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# Day 1: Functions

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# Functions in JavaScript

## **Functions**

Functions in JavaScript are declared using the function keyword. A function declaration creates a function that's a *Function* object having all the properties, methods, and behaviors of Function objects. By default, functions return the value undefined; to return any other value, the function must have a return statement that consists of the return keyword followed by the value to be returned (this can be a literal value, a variable, or even a call to a function).

# - EXAMPLE

Take some time to review the code below that declares functions and prints their return values.

### Input Format

The first line contains a string denoting *name*.

The second line contains two space-separated integers,  $\boldsymbol{a}$  and  $\boldsymbol{b}$ , to be summed.

```
1 'use strict';
2 process.stdin.on('data', function (data) {
      let input = String(data).split(new RegExp("[\n ]+"));
      main(input[0], +(input[1]), +(input[2]));
5 });
6 /**** Ignore above this line. ****/
8 function greetings(name) {
      console.log("Hello, " + name);
9
10 }
11
12 function sum(a, b) {
13
      return a + b;
14 }
15
16 function main(name, a, b) {
17
      greetings(name);
18
      console.log(sum(a, b));
```

# Input The Function Expression Run

A function the same syntax as) a function statement. The main difference between a function expression and a function statement is the function name, which can be omitted from a function expression to create an anonymous function. Function expressions are often used as Immediately Invoked Function Expressions (IIFEs), which run as soon as they're defined.

# **Unnamed Function Expression**

```
EXAMPLE
 The code below demonstrates an unnamed function expression.
 Input Format
 A single integer denoting m{x}.
 1 'use strict';
 2 process.stdin.on('data', function (data) {
      main(+(data));
4 });
 5 /**** Ignore above this line. ****/
7 function main(input) {
8
9
       /**
10
          Defines an unnamed function and assigns it to a variable nam
11
           @param {Number} x
12
          @returns {Number} The value of argument squared.
13
      **/
      var square = function(x) {
14
15
           return x * x;
16
      };
17
18
      // Print the value returned by passing input as x to the
19
       // anonymous function referenced by variable square
20
       console.log(square(input));
21 }
  Input
  4
  Output
```

# Named Function Expression

- EXAMPLE

The code below demonstrates a named function expression.

Imput Format

Two space-separated integers describing the respective values of factN and fibN.

'use strict';

process.stdin.on('data', function (data) {
 let input = String(data).split(new RegExp("[\n ]+"));
 main(+(input[0]), +(input[1]));
});

/\*\*\*\* Ignore above this line. \*\*\*\*/

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**Functions** 

The Function Expression

```
8 function main(factN, fibN) {
9
10
11
         Defines a named recursive function as a property of the math
12
          @param {Number} n
13
          @returns {Number} The value of n factorial.
14
15
      var math = {
16
          // Declare the factorial property
17
          factorial:
               // Declare the function as the property's value
18
19
               function factorial(n) {
20
                   if (n > 1) {
21
                       return n * factorial(n - 1);
22
                   }
23
                   // Returns 1 if n <= 1
24
                   return 1;
25
              }
26
      };
27
28
29
      * Defines a named recursive function referenced by the fib var
30
          @param {Number} n
31
          @returns {Number} The value of fibonacci(n).
32
      **/
33
      var fib = function fibonacci(n){
34
          if (n > 2) {
35
              return fibonacci(n - 1) + fibonacci(n - 2);
36
          }
37
          else if (n < 1) {
38
               return 0;
39
40
          // else, return 1
41
          return 1;
42
     }
43
44
      // Print the value returned by passing factN as n to the
45
      // function referenced by variable math:
46
      console.log(math.factorial(factN));
47
      // and by passing fibN as n to the function referenced by variab
48
      console.log(fib(fibN));
49
50 }
  Input
  5 11
  Output
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```

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# Recursion

## Recursion

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two parts: a *base case* and a *recursive case*. The problem is divided into smaller subproblems which are then solved recursively until such time as they are small enough and meet some base case; once the base case is met, the solutions for each subproblem are combined and their result is the answer to the entire problem.

If the base case is not met, the function's recursive case calls the function again with modified values. The code must be structured in such a way that the base case is reachable after some number of iterations, meaning that each subsequent modified value should bring you closer and closer to the base case; otherwise, you'll be stuck in the dreaded infinite loop!

It's important to note that any task that can be accomplished recursively can also be performed iteratively (i.e., through a sequence of repeatable steps). Recursive solutions tend to be easier to read and understand than iterative ones, but there are often performance drawbacks associated with recursive solutions that you're going to want to evaluate on a case-by-case basis. Typically, we use recursion when each recursive call significantly reduces the size of the problem (e.g., if we can halve the dataset during each recursive call). Regardless of the advisability of recursively solving a problem, it's extremely important to practice and understand *how* to recursively solve problems.

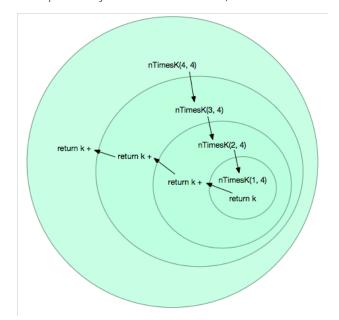


## Example (Java)

#### EXAMPLE The code below produces the multiple of two numbers by combining addition and recursion. Input Format Two space-separated integers to be multiplied. 1 import java.util.\*; 2 3 class Solution { // Multiply 'n' by 'k' using addition: 4 private static int nTimesK(int n, int k) { 5 6 // Print current value of n System.out.println("n: " + n); 7 8 // Recursive Case 9 10 if(n > 1) { 11 return k + nTimesK(n - 1, k); 12 } 13 // Base Case n = 1 14 else { 15 return k; 16 17 } 18 public static void main(String[] args) { Scanner scanner = new Scanner(System.in); 19 20 int result = nTimesK(scanner.nextInt(), scanner.nextInt()); 21 scanner.close(); System.out.println("Result: " + result); 22 23 Input 4 4 Output

The diagram below depicts the execution of the code above using the default input ( 4 4). Each call to nTimesK is represented by a bubble, and each new recursive call bubble is stacked inside and on top of the bubble that was responsible for calling it. The function recursively calls itself using reduced values until it reaches the base case (n = 1). Once it reaches the base case, it passes back the base case's return value (k = 4) to the bubble

that called it and continues passing back  $\, \mathsf{k} \, + \, \mathsf{the}$  previously returned value until the final result (i.e.: the multiplication by addition result of  $n \times k$ ) is returned.



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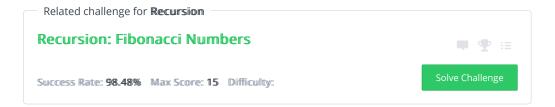
The Function Expression

Once the code hits the base case in the  $\mathbf{4}^{th}$  bubble, it returns k (which is  $\mathbf{4}$ ) to the  $\mathbf{3}^{rd}$  bubble.

Then the  $\mathbf{3}^{rd}$  bubble returns k+4, which is 8, to the  $\mathbf{2}^{nd}$  bubble.

Then the  $2^{nd}$  bubble returns k+8, which is 12, to the  $1^{st}$  bubble.

Then the  $\mathbf{1}^{st}$  bubble returns k+12, which is  $\mathbf{16}$ , to the first line in main as the result for nTimesK(4,4), which assigns  $\mathbf{16}$  to the result variable.



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