Recursion in JavaScript

Ayush Verma · Follow
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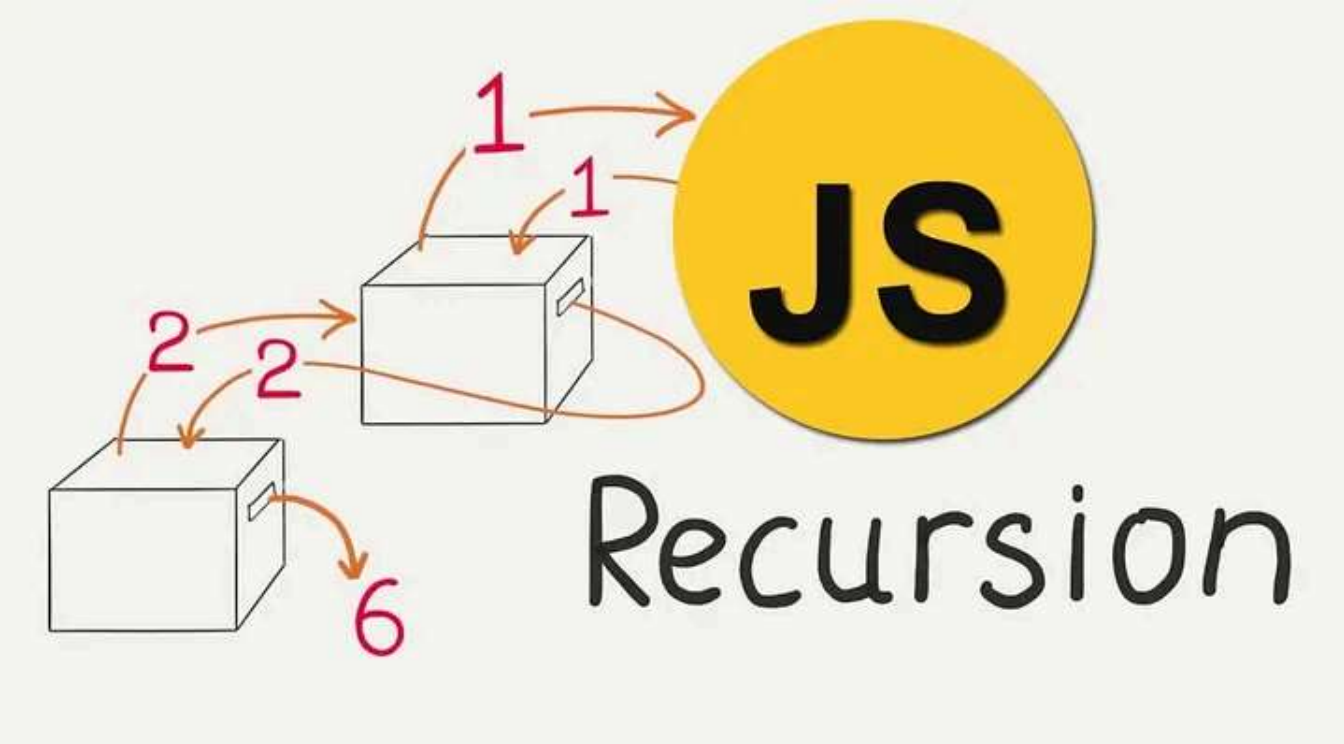

What is Recursion?

A **process** (a function in our case) that **calls itself.**

Why do we need to know Recursion?

It's EVERYWHERE!

- Methods using recursion internally — JSON.parse/JSON.stringify, document.getElementById
- DOM traversal algorithms and Object traversal
- A cleaner alternative to iteration.

> ***Call Stack —*** *First let's talk about functions. In almost all program languages there is a built data structure that manages what happens when functions are invoked. Its named as Call Stack in JavaScript.*
>
> *It's a* ***stack*** *data structure. Any time a function is invoked it is placed (****pushed****) on the top of the call stack. When JavaScript sees the* ***return*** *keyword or when the function ends, the complier will remove(****pop****).*
>
> *We are used to functions being pushed on the call stack and popped off when they are done. When we write recursive functions, we keep pushing new functions (in fact the same function)onto the call stack!*

How recursive functions work?

Two essential parts of any recursive functions — **Base case** and **different input.** Invoke the **same** function with a different input until you reach your base case — the condition where the recursion ends.

Examples:

1. **Countdown —** print numbers to the console from whatever number we pass till
    1.

Without recursion:

```
function countDown(num){
    for(var i = num; i > 0; i--) {
       console.log(i);
    }
    console.log("All done!");
}

countDown(5);
```

With recursion:

```
function countDown(num){
    if (num <= 0) {
       console.log("All done!");
       return;
    }
    console.log(num);
    num--;
    countDown(num);
}

countDown(3);

//print 3
//countDown(2)
```

```
//print 2
//countDown(1)
//print 1
//countDown(0) - base case
//print "All done"
```

2. **SumRange —** print sum to the console from whatever number we pass till 1

```
function sumRange(num){
    if (num === 1) return 1;
    return num + sumRange(num-1);
}
sumRange(3);

//return 3 + sumRange(2)
//           return  2 + sumRange(1)
//                       return 1 - base case
// 3 + 2 + 1 = 6
```

3. **Factorial**-print multiplication to the console from whatever number we pass till 1.

Without recursion:

```
function factorial(num){
    let total = 1;
    for(var i = num; i > 0; i--) {
         total *= i;
    }
    return total;
}

factorial(5); //120
```

With recursion:

```
function factorial(num){
    if(num === 1) return 1;
    return num * factorial(num-1);
}

factorial(3); //6
```

Common Recursion Pitfalls

- No base case
- Forgetting to return or returning the wrong thing!

- Maximum call stack size exceeded — stack overflow!

Helper Method Recursion:

A design pattern that's commonly used with recursion.

```
function outer(input){
    var outerScopedVariable = [];
    function helper(helperInput){
       //modify the outerScopedVariable
        helper(helperInput--)
    }
    helper(input)
    return outerScopedVariable;
}

//Two functions - outer(main) and helper (recursive)
//Commonly done when we need to compile an array or list of data.
```

Example —

Collect all the odd values in an array.

```
function collectOddValues(arr){
    let result = [];

    function helper(helperInput){
        if(helperInput.length === 0){
            return;
        }
        if(helperInput[0] % 2 !== 0){
            result.push(helperInput[0]);
        }
        helper(helperInput.slice(1))
    }
    helper(arr)

 return result;
}

collectOddValues([1,2,2,4,4,5,6,7,8]) //(3) [1, 5, 7]
```

Pure Recursion:

```
function collectOddValues(arr){
    let newArr = [];
```

```
    if(arr.length === 0){
        return newArr;
    }
    if(arr[0] % 2 !== 0){
        newArr.push(arr[0]);
    }
    newArr = newArr.concat(collectOddValues(arr.slice(1)));

    return newArr;
}
collectOddValues([1,2,3,4,5]) //(3) [1, 3, 5]

//[1].concat(collectOddValues([2,3,4,5]));
//         [].concat(collectOddValues([3,4,5]));
//                  [3].concat(collectOddValues([4,5]));
//                    [].concat(collectOddValues([5]));
//                      [5].concat(collectOddValues([]));
//                          []
//[1,3,5]
```

Pure Recursion Tips

- For arrays, use methods like **slice**, the **spread** operator, and **concat** that makes copies of arrays so we do not mutate them.
- Remember strings are immutable, so we will need to use methods like **slice**, **substr**, or **substring** to make copies of strings.
- To make copies of object use **Object.assign**, or the **spread** operator.

Recursion examples:

1. **power** — Write a function called power which accepts a base and an exponent. The function should return the power of the base to the exponent. This function should mimic the functionality of **Math.pow()** — do not worry about negative bases and exponents.

```
function power(base, exponent){
    if(exponent === 0) return 1;
    return base * power(base,exponent-1)
}
power(2,0) // 1
power(2,2) // 4
power(2,4) // 16
```

2. **productOfArray —** Write a function called productOfArray which takes in an array of numbers and returns the product of them all.

```
function productOfArray(arr){
    if(arr.length === 0) return 1;
    return arr[0] * productOfArray(arr.slice(1))
}

productOfArray([1,2,3]) // 6
productOfArray([1,2,3,10]) // 60
```

3. **Fibonacci —** Write a recursive function called fib which accepts a number and returns the nth number in the Fibonacci sequence. Recall that the Fibonacci sequence is the sequence of whole numbers 1, 1, 2, 3, 5, 8, … which starts with 1 and 1, and where every number thereafter is equal to the sum of the previous two numbers.

```
function fib(n){
    if (n <= 2) return 1;
    return fib(n-1) + fib(n-2);
}

fib(4) //3
fib(6) //8
fib(10) //55

//n = 4
//fib(3) + fib(2)
//[fib(2)+ fib(1)] + 1
//1 + 1 + 1
//3

//n = 6
//fib(5) + fib(4)
//[fib(4)+ fib(3)] + [fib(3)+ fib(2)]
//[fib(3)+ fib(2) + fib(2)+ fib(1)] + [fib(2)+ fib(1) + 1]

//[fib(2) + fib(1)+ fib(2) + fib(2)+ fib(1)] + [fib(2)+ fib(1) + 1]
//[1 + 1 + 1 + 1 + 1] + [1 + 1 + 1]
//8
```

4. **reverse —** Write a recursive function called reverse which accepts a string and returns a new string in reverse.

```
function reverse(str){
    if(str.length === 1) return str[0];
    return str[str.length - 1] + reverse(str.slice(0, str.length-1))
}

// reverse('awesome') // 'emosewa'
// reverse('rithmschool') // 'loohcsmhtir'
```

5. **flatten —** Write a recursive function called flatten which accepts an array of arrays and returns a new array with all values flattened.

Helper method:

```
function flatten(arr){
  let resultArr = [];

  function inner(arr){
    for(let i = 0; i< arr.length; i++){
          if(Array.isArray(arr[i])){
              inner(arr[i]);
          }
          else{
              resultArr.push(arr[i])
          }
      }
  }
  inner(arr);
  return resultArr;
}

flatten([1, 2, [3, 4, [5, [6, 7, [[[8]]]]]]]) //[1, 2, 3, 4, 5, 6,
7, 8]
```

Pure recursion:

```
function flatten(arr){
  let resultArr = [];
  for(let i = 0; i < arr.length; i++){
      if(Array.isArray(arr[i])){
          resultArr = resultArr.concat(flatten(arr[i]))
      }
      else{
          resultArr.push(arr[i])
      }
  }
  return resultArr;
}

// flatten([1, 2, 3, [4, 5] ]) // [1, 2, 3, 4, 5]
// flatten([1, [2, [3, 4], [[5]]]]) // [1, 2, 3, 4, 5]
```

```
// flatten([[1],[2],[3]]) // [1,2,3]
// flatten([[[[1], [[[2]]], [[[[[[[3]]]]]]]]]) // [1,2,3]
```

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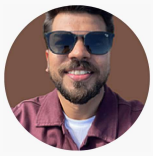

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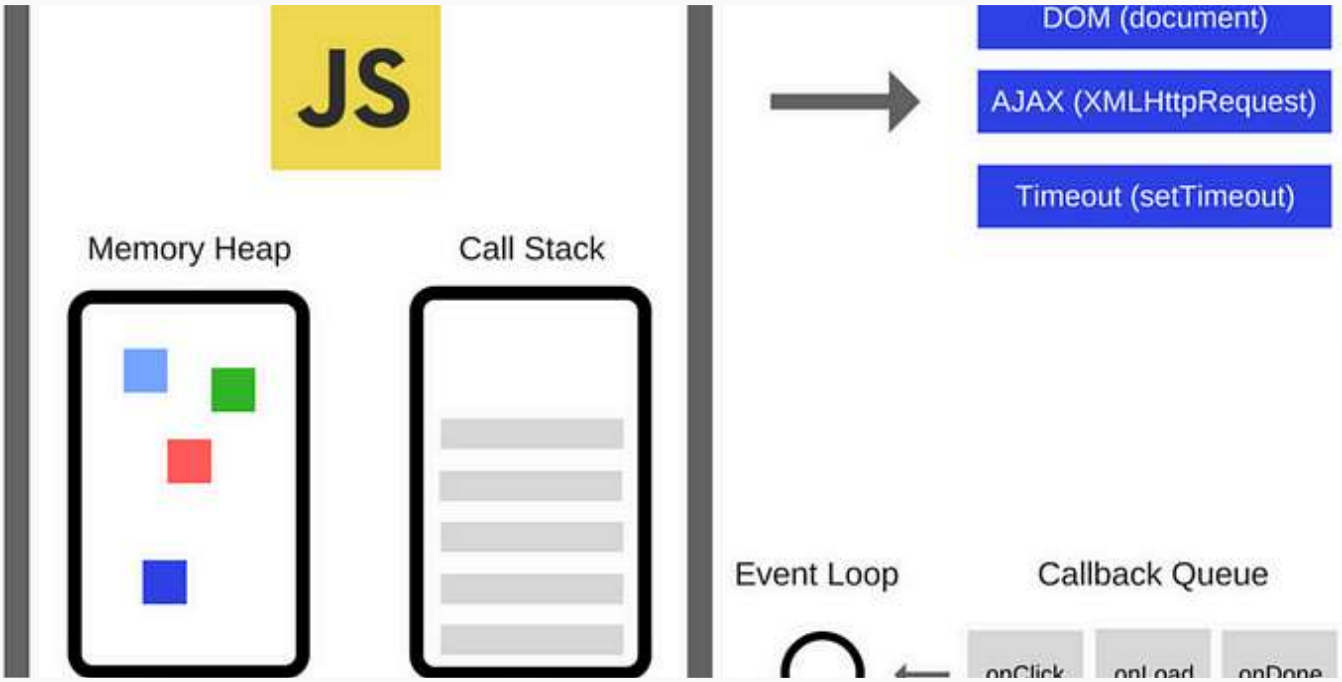

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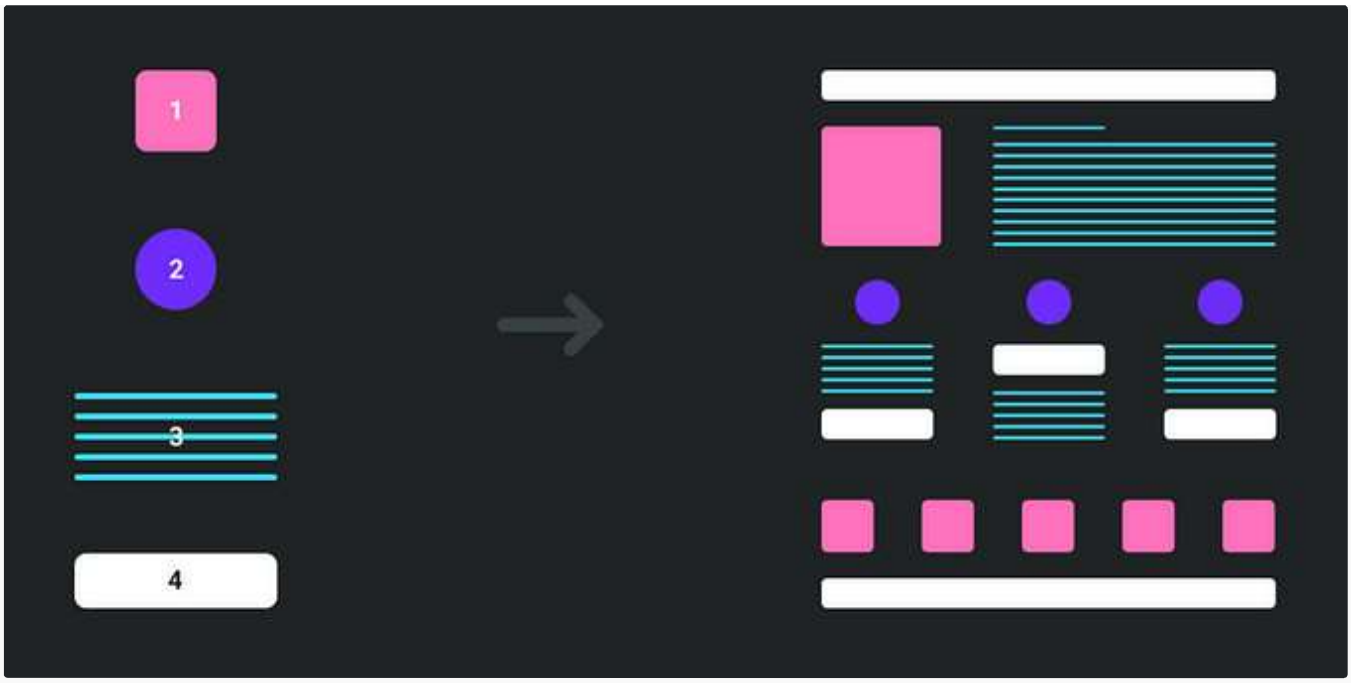

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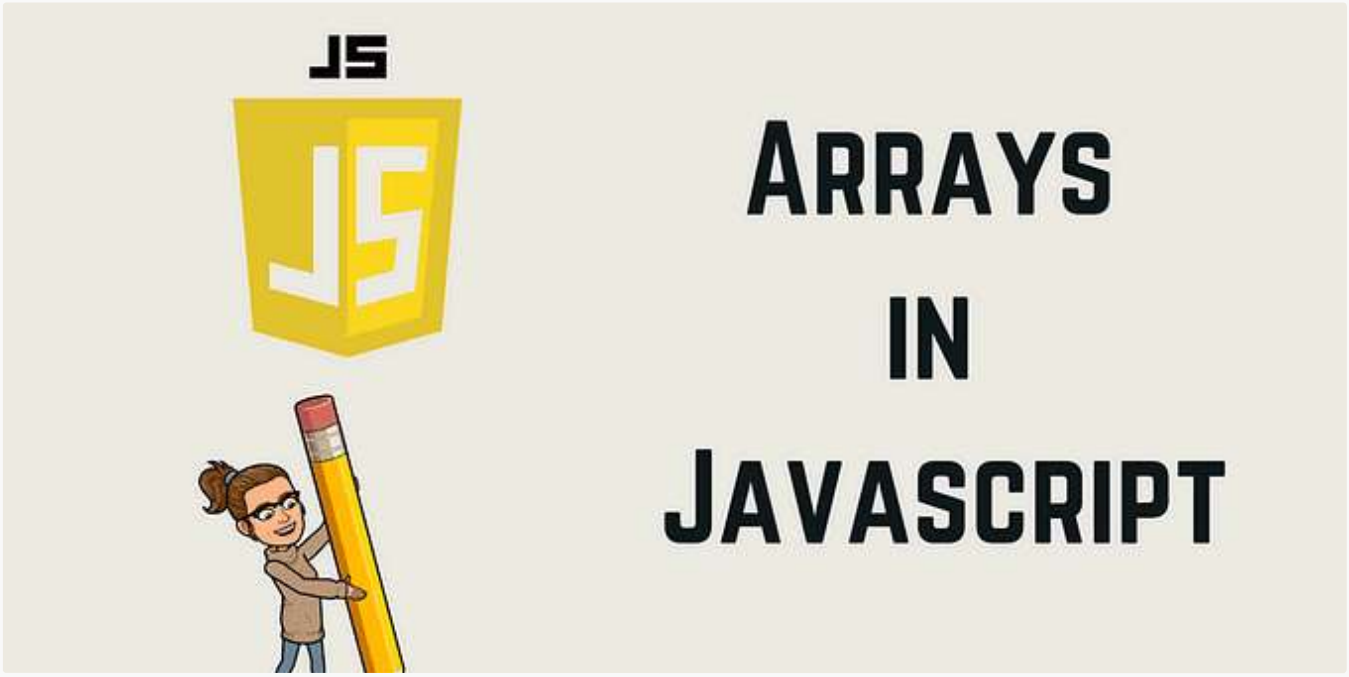

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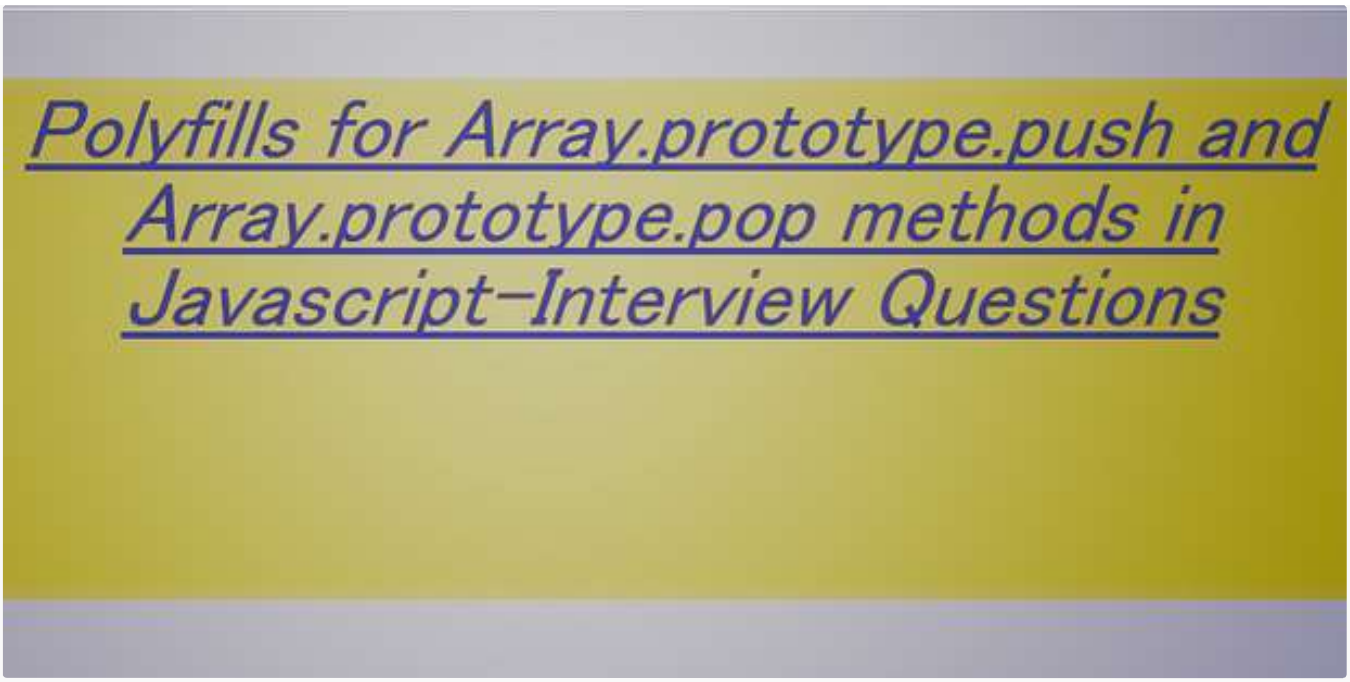

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