JAVASCRIPT FUNCTIONS

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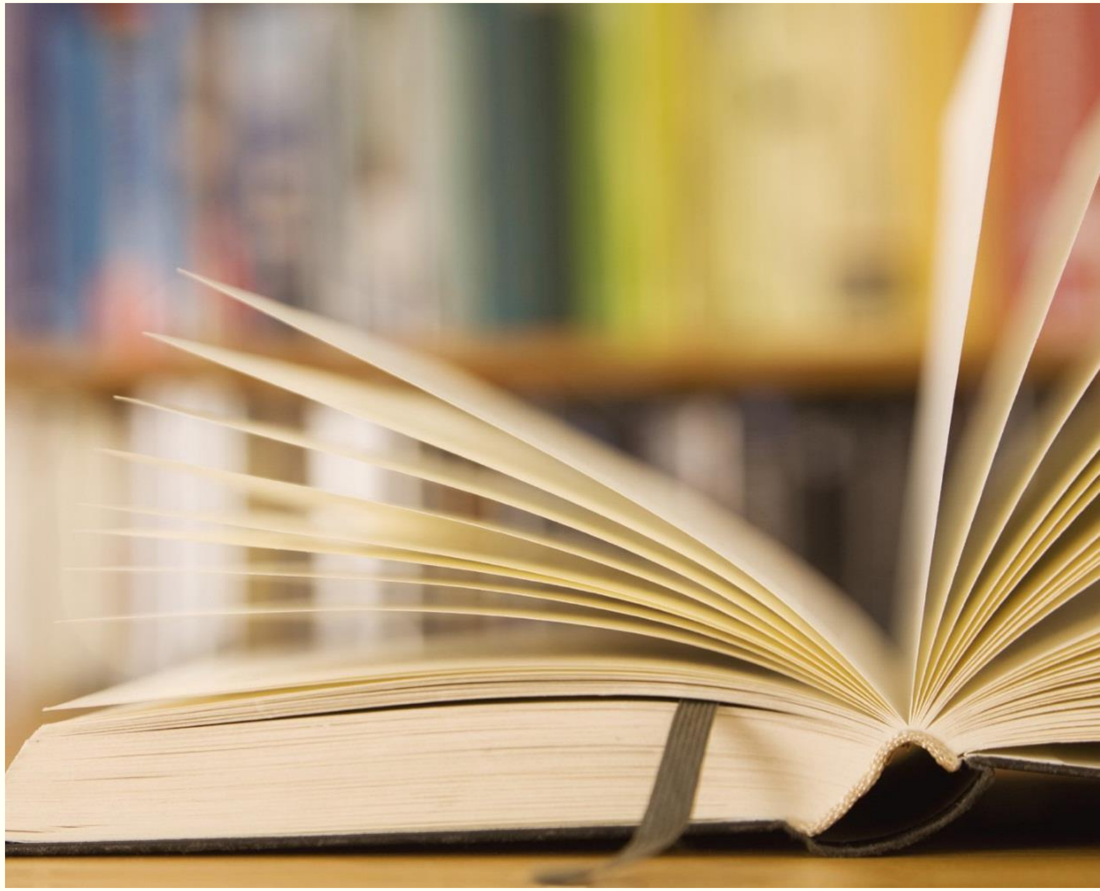
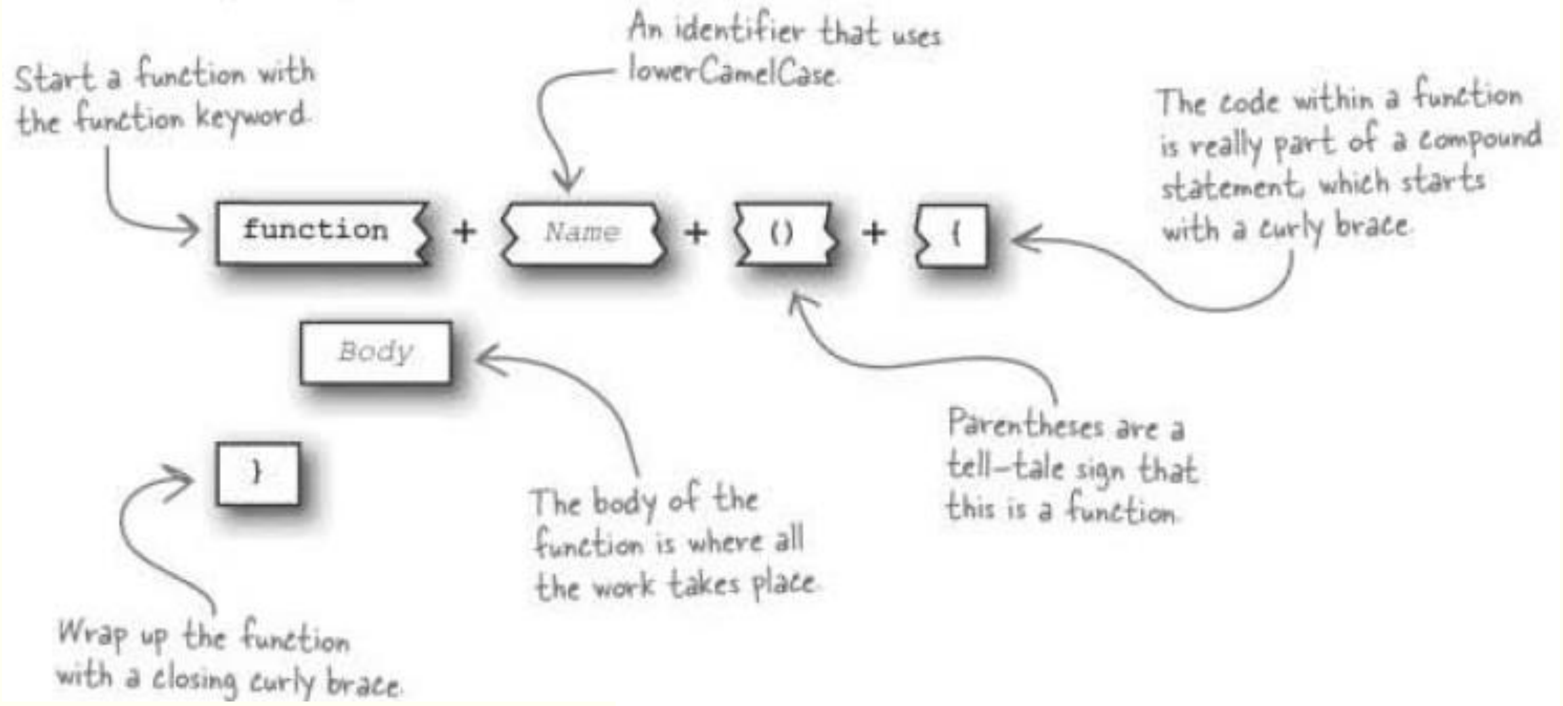


JavaScript Functions

- Generally speaking, a function is a "subprogram" that can be *called* by code external (or internal in the case of recursion) to the function.
- A function is composed of a sequence of statements called the *function body*. Values can be *passed* to a function, and the function can *return* a value.
- In JavaScript, functions are first-class objects, because they can have properties and methods just like any other object. In brief, they are Function objects.

JavaScript functions

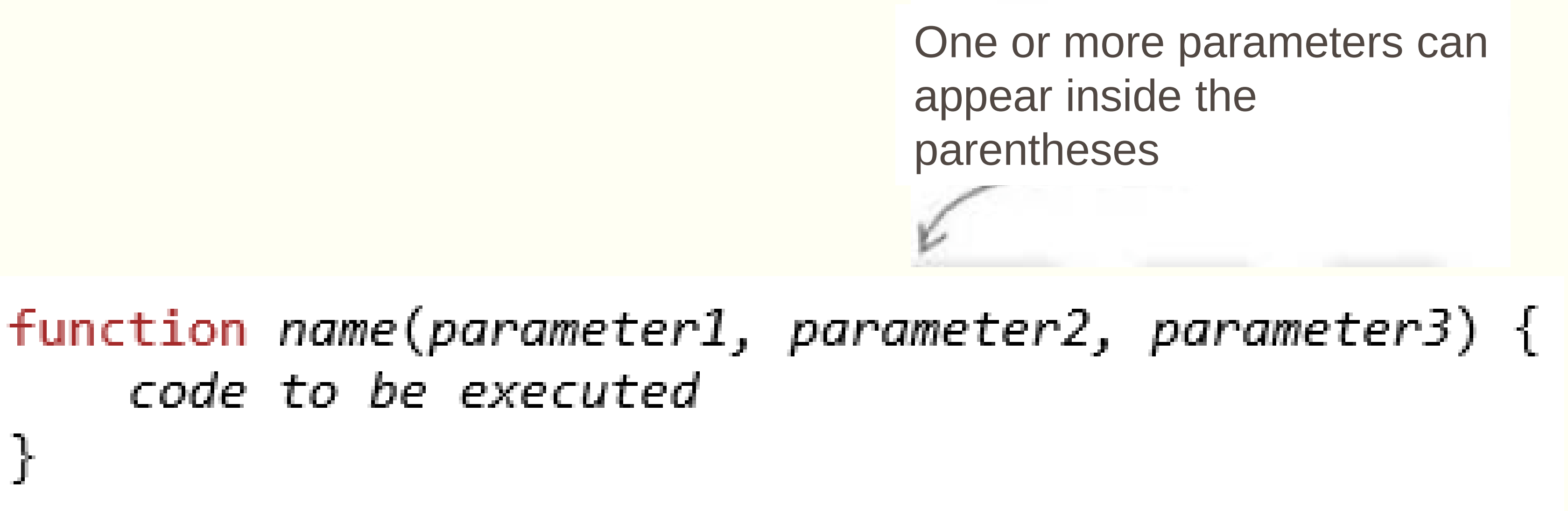
- Functions allow you to make JavaScript code more efficient, more reusable.
- Functions are task-oriented, good to organize code and excellent problem solvers.



Start a function with the function keyword.
An identifier that uses lowerCamelCase.
The code within a function is really part of a compound statement, which starts with a curly brace.
function
+
Name
+
()
+
{
Body
}
Parentheses are a tell-tale sign that this is a function.
The body of the function is where all the work takes place.
Wrap up the function with a closing curly brace.

Passing arguments to a function

- Data is passed into JavaScript functions using function arguments, which are like inputs.

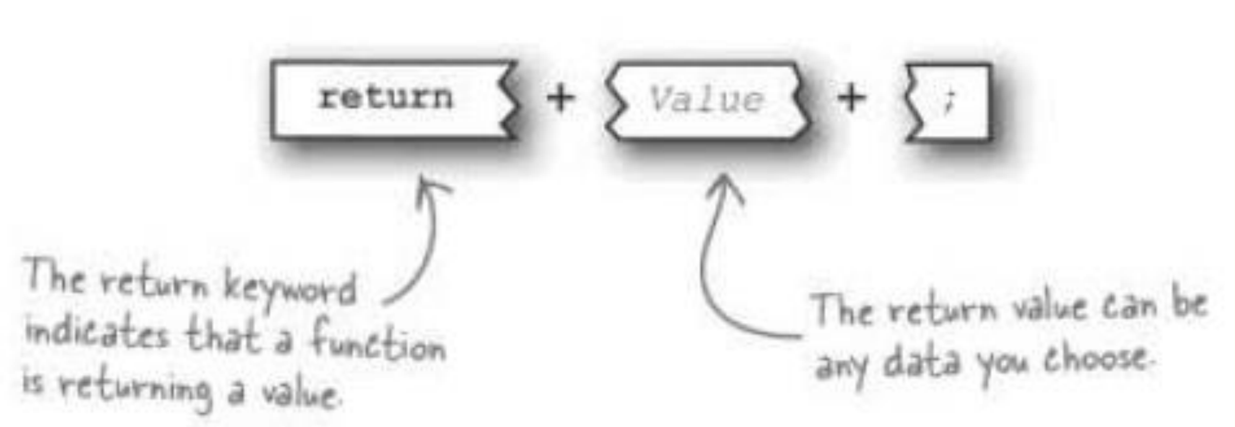


One or more parameters can appear inside the parentheses

```
function name(parameter1, parameter2, parameter3) {
    code to be executed
}
```

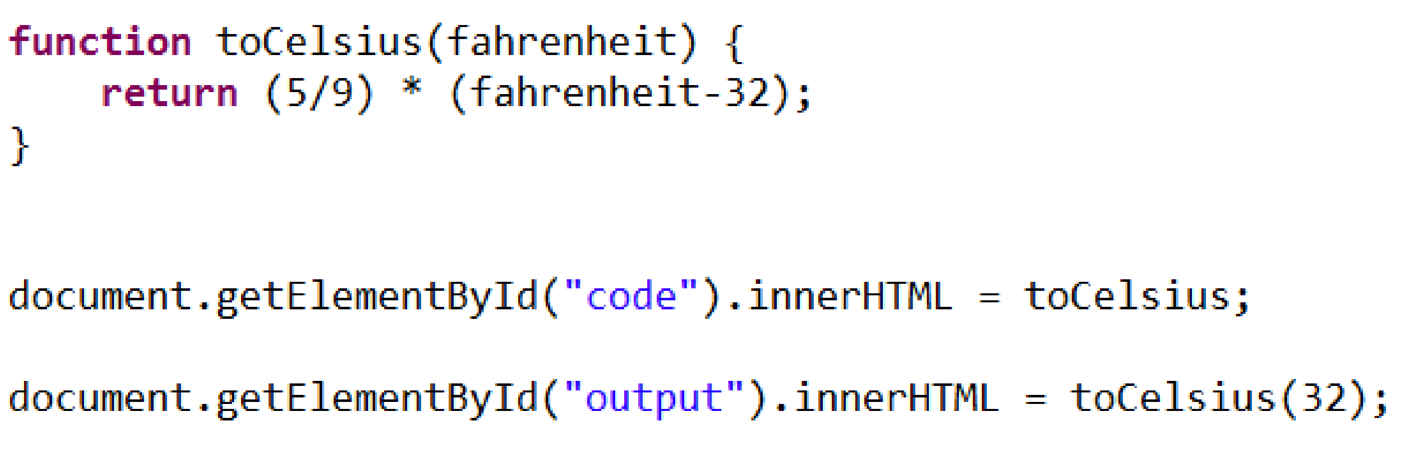
Returning data from functions

- A return value allows you to return a piece of data from a function.
- The “return” keyword followed by the data is used
- A return statement can be placed anywhere within a function; just to know that the function will exit immediately upon encountering a return.


return
+
Value
+
;
The return keyword indicates that a function is returning a value.
The return value can be any data you choose.

The function example

- Convert Fahrenheit to Celsius



```
function toCelsius(fahrenheit) {
    return (5/9) * (fahrenheit-32);
}


document.getElementById("code").innerHTML = toCelsius;

document.getElementById("output").innerHTML = toCelsius(32);
```

- **The () Operator Invokes the Function**
- In the example above, toCelsius refers to the function object, and toCelcius() refers to the function result

JavaScript Methods

- JavaScript methods are the actions that can be performed on objects.
- Methods are functions stored as object properties.
- You access an object method with the following syntax:
    - *objectName.methodName()*
    - *Example:*
        - *employee.getName()*
            - *Employee is an object*
            - *getName() is a method of employee object*

JavaScript String object

- JavaScript strings are used for storing and manipulating text.
- A JavaScript string simply stores a series of characters like **"Welcome to JavaScript world".**
- A string can be any text inside quotes. You can use single or double quotes.

- Strings Can be primitive values or objects
  - Normally, JavaScript strings are primitive values, created from literals:

    var name = “Banuprakash";
  - But strings can also be defined as objects with the keyword new:

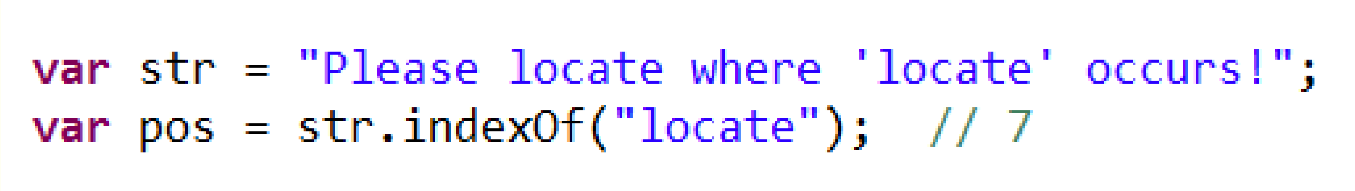
    var name = new String(“Banuprakash");

String Methods

Method	Description
charAt()	Returns the character at the specified index (position)
indexOf()	Returns the position of the first found occurrence of a specified value in a string
lastIndexOf()	Returns the position of the last found occurrence of a specified value in a string
split()	Splits a string into an array of substrings based on the delimiter
substring()	Extracts a part of a string between two specified positions
substr()	Extracts a part of a string from a start position through a number of characters
trim()	Removes whitespace from both ends of a string
match()	Searches a string for a match against a regular expression, and returns the matches

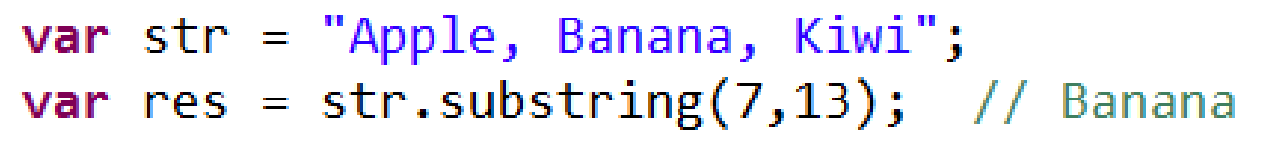
String Methods

- Examples:
  - The indexOf() method returns the index of (the position of) the first occurrence of a specified text in a string:



```
var str = "Please locate where 'locate' occurs!";
var pos = str.indexOf("locate");  // 7
```

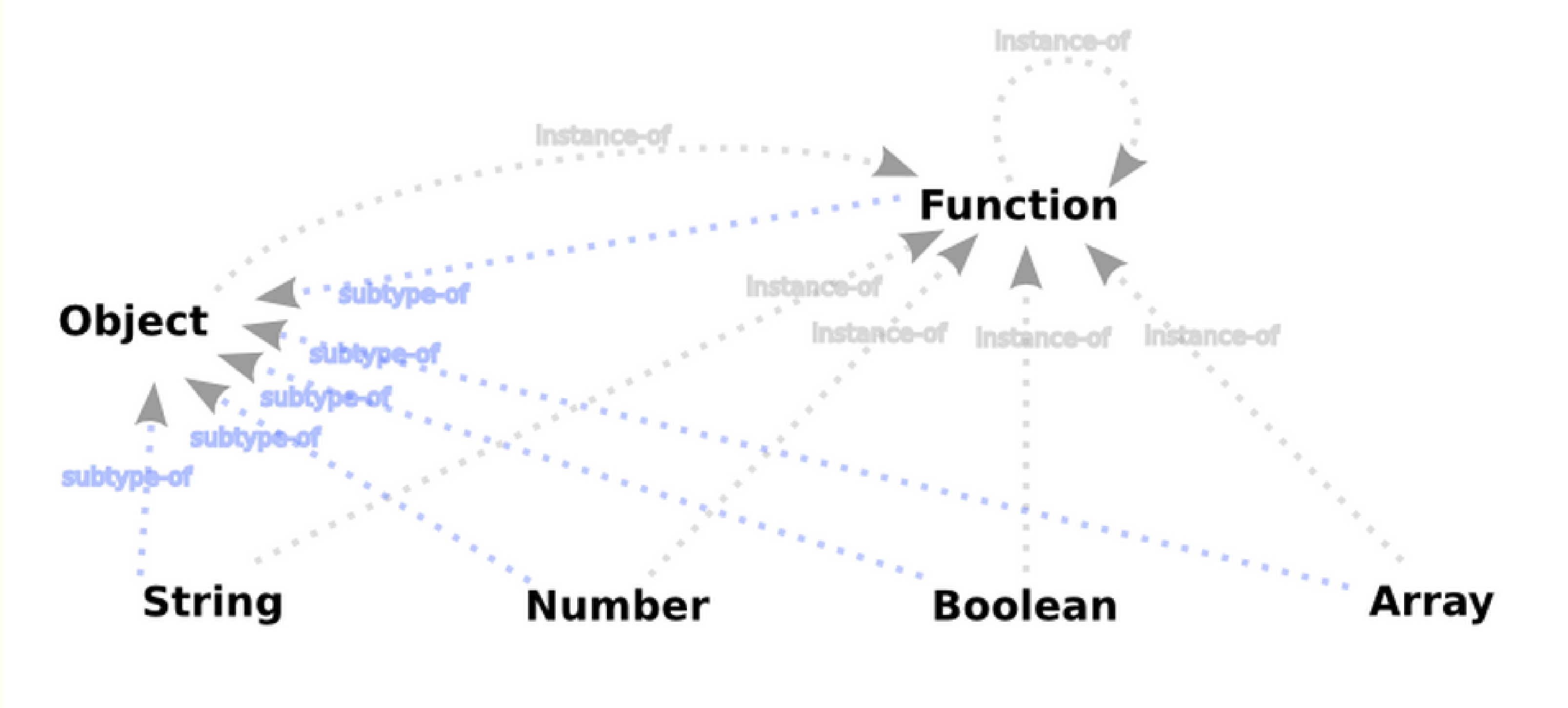
  - The substring() Method
  - The substring() cannot accept negative indexes



```
var str = "Apple, Banana, Kiwi";
var res = str.substring(7,13);  // Banana
```

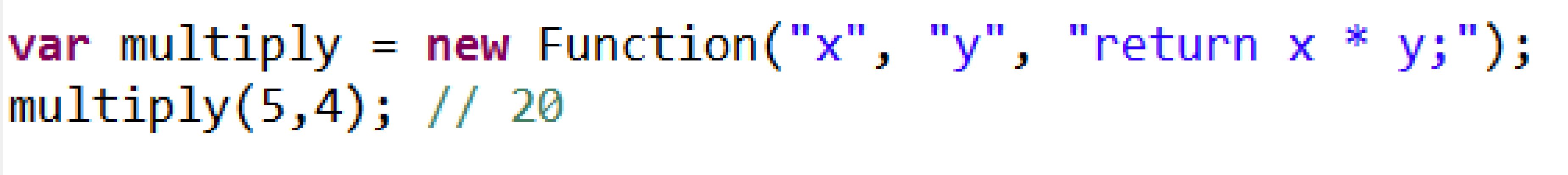
Function constructor

- The Function constructor creates a new Function object.
- In JavaScript every function is actually a Function object



Function constructor

- Constructor
  - new Function ([arg1[, arg2[, ...argN]],] functionBody)
- Parameters
  - arg1, arg2, ... argN Names to be used by the function as formal argument names.
  - Each must be a string that corresponds to a valid JavaScript identifier or a list of such strings separated with a comma; for example "a,b".
- functionBody
  - A string containing the JavaScript statements comprising the function definition.
  - Example:



```
var multiply = new Function("x", "y", "return x * y;");
multiply(5,4); // 20
```

The function expression

- A function expression is very similar to and has almost the same syntax as a function statement.

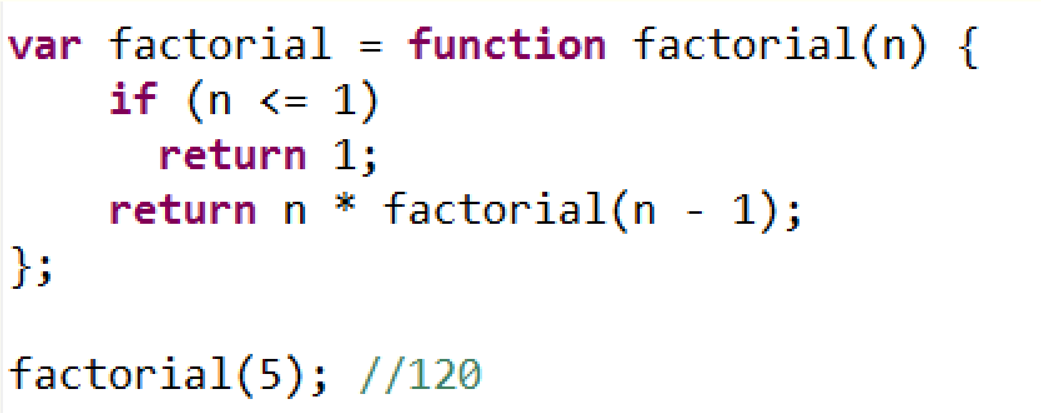
- The main difference between a function expression and a function statement is the function name, which can be omitted in function expressions to create anonymous functions.

- A function expression is similar to and has the same syntax as a function declaration

```
function [name]([param] [, param] [..., param]) {
   statements
}
```

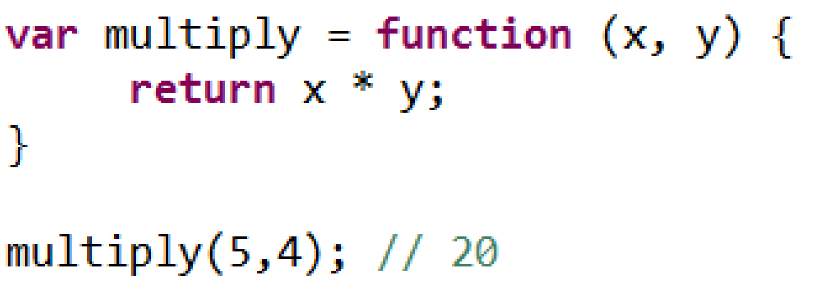
The function expression

- Example:



```
var factorial = function factorial(n) {
    if (n <= 1)
      return 1;
    return n * factorial(n - 1);
};

factorial(5); //120
```

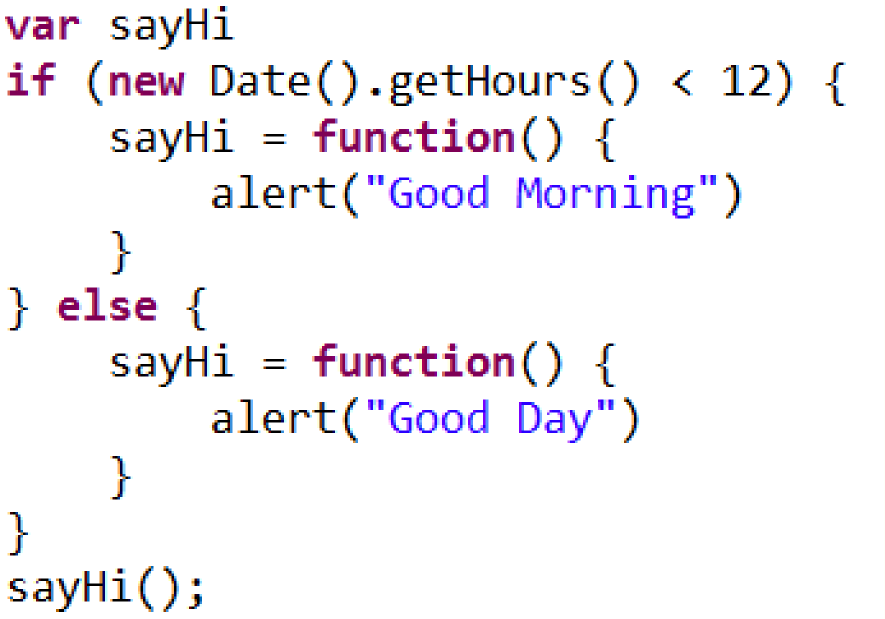
- Function expression to an anonymous function



```
var multiply = function (x, y) {
     return x * y;
}

multiply(5,4); // 20
```

Conditionally created functions

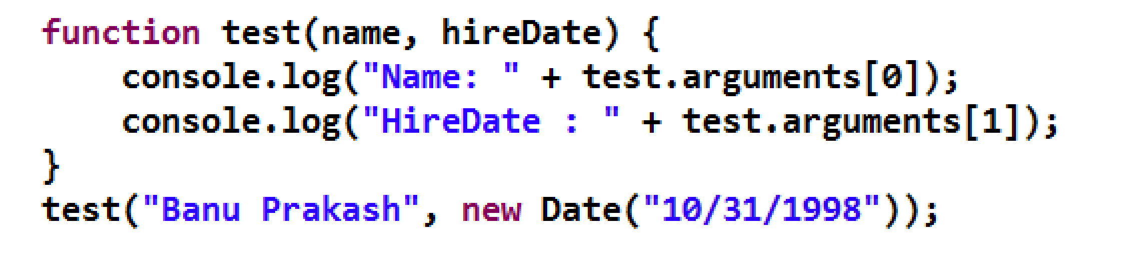
- For conditional creation use function expressions.
- Functions can be conditionally declared, that is, a function statement can be nested within an if statement.



```
var sayHi
if (new Date().getHours() < 12) {
    sayHi = function() {
        alert("Good Morning")
    }
} else {
    sayHi = function() {
        alert("Good Day")
    }
}
sayHi();
```

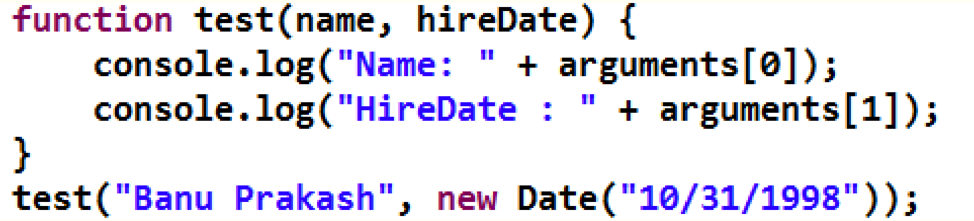
The function Properties

- Properties:
- Function.arguments: An array corresponding to the arguments passed to a function. This is deprecated as property of function, use arguments object available within the function.



```
function test(name, hireDate) {
    console.log("Name: " + test.arguments[0]);
    console.log("HireDate : " + test.arguments[1]);
}
test("Banu Prakash", new Date("10/31/1998"));
```

- The arguments Object is a local variable within all functions.

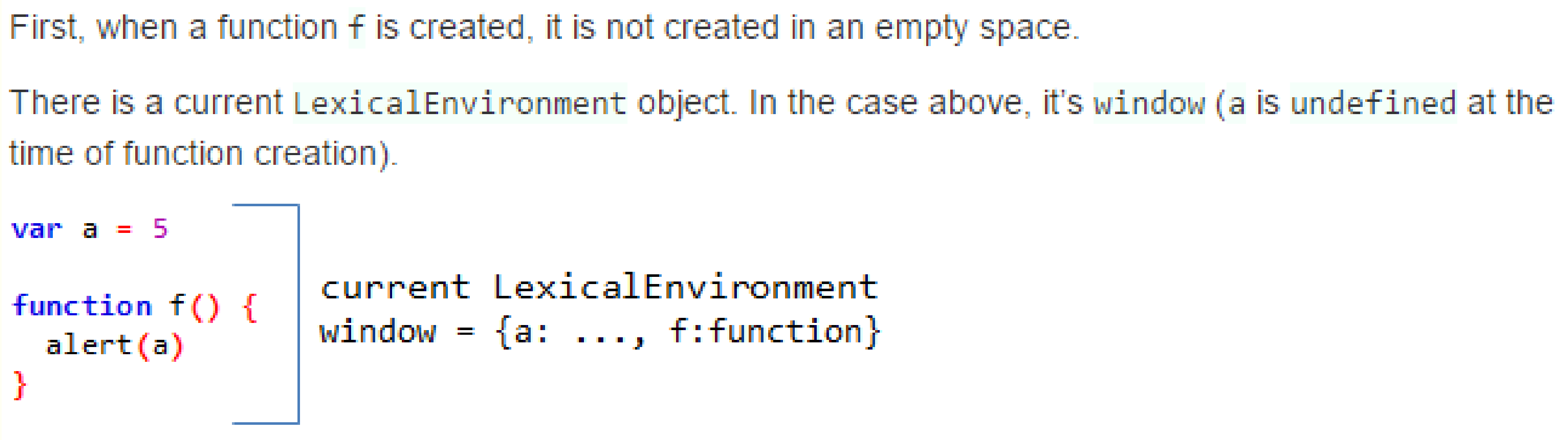


```
function test(name, hireDate) {
    console.log("Name: " + arguments[0]);
    console.log("HireDate : " + arguments[1]);
}
test("Banu Prakash", new Date("10/31/1998"));
```

Environments

- Variables come into existence when program execution enters their scope.
- Then they need storage space.
- The data structure that provides that storage space is called an *environment* in JavaScript.
- It maps variable names to values. Its structure is very similar to that of JavaScript objects.
- Environments sometimes live on after you leave their scope.
- Therefore, they are stored on a heap, not on a stack.

Access to outer variables

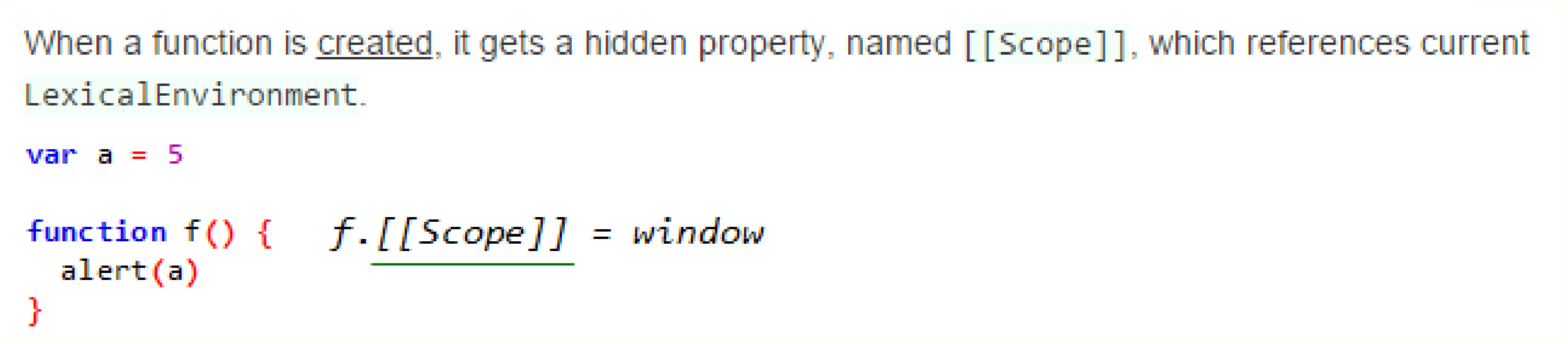


First, when a function `f` is created, it is not created in an empty space.

There is a current `LexicalEnvironment` object. In the case above, it's `window` (`a` is `undefined` at the time of function creation).

```
var a = 5

function f() {
  alert(a)
}
```

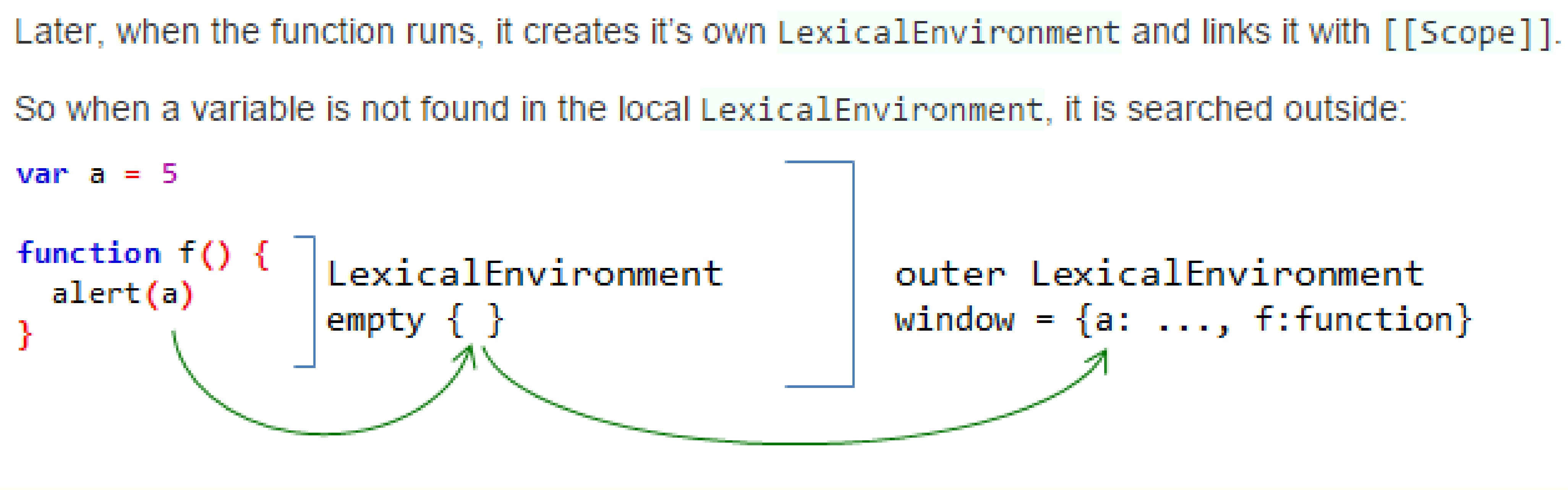
```
current LexicalEnvironment
window = {a: ..., f:function}
```



When a function is created, it gets a hidden property, named `[[Scope]]`, which references current `LexicalEnvironment`.

```
var a = 5

function f() {    f.[[Scope]] = window
  alert(a)
}
```

Access to outer variables

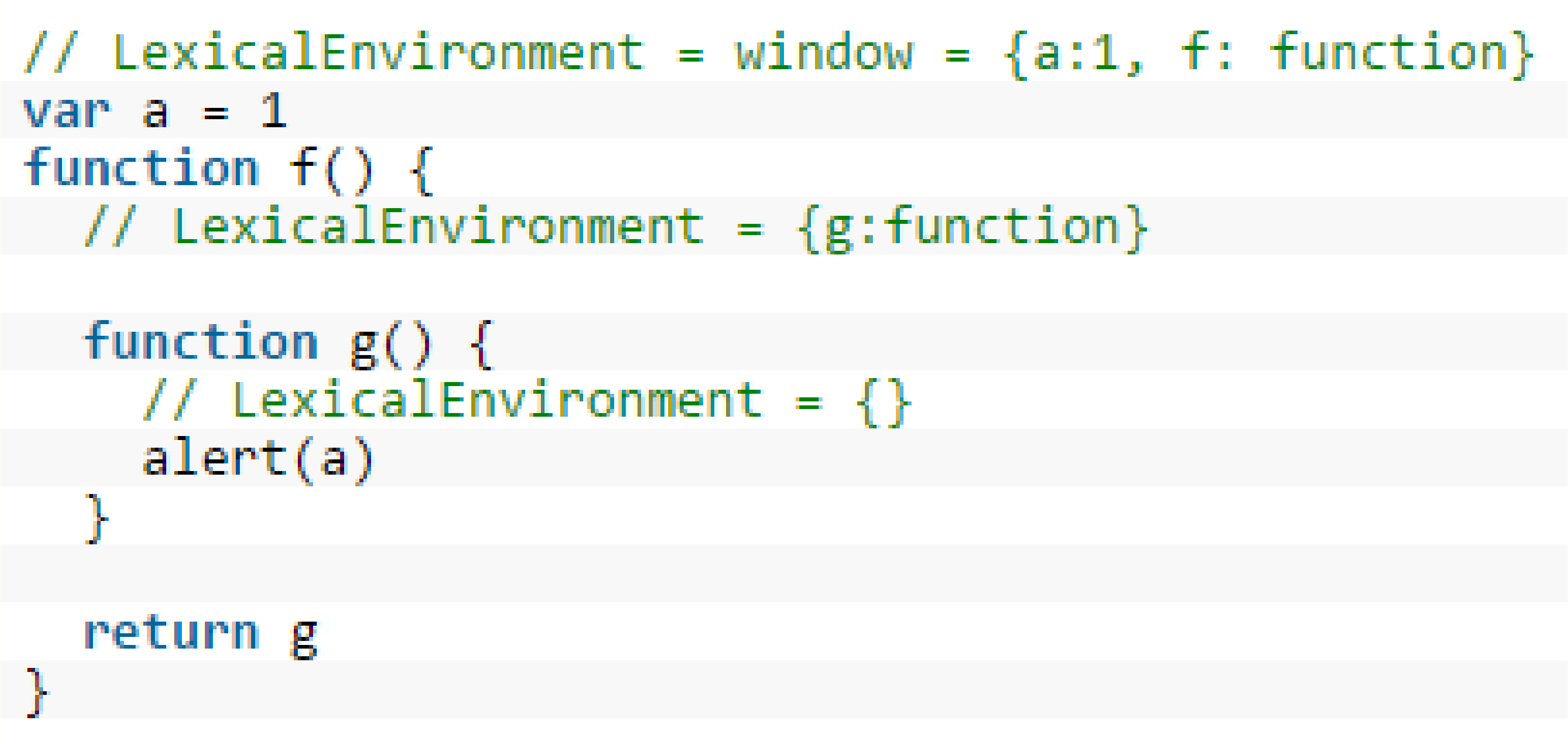


Later, when the function runs, it creates it's own `LexicalEnvironment` and links it with `[[Scope]]`.

So when a variable is not found in the local `LexicalEnvironment`, it is searched outside:

```
var a = 5

function f() {
  alert(a)
}
```

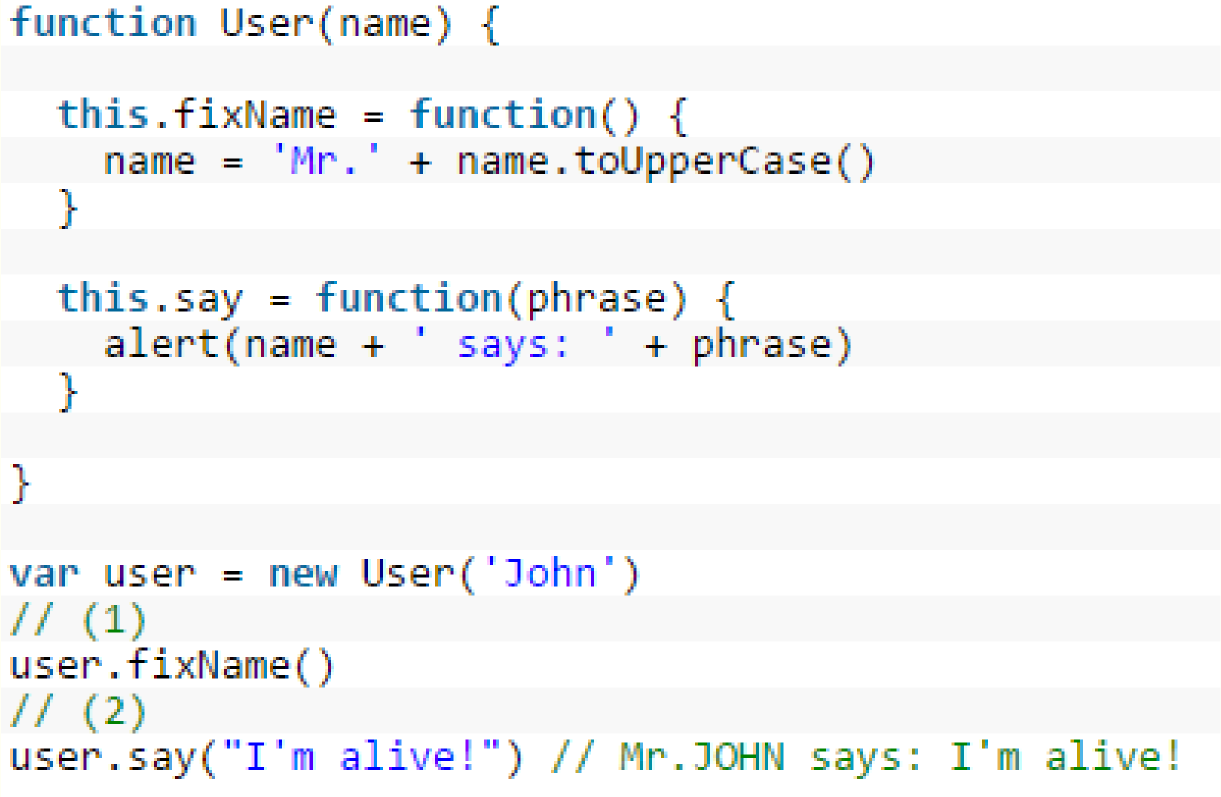
LexicalEnvironments form a chain (from inside out):



```
// LexicalEnvironment = window = {a:1, f: function}
var a = 1
function f() {
  // LexicalEnvironment = {g:function}

  function g() {
    // LexicalEnvironment = {}
    alert(a)
  }

  return g
}
```

Mutability of LexicalEnvironment

- Several function may share same outer LexicalEnvironment.
- Here user.fixName.[[Scope]] and user.say.[[Scope]] reference same LexicalEnvironment, which corresponds to new User run.
- From (1) to (2), the LexicalEnvironment.name is updated, so both functions see the variable change.



```
function User(name) {

  this.fixName = function() {
    name = 'Mr.' + name.toUpperCase()
  }

  this.say = function(phrase) {
    alert(name + ' says: ' + phrase)
  }

}

var user = new User('John')
// (1)
user.fixName()
// (2)
user.say("I'm alive!") // Mr.JOHN says: I'm alive!
```

Lexical dimension: chain of environments

- When a function is called, an environment is created for the new scope that is entered. That environment has a field called outer that points to the outer scope’s environment and is set up via [[Scope]]

- That environment has a field called outer that points to the outer scope’s environment and is set up via [[Scope]]

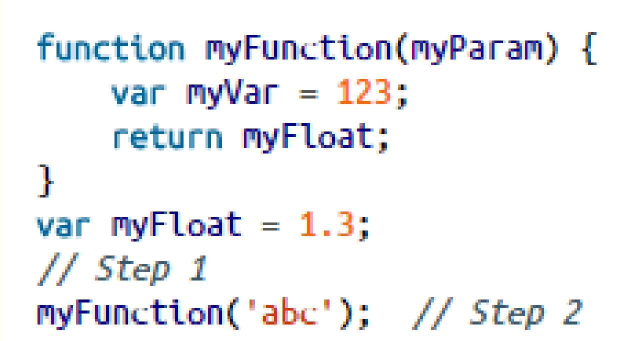
- Every chain ends with the global environment (the scope of all initially invoked functions). The field outer of the global environment is null.

- To resolve an identifier, the complete environment chain is traversed, starting with the active environment.

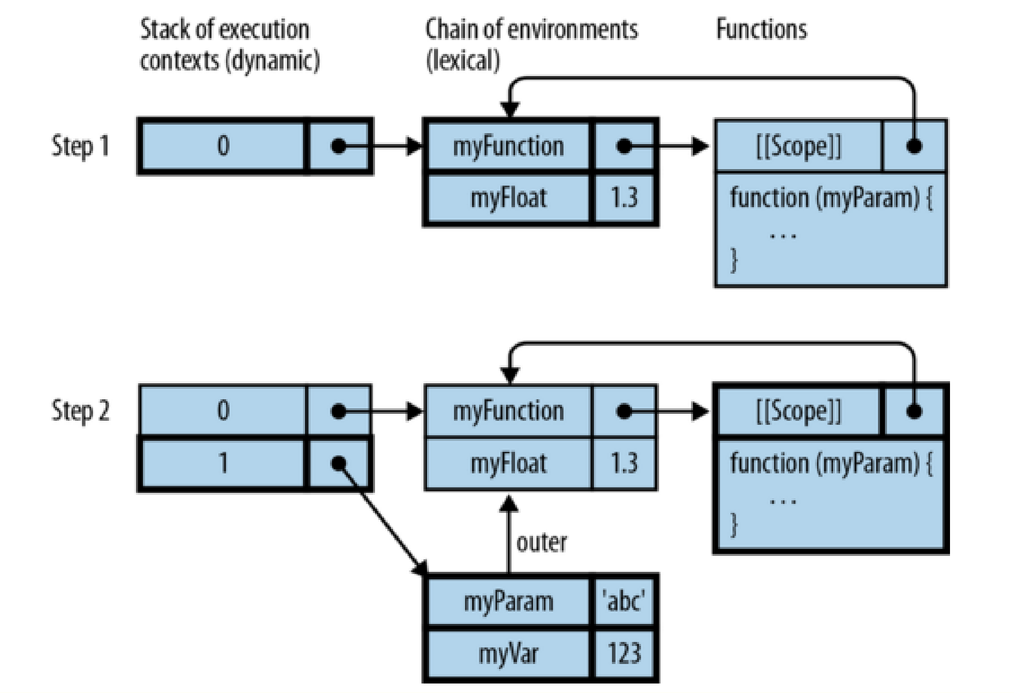
Example

- myFunction and myFloat have been stored in the global environment (#0). Note that the function object referred to by myFunction points to its scope (the global scope) via the internal property [[Scope]].

- For the execution of myFunction('abc'), a new environment (#1) is created that holds the parameter and the local variable. It refers to its outer environment via outer (which is initialized from myFunction.[[Scope]]). Thanks to the outer environment, myFunction can access myFloat.

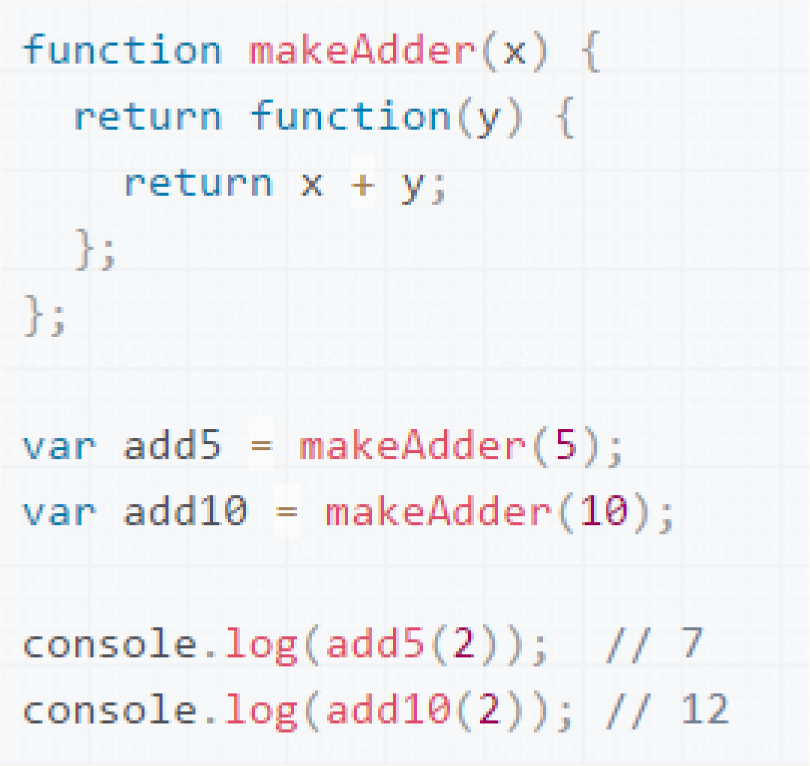


```
function myFunction(myParam) {
    var myVar = 123;
    return myFloat;
}
var myFloat = 1.3;
// Step 1
myFunction('abc');  // Step 2
```



Closures

- A closure is a special kind of object that combines two things: a function, and the environment in which that function was created. The environment consists of any local variables that were in-scope at the time that the closure was created.



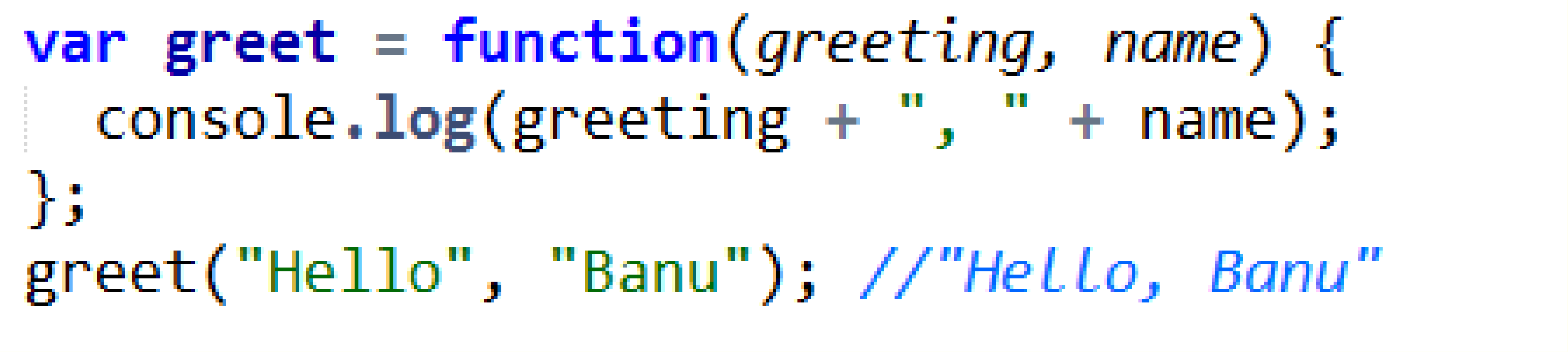
```
function makeAdder(x) {
  return function(y) {
    return x + y;
  };
};

var add5 = makeAdder(5);
var add10 = makeAdder(10);

console.log(add5(2));  // 7
console.log(add10(2)); // 12
```

In this example, we have defined a function makeAdder(x) which takes a single argument x and returns a new function.

The function it returns takes a single argument y, and returns the sum of x and y

CURRYING

- Currying is a useful technique, with which you can *partially evaluate* functions.

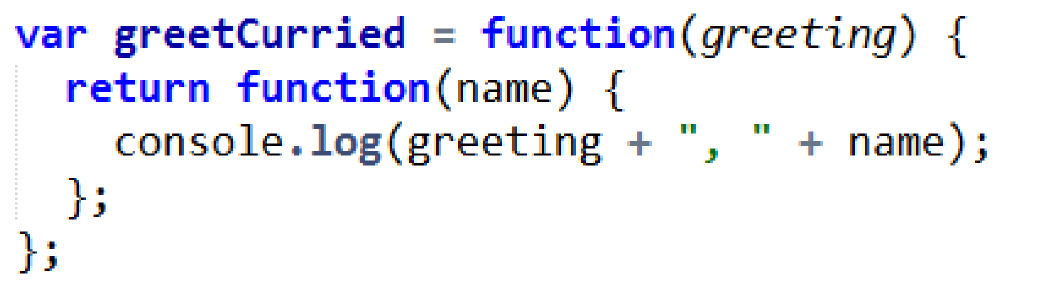


```
var greet = function(greeting, name) {
  console.log(greeting + ", " + name);
};
greet("Hello", "Banu"); //"Hello, Banu"
```

- This function requires both the name and the greeting to be passed as arguments in order to work properly.
- But we could rewrite this function using simple nested currying, so that the basic function only requires a greeting, and it returns another function that takes the name of the person we want to greet

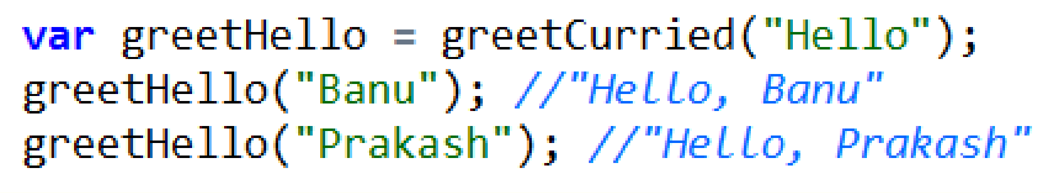
CURRYING

- Curry function



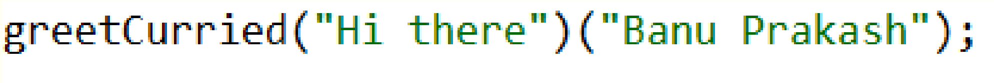
```
var greetCurried = function(greeting) {
  return function(name) {
    console.log(greeting + ", " + name);
  };
};
```

- This tiny adjustment to the way we wrote the function lets us create a new function for any type of greeting, and pass that new function the name of the person that we want to greet:



```
var greetHello = greetCurried("Hello");
greetHello("Banu"); //"Hello, Banu"
greetHello("Prakash"); //"Hello, Prakash"
```

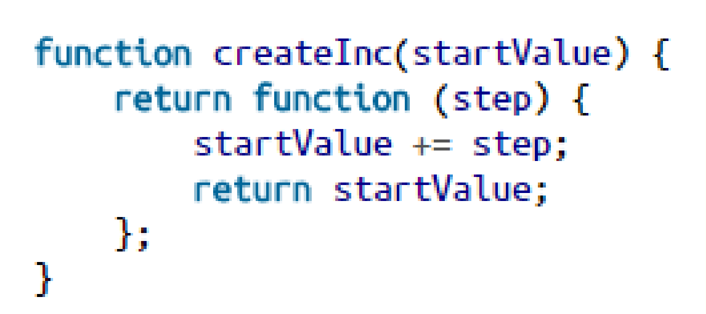
- Or : →



```
greetCurried("Hi there")("Banu Prakash");
```

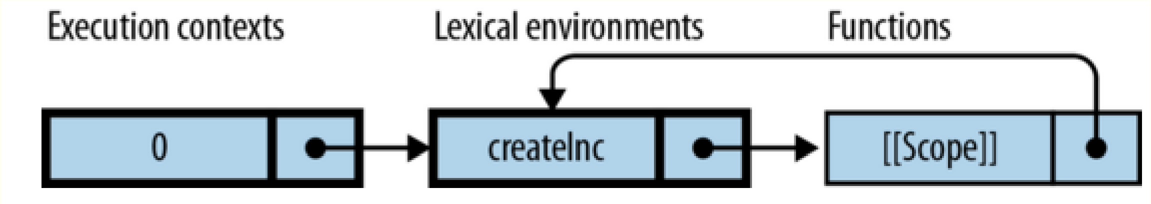
Handling Closures via Environments

- A closure is an example of an environment surviving after execution has left its scope.



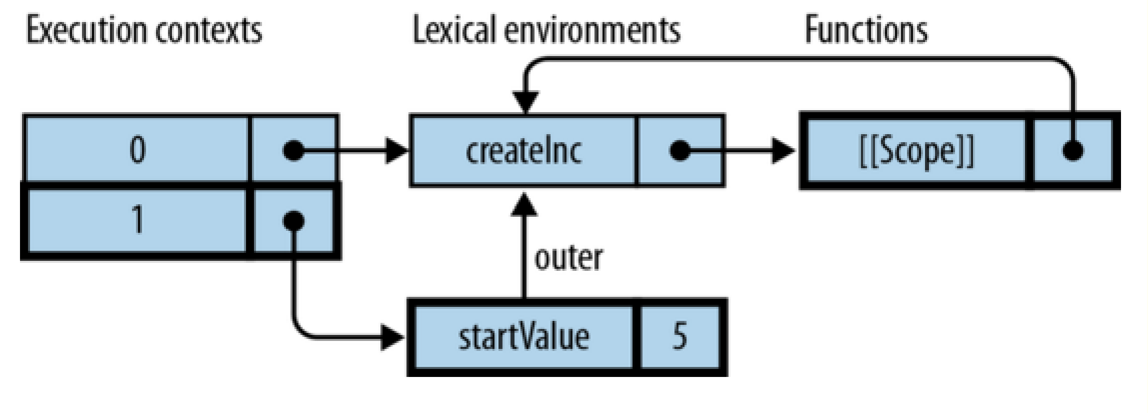
```
function createInc(startValue) {
    return function (step) {
        startValue += step;
        return startValue;
    };
}
```

- This step takes place before the interaction, and after the evaluation of the function declaration of createInc. An entry for createInc has been added to the global environment (#0) and points to a function object



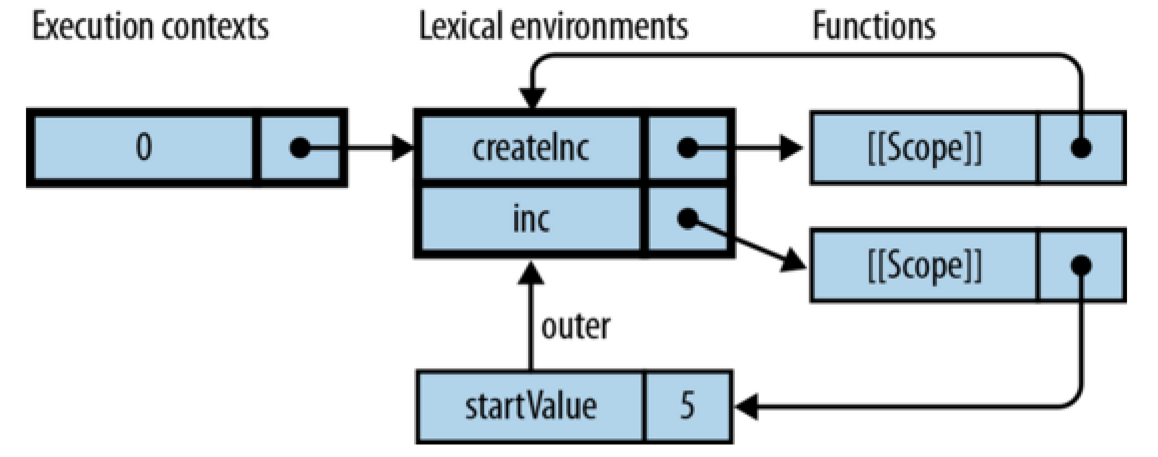
Handling Closures via Environments

- This step occurs during the execution of the function call createInc(5).
- A fresh environment (#1) for createInc is created and pushed onto the stack.
- Its outer environment is the global environment (the same as createInc.[[Scope]]). The environment holds the parameter startValue.



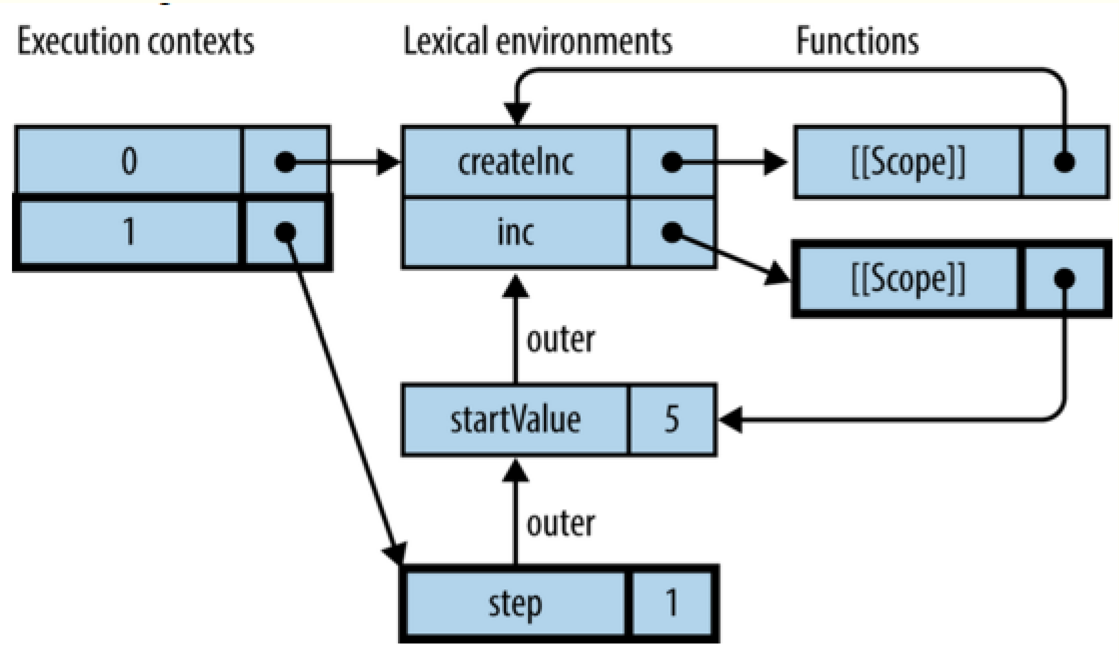
Handling Closures via Environments

- var inc = createInc(5);
- This step happens after the assignment to inc. After we returned from createInc, the execution context pointing to its environment was removed from the stack, but the environment still exists on the heap, because inc.[[Scope]] refers to it. inc is a closure (function plus birth environment).



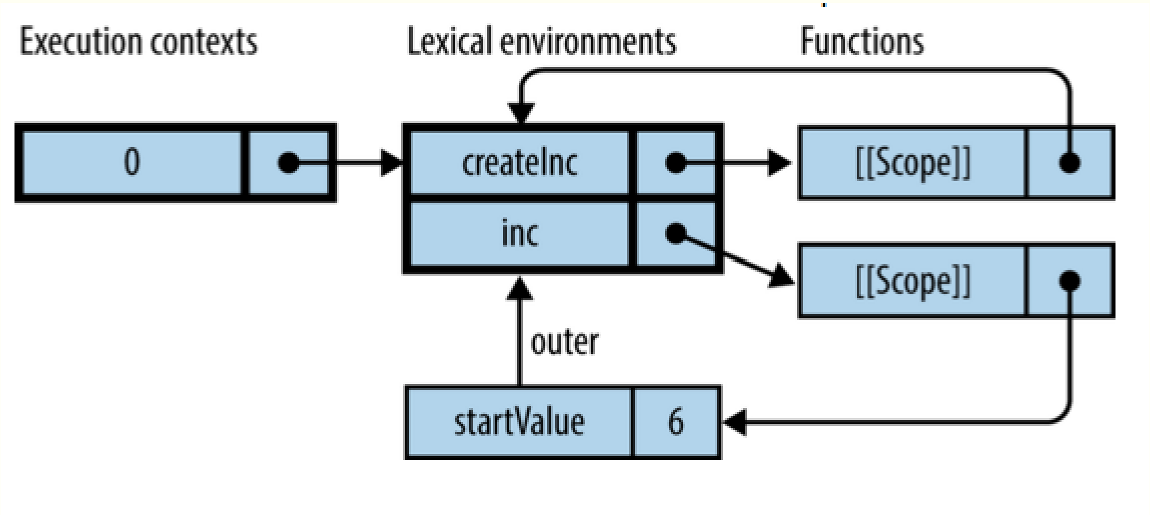
Handling Closures via Environments

- inc(1)
- This step takes place during the execution of inc(1). A new environment (#1) has been created and an execution context pointing to it has been pushed onto the stack. Its outer environment is the [[Scope]] of inc. The outer environment gives inc access to startValue.



Handling Closures via Environments

- This step happens after the execution of inc(1). No reference (execution context, outer field, or [[Scope]]) points to inc’s environment, anymore. It is therefore not needed and can be removed from the heap.

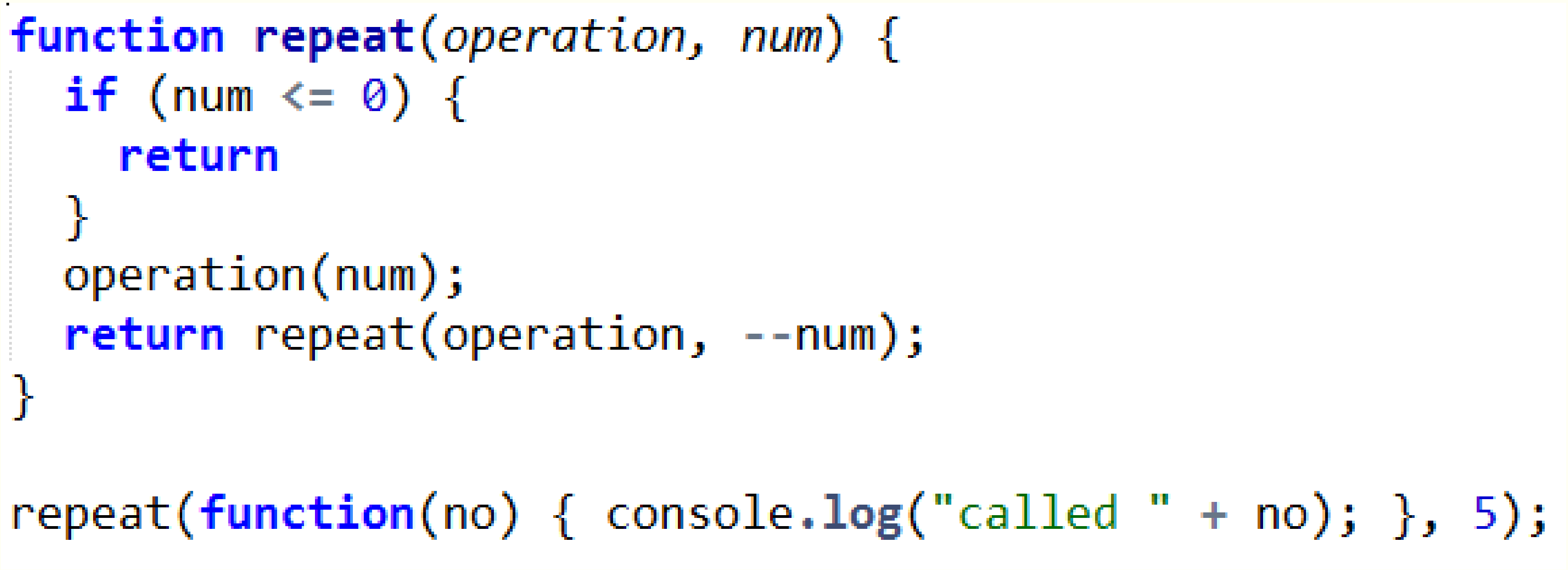


High Order Functions

- A higher-order function is a function that does at least one of the following:
  - Take one or more functions as an input
  - Output a function
- All other functions are first order functions.
- Unlike many other languages with imperative features, JavaScript allows you to utilize higher-order functions because it has "first-class functions".
- This means functions can be treated just like any other value in JavaScript: just like Strings or Numbers, Function values can be stored as variables, properties on objects or passed to other functions as arguments.

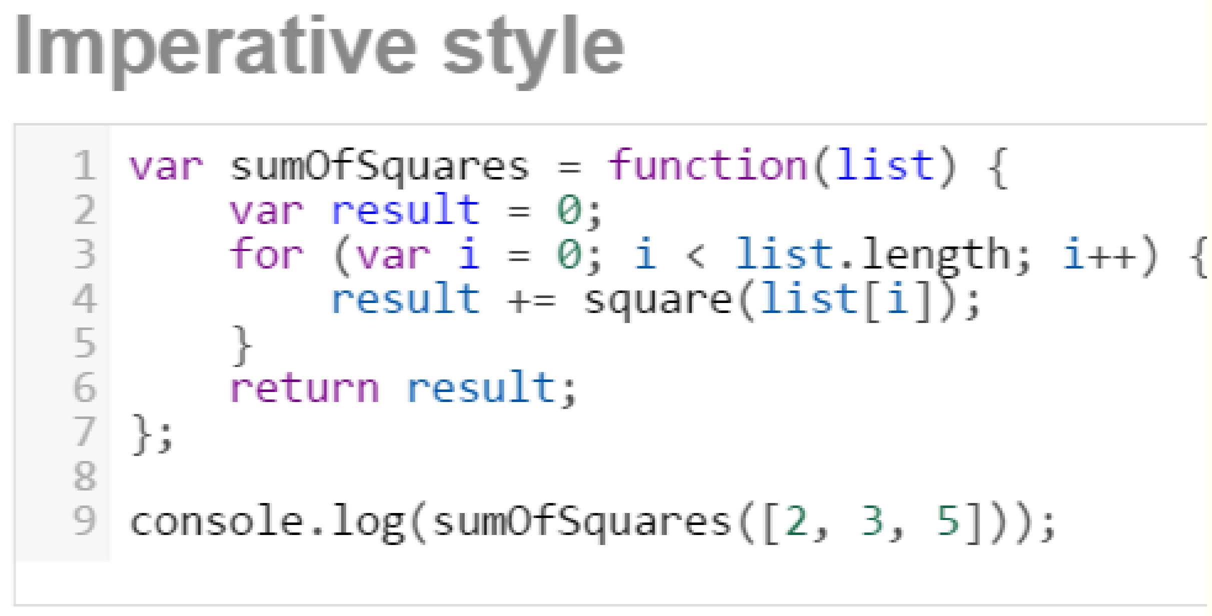
High Order Functions

- Example:
- function that takes a function as its first argument, a number num as its second argument, then executes the passed in function num times.



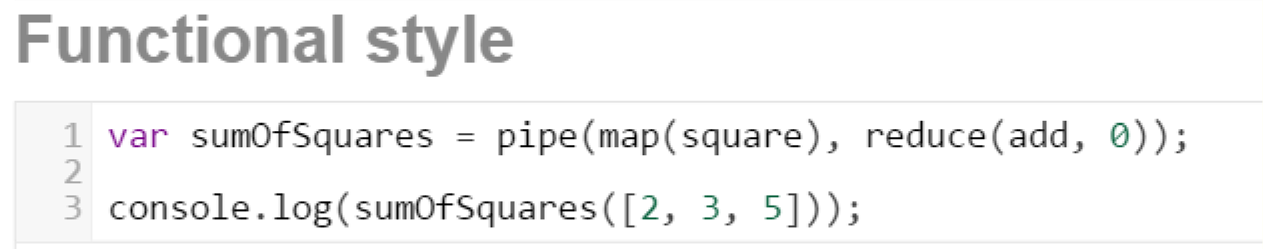
```
function repeat(operation, num) {
  if (num <= 0) {
    return
  }
  operation(num);
  return repeat(operation, --num);
}

repeat(function(no) { console.log("called " + no); }, 5);
```

FP and Imperative Programming



Imperative style

```
var sumOfSquares = function(list) {
    var result = 0;
    for (var i = 0; i < list.length; i++) {
        result += square(list[i]);
    }
    return result;
};

console.log(sumOfSquares([2, 3, 5]));
```

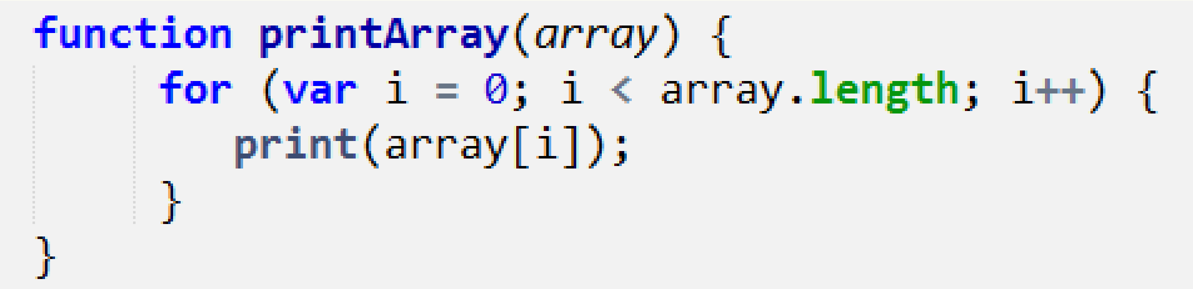


Functional style

```
var sumOfSquares = pipe(map(square), reduce(add, 0));

console.log(sumOfSquares([2, 3, 5]));
```

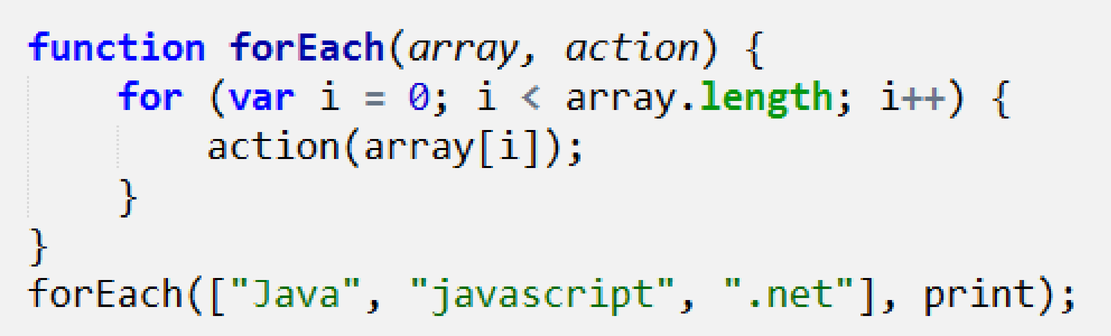
Functional Programming example

- Below listed is a function that goes over an array and prints out every element:



```
function printArray(array) {
    for (var i = 0; i < array.length; i++) {
        print(array[i]);
    }
}
```

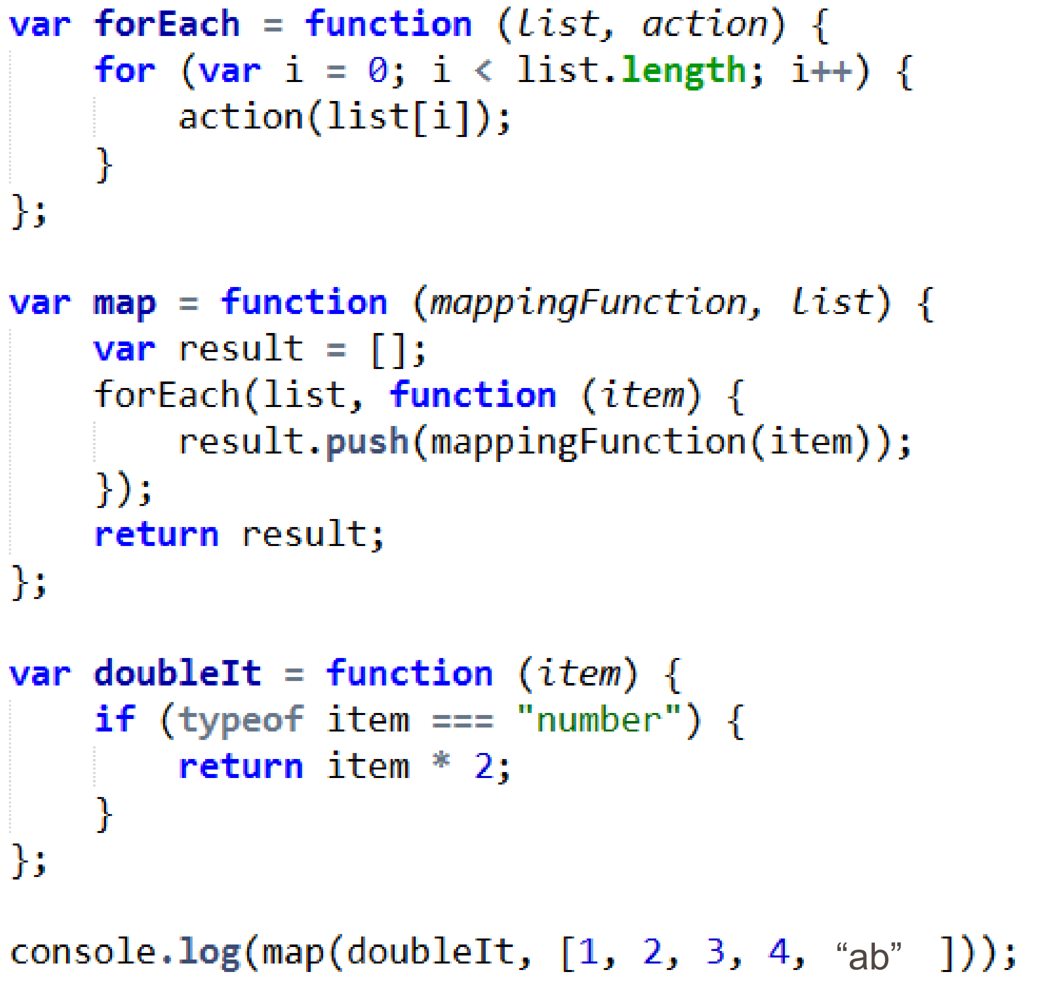
- But what if we want to do something else than print? Since 'doing something' can be represented as a function, and functions are also values, we can pass our action as a function value:



```
function forEach(array, action) {
    for (var i = 0; i < array.length; i++) {
        action(array[i]);
    }
}
forEach(["Java", "javascript", ".net"], print);
```

Functional Programming example

- Map function
- Map function should allow the user to perform a particular action over each item of a list, and then return a result list containing results of actions performed on each list item.

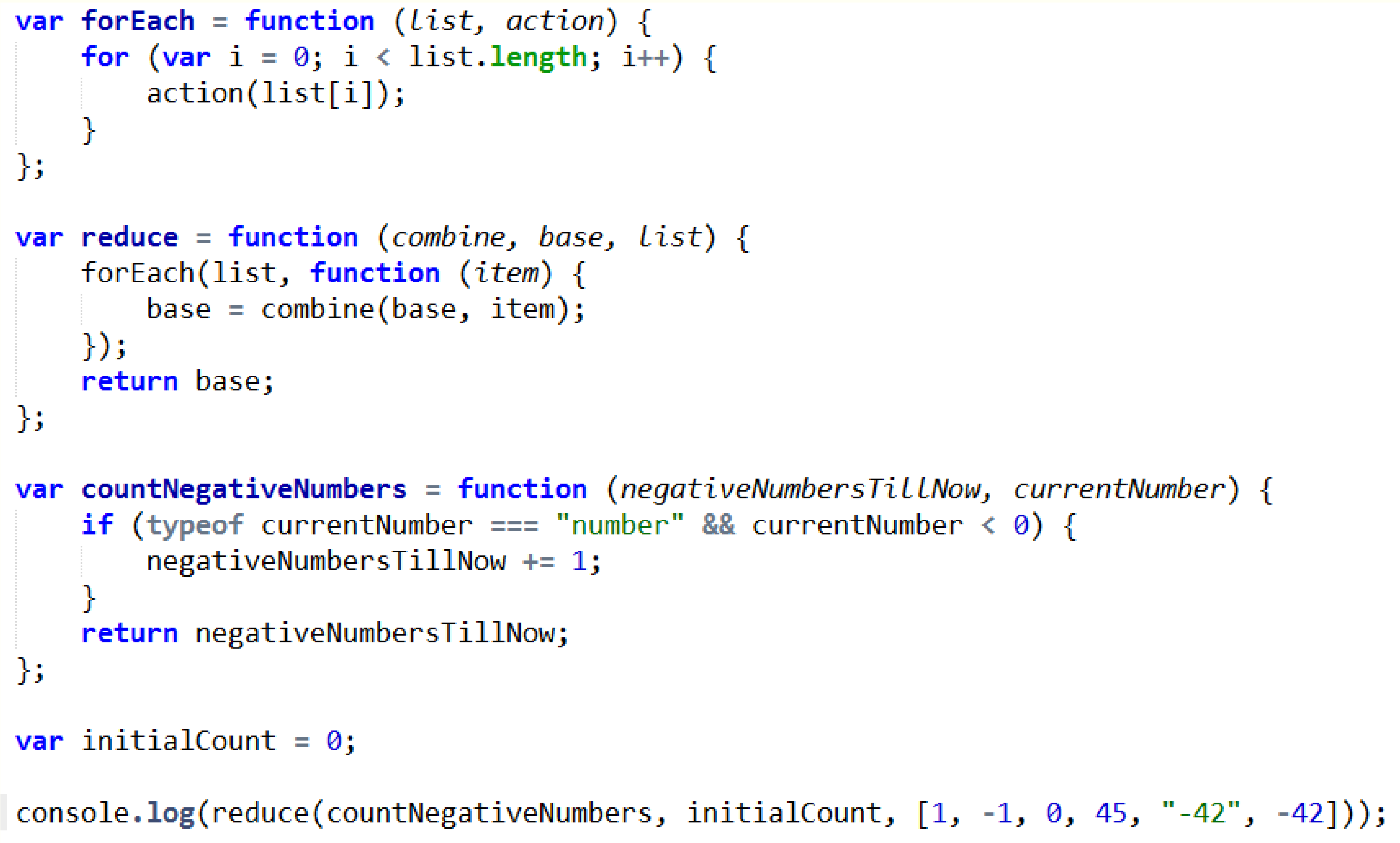


```
var forEach = function (list, action) {
    for (var i = 0; i < list.length; i++) {
        action(list[i]);
    }
};

var map = function (mappingFunction, list) {
    var result = [];
    forEach(list, function (item) {
        result.push(mappingFunction(item));
    });
    return result;
};

var doubleIt = function (item) {
    if (typeof item === "number") {
        return item * 2;
    }
};

console.log(map(doubleIt, [1, 2, 3, 4, “ab” ]));
```

Functional Programming example [reduce function]

- The reduce function will be given a combine function, a base value and a list.
- We need to apply the combine function on the base value and each value in the list and finally return the result.
- In short, Reduce function takes in a list, combines it and gives us a single result.

Functional Programming example [reduce function]



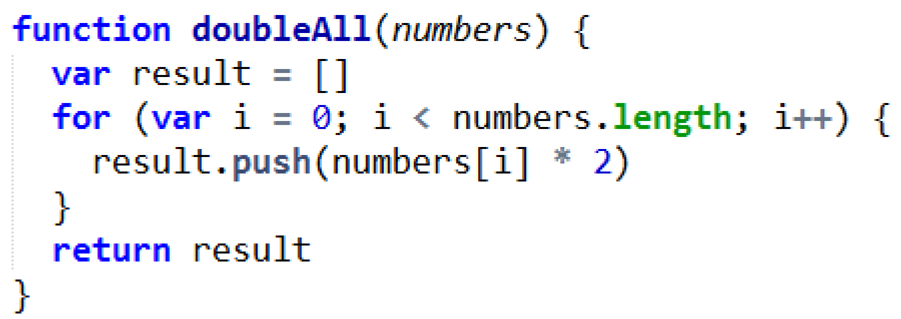
```
var forEach = function (list, action) {
    for (var i = 0; i < list.length; i++) {
        action(list[i]);
    }
};

var reduce = function (combine, base, list) {
    forEach(list, function (item) {
        base = combine(base, item);
    });
    return base;
};

var countNegativeNumbers = function (negativeNumbersTillNow, currentNumber) {
    if (typeof currentNumber === "number" && currentNumber < 0) {
        negativeNumbersTillNow += 1;
    }
    return negativeNumbersTillNow;
};

var initialCount = 0;

console.log(reduce(countNegativeNumbers, initialCount, [1, -1, 0, 45, "-42", -42]));
```

High Order Functions in array

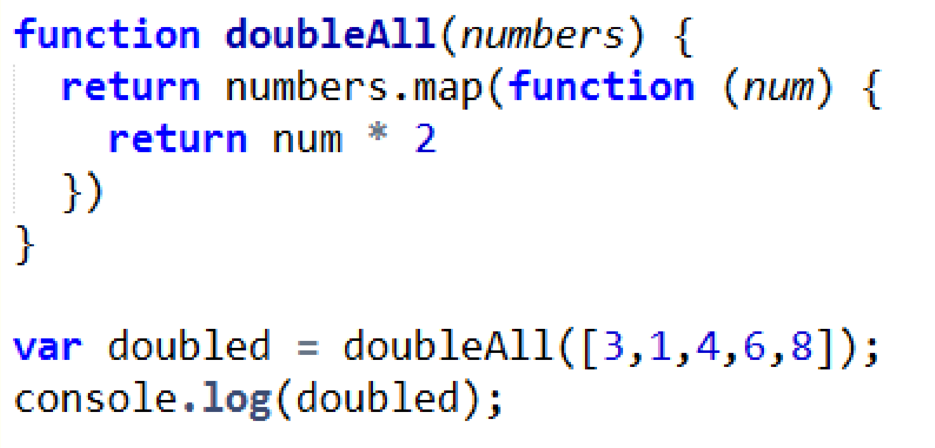
- Array.prototype.map()
    - The map() method creates a new array with the results of calling a provided function on every element in this array.
    - Syntax:
        - arr.map(callback[, thisArg])
    - Parameters
    - callback
        - Function that produces an element of the new Array, taking three arguments:
        - currentValue
            - The current element being processed in the array.
        - index
            - The index of the current element being processed in the array.
        - array
            - The array map was called upon.
    - thisArg
        - Optional. Value to use as this when executing callback.

High Order Functions in array

- Example using Array.prototype.map()
- Convert the following code from a for-loop to Array#map:



```javascript
function doubleAll(numbers) {
  var result = []
  for (var i = 0; i < numbers.length; i++) {
    result.push(numbers[i] * 2)
  }
  return result
}
```



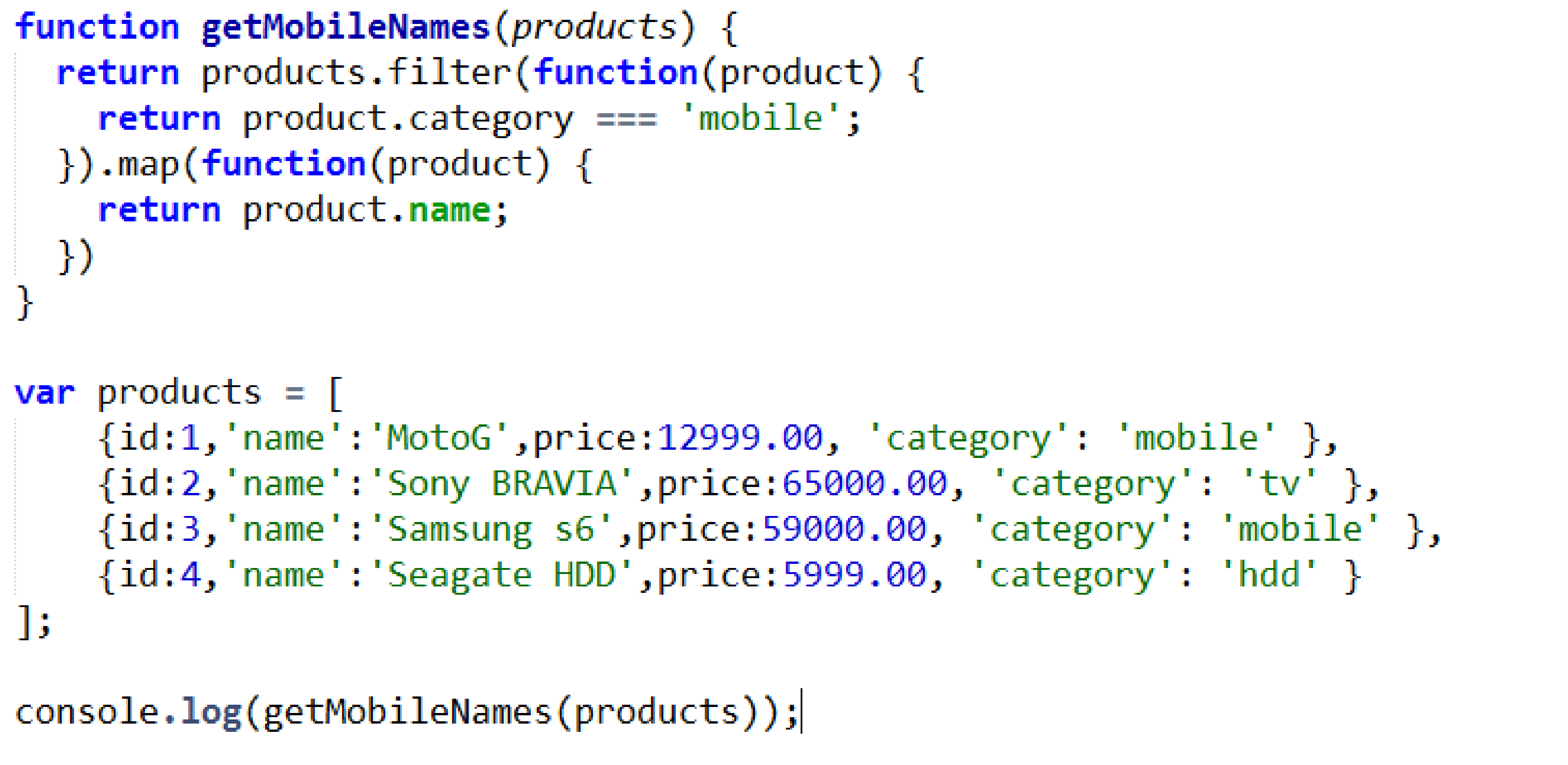
```javascript
function doubleAll(numbers) {
  return numbers.map(function (num) {
    return num * 2
  })
}

var doubled = doubleAll([3,1,4,6,8]);
console.log(doubled);
```

High Order Functions

- Array.prototype.filter()
- Convert the following code from a for-loop to Array#map:The filter() method creates a new array with all elements that pass the test implemented by the provided function.
- Syntax:
  - arr.filter(callback[, thisArg])
- Parameters
  - callback
    - Function to test each element of the array. Invoked with arguments (element, index, array). Return true to keep the element, false otherwise.
  - thisArg
    - Optional. Value to use as this when executing callback.

High Order Functions

- takes an array of objects with '.category' properties and returns an array of mobile names ["MotoG", "Samsung s6"]



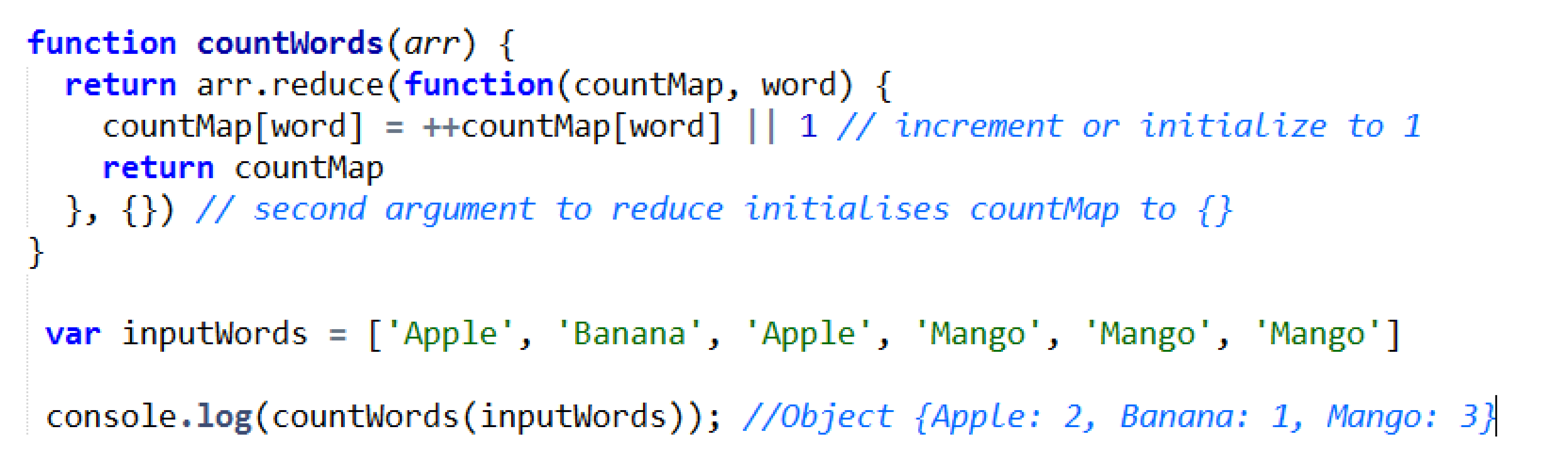
```
function getMobileNames(products) {
  return products.filter(function(product) {
    return product.category === 'mobile';
  }).map(function(product) {
    return product.name;
  })
}

var products = [
    {id:1,'name':'MotoG',price:12999.00, 'category': 'mobile' },
    {id:2,'name':'Sony BRAVIA',price:65000.00, 'category': 'tv' },
    {id:3,'name':'Samsung s6',price:59000.00, 'category': 'mobile' },
    {id:4,'name':'Seagate HDD',price:5999.00, 'category': 'hdd' }
];

console.log(getMobileNames(products));
```

High Order Functions

- Array.prototype.reduce()
  - The reduce() method applies a function against an accumulator and each value of the array (from left-to-right) to reduce it to a single value.
  - **Syntax : arr.reduce(callback[, initialValue])**
    - Parameters
      - callback
        - Function to execute on each value in the array, taking four arguments:
        - previousValue
          - The value previously returned in the last invocation of the callback, or initialValue, if supplied.
        - currentValue
          - The current element being processed in the array.
        - currentIndex
          - The index of the current element being processed in the array.
        - array
          - The array reduce was called upon.
      - initialValue
        - Optional. Value to use as the first argument to the first call of the callback.

High Order Functions

- Example:
- Given an Array of strings, use Array#reduce to create an object that contains the number of times each string occurred in the array.



```
function countWords(arr) {
  return arr.reduce(function(countMap, word) {
    countMap[word] = ++countMap[word] || 1 // increment or initialize to 1
    return countMap
  }, {}) // second argument to reduce initialises countMap to {}
}

 var inputWords = ['Apple', 'Banana', 'Apple', 'Mango', 'Mango', 'Mango']

 console.log(countWords(inputWords)); //Object {Apple: 2, Banana: 1, Mango: 3}
```