How JavaScript Code is Executed: A Deep Dive

When you run a JavaScript program, the JavaScript engine creates an **Execution Context** to manage the execution of the code. Let's break down how this works step by step with an example.

Example Code

```
Line1: var n = 2;
Line2: function square(num) {
Line3: var ans = num * num;
Line4:     return ans;
Line5: }
Line6: var square2 = square(n);
Line7: var square4 = square(4);
```

Execution Context and Call Stack

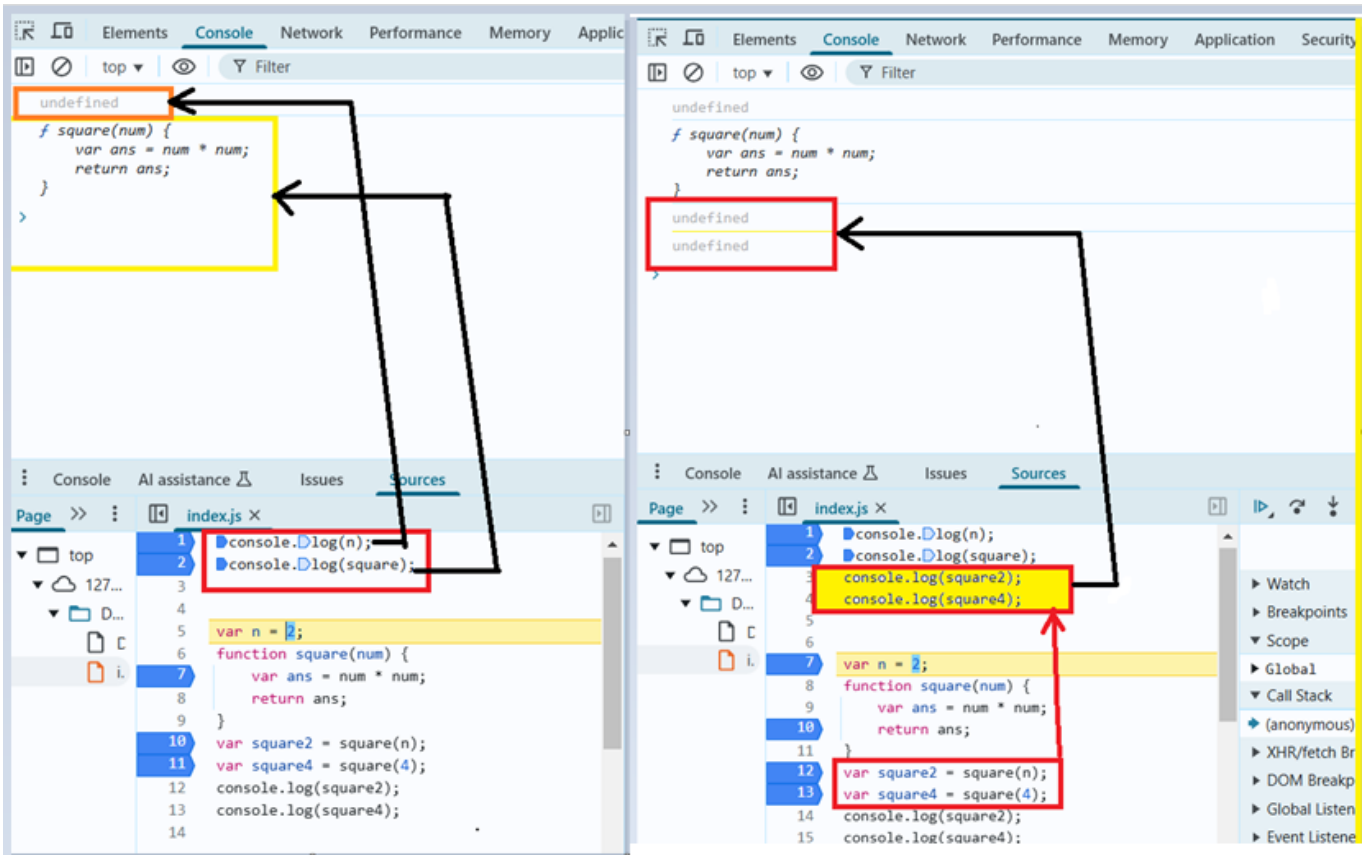
JavaScript code is executed in two phases: 1. **Memory Allocation Phase** 2. **Code Execution Phase**

Each function invocation creates a new **Execution Context**, and the **Call Stack** manages the order of execution.

Step 1: Global Execution Context (GEC) - Memory Allocation Phase

```
Global Execution Context (GEC):
-------------------------------------
| Memory              | Code          |
-------------------------------------
| n: undefined        |               |
| square: { ... }     | (function)    |
| square2: undefined  |               |
| square4: undefined  |               |
-------------------------------------
```

- Variables are initialized with `undefined`.
- Functions are stored in memory as a whole.



Step 2: Global Execution Context (GEC) - Code Execution Phase

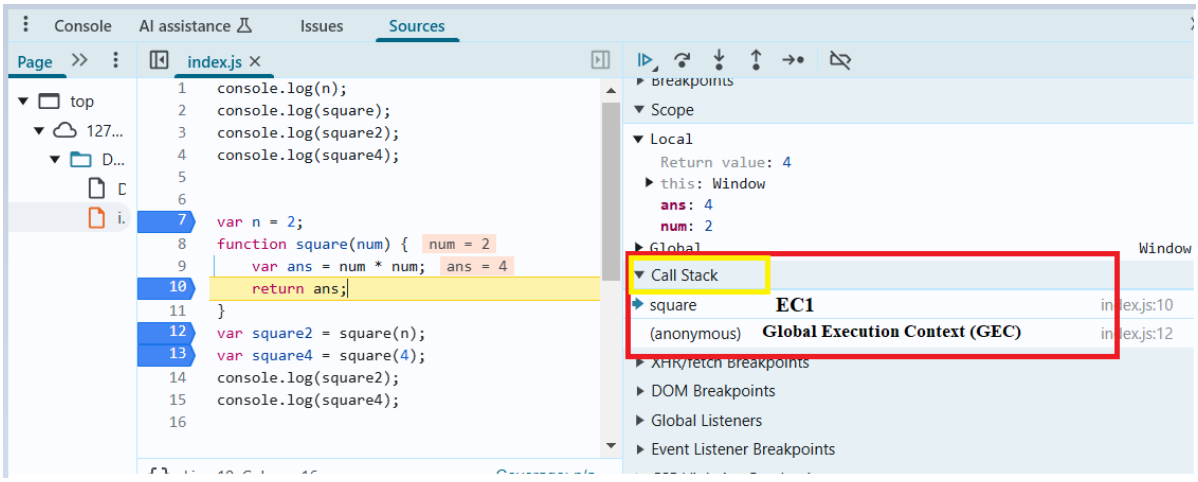
Line 1: `n = 2` is executed.

```
Global Execution Context (GEC):
-----------------------------------
| Memory                | Code      |
-----------------------------------
| n: 2                  |           |
| square: { ... }       | (function)|
| square2: undefined    |           |
| square4: undefined    |           |
-----------------------------------
```

Line 6: `square(n)` is invoked.

- A new **Local Execution Context (EC1)** is created for `square`.

```
Call Stack:
----------------------
| square EC1         |
| Global EC (GEC)    |
----------------------
```



Local Execution Context (EC1) - Memory Allocation Phase:

```
Local Execution Context (EC1):
-----------------------------------
| Memory           | Code         |
-----------------------------------
| num: undefined   |              |
| ans: undefined   |              |
-----------------------------------
```

Local Execution Context (EC1) - Code Execution Phase:

- `num` is assigned the value of `n` (which is 2).
- `ans = num * num` → `ans = 4`.
- `return ans` → The value 4 is returned to the GEC.

```
Local Execution Context (EC1):
-----------------------------------
| Memory           | Code         |
-----------------------------------
| num: 2           |              |
| ans: 4           |              |
-----------------------------------
```

- After execution, `square2` is assigned the value `4` in the GEC.

```
Global Execution Context (GEC):
-----------------------------------
| Memory              | Code      |
-----------------------------------
| n: 2                |           |
| square: { ... }     | (function)|
| square2: 4          |           |
| square4: undefined  |           |
-----------------------------------
```

- The Local Execution Context (EC1) is popped off the Call Stack.

```
Call Stack:
----------------------
| Global EC (GEC)    |
----------------------
```

Line 7: `square(4)` is invoked.

- A new **Local Execution Context (EC2)** is created for `square`.

```
Call Stack:
----------------------
| square EC2         |
| Global EC (GEC)    |
----------------------
```

Local Execution Context (EC2) - Memory Allocation Phase:

```
Local Execution Context (EC2):



-----------------------------------
| Memory           | Code         |
-----------------------------------
| num: undefined   |              |
| ans: undefined   |              |
-----------------------------------
```

Local Execution Context (EC2) - Code Execution Phase:

- `num` is assigned the value 4.
- `ans = num * num` → `ans = 16`.
- `return ans` → The value `16` is returned to the GEC.

```
Local Execution Context (EC2):
-----------------------------------
| Memory           | Code         |
-----------------------------------
| num: 4           |              |
| ans: 16          |              |
-----------------------------------
```

- After execution, `square4` is assigned the value `16` in the GEC.

```
Global Execution Context (GEC):
-----------------------------------
| Memory              | Code       |
-----------------------------------
| n: 2                |            |
| square: { ... }     | (function) |
| square2: 4          |            |
| square4: 16         |            |
-----------------------------------
```

- The Local Execution Context (EC2) is popped off the Call Stack.

```
Call Stack:
----------------------
| Global EC (GEC)    |
----------------------
```

Program Ends:

- The Global Execution Context (GEC) is popped off the Call Stack.

```
Call Stack:
----------------------
| (Empty)            |
----------------------
```

Call Stack Visualization

The **Call Stack** maintains the order of execution contexts. Here's how it works:

1. **Initial State:**

   ```
   Call Stack:
   - Global Execution Context (GEC)
   ```

2. **After `square(n)` is invoked:**

   ```
   Call Stack:
   - square Execution Context (EC1)
   - Global Execution Context (GEC)
   ```

3. **After `square(n)` completes:**

   ```
   Call Stack:
   - Global Execution Context (GEC)
   ```

4. **After `square(4)` is invoked:**

   ```
   Call Stack:
   - square Execution Context (EC2)
   - Global Execution Context (GEC)
   ```

5. **After `square(4)` completes:**

   ```
   Call Stack:
   - Global Execution Context (GEC)
   ```

6. **Program Ends:**

   ```
   Call Stack:
   - (Empty)
   ```

Key Takeaways

- JavaScript execution is managed through **Execution Contexts** and the **Call Stack**.
- The **Memory Allocation Phase** sets up variables and functions.
- The **Code Execution Phase** runs the code and assigns values.
- Functions create their own Execution Contexts, which are managed in the Call Stack.