JavaScript learning path

Perfect 🚀 Let's now start **Functions in JavaScript** — one of the **most important topics** because functions are the backbone of JS (everything from callbacks, event handlers, async/await, closures, to OOP prototypes all use functions).

I'll keep it **structured** like before:
👉 **Syntax → Example → Output → Internal behavior → Pitfalls/Interview notes.**

🔹 Functions in JavaScript (Deep Dive)

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1. What is a Function?

- A **function** is a **reusable block of code** designed to perform a specific task.
- Functions allow us to:
  - Avoid repetition (DRY principle).
  - Organize code into logical units.
  - Enable modularity and abstraction.

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2. Function Declaration (Classic)

Syntax

```js
function functionName(parameters) {
  // body
  return value;  // optional
}
```

Example

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

```
console.log(add(2, 3));
```

Output

```
5
```

Internal Behavior

- Stored in memory **before execution** (hoisted).
- Can be called **before or after** its definition.

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3. Function Expression

Syntax

```js
const functionName = function(parameters) {
  return value;
};
```

Example

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

console.log(multiply(4, 5));
```

Output

```
20
```

Key Difference

- **Not hoisted**.
- Cannot be called before definition.

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4. Arrow Functions (ES6+)

Syntax

```js
const functionName = (params) => expression;
```

Example

```js
const square = (x) => x * x;

console.log(square(6));
```

Output

```
36
```

Internal Behavior

- Shorter syntax.
- Does **not** have its own `this` (important for callbacks, classes).

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5. Default Parameters

```js
function greet(name = "Anonymous") {
  return `Hello, ${name}!`;
}
```

```
console.log(greet());
console.log(greet("Alice"));
```

Output:

```
mathematica

Hello, Anonymous!
Hello, Alice!
```

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6. Rest Parameters (`...`)

```
js

function sum(...numbers) {
  return numbers.reduce((acc, n) => acc + n, 0);
}

console.log(sum(1, 2, 3, 4));
```

Output:

```


10
```

👉 Collects multiple arguments into an array.

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7. Function Hoisting

```
js

console.log(greet("Sam"));

function greet(name) {
  return `Hi, ${name}`;
}
```

Output:

```
Hi, Sam
```

👉 Function declarations are **hoisted**.

But:

```js
console.log(add(2, 3));

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

Output:

```pgsql
ReferenceError: Cannot access 'add' before initialization
```

👉 Function expressions are **not hoisted.**

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8. Functions as First-Class Citizens

- Functions can be:
  - Assigned to variables.
  - Passed as arguments.
  - Returned from other functions.

Example:

```js
function greet(name) {
  return `Hello, ${name}`;
}

function executor(fn, value) {
  return fn(value);
}
```

```
console.log(executor(greet, "Bob"));
```

Output:

```
Hello, Bob
```

⚠️ Common Pitfalls + Interview Traps

1. **Hoisting confusion** → declaration vs expression.
2. **Arrow function `this` binding** → `this` is taken from enclosing scope.
3. **Rest vs arguments object** → `arguments` is array-like, rest is real array.
4. **Default parameter traps** → expressions evaluated at call-time.

   ```js
   function f(a = Date.now()) { console.log(a); }
   f(); // uses current time
   f(); // different time again
   ```

5. **Function overloading** → JS doesn't support it directly, last definition overrides.

✅ That's the **foundation of functions in JavaScript**.
We've covered **declaration, expression, arrow functions, default/rest parameters, hoisting, first-class behavior**.

Do you want me to go **deeper next into advanced function concepts** like:
👉 **`this` inside functions, closures, IIFE, higher-order functions**?