50 Essential HTML, CSS, and JavaScript Interview Questions

A comprehensive guide for web development interviews

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JavaScript Performance Tips

Optimizing JavaScript Performance

💡 **Key Areas for Optimization:**

1. ⚡ **DOM Manipulations**
   - Batch DOM operations
   - Use document fragments
   - Reduce reflows and repaints
2. ⚡ **Event Handling**
   - Use event delegation
   - Debounce/throttle high-frequency events
   - Remove unused event listeners
3. ⚡ **Data Structures & Algorithms**
   - Choose appropriate data structures
   - Optimize loops and iterations
   - Consider time complexity
4. ⚡ **Memory Management**
   - Avoid memory leaks
   - Properly scope variables

- Clean up unused resources

🛠️ Practical Techniques:

javascript

Copy

```javascript
// ❌ Inefficient (multiple DOM operations)
for (let i = 0; i < 1000; i++) {
  container.innerHTML += `<div>${i}</div>`;
}

// ✅ Optimized (single DOM operation)
const fragment = document.createDocumentFragment();
for (let i = 0; i < 1000; i++) {
  const div = document.createElement('div');
  div.textContent = i;
  fragment.appendChild(div);
}
container.appendChild(fragment);
```

javascript

Copy

```javascript
// ❌ Inefficient (causes layout thrashing)
const boxes = document.querySelectorAll('.box');
boxes.forEach(box => {
  const height = box.offsetHeight; // Forces layout
  box.style.width = `${height}px`; // Forces another layout
});

// ✅ Optimized (batches reads and writes)
const boxes = document.querySelectorAll('.box');
const heights = Array.from(boxes).map(box => box.offsetHeight); // Read phase
boxes.forEach((box, i) => {
  box.style.width = `${heights[i]}px`; // Write phase
});
```

📈 Performance Measurement:

- Use `console.time()` and `console.timeEnd()`
- Leverage Browser DevTools Performance panel
- Test with realistic data volumes

- Profile in multiple browsers

CSS Grid & Flexbox Reference

CSS Grid Layout

💡 **Key Concept:** CSS Grid is a two-dimensional layout system ideal for both overall page layout and complex component structure.

🛠️ Basic Grid Container:

```
css
```

Copy

```css
.container {
  display: grid;
  grid-template-columns: 1fr 2fr 1fr;    /* Three columns */
  grid-template-rows: 100px auto 100px;   /* Three rows */
  gap: 20px;                              /* Gap between grid items */
}
```

📋 Essential Grid Properties:

Container Property	Purpose	Example
`grid-template-columns`	Defines column sizes	`grid-template-columns: repeat(3, 1fr)`
`grid-template-rows`	Defines row sizes	`grid-template-rows: 100px auto 50px`
`grid-template-areas`	Names grid areas	`grid-template-areas: "header header" "sidebar content"`
`grid-auto-columns`	Default size for auto-created columns	`grid-auto-columns: 100px`
`grid-auto-rows`	Default size for auto-created rows	`grid-auto-rows: min-content`
`gap`	Space between items	`gap: 20px`
`justify-items`	Horizontal alignment	`justify-items: center`
`align-items`	Vertical alignment	`align-items: start`

Item Property	Purpose	Example
`grid-column`	Column start/end	`grid-column: 1 / 3`
`grid-row`	Row start/end	`grid-row: 2 / span 2`
`grid-area`	Named area placement	`grid-area: header`
`justify-self`	Horizontal self-alignment	`justify-self: end`
`align-self`	Vertical self-alignment	`align-self: center`

🧿 Complex Grid Example:

css

Copy

```css
.dashboard {
  display: grid;
  grid-template-columns: repeat(4, 1fr);
  grid-template-rows: auto 1fr auto;
  grid-template-areas:
    "header header header header"
    "sidebar content content content"
    "footer footer footer footer";
  min-height: 100vh;
  gap: 20px;
}

.header { grid-area: header; }
.sidebar { grid-area: sidebar; }
.content { grid-area: content; }
.footer { grid-area: footer; }
```

CSS Flexbox Layout

💡 **Key Concept:** Flexbox is a one-dimensional layout system ideal for distributing space among items in a container, even when their size is unknown or dynamic.

🛠️ Basic Flex Container:

css

Copy

```css
.container {
  display: flex;
  flex-direction: row;        /* Default: items in a row */
  justify-content: space-between;  /* Horizontal spacing */
  align-items: center;        /* Vertical alignment */
  flex-wrap: wrap;            /* Allow items to wrap to next line */
}
```

📋 Essential Flexbox Properties:

Container Property	Purpose	Values
`flex-direction`	Direction of flex items	`row`, `row-reverse`, `column`, `column-reverse`
`justify-content`	Main-axis alignment	`flex-start`, `flex-end`, `center`, `space-between`, `space-around`, `space-evenly`
`align-items`	Cross-axis alignment	`flex-start`, `flex-end`, `center`, `stretch`, `baseline`
`flex-wrap`	Whether items can wrap	`nowrap`, `wrap`, `wrap-reverse`
`gap`	Space between items	`10px`, `1rem`

Item Property	Purpose	Example
`flex-grow`	Growth factor	`flex-grow: 1`
`flex-shrink`	Shrink factor	`flex-shrink: 0`
`flex-basis`	Initial size	`flex-basis: 200px`
`flex`	Shorthand	`flex: 1 0 auto`
`align-self`	Individual alignment	`align-self: flex-end`
`order`	Position in layout	`order: -1`

🎯 Common Flexbox Patterns:

Centering an Element:

css

Copy

```css
.container {
  display: flex;
  justify-content: center;
  align-items: center;
  height: 100vh;
}
```

Card Layout with Variable Height:

css

Copy

```css
.card-container {
  display: flex;
  flex-wrap: wrap;
  gap: 20px;
}

.card {
  flex: 0 1 calc(33.333% - 20px);
  display: flex;
  flex-direction: column;
}

.card-body {
  flex: 1 0 auto;
}

.card-footer {
  margin-top: auto;
}
```

Navigation Menu:

```css
.navbar {
  display: flex;
  justify-content: space-between;
  align-items: center;
  padding: 1rem;
}

.nav-links {
  display: flex;
  gap: 1rem;
}

/* Responsive toggle */
@media (max-width: 768px) {
  .navbar {
    flex-direction: column;
  }

  .nav-links {
    flex-direction: column;
    width: 100%;
  }
}
```

Grid vs Flexbox: When to Use Each

Need	Better Solution	Why
Overall page layout	Grid	Designed for 2D layouts with both rows and columns
Card layouts with variable content	Flexbox	Better for handling unknown content sizes
Complex alignment needs	Grid	Precise control over both dimensions
One-dimensional layouts	Flexbox	Simpler for single row/column arrangements
Dynamic number of items	Flexbox	Naturally handles varying item counts
Overlapping elements	Grid	Can position items in same grid cell
Responsive design without media queries	Grid	`minmax()`, `auto-fill`, and `auto-fit`
Form controls alignment	Flexbox	Simpler for aligning related form elements

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Common JavaScript Interview Coding Questions

1. Implement a Debounce Function

javascript

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```javascript
function debounce(func, wait) {
  let timeout;
  return function executedFunction(...args) {
    const later = () => {
      clearTimeout(timeout);
      func(...args);
    };
    clearTimeout(timeout);
    timeout = setTimeout(later, wait);
  };
}
```

2. Create a Deep Clone Function

javascript

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```javascript
function deepClone(obj) {
  if (obj === null || typeof obj !== 'object') {
    return obj;
  }

  // Handle Date
  if (obj instanceof Date) {
    return new Date(obj.getTime());
  }

  // Handle Array
  if (Array.isArray(obj)) {
    return obj.map(item => deepClone(item));
  }

  // Handle Object
  if (obj instanceof Object) {
    const copy = {};
    Object.keys(obj).forEach(key => {
      copy[key] = deepClone(obj[key]);
    });
    return copy;
  }

  throw new Error(`Unable to copy object: ${obj}`);
}
```

3. Implement Promise.all()

javascript

Copy

```javascript
function myPromiseAll(promises) {
  return new Promise((resolve, reject) => {
    const results = [];
    let completed = 0;

    if (promises.length === 0) {
      resolve(results);
      return;
    }

    promises.forEach((promise, index) => {
      Promise.resolve(promise)
        .then(result => {
          results[index] = result;
          completed++;

          if (completed === promises.length) {
            resolve(results);
          }
        })
        .catch(error => {
          reject(error);
        });
    });
  });
}
```

4. Flatten a Nested Array

javascript

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```javascript
function flattenArray(arr) {
  return arr.reduce((flat, item) => {
    return flat.concat(Array.isArray(item) ? flattenArray(item) : item);
  }, []);
}

// Usage
flattenArray([1, [2, [3, 4], 5], 6]); // [1, 2, 3, 4, 5, 6]
```

✈️ **Reading Guide**: This document is organized for easy in-flight reading. Each question includes a concise explanation and practical code examples. The topics progress from fundamental to advanced concepts. Take breaks between sections to help with retention.

JavaScript Core Concepts

1. What Is Hoisting in JavaScript?

💡 **Key Concept:** Hoisting moves variable and function declarations to the top of their scope during compilation.

⚠️ **Important Details:**

- Only declarations are hoisted, not initializations
- Function declarations are fully hoisted (with their body)
- Variables declared with `let` and `const` are hoisted but remain in the "temporal dead zone" until declaration

Example with `var`:

javascript Copy

```javascript
console.log(foo); // undefined
var foo = 1;
console.log(foo); // 1

// Visualized as:
var foo;
console.log(foo); // undefined
foo = 1;
console.log(foo); // 1
```

Variables declared with `let`, `const`, and `class`:

These are hoisted but remain uninitialized, causing a ReferenceError if accessed before declaration.

javascript Copy

```javascript
console.log(bar); // ReferenceError
let bar = 'value';
```

Function declarations vs. expressions:
Function declarations are fully hoisted (both declaration and definition), while function expressions are only partially hoisted.

javascript Copy

```javascript
console.log(declared()); // Works
function declared() {
  return 'Declared function';
}

console.log(expr); // undefined
console.log(expr()); // TypeError: expr is not a function
var expr = function() {
  return 'Function expression';
};
```

2. How Do `let`, `var`, and `const` Differ?

💡 **Key Concept:** These keywords have different scoping, hoisting, redeclaration, and reassignment rules.

📋 **Comparison Chart:**

Feature	`var`	`let`	`const`
Scope	Function or global	Block	Block
Hoisting	Yes, initialized as `undefined`	Yes, but not initialized	Yes, but not initialized
Redeclaration	Allowed	Not allowed	Not allowed
Reassignment	Allowed	Allowed	Not allowed
Initialization	Optional	Optional	Required

⚠️ **Common Pitfall:** Using `var` in loops creates a single variable for all iterations due to function scope.

3. What Is the Difference Between `==` and `===`?

💡 **Key Concept:** `==` performs type coercion before comparison, while `===` compares both value and type without conversion.

📊 **Examples:**

javascript

Copy

```javascript
// Loose equality (==)
42 == '42'     // true (string '42' is converted to number 42)
0 == false     // true (boolean false is converted to number 0)
null == undefined // true (special case in the spec)

// Strict equality (===)
42 === '42'    // false (different types: number vs string)
0 === false    // false (different types: number vs boolean)
null === undefined // false (different types)
```

🚀 **Best Practice:** Use `===` by default to avoid unexpected type coercion. Only use `==` when you specifically want type coercion (rare cases).

4. What Is the Event Loop in JavaScript?

💡 **Key Concept:** The event loop allows JavaScript to execute non-blocking asynchronous code despite being single-threaded.

🔄 **Key Components:**

- **Call Stack**: Tracks the current function being executed
- **Callback Queue**: Holds callbacks from completed async operations
- **Microtask Queue**: High-priority queue for Promises (processed before the Callback Queue)
- **Web APIs**: Browser features that handle async operations outside JavaScript's main thread

📈 **Execution Flow:**

1. Execute synchronous code on call stack
2. When stack is empty, process all microtasks
3. Render UI updates if needed
4. Process one task from the callback queue
5. Repeat

💉 **Example:**

javascript

Copy

```javascript
console.log('Start');                  // 1. Synchronous: Logs immediately

setTimeout(() => {                     // 2. Async: Scheduled in Web APIs
  console.log('Timeout');              //    Goes to Callback Queue when timer completes
}, 0);

Promise.resolve().then(() => {         // 3. Async: Creates a microtask
  console.log('Promise');              //    Goes to Microtask Queue
});

console.log('End');                    // 4. Synchronous: Logs immediately

// Output order:
// Start
// End      (Call stack now empty)
// Promise  (Process microtask queue)
// Timeout  (Process callback queue)
```

⚠️ **Common Misconception:** `setTimeout(fn, 0)` doesn't execute immediately; it still goes through the event loop after the call stack is empty.

5. What Are the Different Data Types in JavaScript?

💡 **Key Concept:** JavaScript has primitive types (stored by value) and objects (stored by reference).

🧩 **Primitive Types:**

- **Number**: Both integers and floating-point (e.g., `42`, `3.14`)
- **String**: Text data (e.g., `'hello'`, `"world"`, `` `template` ``)
- **Boolean**: `true` or `false`
- **null**: Intentional absence of value
- **undefined**: Variable declared but not assigned
- **Symbol**: Unique, immutable value (e.g., `Symbol('id')`)
- **BigInt**: Large integers (e.g., `9007199254740991n`)

📐 **Reference Types:**

- **Object**: Collections of properties (e.g., `{}`, `new Object()`)

- **Array**: Ordered lists (e.g., `[]`, `new Array()`)
- **Function**: Callable objects (e.g., `function() {}`, `() => {}`)
- **Date**: Date and time (e.g., `new Date()`)
- **RegExp**: Regular expressions (e.g., `/\d+/`, `new RegExp('\d+')`)
- **Map/Set**: Collections with unique keys/values
- **WeakMap/WeakSet**: Collections with weak references

🔍 Type Checking:

javascript Copy

```javascript
// Using typeof (works well for primitives except null)
typeof 42;           // 'number'
typeof 'hello';      // 'string'
typeof true;         // 'boolean'
typeof undefined;    // 'undefined'
typeof null;         // 'object' (⚠️ historical bug)
typeof {};           // 'object'
typeof [];           // 'object' (⚠️ arrays are objects)
typeof function() {}; // 'function'

// Better checks for specific object types
Array.isArray([]);   // true
obj instanceof Array; // true if obj is an array
Object.prototype.toString.call([]); // '[object Array]'
```

⚠️ Gotchas:

- `typeof null` returns `'object'` (a historical bug)
- `typeof` can't distinguish between object subtypes (except functions)
- Primitive wrapper objects (`new String()`, `new Number()`) have type `'object'`

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6. How Does `this` Work in JavaScript?

💡 **Key Concept:** The value of `this` is determined by how a function is called, not where it's defined (except for arrow functions).

📋 `this` Resolution Rules:

Context	Value of `this`	Example
Global context	Global object (or `undefined` in strict mode)	`console.log(this)`
Object method	The object that owns the method	`obj.method()`
Constructor	The newly created instance	`new Person()`
Event handler	The element that triggered the event	`button.onclick = function() {...}`
Call/Apply/Bind	The value explicitly provided	`func.call(obj)`
Arrow function	Lexically inherited from parent scope	`() => { console.log(this) }`

🧪 **Examples:**

javascript

Copy

```javascript
// Global context
console.log(this); // Window (browser) or global (Node)

// Object method
const user = {
  name: 'Alice',
  greet() {
    console.log(`Hello, I'm ${this.name}`);
  }
};
user.greet(); // "Hello, I'm Alice"

// Constructor
function User(name) {
  this.name = name;
  this.sayHi = function() {
    console.log(`Hi, I'm ${this.name}`);
  };
}
const bob = new User('Bob');
bob.sayHi(); // "Hi, I'm Bob"

// Explicit binding
function introduce(greeting) {
  console.log(`${greeting}, I'm ${this.name}`);
}
introduce.call(user, 'Howdy'); // "Howdy, I'm Alice"
introduce.apply(user, ['Hello']); // "Hello, I'm Alice"
const boundIntroduce = introduce.bind(user);
boundIntroduce('Hey'); // "Hey, I'm Alice"

// Arrow functions
const team = {
  name: 'Developers',
  members: ['Alice', 'Bob'],
  showMembers() {
    // Arrow function inherits `this` from showMembers
    this.members.forEach(member => {
      console.log(`${member} is in team ${this.name}`);
    });
  }
```

```
};
team.showMembers();
// "Alice is in team Developers"
// "Bob is in team Developers"
```

⚠️ **Common Pitfalls:**

- Losing `this` context when passing methods as callbacks
- Using regular functions instead of arrow functions in event handlers
- Forgetting to bind methods in class constructors

7. What Is Function.prototype.bind and Why Is It Useful?

The `bind` method creates a new function with a specific `this` context and optional preset arguments.

javascript Copy

```javascript
const john = {
  age: 42,
  getAge: function() {
    return this.age;
  },
};

console.log(john.getAge()); // 42

const unboundGetAge = john.getAge;
console.log(unboundGetAge()); // undefined

const boundGetAge = john.getAge.bind(john);
console.log(boundGetAge()); // 42
```

Common Uses:

- Binding `this`: Fixing the `this` value for a method
- Partial Application: Predefining arguments for a function
- Method Borrowing: Using methods from one object on another object

8. What's the Difference Between Function Declarations and Expressions?

Function Declarations:

javascript Copy

```javascript
function foo() {
  console.log('Function declaration');
}
```

- Hoisted with their body
- Can be invoked before their definition

Function Expressions:

javascript Copy

```javascript
const foo = function() {
  console.log('Function expression');
};
```

- Only the variable is hoisted, not the function body
- Cannot be invoked before their definition

9. What Are Higher-Order Functions?

Higher-order functions either:

- Take other functions as arguments
- Return functions

javascript Copy

```javascript
function multiplier(factor) {
  return function(number) {
    return number * factor;
  };
}

const double = multiplier(2);
console.log(double(5)); // 10
```

10. What is Lexical Scoping?

Lexical scoping determines how variable names are resolved based on their location in the code. Nested functions have access to variables from their parent scopes.

javascript Copy

```javascript
function outerFunction() {
  let outerVariable = 'I am outside!';

  function innerFunction() {
    console.log(outerVariable); // 'I am outside!'
  }

  innerFunction();
}
```

11. What is Scope in JavaScript?

Scope defines the accessibility of variables and functions in different parts of code:

Global Scope:

- Variables declared outside any function/block
- Accessible throughout the entire code

Function Scope:

- Variables declared within a function
- Accessible only within that function

Block Scope:

- Introduced in ES6 with `let`/`const`
- Variables declared within a block (e.g., within `{}`)
- Accessible only within that block

javascript

Copy

```javascript
// Global scope
var globalVar = 'I am global';

function myFunction() {
  // Function scope
  var functionVar = 'I am in a function';

  if (true) {
    // Block scope
    let blockVar = 'I am in a block';
    console.log(blockVar); // Accessible
  }

  // console.log(blockVar); // Error
}
```

DOM and Browser APIs

HTML Essentials

HTML5 Semantic Elements

💡 **Key Concept:** HTML5 introduced semantic elements that clearly describe their meaning to browsers and developers.

Element	Purpose	Example Use Case
`<header>`	Introductory content	Site headers, article titles
`<nav>`	Navigation links	Main menu, pagination
`<main>`	Main content area	Primary content of the page
`<article>`	Self-contained content	Blog posts, news articles
`<section>`	Thematic grouping	Chapters, tabbed content
`<aside>`	Tangentially related content	Sidebars, call-out boxes
`<footer>`	Footer information	Copyright info, related links
`<figure>`	Self-contained media	Images with captions
`<figcaption>`	Caption for figure	Description of an image
`<time>`	Date/time information	Publication dates

🚀 **Benefits:**

- Improved accessibility for screen readers
- Better SEO through clearer content structure
- Easier to style and maintain
- More readable code

⚠️ **Common Misuse:**

- Using `<div>` when a semantic element would be more appropriate
- Nesting semantic elements incorrectly
- Using elements for their visual style rather than their semantic meaning

Accessibility Attributes

💡 **Key Concept:** HTML provides attributes to improve accessibility for users with disabilities.

Attribute	Purpose	Example
`alt`	Alternative text for images	`<img src="logo.png" alt="Company Logo">`
`aria-label`	Label for element without visible text	`<button aria-label="Close">×</button>`
`aria-labelledby`	Links element to separate labeling element	`<div aria-labelledby="title">...</div>`
`aria-describedby`	Links to extended description	`<input aria-describedby="hint">`
`role`	Explicit ARIA role for element	`<div role="alert">Error message</div>`
`tabindex`	Controls tab order	`<div tabindex="0">Interactive</div>`

🚀 **Best Practices:**

- Use semantic HTML elements whenever possible before resorting to ARIA
- Ensure all interactive elements are keyboard accessible
- Test with screen readers to verify accessibility
- Maintain sufficient color contrast for text

Event delegation uses a single event listener on a parent element to manage events on its child elements, utilizing event bubbling for efficiency.

Benefits:

- Reduces memory usage by limiting the number of listeners
- Dynamically handles added or removed child elements

javascript Copy

```javascript
document.getElementById('parent').addEventListener('click', (event) => {
  if (event.target.tagName === 'BUTTON') {
    console.log(`Clicked ${event.target.textContent}`);
  }
});
```

13. How Do Cookies, localStorage, and sessionStorage Differ?

💡 **Key Concept:** Browsers offer three main mechanisms for client-side storage, each with different limitations and use cases.

📋 **Storage Comparison:**

Feature	Cookies	localStorage	sessionStorage
Capacity	~4KB	~5MB	~5MB
Expiration	Manually set	Never	Tab close
Storage Location	Browser + Server	Browser only	Browser only
Sent with Requests	Yes	No	No
Accessibility	Any window	Any window	Same tab only
APIs	`document.cookie`	`localStorage` API	`sessionStorage` API

🛠️ **Usage Examples:**

javascript

Copy

```javascript
// Cookies
document.cookie = "username=John; expires=Fri, 31 Dec 2023 23:59:59 GMT; path=/; Secure; SameSi

// Reading cookies requires parsing
function getCookie(name) {
  const value = `; ${document.cookie}`;
  const parts = value.split(`; ${name}=`);
  if (parts.length === 2) return parts.pop().split(';').shift();
}

// localStorage (persists indefinitely)
localStorage.setItem('username', 'John');
const username = localStorage.getItem('username'); // "John"
localStorage.removeItem('username');
localStorage.clear(); // Remove all items

// sessionStorage (cleared when tab closes)
sessionStorage.setItem('tempData', JSON.stringify({id: 123}));
const data = JSON.parse(sessionStorage.getItem('tempData'));
```

🚀 **Best Use Cases:**

- **Cookies**: Authentication tokens, server-side session data, tracking
- **localStorage**: User preferences, cached data, application state
- **sessionStorage**: Form data, shopping cart, per-tab settings

⚠️ **Security Considerations:**

- Never store sensitive information (passwords, credit cards) in client-side storage
- Use `HttpOnly` and `Secure` flags for cookies with sensitive data
- Set appropriate `SameSite` attribute on cookies (usually `Strict` or `Lax`)
- Consider encrypting sensitive data if client-side storage is necessary

14. What Are `<script>`, `<script async>`, and `<script defer>`?

`<script>`:

- Blocks HTML parsing until the script loads and executes

`<script async>`:

- Loads scripts asynchronously
- Executes as soon as the script is ready

`<script defer>`:

- Loads scripts asynchronously
- Executes only after HTML parsing is complete

```html
<script src="main.js"></script>
<script async src="async.js"></script>
<script defer src="defer.js"></script>
```

15. What is Event Bubbling?

Event bubbling occurs when an event starts at the target element and propagates up through its ancestors.

```javascript
parent.addEventListener('click', () => console.log('Parent clicked'));
child.addEventListener('click', () => console.log('Child clicked'));
// Clicking child triggers both handlers
```

16. What is Event Capturing?

Event capturing is when an event starts at the root and propagates down to the target element.

```javascript
parent.addEventListener('click', () => console.log('Parent capturing'), true);
```

17. How Do mouseenter and mouseover Events Differ?

mouseenter:

- Does not bubble through the DOM tree
- Fires only when cursor enters the element itself

- Triggers once upon entering the parent element

mouseover:

- Bubbles through the DOM hierarchy
- Fires when cursor enters the element or any child elements
- May trigger multiple times with nested elements

18. Explain AJAX (Asynchronous JavaScript and XML)

AJAX allows web applications to send and retrieve data from a server asynchronously without page reloads.

Key Components:

- XMLHttpRequest or fetch API
- Asynchronous data exchange
- JSON or XML data formats
- DOM manipulation to update content

fetch API Example:

javascript Copy

```javascript
fetch('https://api.example.com/data')
  .then(response => response.json())
  .then(data => console.log(data))
  .catch(error => console.error('Error:', error));
```

19. How Do XMLHttpRequest and fetch() Differ?

XMLHttpRequest:

- Event-based approach
- More verbose syntax
- Requires explicit configuration for common tasks

fetch():

- Promise-based API
- Cleaner, more concise syntax

- Easier to chain operations
- Doesn't automatically reject on HTTP error status

CSS Fundamentals

20. What is a Block Formatting Context (BFC)?

💡 **Key Concept:** A Block Formatting Context (BFC) is a region where the layout of block boxes occurs and floats interact with each other.

🧱 **BFC Creation Triggers:**

- Elements with `float` other than `none`
- Elements with `position: absolute` or `position: fixed`
- Elements with `display: inline-block`, `table-cell`, `flex`, or `grid`
- Elements with `overflow` other than `visible`

🛠️ **Practical Uses:**

- Containing floated elements (prevent float collapse)
- Preventing margin collapsing between elements
- Creating layout isolation for components
- Building multi-column layouts

📝 **Example:**

css

Copy

```css
.container {
  /* Creates a BFC */
  overflow: hidden;

  /* Now this container will:
   * 1. Contain all floated children
   * 2. Prevent margin collapsing with other elements
   * 3. Not overlap with floated siblings
   */
}
```

⚠️ **Common Pitfalls:** Using `overflow: hidden` to create a BFC can cut off content if it overflows the container.

21. What is z-index and How is a Stacking Context Created?

z-index:

- Controls the vertical stacking order of positioned elements
- Only affects positioned elements (not static)
- Higher values appear on top

Stacking Context Creation:

- Root element (HTML)
- Position fixed or sticky
- Position absolute/relative with z-index other than auto
- Elements with opacity less than 1
- Elements with transform, filter, or backdrop-filter
- Elements with will-change property

22. What is the Box Model in CSS?

The CSS box model describes the rectangular boxes for elements with:

- Content: The actual content area
- Padding: Space between content and border
- Border: Line around the padding
- Margin: Space outside the border

Box Sizing Options:

- `content-box` (default): Width and height apply to content only
- `border-box`: Width and height include content, padding, and border

23. How Do block, inline, and inline-block Display Types Differ?

Property	block	inline-block	inline
Width	Fills parent width	Based on content	Based on content
Height	Based on content	Can be specified	Cannot be specified
New line	Starts on new line	Flows inline	Flows inline
Margins/Padding	All sides respected	All sides respected	Only horizontal sides affect layout
Examples	`<div>`, `<p>`	Custom buttons	`<span>`, `<a>`

Layout and Positioning

24. How Do relative, fixed, absolute, sticky, and static Positioning Differ?

💡 **Key Concept:** The `position` property determines how an element is positioned in the document flow.

📋 **Positioning Types:**

Position	Document Flow	Positioned Relative To	Scrolls With Page	Creates Stacking Context
`static`	In flow	N/A (normal position)	Yes	No
`relative`	In flow	Normal position	Yes	No (unless z-index)
`absolute`	Removed	Nearest positioned ancestor	Yes	No (unless z-index)
`fixed`	Removed	Viewport	No	Yes
`sticky`	In flow until threshold	Nearest scrolling ancestor	Yes, until "stuck"	Yes

🔄 **Position Examples:**

css

Copy

```css
/* Default positioning */
.static {
  position: static;
  /* top, right, bottom, left have no effect */
}

/* Offset from normal position */
.relative {
  position: relative;
  top: 10px;
  left: 20px;
  /* Moves 10px down and 20px right from normal position */
}

/* Positioned relative to nearest positioned ancestor */
.absolute {
  position: absolute;
  top: 0;
  right: 0;
  /* Top-right corner of nearest positioned ancestor */
}

/* Positioned relative to viewport */
.fixed {
  position: fixed;
  bottom: 20px;
  right: 20px;
  /* Stays 20px from bottom-right corner of viewport */
}

/* Hybrid of relative/fixed positioning */
.sticky {
  position: sticky;
  top: 0;
  /* Behaves like relative until page scrolls, then sticks to top */
}
```

⚠️ **Common Pitfalls:**

- `absolute` elements are positioned relative to the viewport if no ancestor has positioning

- `fixed` elements can behave unexpectedly with CSS transforms on ancestors
- `sticky` requires a threshold value (like `top: 0`) to work

25. When Would You Prefer translate() Over Absolute Positioning?

Use translate():

- For animations and transitions (better performance)
- When you want to preserve document flow
- To utilize GPU acceleration
- For smoother animations

Use absolute positioning:

- For entirely removing elements from document flow
- When precise positioning relative to a container is needed
- For overlays, modals, and tooltips

26. What Does * { box-sizing: border-box; } Do?

This CSS rule applies the `border-box` box-sizing model to all elements, meaning:

- Width and height include content, padding, and border
- Makes sizing more intuitive and predictable
- Simplifies responsive layouts
- Prevents unexpected sizing issues when adding padding/borders

Advantages:

- Easier to calculate element dimensions
- More intuitive sizing behavior
- Consistent with most modern CSS frameworks

Web Design Considerations

27. What Should You Consider When Designing for Multilingual Websites?

💡 **Key Concept:** Designing multilingual websites involves technical, cultural, and UX considerations to ensure the site works well across different languages and regions.

🌐 **Technical Implementation:**

1. **HTML Language Attributes:**

```html
<html lang="en"> <!-- Base language -->
<p lang="fr">Bonjour le monde</p> <!-- Content-specific language -->
```

2. **URL Structure Options:**

```
domain.com/en/page   (path-based)
en.domain.com/page   (subdomain-based)
domain.com/page?lang=en (parameter-based)
```

3. **Alternate Language Links:**

```html
<link rel="alternate" hreflang="es" href="https://domain.com/es/page">
<link rel="alternate" hreflang="x-default" href="https://domain.com/">
```

UX & Design Considerations:

1. **Text Expansion/Contraction:**
   - German and Finnish text can be 30% longer than English
   - Chinese and Japanese can be 50% shorter
   - Design flexible layouts that accommodate text length variation

2. **Reading Direction:**
   - Support both LTR (left-to-right) and RTL (right-to-left) layouts
   - Use CSS `dir` attribute and logical properties:

```css
.container {
  padding-inline-start: 20px; /* Works for both LTR and RTL */
}
```

3. **Date, Time, and Number Formats:**
   - Use locale-aware formatting:

javascript Copy

```javascript
// US: "5/24/2023" vs. European: "24/5/2023"
new Date().toLocaleDateString('en-US');
new Date().toLocaleDateString('de-DE');
```

4. **Cultural Considerations:**
   - Colors have different meanings across cultures
   - Icons may need adaptation (e.g., mailbox designs vary globally)
   - Avoid text in images to facilitate translation

⚠️ **Common Pitfalls:**

- Hard-coding strings instead of using translation files
- Concatenating translated strings (breaks grammar in many languages)
- Fixed-width containers that can't accommodate longer text
- Forgetting to translate meta content (titles, descriptions)
- Using images with embedded text

28. How Do You Utilize the CSS display Property?

Common Values:

- `none`: Removes element from rendering
- `block`: Full-width, starts on new line
- `inline`: Flows with text, width based on content
- `inline-block`: Inline flow with block properties
- `flex`: Creates flexible container
- `grid`: Creates grid-based layout
- `table`, `table-row`, `table-cell`: Table-like behavior

Use Cases:

- `none`: Hiding elements without removing from DOM
- `flex`: Modern layout for one-dimensional content
- `grid`: Two-dimensional layouts
- `inline-block`: Creating horizontally aligned elements with specific dimensions

29. How Does Destructuring Assignment Work?

Destructuring extracts values from arrays or objects into individual variables.

Array Destructuring:

javascript Copy

```javascript
const [a, b, ...rest] = [1, 2, 3, 4, 5];
// a: 1, b: 2, rest: [3, 4, 5]
```

Object Destructuring:

javascript Copy

```javascript
const { name, age, ...other } = { name: 'John', age: 30, city: 'New York', job: 'Developer' };
// name: 'John', age: 30, other: { city: 'New York', job: 'Developer' }
```

30. What is the Spread Operator and How is it Used?

The spread operator (`...`) expands iterables into individual elements:

Array Operations:

javascript Copy

```javascript
// Copying arrays
const original = [1, 2, 3];
const copy = [...original];

// Merging arrays
const merged = [...array1, ...array2];
```

Object Operations:

javascript Copy

```javascript
// Copying objects
const original = { a: 1, b: 2 };
const copy = { ...original };

// Merging objects
const merged = { ...obj1, ...obj2 };
```

Function Arguments:

javascript Copy

```javascript
const numbers = [1, 2, 3];
Math.max(...numbers); // Same as Math.max(1, 2, 3)
```

31. How Do You Create Objects in JavaScript?

Object Literals:

javascript Copy

```javascript
const person = { firstName: 'John', lastName: 'Doe' };
```

Constructor Function:

javascript Copy

```javascript
function Person(name) {
  this.name = name;
}
const john = new Person('John');
```

Object.create():

javascript Copy

```javascript
const proto = { greet() { console.log('Hello!'); } };
const person = Object.create(proto);
```

ES6 Classes:

javascript Copy

```javascript
class Person {
  constructor(name) {
    this.name = name;
  }

  greet() {
    console.log(`Hello, ${this.name}!`);
  }
}
```

32. How Does Inheritance Work in ES2015 Classes?

ES2015 classes use the `extends` keyword for inheritance and `super` to access parent methods:

javascript Copy

```javascript
class Animal {
  constructor(name) {
    this.name = name;
  }

  speak() {
    console.log(`${this.name} makes a noise.`);
  }
}

class Dog extends Animal {
  constructor(name, breed) {
    super(name);  // Call parent constructor
    this.breed = breed;
  }

  speak() {
    console.log(`${this.name} barks.`);  // Override parent method
  }
}
```

33. How Does Prototypal Inheritance Work?

In JavaScript, objects inherit properties and methods from a prototype:

javascript

Copy

```javascript
function Animal(name) {
  this.name = name;
}

Animal.prototype.speak = function() {
  console.log(`${this.name} makes a noise.`);
};

function Dog(name, breed) {
  Animal.call(this, name);  // Call parent constructor
  this.breed = breed;
}

// Set up inheritance
Dog.prototype = Object.create(Animal.prototype);
Dog.prototype.constructor = Dog;

// Add or override methods
Dog.prototype.speak = function() {
  console.log(`${this.name} barks.`);
};
```

Additional Topics

34. Can You Differentiate Between Synchronous and Asynchronous Functions?

Synchronous Functions:

- Execute operations sequentially, step-by-step
- Block program execution until the current task completes
- Follow strict line-by-line execution order
- Generally easier to debug due to predictable flow

javascript

Copy

```
const fs = require('fs');
const data = fs.readFileSync('large-file.txt', 'utf8');
console.log(data); // Blocks until file is read
console.log('End of the program');
```

Asynchronous Functions:

- Allow the program to continue running without waiting for task completion
- Non-blocking, enabling concurrent execution
- Enhance performance and responsiveness
- Commonly used for network requests, file I/O, timers, and animations

javascript

Copy

```
console.log('Start of the program');

fetch('https://api.example.com/data')
  .then((response) => response.json())
  .then((data) => console.log(data)) // Non-blocking
  .catch((error) => console.error(error));

console.log('End of program');
```

35. What Are the Pros and Cons of Using AJAX?

Advantages:

- Enhanced user experience (no full page reloads)
- Reduced server load (fetches only required data)
- Maintains state (preserves user interactions)
- Better responsiveness and interactivity

Disadvantages:

- Dependency on JavaScript (breaks if disabled)
- Bookmarking issues (dynamic states hard to bookmark)
- SEO challenges (dynamic content harder to index)

- Performance issues on low-end devices
- Potential accessibility concerns

36. How Do You Iterate Over Object Properties and Array Elements?

For Objects:

javascript Copy

```javascript
// for...in loop
for (const key in obj) {
  if (Object.hasOwn(obj, key)) {
    console.log(`${key}: ${obj[key]}`);
  }
}

// Object.keys()
Object.keys(obj).forEach(key => {
  console.log(`${key}: ${obj[key]}`);
});

// Object.entries()
Object.entries(obj).forEach(([key, value]) => {
  console.log(`${key}: ${value}`);
});
```

For Arrays:

javascript Copy

```javascript
// for loop
for (let i = 0; i < arr.length; i++) {
  console.log(arr[i]);
}

// forEach method
arr.forEach((item, index) => {
  console.log(item, index);
});

// for...of loop
for (const item of arr) {
  console.log(item);
}
```

37. What are Arrow Functions Good For?

Arrow functions (`=>`) provide concise syntax and lexical `this` binding:

Concise Syntax:

javascript Copy

```javascript
// Traditional function
const double = function(x) {
  return x * 2;
};

// Arrow function
const double = x => x * 2;
```

Lexical `this`:

javascript

Copy

```javascript
function Person() {
  this.age = 0;

  // Arrow function preserves `this` from surrounding scope
  setInterval(() => {
    this.age++;  // `this` refers to the Person instance
  }, 1000);
}
```

38. What is Asynchronous JavaScript?

Synchronous Code:

- Executes line by line
- Blocks execution until current operation completes

Asynchronous Code:

- Non-blocking execution
- Operations can run in parallel
- Results processed when available

Async Techniques:

javascript

Copy

```javascript
// Callbacks
function fetchData(callback) {
  setTimeout(() => {
    callback('Data');
  }, 1000);
}

// Promises
fetch('https://api.example.com/data')
  .then(response => response.json())
  .then(data => console.log(data));

// Async/Await
async function getData() {
  try {
    const response = await fetch('https://api.example.com/data');
    const data = await response.json();
    return data;
  } catch (error) {
    console.error(error);
  }
}
```

39. Explain Debouncing and Throttling

💡 **Key Concept:** Debouncing and throttling are performance optimization techniques that control how many times a function is executed.

🔄 **Debouncing:**

- Delays function execution until after a specified period of inactivity
- Resets the timer whenever the event fires again
- Ensures function only runs once after rapid successive calls stop

⏱️ **Debouncing Implementation:**

javascript

Copy

```javascript
function debounce(func, delay) {
  let timeoutId;

  return function(...args) {
    // Clear previous timeout
    clearTimeout(timeoutId);

    // Set new timeout
    timeoutId = setTimeout(() => {
      func.apply(this, args);
    }, delay);
  };
}

// Example use case: Search input
const searchInput = document.getElementById('search');
const debouncedSearch = debounce((query) => {
  console.log(`Searching for: ${query}`);
  fetchSearchResults(query);
}, 500);

searchInput.addEventListener('input', (e) => {
  debouncedSearch(e.target.value);
});
```

🔄 Throttling:

- Executes the function at a regular interval, regardless of how many times the event is fired
- Guarantees function execution at most once per specified time period
- Useful for consistent execution rates

⏱️ Throttling Implementation:

javascript

Copy

```javascript
function throttle(func, limit) {
  let inThrottle = false;

  return function(...args) {
    // If we're not throttled, execute the function
    if (!inThrottle) {
      func.apply(this, args);
      inThrottle = true;

      // Reset throttle after specified time
      setTimeout(() => {
        inThrottle = false;
      }, limit);
    }
  };
}

// Example use case: Scroll event
const throttledScroll = throttle(() => {
  console.log('Scroll position:', window.scrollY);
  updateScrollIndicator(window.scrollY);
}, 300);

window.addEventListener('scroll', throttledScroll);
```

📊 Comparison:

Feature	Debounce	Throttle
Execution timing	After period of inactivity	At regular intervals
Usefulness	When final state matters	When regular updates matter
Example use cases	Search inputs, resize events	Scroll events, game loops
Behavior with rapid events	Executes once at end	Executes regularly throughout

🚀 Real-world Applications:

- **Debounce**: Autocomplete, form validation, resize handlers, save buttons
- **Throttle**: Infinite scroll, scroll animations, mousemove events, game input

40. How Do Map Objects Differ from Plain Objects?

Map Objects:

- Keys can be any type (objects, functions, primitives)
- Maintains insertion order
- Has size property
- Directly iterable
- Better performance for frequent additions/removals

Plain Objects:

- Keys are strings or symbols
- No guaranteed order (though modern engines typically preserve it)
- No size property
- Not directly iterable
- Better for simple key-value storage

javascript Copy

```javascript
// Map
const map = new Map();
map.set('key1', 'value1');
map.set({}, 'value2');
console.log(map.size); // 2

// Object
const obj = {};
obj.key1 = 'value1';
obj[{}] = 'value2'; // {} becomes '[object Object]'
```

41. What is the Difference Between .call and .apply?

Both methods invoke a function with a specific `this` context, but differ in how they pass arguments:

.call:

- Accepts arguments as a comma-separated list

javascript

Copy

```
function sum(a, b) {
  return a + b;
}
sum.call(null, 1, 2); // 3
```

.apply:

- Accepts arguments as an array

javascript

Copy

```
function sum(a, b) {
  return a + b;
}
sum.apply(null, [1, 2]); // 3
```

42. How Do null, undefined, and Undeclared Variables Differ?

null:

- Explicitly represents absence of value
- Type is 'object'
- Must be assigned

undefined:

- Variable declared but not assigned a value
- Default value for function parameters, return values
- Type is 'undefined'

Undeclared:

- Variable not declared with var/let/const
- Accessing causes ReferenceError
- Not a type (it's an error condition)

javascript Copy

```
let a;          // undefined
const b = null; // null
console.log(c); // ReferenceError (undeclared)
```

---

43. What are the Differences Between ES2015 Classes and ES5 Constructors?

ES5 Constructor:

javascript Copy

```
function Person(name) {
  this.name = name;
}
Person.prototype.greet = function() {
  console.log(`Hello, I'm ${this.name}`);
};
```

ES2015 Class:

javascript Copy

```
class Person {
  constructor(name) {
    this.name = name;
  }

  greet() {
    console.log(`Hello, I'm ${this.name}`);
  }
}
```

Key Differences:

- Syntax: Classes are more readable and concise
- Inheritance: Classes use `extends` and `super` for cleaner inheritance
- Hoisting: Class declarations are not hoisted
- Method assignment: Class methods are added to prototype automatically

- Constructors: Classes use a dedicated `constructor` method

44. What Are the Differences Between Map/Set and WeakMap/WeakSet?

Key Differences:

- Key Types:
  - Map/Set: Accept any value as keys
  - WeakMap/WeakSet: Only accept objects as keys
- Memory Management:
  - Map/Set: Strong references prevent garbage collection
  - WeakMap/WeakSet: Weak references allow garbage collection
- Enumeration:
  - Map/Set: Keys can be enumerated
  - WeakMap/WeakSet: Keys cannot be enumerated
- Size Property:
  - Map/Set: Have a size property
  - WeakMap/WeakSet: No size property

45. How Do You Use the CSS display Property?

The `display` property controls how elements are rendered on the page:

- `block`: Full width, creates a new line
- `inline`: Flows with text, width based on content
- `inline-block`: Inline flow with block features
- `flex`: Creates a flexible box layout
- `grid`: Creates a grid layout
- `none`: Removes element from rendering
- `table`, `table-row`, `table-cell`: Table-like behavior

Examples:

```css
/* Block layout */
.container { display: block; }

/* Flexible box layout */
.flex-container { display: flex; }

/* Grid layout */
.grid-container { display: grid; }

/* Hide element */
.hidden { display: none; }
```

46. Why Use Arrow Functions in Constructors?

Arrow functions automatically bind `this` to the surrounding lexical scope, which can be useful in constructors for methods that need to preserve context:

javascript

Copy

```javascript
const Person = function(name) {
  this.name = name;

  // Regular function: 'this' context can change
  this.sayName1 = function() {
    console.log(this.name);
  };

  // Arrow function: 'this' is lexically bound to Person instance
  this.sayName2 = () => {
    console.log(this.name);
  };
};

const john = new Person('John');
const dave = new Person('Dave');

// Regular function's 'this' can be changed
john.sayName1.call(dave); // Dave

// Arrow function's 'this' stays bound to original instance
john.sayName2.call(dave); // John
```

This is particularly useful in cases where methods are passed as callbacks or event handlers.

47. How Do Callback Functions Operate in Asynchronous Tasks?

Callback functions are passed as arguments to other functions and executed when an asynchronous operation completes:

javascript Copy

```javascript
function fetchData(callback) {
  // Simulate async operation (e.g., API request)
  setTimeout(() => {
    const data = { name: 'John', age: 30 };
    callback(data); // Execute callback with result
  }, 1000);
}

fetchData((data) => {
  console.log(data); // { name: 'John', age: 30 }
});
```

Key characteristics:

- Enables non-blocking code execution
- Follows the "continuation-passing style"
- Can lead to callback hell (deeply nested callbacks)
- Often replaced by Promises or async/await in modern code

48. What's the Difference Between function Person(){}, const person = Person(), and const person = new Person()?

function Person() {}:

- Declares a constructor function
- Uses PascalCase by convention
- Does not execute the function

const person = Person():

- Calls the function as a regular function
- Executes the code inside Person
- Returns whatever Person returns
- `this` inside the function refers to the global object (or undefined in strict mode)

const person = new Person():

- Creates a new instance using Person as a constructor

- Sets the new object's prototype to Person.prototype
- Sets `this` to reference the new object
- Executes the constructor function
- Returns the new object (unless constructor returns something else)

49. What is a Practical Scenario for Using Arrow Function Syntax?

Arrow functions are especially useful for callbacks in array methods and event handlers:

Array methods:

javascript Copy

```javascript
// Traditional approach
const numbers = [1, 2, 3, 4, 5];
const doubled = numbers.map(function(number) {
  return number * 2;
});

// Arrow function approach
const doubled = numbers.map(number => number * 2);
```

Event handlers:

javascript

Copy

```javascript
// Traditional approach with 'this' issues
class Counter {
  constructor() {
    this.count = 0;
    this.button = document.querySelector('#button');

    // Need to bind 'this' or it will refer to the button
    this.button.addEventListener('click', this.increment.bind(this));
  }

  increment() {
    this.count++;
  }
}

// Arrow function approach
class Counter {
  constructor() {
    this.count = 0;
    this.button = document.querySelector('#button');

    // Arrow function preserves 'this' from the class
    this.button.addEventListener('click', () => {
      this.count++;
    });
  }
}
```

50. What Does * { box-sizing: border-box; } Do?

This CSS rule applies the `border-box` box sizing model to all elements on the page:

Effects:

- Width and height include content, padding, and border (but not margin)
- Makes sizing more intuitive (add padding without changing dimensions)
- Simplifies layouts (especially responsive ones)

Comparison:

- Default (`content-box`): width/height = content only

- `border-box`: width/height = content + padding + border

Advantages:

- More predictable layouts
- Easier to calculate dimensions
- Consistent with modern CSS frameworks
- Simplifies responsive design

Final Tips for Interview Success

⭐ Preparation Strategies

1. **Focus on fundamentals**: Interviewers often look for solid understanding of core concepts over trendy frameworks.
2. **Practice explaining concepts verbally**: Record yourself explaining key concepts in simple terms.
3. **Code on paper first**: Practice writing code without IDE assistance to simulate whiteboard interviews.
4. **Review your own projects**: Be ready to discuss architectural decisions and challenges from your past work.
5. **Create cheat sheets**: Make your own concise summary cards for quick review before interviews.

⭐ During the Interview

1. **Clarify questions**: Ask for clarification before starting to solve a problem.
2. **Think aloud**: Explain your thought process as you work through solutions.
3. **Start with a naive solution**: Begin with a working solution, then optimize.
4. **Test your code**: Walk through your solution with test cases before declaring it complete.
5. **Be honest about what you don't know**: Say "I don't know, but here's how I'd figure it out" instead of guessing.

⭐ Common Interview Scenarios

Scenario	Strategy
Coding challenge	Break down the problem, consider edge cases, test your solution
System design	Clarify requirements, start with high-level architecture, then dive deeper
Behavioral questions	Use the STAR method (Situation, Task, Action, Result)
Framework-specific	Connect answers to core JavaScript concepts
Debugging exercise	Methodically isolate the issue before fixing

⭐ Post-Interview

1. **Follow up with a thank-you note**: Briefly express appreciation for the opportunity.
2. **Review and learn**: Note any questions you struggled with and study them.
3. **Reflection**: Consider what went well and what could be improved for next time.

Good luck with your interviews! Remember that preparation builds confidence, and confidence leads to success.