects vs Arrays

Objects and arrays are both used to store data, but they serve different purposes and have distinct characteristics:

**1. Data Structure**

- **Objects** store **key-value pairs**, where the keys are typically strings (or symbols), and the values can be any data type.
- **Arrays** store **ordered lists** of values, and each value is accessed by its **index** (a numeric position).

**2. Use Case**

- **Objects** are used for representing and grouping **related data** with descriptive keys (e.g., a person's name, age, and job).
- **Arrays** are used for storing **ordered collections** of data, where the order of elements matters and can be accessed by index (e.g., a list of numbers, names, or other data).

**3. Accessing Elements**

- **Objects** use **keys** to access data.
- **Arrays** use **indexes** (starting from 0) to access data.

**4. Syntax**

- **Objects** use curly braces {} and key-value pairs.
- **Arrays** use square brackets [] and elements are separated by commas.

**Example of Object vs Array:**

javascript

CopyEdit

```
// Object
let person = {
  name: "Alice",
  age: 25,
  job: "Developer"
};

// Accessing properties
console.log(person.name);  // Output: "Alice"

// Array
let fruits = ["Apple", "Banana", "Orange"];
```

```
// Accessing elements by index
console.log(fruits[0]);  // Output: "Apple"
```

**5. Order**

- **Objects**: The order of properties in an object is not guaranteed. In modern JavaScript, properties are usually ordered as follows: first, integer keys (if any), then string keys, and finally symbol keys. However, it's not ideal to rely on this order.
- **Arrays**: Arrays are **ordered collections**, and the order of elements is preserved.

---

✅ **Key Differences Between Objects and Arrays**

| **Feature** | **Object** | **Array** |
|---|---|---|
| **Structure** | Key-value pairs | Ordered list of values |
| **Access Method** | Access values via **keys** (strings) | Access values via **indexes** (numbers) |
| **Use Case** | Storing related data with named properties | Storing ordered data, like lists or sequences |
| **Order** | No guaranteed order | Order is preserved |
| **Syntax** | { key: value, key2: value2, ... } | [value1, value2, ...] |

---

### 💡 When to Use an Object or Array:

- Use **objects** when you need to store data that is **related** and you want to access the data by **names** or **keys**.
- Use **arrays** when you have an **ordered collection** of elements that you want to access by **index**.

---

### 📝 Example:

**Object (Person's Information):**

javascript

CopyEdit

```
let person = {
  name: "Alice",
  age: 30,
  job: "Developer"
};
console.log(person.name); // "Alice"
```

**Array (List of Fruits):**

javascript

CopyEdit

```
let fruits = ["Apple", "Banana", "Orange"];
console.log(fruits[0]);  // "Apple"
```

**Question 2: Explain how to access and update object properties using dot notation and bracket notation?**

Answer : **Accessing and Updating Object Properties in JavaScript**

In JavaScript, objects store data in the form of key-value pairs. You can **access** and **update** these properties using two main methods: **dot notation** and **bracket notation**. Both methods are commonly used, but they serve slightly different purposes.

---

### ✅ 1. Dot Notation

**Dot notation** is the most common way to access or update properties in an object. It is simple, clean, and works when the property name is a valid identifier (e.g., it doesn't contain spaces or special characters).

**Syntax for Accessing:**

javascript

CopyEdit

object.property

**Syntax for Updating:**

javascript

CopyEdit

object.property = newValue;

**Example:**

javascript

CopyEdit

```
let person = {
  name: "Alice",
  age: 30,
  job: "Developer"
};

// Accessing property
console.log(person.name);  // Output: "Alice"

// Updating property
person.age = 31;
console.log(person.age);  // Output: 31
```

In the example above:

- person.name accesses the name property of the person object.
- person.age = 31 updates the age property to 31.

---

### ✅ 2. Bracket Notation

**Bracket notation** is used when the property name is stored in a variable or if the property name is not a valid JavaScript identifier

(e.g., it contains spaces, special characters, or starts with a number). It is also useful when the property name is dynamic.

**Syntax for Accessing:**

javascript

CopyEdit

object["property"]

**Syntax for Updating:**

javascript

CopyEdit

object["property"] = newValue;

**Example:**

javascript

CopyEdit

```
let person = {
  name: "Alice",
  age: 30,
  job: "Developer"
};

// Accessing property using a string key
console.log(person["name"]);  // Output: "Alice"
```

```
// Updating property using a string key
person["age"] = 31;
console.log(person["age"]);  // Output: 31

// Accessing property using a variable
let key = "job";
console.log(person[key]);  // Output: "Developer"

// Updating property using a variable
person[key] = "Designer";
console.log(person[key]);  // Output: "Designer"
```

In this example:

- person["name"] accesses the name property.
- person["age"] = 31 updates the age property to 31.
- You can also use a **variable** (e.g., key) to access or update properties, which is especially useful when the property name is dynamic.

---

✅ **Key Differences Between Dot Notation and Bracket Notation**

| Feature | Dot Notation | Bracket Notation |
|---|---|---|
| **Syntax** | object.property | object["property"] |
| **Valid Property Names** | Only works with valid identifiers (no spaces, special characters, or numbers at the start) | Works with any property name (even with spaces, special characters, or numbers) |
| **Accessing with Variables** | Not possible (unless the property name is hard-coded) | Possible (use a variable to reference the property name) |
| **Common Use Case** | Preferred when property names are static and valid identifiers | Preferred when property names are dynamic, contain special characters, or spaces |

---

✅ **When to Use Dot Notation vs. Bracket Notation:**

- **Dot Notation**: Use this when you know the exact property name and it's a valid identifier.
- **Bracket Notation**: Use this when the property name is dynamic (e.g., stored in a variable) or not a valid identifier (e.g., contains spaces or starts with a number).

---

📝 **Examples to Illustrate When to Use Each Notation**

**Example 1: Dot Notation**

javascript

CopyEdit

```
let person = {
  name: "Alice",
  age: 30
};

console.log(person.name);  // Accessing with dot notation
person.age = 31;           // Updating with dot notation
console.log(person.age);   // Output: 31
```

**Example 2: Bracket Notation**

javascript

CopyEdit

```
let person = {
  "full name": "Alice",
  age: 30
};

// Accessing with bracket notation (space in property name)
console.log(person["full name"]);  // Output: "Alice"
```

```
// Using a variable for dynamic access
let key = "age";
console.log(person[key]);  // Output: 30

// Updating property using bracket notation with a variable
person[key] = 31;
console.log(person[key]);  // Output: 31
```

## 9. ***JavaScript Events Theory Assignment***

### ***• Question 1: What are JavaScript events? Explain the role of event listeners.***

Answer : **What are JavaScript Events?**

**JavaScript events** are actions or occurrences that happen in the browser, typically as a result of user interaction or system-generated activity. These events are used to **trigger specific behaviors** in response to user actions or other events, such as a **click**, **keypress**, **scroll**, **resize**, **mouse movement**, and more.

In JavaScript, events allow developers to create dynamic, interactive web pages that respond to the user's behavior.

---

**Types of JavaScript Events:**

1. **Mouse Events**:
    - click: Triggered when the user clicks on an element.

- dblclick: Triggered when the user double-clicks on an element.
- mouseover: Triggered when the mouse pointer moves over an element.
- mouseout: Triggered when the mouse pointer moves out of an element.
- mousedown and mouseup: Triggered when the mouse button is pressed or released on an element.

2. **Keyboard Events**:
   - keydown: Triggered when a key is pressed down.
   - keyup: Triggered when a key is released.
   - keypress: Triggered when a key is pressed and released (deprecated in favor of keydown and keyup).
3. **Form Events**:
   - submit: Triggered when a form is submitted.
   - change: Triggered when the value of an input field changes.
   - focus: Triggered when an input element gains focus.
   - blur: Triggered when an input element loses focus.
4. **Window Events**:
   - load: Triggered when the page finishes loading.
   - resize: Triggered when the browser window is resized.
   - scroll: Triggered when the page is scrolled.

5. **Touch Events** (on mobile devices):
    - touchstart: Triggered when a touch begins.
    - touchmove: Triggered when a touch moves across the screen.
    - touchend: Triggered when a touch ends.

---

**What is an Event Listener?**

An **event listener** is a JavaScript function that "listens" for specific events to occur on an element (or an object) and **responds** when that event happens. Event listeners are used to add **event handlers** to DOM elements, making the page interactive.

An event listener is typically attached to an element, and when the specified event occurs (e.g., a click), the associated callback function is executed.

---

**How to Use Event Listeners**

**Syntax for Adding an Event Listener:**

javascript

CopyEdit

element.addEventListener(event, function, useCapture);

- **element**: The DOM element to which the event listener is attached.

- **event**: The type of event to listen for (e.g., 'click', 'mouseover', 'keydown').
- **function**: The callback function that will be executed when the event occurs.
- **useCapture** (optional): A boolean value indicating whether the event should be captured in the capture phase (default is false).

**Example:**

javascript

CopyEdit

```
let button = document.getElementById("myButton");


button.addEventListener("click", function() {
  alert("Button clicked!");
});
```

In this example:

- The event listener is attached to the button with the ID myButton.
- When the user clicks the button, the anonymous function (callback) is executed, displaying an alert.

---

**Example of Multiple Event Listeners on the Same Element:**

javascript

CopyEdit

```
let inputField = document.getElementById("myInput");

inputField.addEventListener("focus", function() {
  console.log("Input field focused!");
});

inputField.addEventListener("blur", function() {
  console.log("Input field blurred!");
});
```

In this case, the event listener listens for two events:

- **focus**: Logs when the input field gains focus.
- **blur**: Logs when the input field loses focus.

---

**Removing Event Listeners**

You can also **remove** an event listener using the removeEventListener() method. This is useful when you no longer need to listen for an event.

**Syntax for Removing an Event Listener:**

javascript

CopyEdit

```
element.removeEventListener(event, function, useCapture);
```

**Example:**

javascript

CopyEdit

```
function handleClick() {
  alert("Button clicked!");
}

let button = document.getElementById("myButton");

button.addEventListener("click", handleClick);

// Later in the code, remove the event listener
button.removeEventListener("click", handleClick);
```

In this example, the handleClick function is removed as an event listener from the click event on the button.

---

**Event Propagation:**

Event propagation is a mechanism that defines the order in which events are received on the DOM elements. It has two phases:

1. **Capture Phase** (optional): The event is handled from the outermost element to the target element.
2. **Bubble Phase**: The event is handled from the target element back up to the outermost element.

You can control whether an event is handled during the capture phase or the bubble phase by setting the useCapture argument in the addEventListener() method.

**Example of Event Propagation:**

javascript

CopyEdit

```
document.getElementById("parent").addEventListener("click", function() {
  console.log("Parent clicked!");
}, false);  // Bubbling phase

document.getElementById("child").addEventListener("click", function() {
  console.log("Child clicked!");
}, false);  // Bubbling phase
```

In this example, if the child element is clicked, the event will bubble up, and both the child and parent click handlers will be triggered.

**Question 2: How does the addEventListener() method work in JavaScript? Provide anexample?**

Answer : **How Does the addEventListener() Method Work in JavaScript?**

The addEventListener() method in JavaScript is used to **attach an event handler** (a function) to a specified event (such as click, keydown, submit, etc.) on a specific DOM element. This method allows you to respond to user interactions, changes, or other events on a web page.

**Syntax:**

javascript

CopyEdit

element.addEventListener(event, function, useCapture);

- **element**: The DOM element to which the event listener is attached (e.g., a button, div, input field).
- **event**: A string that specifies the name of the event you want to listen for (e.g., 'click', 'keydown', 'submit').
- **function**: A callback function that will be executed when the event occurs.
- **useCapture** (optional): A boolean value (true or false) that specifies whether the event should be captured in the capturing phase or handled in the bubbling phase. The default value is false (which uses the bubbling phase).

---

**How It Works:**

- When an event (like a click or submit) occurs on an element, the **callback function** provided in addEventListener() is executed.

- This function is **not executed immediately**; instead, it will run only when the specified event happens.
- The useCapture parameter (optional) determines whether the event is captured during the capture phase (before reaching the target element) or during the bubbling phase (after reaching the target element).

---

**Example:**

Here's an example that demonstrates how to use the addEventListener() method to handle a click event on a button:

html

CopyEdit

```
<!DOCTYPE html>

<html lang="en">

<head>

  <meta charset="UTF-8">

  <meta name="viewport" content="width=device-width, initial-scale=1.0">

  <title>Event Listener Example</title>

</head>

<body>


  <button id="myButton">Click Me!</button>
```

```
 <script>
  // Select the button element by its ID
  let button = document.getElementById("myButton");

  // Add an event listener for the 'click' event
  button.addEventListener("click", function() {
   alert("Button was clicked!");
  });
 </script>

</body>
</html>
```

**Explanation of the Example:**

1. **Element Selection**: The button element is selected using getElementById("myButton").
2. **addEventListener()**: The addEventListener() method is called on the button to listen for a click event.
3. **Callback Function**: When the button is clicked, the callback function (function() { alert("Button was clicked!"); }) will execute, showing an alert message.

4. **Event Occurrence**: When the user clicks the button, the alert box will appear with the message "Button was clicked!".

---

**Example with Multiple Event Listeners:**

You can also attach multiple event listeners to the same element for different events. Here's an example where we handle both click and mouseover events:

html

CopyEdit

```
<!DOCTYPE html>
<html lang="en">
<head>
  <meta charset="UTF-8">
  <meta name="viewport" content="width=device-width, initial-scale=1.0">
  <title>Multiple Event Listeners</title>
</head>
<body>

  <button id="myButton">Hover or Click Me!</button>

  <script>
```

```
    let button = document.getElementById("myButton");

    // Add event listener for 'click' event
    button.addEventListener("click", function() {
      alert("Button clicked!");
    });

    // Add event listener for 'mouseover' event
    button.addEventListener("mouseover", function() {
      console.log("Mouse is over the button!");
    });
  </script>

</body>
</html>
```

In this example:

- The **click** event listener will trigger an alert when the button is clicked.
- The **mouseover** event listener will log a message to the console whenever the mouse hovers over the button.

---

**Removing an Event Listener:**

If you want to remove an event listener after it has been added, you can use the removeEventListener() method. This requires passing the exact same function reference that was used when attaching the event listener.

**Syntax:**

javascript

CopyEdit

element.removeEventListener(event, function, useCapture);

**Example:**

html

CopyEdit

<!DOCTYPE html>

<html lang="en">

<head>

<meta charset="UTF-8">

<meta name="viewport" content="width=device-width, initial-scale=1.0">

<title>Remove Event Listener Example</title>

</head>

<body>

```
  <button id="myButton">Click Me to Remove Event
Listener</button>

  <script>
    let button = document.getElementById("myButton");

    function handleClick() {
      alert("Button was clicked!");
    }

    // Add event listener
    button.addEventListener("click", handleClick);

    // Remove event listener after 5 seconds
    setTimeout(function() {
      button.removeEventListener("click", handleClick);
      console.log("Event listener removed!");
    }, 5000);
  </script>

</body>
```

</html>

In this example:

- The click event listener is added to the button.
- After 5 seconds, the event listener is removed using removeEventListener(), so subsequent clicks will not trigger the alert.

---

**Event Propagation and useCapture:**

By default, events propagate in the **bubbling phase** (from the target element up to the document). You can specify that an event should be captured in the **capturing phase** by setting the useCapture argument to true.

**Example with useCapture:**

javascript

CopyEdit

```
document.getElementById("parent").addEventListener("click", function() {
  console.log("Parent clicked (capture phase)!");
}, true);  // Capture phase


document.getElementById("child").addEventListener("click", function() {
  console.log("Child clicked!");
```

}, false);  // Bubbling phase

In this example, the parent element listens for the click event during the capturing phase, while the child element listens during the bubbling phase. So, if both elements are clicked, the parent's handler will execute first.

## 10. DOM Manipulation Theory Assignment

- **Question 1: What is the DOM (Document Object Model) in JavaScript? How does JavaScript interact with the DOM?**

Answer : **What is the DOM (Document Object Model) in JavaScript?**

The **DOM** (Document Object Model) is a programming interface for web documents. It represents the structure of an HTML or XML document as a tree of objects (nodes), where each node corresponds to a part of the document such as an element, attribute, or piece of text.

In simpler terms, the DOM is the bridge between the web page's HTML (or XML) content and JavaScript, allowing JavaScript to interact with and manipulate the page's structure, style, and content dynamically.

The DOM represents the entire structure of a web page as a **hierarchical tree**. Each HTML element (e.g., , <p>, <img>, etc.) becomes a node in this tree. The DOM makes it possible to access and modify elements, attributes, and text on a web page, as well as handle events (like clicks or keypresses).

---

**Structure of the DOM:**

- **Document**: The root of the DOM tree, representing the entire HTML document.
- **Element Nodes**: Represent HTML tags (e.g., , , <img>).
- **Text Nodes**: Represent the text content inside HTML tags.
- **Attribute Nodes**: Represent the attributes of HTML elements (e.g., src, id, class).

For example, the HTML code:

html

CopyEdit

  Welcome to the DOM tutorial!

Would be represented in the DOM as a tree like this:

php-template

CopyEdit

Document

 └── 

     └── Welcome to the DOM tutorial!

---

**How Does JavaScript Interact with the DOM?**

JavaScript interacts with the DOM by **selecting elements**, **modifying their content**, and **responding to events**. This allows JavaScript to dynamically change the content, structure, and styling of a web page in response to user actions or other events.

JavaScript can:

1. **Select elements** from the DOM (using methods like getElementById(), querySelector(), etc.).
2. **Modify content** and attributes of elements (e.g., changing text, adding/removing classes, modifying styles).
3. **Create, remove, or update elements** in the DOM.
4. **Attach event listeners** to elements, so JavaScript can respond to user interactions like clicks, keypresses, etc.
5. **Manipulate the structure** by adding, removing, or modifying HTML elements dynamically.

---

**Common DOM Manipulation Methods in JavaScript:**

1. **Selecting Elements:**
    - getElementById(id):
        - Selects an element by its id attribute.

javascript

CopyEdit

let element = document.getElementById("example");

    - querySelector(selector):

        - Selects the first element that matches the CSS selector.

javascript

CopyEdit

```
let element = document.querySelector(".myClass");
```

    - getElementsByClassName(className):
        - Selects all elements with the specified class name.

javascript

CopyEdit

```
let elements = document.getElementsByClassName("myClass");
```

    - querySelectorAll(selector):
        - Selects all elements matching the CSS selector.

javascript

CopyEdit

```
let elements = document.querySelectorAll("div > p");
```

2. **Modifying Element Content:**
    - innerHTML:
        - Changes or retrieves the HTML content inside an element.

javascript

CopyEdit

```
let element = document.getElementById("example");
```

element.innerHTML = "<h1>Updated Content!</h1>";

- textContent:
  - Changes or retrieves the text content inside an element.

javascript

CopyEdit

let element = document.getElementById("example");

element.textContent = "New Text!";

3. **Modifying Attributes:**
   - setAttribute(attribute, value):
     - Sets the value of an attribute on an element.

javascript

CopyEdit

let img = document.querySelector("img");

img.setAttribute("src", "newImage.jpg");

- getAttribute(attribute):
  - Gets the value of an attribute from an element.

javascript

CopyEdit

let srcValue = img.getAttribute("src");

- removeAttribute(attribute):

        - Removes an attribute from an element.

javascript

CopyEdit

img.removeAttribute("src");

4. **Creating, Removing, and Modifying Elements:**
    - createElement(tagName):
        - Creates a new element node.

javascript

CopyEdit

let newDiv = document.createElement("div");

    - appendChild(child):
        - Adds a new child node to an element.

javascript

CopyEdit

let parent = document.getElementById("parent");

parent.appendChild(newDiv);

    - removeChild(child):
        - Removes a child node from an element.

javascript

CopyEdit

let parent = document.getElementById("parent");

```
parent.removeChild(newDiv);
```

5. **Modifying Styles:**
    - style:
        - Changes the inline CSS styles of an element.

```
javascript

CopyEdit

let element = document.getElementById("example");

element.style.color = "red";
```

6. **Event Handling:**
    - addEventListener():
        - Adds an event listener to an element.

```
javascript

CopyEdit

let button = document.getElementById("myButton");

button.addEventListener("click", function() {

  alert("Button clicked!");

});
```

---

**Example: DOM Manipulation with JavaScript**

Here’s an example where JavaScript interacts with the DOM to change the content and style of elements when a button is clicked:

```
html
CopyEdit
<!DOCTYPE html>
<html lang="en">
<head>
  <meta charset="UTF-8">
  <meta name="viewport" content="width=device-width, initial-scale=1.0">
  <title>DOM Example</title>
  <style>
    #example {
      color: blue;
      font-size: 20px;
    }
  </style>
</head>
<body>

  <p id="example">Hello, this is an example text.</p>
  <button id="changeTextButton">Change Text</button>
```

```
  <script>
    // Selecting elements
    let pElement = document.getElementById("example");
    let button = document.getElementById("changeTextButton");

    // Adding an event listener to the button
    button.addEventListener("click", function() {
      // Modifying the content of the <p> element
      pElement.textContent = "Text has been changed!";

      // Modifying the style of the <p> element
      pElement.style.color = "red";
    });
  </script>

</body>
</html>
```

**Explanation:**

- When the page loads, the paragraph with the ID example displays the text "Hello, this is an example text."

- When the user clicks the "Change Text" button, the click event is triggered, and the content of the paragraph is updated to "Text has been changed!".
- The paragraph's text color is also changed to red.

• **Question 2: Explain the methods getElementById(), getElementsByClassName(), and querySelector() used to select elements from the DOM?**

Answer : **Methods to Select Elements from the DOM**

JavaScript provides several methods to select elements from the Document Object Model (DOM). The most commonly used methods are getElementById(), getElementsByClassName(), and querySelector(). Each of these methods is used to access elements in a document, but they differ in their selection process and return values.

---

**1. getElementById()**

**Purpose:**

- getElementById() is used to **select a single element** by its id attribute.
- The id attribute is expected to be unique within a document, so this method will return only the first element with the specified id.

**Syntax:**

javascript

CopyEdit

```
document.getElementById("id");
```

- **Returns:** A single DOM element (or null if no element is found).

**Example:**

html

CopyEdit

```
<!DOCTYPE html>
<html lang="en">
<head>
  <meta charset="UTF-8">
  <title>getElementById Example</title>
</head>
<body>

  <div id="myDiv">Hello, World!</div>

  <script>
    let element = document.getElementById("myDiv");
    console.log(element.textContent);  // Output: Hello, World!
  </script>
```

</body>

</html>

In this example:

- The getElementById("myDiv") selects the  element with the id="myDiv".
- The textContent property of the selected element is logged to the console.

---

**2. getElementsByClassName()**

**Purpose:**

- getElementsByClassName() is used to select **multiple elements** with a specified class name.
- It returns a **live HTMLCollection** of elements that match the specified class name. A live collection means that if the document changes after the collection is obtained (e.g., if more elements are added with the same class), the collection is updated automatically.

**Syntax:**

javascript

CopyEdit

document.getElementsByClassName("className");

- **Returns:** A live HTMLCollection of elements with the specified class name.

**Example:**

html

CopyEdit

```
<!DOCTYPE html>
<html lang="en">
<head>
  <meta charset="UTF-8">
  <title>getElementsByClassName Example</title>
</head>
<body>

  <div class="myClass">Item 1</div>
  <div class="myClass">Item 2</div>
  <div class="myClass">Item 3</div>

  <script>
    let elements = document.getElementsByClassName("myClass");
    console.log(elements.length);  // Output: 3
    console.log(elements[0].textContent);  // Output: Item 1
  </script>
```

</body>

</html>

In this example:

- getElementsByClassName("myClass") returns a collection of  elements with the class="myClass".
- The length of the collection (3) is logged to the console.
- The textContent of the first element in the collection is logged.

---

**3. querySelector()**

**Purpose:**

- querySelector() is used to select **the first element** that matches a **CSS selector**.
- It allows for much more flexible selection than the other methods because it supports a wide range of selectors (e.g., class selectors, ID selectors, attribute selectors, pseudo-classes, etc.).

**Syntax:**

javascript

CopyEdit

document.querySelector("selector");

- **Returns:** The first element that matches the CSS selector (or null if no match is found).

**Example:**

html

CopyEdit

```
<!DOCTYPE html>
<html lang="en">
<head>
  <meta charset="UTF-8">
  <title>querySelector Example</title>
</head>
<body>

  <div class="myClass">Item 1</div>
  <p class="myClass">Item 2</p>

  <script>
    let element = document.querySelector(".myClass");
    console.log(element.textContent);  // Output: Item 1
  </script>

</body>
</html>
```

In this example:

- querySelector(".myClass") selects the **first element** with the class="myClass".
- In this case, it selects the first  element with the class "myClass", and the textContent of that element is logged.

---

**Comparison of Methods**

| Method | Returns | When to Use | Example Selector Syntax |
|---|---|---|---|
| getElementById() | A single element (or null) | When you need to select a single element by its id | #myId (CSS ID selector) |
| getElementsByClassName() | A live HTMLCollection of elements | When you need to select all elements with a specific class | .myClass (CSS class selector) |

| Method | Returns | When to Use | Example Selector Syntax |
|---|---|---|---|
| querySelector() | The first matching element (or null) | When you need to select the first matching element using any CSS selector | .myClass, #myId, div > p |

---

**Key Differences:**

1. **Single vs Multiple Elements:**
    - getElementById() is used for selecting a **single** element by its unique id.
    - getElementsByClassName() is used for selecting **multiple** elements that share the same class name. It returns a **live HTMLCollection**.
    - querySelector() returns the **first** element that matches the given selector, allowing you to use various types of CSS selectors.

2. **Return Type:**
    - getElementById() returns a **single element** (or null if not found).
    - getElementsByClassName() returns a **live HTMLCollection** (which can be iterated but not directly modified like an array).
    - querySelector() returns a **single element** (or null if no match).
3. **Flexibility:**
    - querySelector() is much more flexible because it supports **all CSS selector types**, making it a more powerful and general-purpose method compared to the others.

---

**Example Showing All Three Methods:**

html

CopyEdit

```
<!DOCTYPE html>
<html lang="en">
<head>
  <meta charset="UTF-8">
  <title>All Methods Example</title>
</head>
<body>
```

```
<div id="myDiv" class="myClass">This is a div</div>
<div class="myClass">This is another div</div>
<p class="myClass">This is a paragraph</p>

<script>
  // Using getElementById
  let divElement = document.getElementById("myDiv");
  console.log(divElement.textContent);  // Output: This is a div

  // Using getElementsByClassName
  let elementsByClass =
document.getElementsByClassName("myClass");
  console.log(elementsByClass.length);  // Output: 3
  console.log(elementsByClass[1].textContent);  // Output: This is
another div

  // Using querySelector
  let firstElement = document.querySelector(".myClass");
  console.log(firstElement.textContent);  // Output: This is a div
</script>
```

</body>

</html>

## *11. JavaScript Timing Events (setTimeout, setInterval) Theory Assignment*

***• Question 1: Explain the setTimeout() and setInterval() functions in JavaScript. How are theyused for timing events?***

Answer : **setTimeout() and setInterval() Functions in JavaScript**

Both setTimeout() and setInterval() are used to handle **timing events** in JavaScript. They allow you to run code after a specified delay, either once or repeatedly. They are useful for tasks like delaying actions, animations, or executing code periodically.

---

**1. setTimeout()**

**Purpose:**

- The setTimeout() function is used to **execute a function or code block after a specified delay** (in milliseconds). It only runs **once** after the specified time interval.

**Syntax:**

javascript

CopyEdit

```
setTimeout(function, delay, param1, param2, ...);
```

- **function**: The function or code block you want to run after the delay.
- **delay**: The time (in milliseconds) to wait before executing the function.
- **param1, param2, ...** (Optional): Any additional parameters to pass to the function when it is called.

**Returns:**

- A **timeout ID** (a unique identifier), which can be used with clearTimeout() to cancel the timeout before it executes.

**Example:**

javascript

CopyEdit

```
// Using setTimeout to log a message after 3 seconds
setTimeout(function() {
  console.log("Hello after 3 seconds!");
}, 3000);
```

In this example:

- The message "Hello after 3 seconds!" will be printed to the console after **3 seconds** (3000 milliseconds).

**Cancelling a Timeout:**

You can cancel a timeout before it occurs using clearTimeout() by passing the **timeout ID** returned by setTimeout().

javascript

CopyEdit

```
let timeoutID = setTimeout(function() {
  console.log("This won't be shown.");
}, 5000);

// Cancel the timeout before it executes
clearTimeout(timeoutID);
```

In this example:

- The timeout is canceled, so the message won't be displayed.

---

**2. setInterval()**

**Purpose:**

- The setInterval() function is used to **execute a function or code block repeatedly** after a specified time interval (in milliseconds). It will continue running the function at regular intervals until it is explicitly stopped.

**Syntax:**

javascript

CopyEdit

```
setInterval(function, interval, param1, param2, ...);
```

- **function**: The function or code block to execute at each interval.

- **interval**: The time (in milliseconds) to wait between each execution.
- **param1, param2, ...** (Optional): Additional parameters to pass to the function.

**Returns:**

- An **interval ID** (a unique identifier), which can be used with clearInterval() to stop the interval.

**Example:**

javascript

CopyEdit

```
// Using setInterval to log a message every 2 seconds
let intervalID = setInterval(function() {
  console.log("Hello every 2 seconds!");
}, 2000);
```

In this example:

- The message "Hello every 2 seconds!" will be printed to the console every **2 seconds** (2000 milliseconds).

**Cancelling an Interval:**

You can stop an interval using clearInterval() by passing the **interval ID** returned by setInterval().

javascript

CopyEdit

```
let intervalID = setInterval(function() {
  console.log("This will stop after 5 seconds.");
}, 1000);

// Stop the interval after 5 seconds
setTimeout(function() {
  clearInterval(intervalID);
  console.log("Interval stopped!");
}, 5000);
```

In this example:

- The interval will print the message every second.
- After **5 seconds**, the clearInterval() method will stop the interval, and the message "Interval stopped!" will be printed.

---

**Key Differences Between setTimeout() and setInterval()**

| Feature | setTimeout() | setInterval() |
|---|---|---|
| **Purpose** | Executes a function once after a specified delay. | Executes a function repeatedly at specified intervals. |
| **Execution** | Runs once after the specified time delay. | Runs continuously at the specified time interval. |

| Feature | setTimeout() | setInterval() |
| --- | --- | --- |
| **Canceling** | Can be canceled using clearTimeout(timeoutID). | Can be canceled using clearInterval(intervalID). |
| **Usage Example** | Delaying a single action (e.g., hiding a notification after a delay). | Repeating actions (e.g., updating a clock every second). |

---

**Example: Combining setTimeout() and setInterval()**

html

CopyEdit

```
<!DOCTYPE html>
<html lang="en">
<head>
  <meta charset="UTF-8">
  <meta name="viewport" content="width=device-width, initial-scale=1.0">
  <title>setTimeout and setInterval Example</title>
</head>
<body>

  <h1 id="message"></h1>
```

```
  <script>
    // Using setInterval to update a countdown every second
    let countdown = 10;
    let countdownInterval = setInterval(function() {
      document.getElementById("message").textContent =
"Countdown: " + countdown;
      countdown--;

      if (countdown < 0) {
        clearInterval(countdownInterval);
        document.getElementById("message").textContent = "Time's
up!";
      }
    }, 1000);

    // Using setTimeout to show a message after 5 seconds
    setTimeout(function() {
      alert("5 seconds have passed!");
    }, 5000);
  </script>

</body>
```

</html>

**Explanation:**

- **setInterval()** is used to update the countdown every second. When the countdown reaches 0, the interval is cleared, and a "Time's up!" message is displayed.
- **setTimeout()** triggers an alert after 5 seconds, notifying the user that the time has passed.

---

**Question 2: Provide an example of how to use setTimeout() to delay an action by 2 seconds?**

Answer : Here's an example of how you can use setTimeout() to delay an action by 2 seconds in JavaScript:

**Example: Delaying an Action by 2 Seconds**

html

CopyEdit

<!DOCTYPE html>

<html lang="en">

<head>

<meta charset="UTF-8">

<meta name="viewport" content="width=device-width, initial-scale=1.0">

<title>setTimeout Example</title>

</head>

```
<body>

 <button id="myButton">Click Me</button>
 <p id="message"></p>

 <script>
  // When the button is clicked, delay the action by 2 seconds
  document.getElementById("myButton").addEventListener("click", function() {
    setTimeout(function() {
      document.getElementById("message").textContent = "Action performed after 2 seconds!";
    }, 2000); // 2000 milliseconds = 2 seconds
  });
 </script>

</body>
</html>
```

**Explanation:**

- When the **button** is clicked, the setTimeout() function is triggered.
- The setTimeout() function delays the execution of the code inside the function by **2 seconds** (2000 milliseconds).

- After 2 seconds, the message "Action performed after 2 seconds!" will appear in the <p> element with the id="message".

## *12. JavaScript Error Handling Theory Assignment*

***• Question 1: What is error handling in JavaScript? Explain the try, catch, and finally blockswith an example***?

Answer : **Error Handling in JavaScript**

Error handling in JavaScript refers to the process of anticipating and responding to potential errors in your code during its execution. JavaScript provides a mechanism for catching exceptions and handling errors using the try, catch, and finally blocks. This helps to prevent the entire program from crashing when an error occurs and allows for graceful recovery or appropriate messaging.

---

**try, catch, and finally Blocks**

**1. try Block:**

The try block is used to wrap code that might throw an error. If any error occurs inside the try block, the control is transferred to the catch block (if defined).

**2. catch Block:**

The catch block is used to handle the error. If an error occurs in the try block, the control moves to the catch block, where you can

handle the error gracefully (e.g., logging the error, showing a user-friendly message).

**3. finally Block:**

The finally block is optional. It is used to execute code that needs to run regardless of whether an error occurred or not. The finally block will always execute after the try block (and after catch, if an error occurred).

---

**Syntax:**

javascript

CopyEdit

```
try {
  // Code that may throw an error
} catch (error) {
  // Code to handle the error
} finally {
  // Code to execute regardless of whether an error occurred
}
```

- **error**: In the catch block, the error object contains information about the error (like the error message, stack trace, etc.).

---

**Example: Error Handling with try, catch, and finally**

javascript

CopyEdit

```
try {
  // Code that may throw an error
  let result = 10 / 0; // Division by zero will cause an error
  console.log(result); // This won't be executed
} catch (error) {
  // Handling the error
  console.log("An error occurred: " + error.message); // Outputs: An error occurred: Infinity
} finally {
  // Code that always runs, regardless of whether there was an error
  console.log("This will always run, no matter what.");
}
```

**Explanation:**

- **try block:** The code inside the try block attempts to divide 10 by 0, which results in Infinity. In this case, no exception is thrown (division by zero in JavaScript results in Infinity rather than an error), but we can still handle such results.
- **catch block:** This block catches any error that occurs within the try block. If an error occurs, the error message is logged to the console. Here, the message An error occurred: Infinity will be

logged (though division by zero does not throw a traditional error, it may still be useful to handle it).

- **finally block:** The code inside the finally block is executed regardless of whether an error occurred or not. In this case, it will always log "This will always run, no matter what.".

---

**Example with Actual Error:**

javascript

CopyEdit

```
try {
  let num = 10;
  let divisor = 0;
  if (divisor === 0) {
    throw new Error("Division by zero is not allowed!"); // Throwing a custom error
  }
  let result = num / divisor;
  console.log(result);
} catch (error) {
  console.log("Error: " + error.message); // Output: Error: Division by zero is not allowed!
} finally {
```

```
  console.log("This code runs regardless of the error.");
}
```

**Explanation:**

- In this example, we explicitly throw a custom error using throw new Error("message") when the divisor is 0.
- The catch block then catches the thrown error, and the error message is logged to the console: "Error: Division by zero is not allowed!".
- The finally block ensures that the message "This code runs regardless of the error." is logged to the console, regardless of whether an error occurred.

---

**Key Points to Remember:**

1. **try block**: Used to wrap code that may throw an error.
2. **catch block**: Handles errors that occur in the try block. It receives an error object with details about the exception.
3. **finally block**: Always runs, regardless of whether an error occurred or not. It is typically used for cleanup tasks (e.g., closing files or releasing resources).
4. **throw**: Used to manually throw an error if needed.

---

**Use Cases for Error Handling:**

- **Graceful failure**: Handling potential runtime errors (e.g., invalid user input, network issues).
- **Logging errors**: For debugging purposes, you can log errors for later investigation.
- **Fallback logic**: Provide alternative actions or defaults when an error occurs.

## Question 2: Why is error handling important in JavaScript applications?

Answer : **Why is Error Handling Important in JavaScript Applications?**

Error handling is a crucial aspect of writing robust and reliable JavaScript applications. It allows developers to manage unexpected situations, enhance user experience, and maintain system stability. Without proper error handling, an application might crash, show misleading outputs, or behave unpredictably.

Here are some key reasons why error handling is important:

---

### 1. Preventing Application Crashes

Errors can cause the application to stop executing, resulting in a crash or unexpected behavior. For instance, if a function expects an argument to be a number but receives null or undefined, it could break the logic. By catching these errors, you can prevent the application from crashing entirely.

**Example:**

Without error handling:

javascript

CopyEdit

```
let result = 10 / "string"; // This results in NaN (Not-a-Number), causing issues later

console.log(result);
```

With error handling:

javascript

CopyEdit

```
try {
  let result = 10 / "string"; // Potential error
} catch (error) {
  console.error("An error occurred:", error.message); // Gracefully handling the error
}
```

**Benefit**: Prevents crashes and allows the program to continue running with fallback options or notifications to the user.

---

**2. Improving User Experience (UX)**

In web applications, users should not encounter the raw error messages or blank screens. Handling errors gracefully ensures that

users get friendly, clear, and helpful messages when something goes wrong. This way, users can understand what happened and, if possible, fix the issue or report it.

**Example:**

javascript

CopyEdit

```
try {
  let user = getUserById(123); // Imagine this function can throw an error if user doesn't exist
} catch (error) {
  alert("Oops! We couldn't find the user. Please try again later."); // Friendly error message
}
```

**Benefit**: Enhances the user experience by avoiding cryptic error messages and instead providing user-friendly notifications.

---

**3. Debugging and Maintenance**

Proper error handling makes it easier for developers to **track down bugs** during development or after deployment. When an error occurs, logging the error (with a stack trace and relevant information) provides valuable insights into what went wrong. This helps developers quickly fix issues.

**Example:**

javascript

CopyEdit

```
try {
  someFunctionThatMightFail();
} catch (error) {
  console.error("Error Details:", error); // Logs the error for debugging
}
```

**Benefit**: Helps in identifying the root cause of issues, speeding up debugging and ongoing maintenance.

---

**4. Handling Asynchronous Errors**

In JavaScript, much of the code runs asynchronously (e.g., handling events, making network requests). Errors in asynchronous code need to be handled differently than synchronous errors. **Promises** and **async/await** patterns allow us to handle these types of errors.

**Example with Promise:**

javascript

CopyEdit

```
fetch('https://api.example.com/data')
  .then(response => response.json())
  .catch(error => console.error("Network error:", error)); // Handling asynchronous errors
```

**Example with async/await:**

javascript

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```
async function fetchData() {
  try {
    let response = await fetch('https://api.example.com/data');
    let data = await response.json();
  } catch (error) {
    console.error("Failed to fetch data:", error);
  }
}
```

**Benefit**: Prevents unhandled rejections or errors from crashing the application and ensures smooth asynchronous operations.

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**5. Enhancing Security**

Without proper error handling, sensitive information (like stack traces or database errors) could be exposed to the user, potentially revealing vulnerabilities in your application. It's essential to **mask** sensitive details and only show relevant error messages to the user.

**Example:**

javascript

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```
try {
  // Code that could throw an error
} catch (error) {
  console.error("An error occurred:", error.message); // Hide stack trace and sensitive data
}
```

**Benefit**: Protects sensitive information and enhances the security of the application by preventing potential attackers from exploiting errors.

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### 6. Allowing Graceful Degradation

Graceful degradation is when your application can still function with reduced features or limited functionality in case of an error. Proper error handling allows your application to continue working in a limited capacity instead of failing completely.

**Example:**

javascript

CopyEdit

```
try {
  let data = fetchDataFromDatabase();
  processData(data);
} catch (error) {
  console.log("Error fetching data. Showing cached data instead.");
```

```
  showCachedData();
}
```

**Benefit**: Provides a backup solution or alternative path, ensuring the app can still serve users even if something goes wrong.

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**7. Preventing Unintended Consequences**

Without proper error handling, one error might cause a **cascade** of issues throughout the application. Catching errors early helps prevent such cascades and makes it easier to contain and resolve problems locally without letting them affect the entire system.

**Example:**

javascript

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```
try {
  let userData = getUserDataFromAPI();
  let userProfile = processUserData(userData); // This depends on successful API call
} catch (error) {
  console.log("Error processing user data:", error.message);
  // App still functions by handling the failure gracefully
}
```

**Benefit**: Reduces the risk of cascading failures and makes your application more resilient.

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**Conclusion:**

Error handling is crucial in JavaScript applications for several reasons:

- **Prevents crashes** and maintains application stability.
- **Improves user experience** by providing clear, understandable error messages.
- **Aids in debugging** and maintaining code.
- **Manages asynchronous errors** effectively.
- **Enhances security** by preventing the exposure of sensitive information.
- **Allows graceful degradation**, ensuring the app continues to work even in the event of failure.
- **Prevents unintended consequences** by catching and handling errors early.