



Visit the Wondrous
FOREST OF FUNCTION EXPRESSIONS



LEVEL 1

FOREST OF FUNCTION EXPRESSIONS

FUNCTIONS ON THE FLY

Building functions within code execution rather than at program load time

```
function diffOfSquares (a, b) {  
    return a*a - b*b;  
}
```



Builds in memory immediately
when the program loads

FUNCTIONS ON THE FLY

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```
function diffOfSquares (a, b) {  
    return a*a - b*b;  
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Builds in memory immediately
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```
var diff =
```

FUNCTIONS ON THE FLY

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```
function diffOfSquares (a, b) {  
    return a*a - b*b;  
}
```

Builds in memory immediately
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```
var diff = function diffOfSquares (a, b) {  
    return a*a - b*b;  
};
```

The function keyword
will now assign the
following function to the
variable.

FUNCTIONS ON THE FLY

Building functions within code execution rather than at program load time

```
function diffOfSquares (a, b) {  
    return a*a - b*b;  
}
```

Builds in memory immediately
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```
var diff = function diffOfSquares (a, b) {  
    return a*a - b*b;  
};
```

Needs a semicolon to complete the
assignment statement in a file.

FUNCTIONS ON THE FLY

Building functions within code execution rather than at program load time

```
function diffOfSquares (a, b) {  
    return a*a - b*b;  
}
```

Builds in memory immediately
when the program loads

```
var diff = function diffOfSquares (a, b) {  
    return a*a - b*b;  
};
```

Now the function builds
ONLY when this line of
code is reached.

```
diff( 9, 5 );
```

→ 56

FUNCTIONS ON THE FLY

Building functions within code execution rather than at program load time

```
function diffOfSquares (a, b) {  
    return a*a - b*b;  
}
```

This name is optional in JavaScript
since we now use the variable name.

```
var diff = function diffOfSquares (a, b) {  
    return a*a - b*b;  
};
```

```
diff( 9, 5 );
```

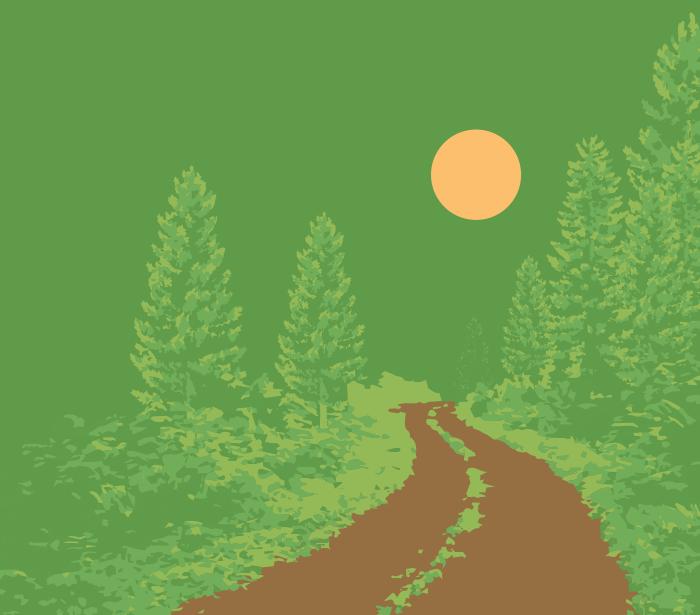
→ 56

Notice the variable name
needs parentheses,
parameters and a semicolon to
execute the function it
contains.

ANONYMOUS FUNCTIONS

No need for naming the function a second time

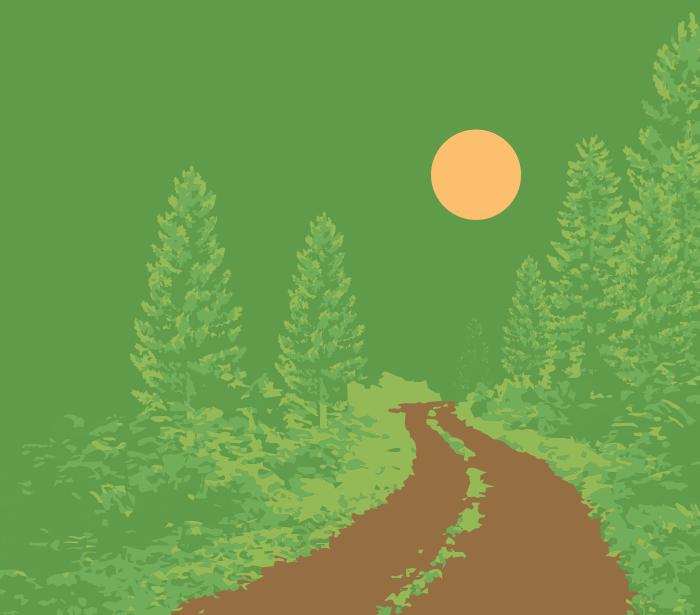
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var diff = function diffOfSquares (a, b) {  
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```



ANONYMOUS FUNCTIONS

No need for naming the function a second time

```
var diff = function (a, b) {  
    return a*a - b*b;  
};
```



ANONYMOUS FUNCTIONS

No need for naming the function a second time

```
var diff = function (a, b) {  
    return a*a - b*b;  
};
```

Look Ma, no name!

```
diff( 4, 2 );
```

→ 12

Parameters are still passed to the variable name, which JavaScript believes is a function.

ANONYMOUS FUNCTIONS

No need for naming the function a second time

```
var diff = function (a, b) {  
    return a*a - b*b;  
};
```

```
console.log(diff);
```

```
→function (a, b) {  
    return a*a - b*b;  
}
```

Logging out using the variable name will display the entire function it contains.

STORED FUNCTIONS IN A NATIONAL PARK TERMINAL

A variable that holds a function can be passed into other functions

```
var greeting = function () {  
    alert("Thanks for visiting the Badlands!\n" +  
        "We hope your stay is...better than most.");  
};
```

...

```
closeTerminal( greeting );
```

```
function closeTerminal( message ){  
    ...  
    message();  
    ...  
}
```

terminal.js

The greeting variable is passed in as a parameter to an existing declared function.

STORED FUNCTIONS IN A NATIONAL PARK TERMINAL

A variable that holds a function can be passed into other functions

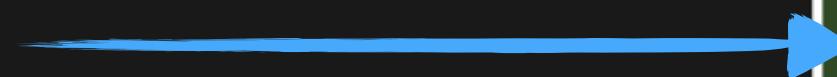
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var greeting = function () {  
    alert("Thanks for visiting the Badlands!\n" +  
        "We hope your stay is...better than most.");  
};
```

terminal.js

...

```
closeTerminal( greeting );
```

```
function closeTerminal( message ){  
    ...  
    message();  
    ...  
}
```



```
function closeTerminal( message ){  
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terminal.js

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closeTerminal( greeting );
```

```
function closeTerminal( message ){  
    ...  
    message();  
    ...  
}
```



```
function closeTerminal( ){  
    ...  
    message();  
    ...  
}
```

)

STORED FUNCTIONS IN A NATIONAL PARK TERMINAL

A variable that holds a function can be passed into other functions

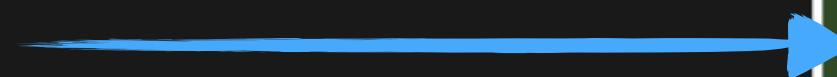
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var greeting = function () {  
    alert("Thanks for visiting the Badlands!\n" +  
        "We hope your stay is...better than most.");  
};
```

terminal.js

...

```
closeTerminal( greeting );
```

```
function closeTerminal( message ){  
    ...  
    message();  
    ...  
}
```



```
function closeTerminal( greeting ){  
    ...  
    message();  
    ...  
}
```

STORED FUNCTIONS IN A NATIONAL PARK TERMINAL

A variable that holds a function can be passed into other functions

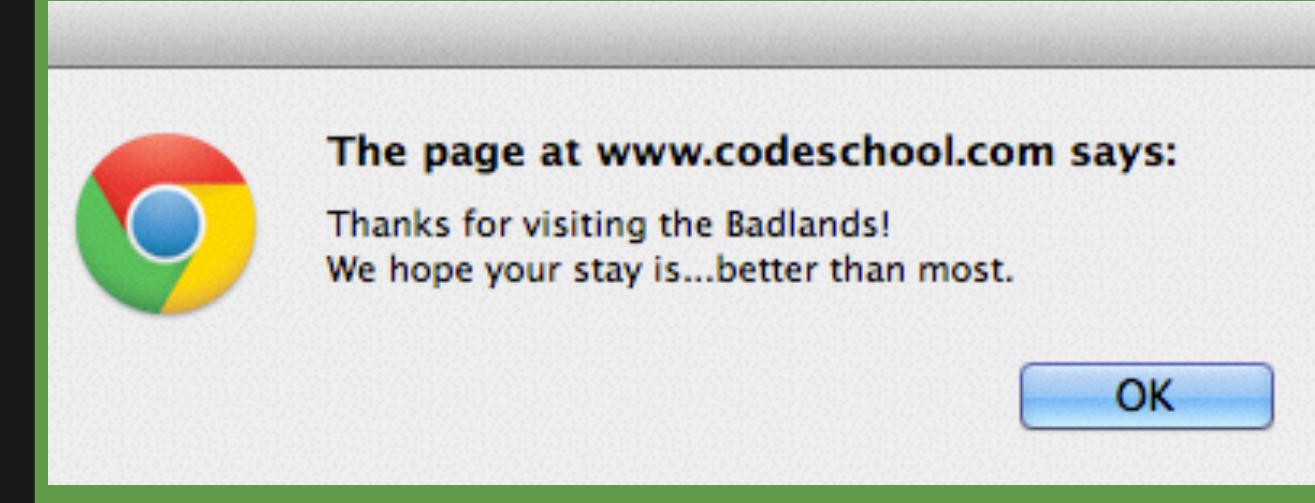
```
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        "We hope your stay is...better than most.");  
};
```

...

```
closeTerminal( greeting );
```

```
function closeTerminal( message ){  
    ...  
    message();  
    ...  
}
```

terminal.js



```
function closeTerminal( greeting ){  
    ...  
    greeting();  
    ...  
}
```

NOW, WHAT IF WE HAD MULTIPLE GREETINGS?

Function expressions can give flexibility in choosing which functionality to build

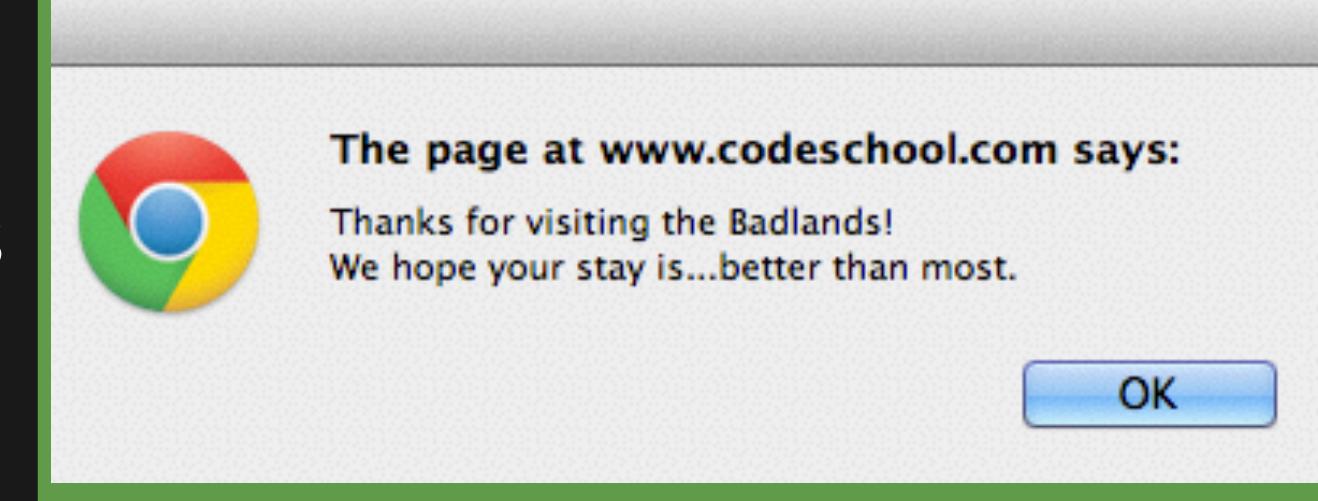
```
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closeTerminal( greeting );
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function closeTerminal( message ){  
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terminal.js



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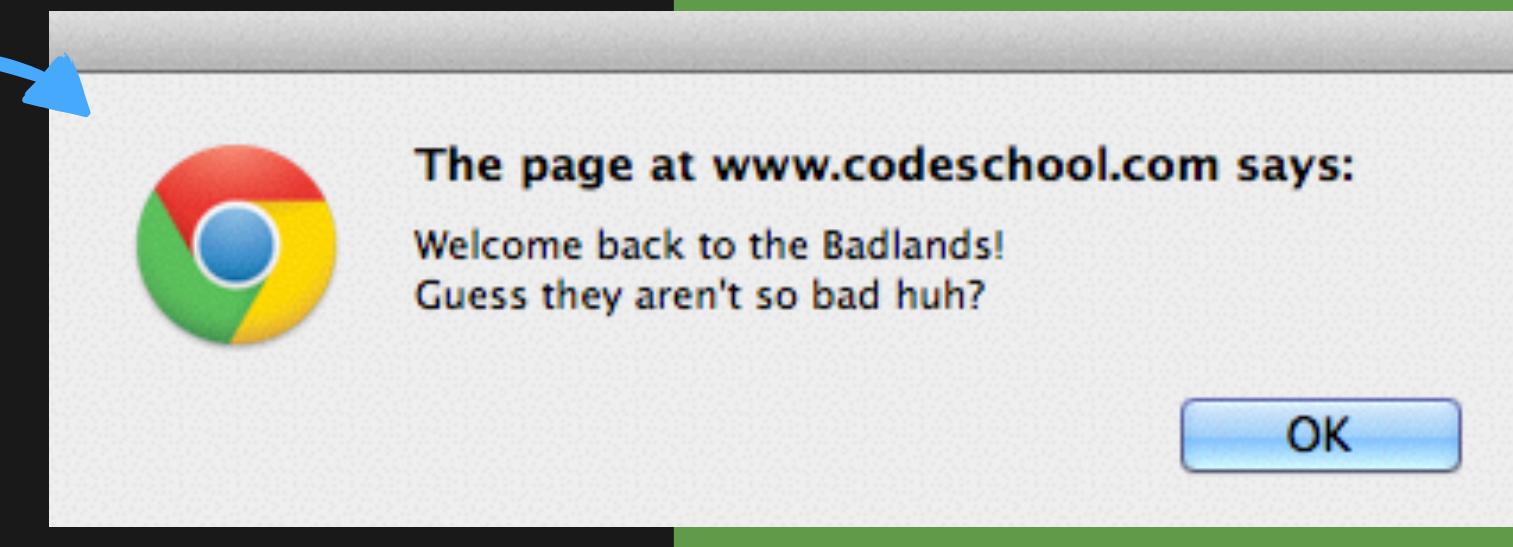
NOW, WHAT IF WE HAD MULTIPLE GREETINGS?

Function expressions can give flexibility in choosing which functionality to build

```
var greeting;  
...some code sets newCustomer to true or false...  
if( newCustomer ){  
    greeting = function () {  
        alert("Thanks for visiting the Badlands!\n" +  
            "We hope your stay is...better than most.");  
    };  
} else {  
    greeting = function () {  
        alert("Welcome back to the Badlands!\n" +  
            "Guess they aren't so bad huh?");  
    };  
}  
closeTerminal( greeting );  
function closeTerminal( message ){  
    ...  
    message();  
    ...  
}
```

terminal.js

```
var newCustomer = false;
```



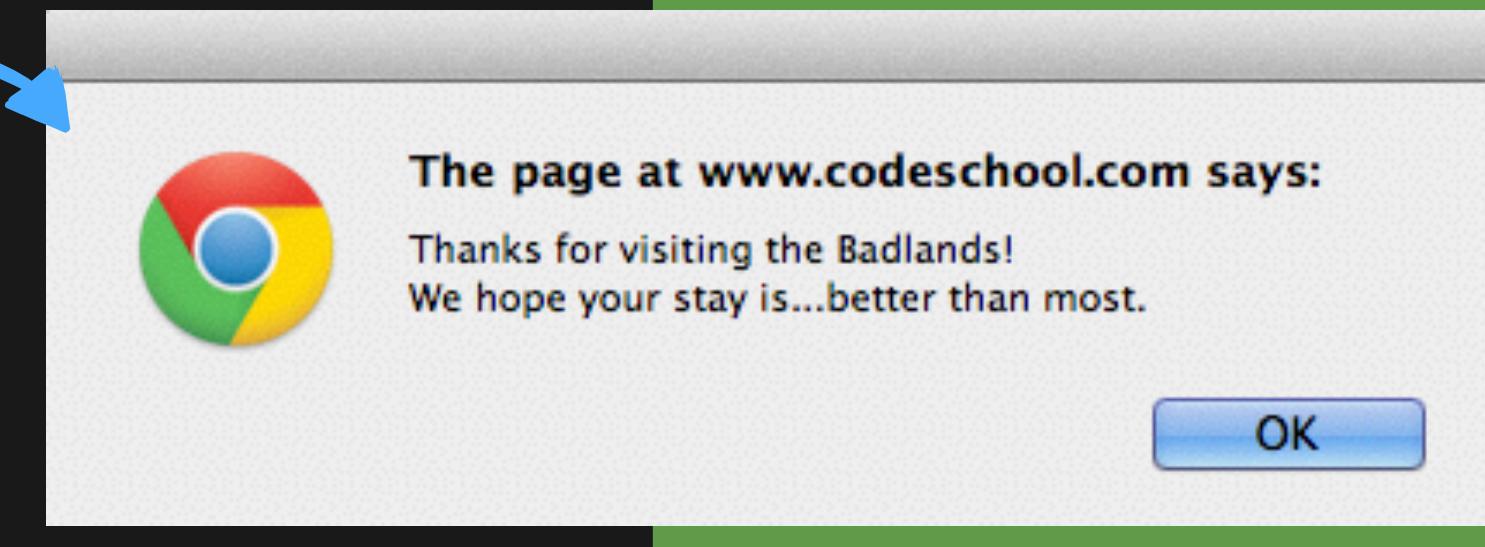
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Function expressions can give flexibility in choosing which functionality to build

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        alert("Welcome back to the Badlands!\n" +  
            "Guess they aren't so bad huh?");  
    };  
}  
closeTerminal( greeting );  
function closeTerminal( message ){  
    ...  
    message();  
    ...  
}
```

terminal.js

```
var newCustomer = true;
```





Visit the Wondrous
FOREST OF FUNCTION EXPRESSIONS

USING FE'S WITH ARRAYS AND MAP()

A function expression is just that...an expression. We can pass them without variables!

```
var numbers = [12, 4, 3, 9, 8, 6, 10, 1];
```

```
var results = numbers.map( *some coolFunction goes here* );
```

The map() method will always take in a function as a parameter, and return a new array with the results.

12	4	3	9	8	6	10	1
----	---	---	---	---	---	----	---



coolFunction

WOW							
-----	--	--	--	--	--	--	--

WOW

USING FE'S WITH ARRAYS AND MAP()

A function expression is just that...an expression. We can pass them without variables!

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var numbers = [12, 4, 3, 9, 8, 6, 10, 1];
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var results = numbers.map( *some coolFunction goes here* );
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coolFunction



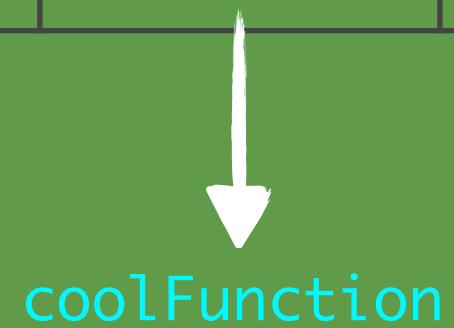
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12	4	3	9	8	6	10	1
----	---	---	---	---	---	----	---



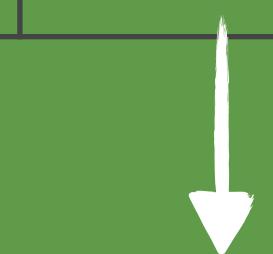
wow	these	are					
-----	-------	-----	--	--	--	--	--

USING FE'S WITH ARRAYS AND MAP()

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var numbers = [12, 4, 3, 9, 8, 6, 10, 1];
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coolFunction



wow

these

are

some

USING FE'S WITH ARRAYS AND MAP()

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coolFunction



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coolFunction

cool

USING FE'S WITH ARRAYS AND MAP()

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var numbers = [12, 4, 3, 9, 8, 6, 10, 1];
```

```
var results = numbers.map( *some coolFunction goes here* );
```



coolFunction



results



USING FE'S WITH ARRAYS AND MAP()

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```
var numbers = [12, 4, 3, 9, 8, 6, 10, 1];
```

```
var results = numbers.map( *some coolFunction goes here* );
```



1



coolFunction



!

USING FE'S WITH ARRAYS AND MAP()

A function expression is just that...an expression. We can pass them without variables!

```
var numbers = [12, 4, 3, 9, 8, 6, 10, 1];
```

```
var results = numbers.map( *some coolFunction goes here* );
```

12	4	3	9	8	6	10	1
----	---	---	---	---	---	----	---

--	--	--	--	--	--	--	--

USING FE'S WITH ARRAYS AND MAP()

Map works like a loop that applies a function to each array index

```
var numbers = [12, 4, 3, 9, 8, 6, 10, 1];
```

```
var results = numbers.map( *some coolFunction goes here* );
```

```
var results = [ ];
for(var i = 0; i < numbers.length; i++){
    results[i] =
}
```



USING FE'S WITH ARRAYS AND MAP()

Map works like a loop that applies a function to each array index

```
var numbers = [12, 4, 3, 9, 8, 6, 10, 1];
```

```
var results = numbers.map( *some coolFunction goes here* );
```

```
var results = [ ];
for(var i = 0; i < numbers.length; i++){
  results[i] = coolFunction(numbers[i]);
}
```

The array's map conveniently takes this entire loop format and consolidates it to one nice line of code.



USING FE'S WITH ARRAYS AND MAP()

Let's pass in function that will double each cell's value in our numbers array.

```
var numbers = [12, 4, 3, 9, 8, 6, 10, 1];
```

```
var results = numbers.map(function (arrayCell) {  
    return arrayCell * 2;  
});
```

We build an anonymous function for map's parameter, which takes in the contents of each cell of numbers and returns a doubled value to results.

12	4	3	9	8	6	10	1

USING FE'S WITH ARRAYS AND MAP()

Let's pass in function that will double each cell's value in our numbers array.

```
var numbers = [12, 4, 3, 9, 8, 6, 10, 1];
```

```
var results = numbers.map(function (arrayCell) {  
    return arrayCell * 2;  
});
```

Don't forget to close both your anonymous function with a } and the map method with a), while also adding a semicolon in order to execute the map.

12	4	3	9	8	6	10	1

USING FE'S WITH ARRAYS AND MAP()

Let's pass in function that will double each cell's value in our numbers array.

```
var numbers = [12, 4, 3, 9, 8, 6, 10, 1];
```

```
var results = numbers.map(function (arrayCell) {  
    return arrayCell * 2;  
};
```

12	4	3	9	8	6	10	1
----	---	---	---	---	---	----	---

doubled!

24							
----	--	--	--	--	--	--	--

USING FE'S WITH ARRAYS AND MAP()

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```
var numbers = [12, 4, 3, 9, 8, 6, 10, 1];
```

```
var results = numbers.map(function (arrayCell) {  
    return arrayCell * 2;  
};
```

12	4	3	9	8	6	10	1
----	---	---	---	---	---	----	---

doubled!

24	8						
----	---	--	--	--	--	--	--

USING FE'S WITH ARRAYS AND MAP()

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```
var numbers = [12, 4, 3, 9, 8, 6, 10, 1];
```

```
var results = numbers.map(function (arrayCell) {  
    return arrayCell * 2;  
};
```

12	4	3	9	8	6	10	1
----	---	---	---	---	---	----	---

doubled!

24	8	6					
----	---	---	--	--	--	--	--

USING FE'S WITH ARRAYS AND MAP()

Let's pass in function that will double each cell's value in our numbers array.

```
var numbers = [12, 4, 3, 9, 8, 6, 10, 1];
```

```
var results = numbers.map(function (arrayCell) {  
    return arrayCell * 2;  
};
```

12	4	3	9	8	6	10	1
----	---	---	---	---	---	----	---



doubled!



24	8	6	18				
----	---	---	----	--	--	--	--

USING FE'S WITH ARRAYS AND MAP()

Let's pass in function that will double each cell's value in our numbers array.

```
var numbers = [12, 4, 3, 9, 8, 6, 10, 1];
```

```
var results = numbers.map(function (arrayCell) {  
    return arrayCell * 2;  
};
```

12	4	3	9	8	6	10	1
----	---	---	---	---	---	----	---



doubled!



24	8	6	18	16			
----	---	---	----	----	--	--	--

USING FE'S WITH ARRAYS AND MAP()

Let's pass in function that will double each cell's value in our numbers array.

```
var numbers = [12, 4, 3, 9, 8, 6, 10, 1];
```

```
var results = numbers.map(function (arrayCell) {  
    return arrayCell * 2;  
};
```

12	4	3	9	8	6	10	1
----	---	---	---	---	---	----	---



doubled!



24	8	6	18	16	12		
----	---	---	----	----	----	--	--

USING FE'S WITH ARRAYS AND MAP()

Let's pass in function that will double each cell's value in our numbers array.

```
var numbers = [12, 4, 3, 9, 8, 6, 10, 1];
```

```
var results = numbers.map(function (arrayCell) {  
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};
```

12	4	3	9	8	6	10	1
----	---	---	---	---	---	----	---

doubled!

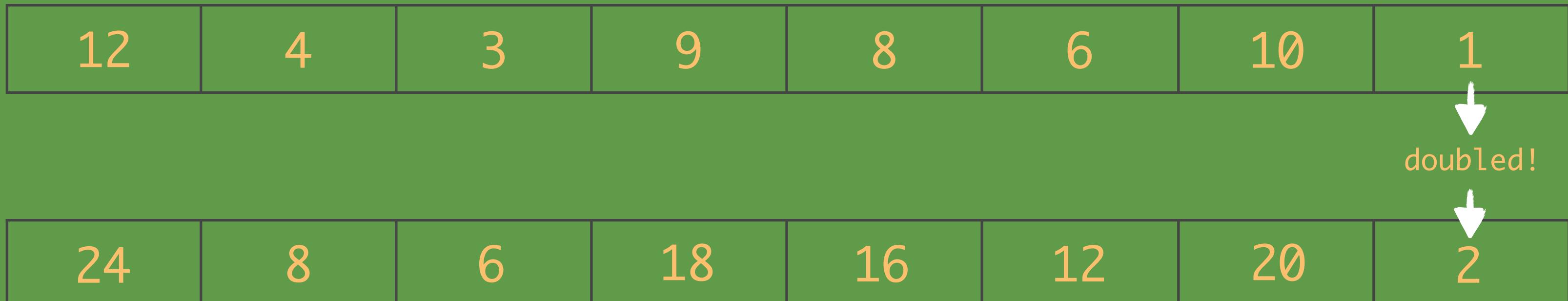
24	8	6	18	16	12	20	
----	---	---	----	----	----	----	--

USING FE'S WITH ARRAYS AND MAP()

Let's pass in function that will double each cell's value in our numbers array.

```
var numbers = [12, 4, 3, 9, 8, 6, 10, 1];
```

```
var results = numbers.map(function (arrayCell) {
    return arrayCell * 2;
});
```



USING FE'S WITH ARRAYS AND MAP()

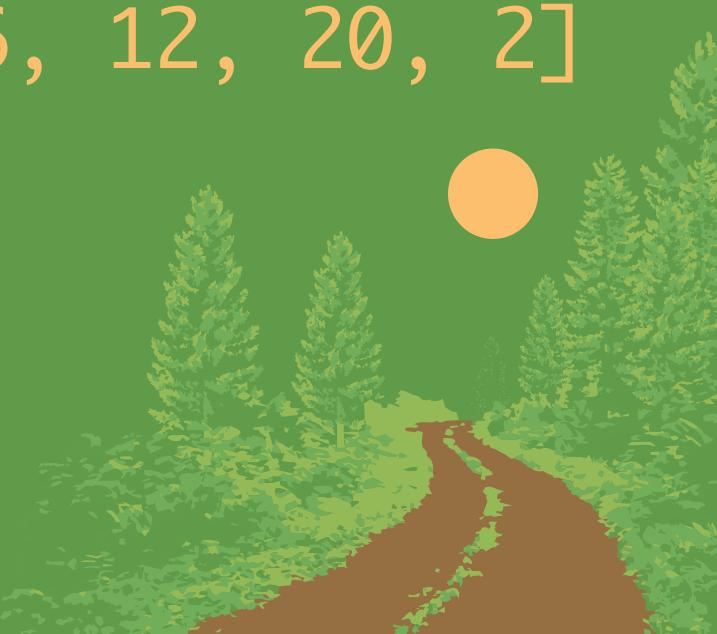
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```
var numbers = [12, 4, 3, 9, 8, 6, 10, 1];
```

```
var results = numbers.map(function (arrayCell) {  
    return arrayCell * 2;  
};
```

```
console.log(results);
```

→ [24, 8, 6, 18, 16, 12, 20, 2]



USING FE'S WITH ARRAYS AND MAP()

Let's pass in function that will double each cell's value in our numbers array.

```
var numbers = [12, 4, 3, 9, 8, 6, 10, 1];
```

```
var results = numbers.map( function (arrayCell) { return arrayCell * 2; } );
```



Short functions are often built in
one line for clarity and simplicity.

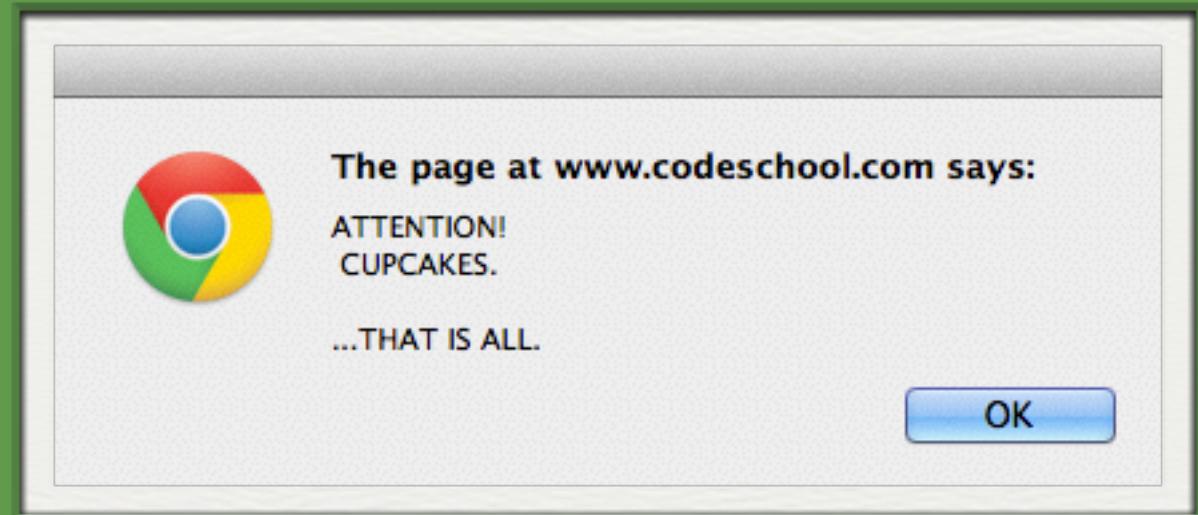
```
console.log(results);
```

→ [24, 8, 6, 18, 16, 12, 20, 2]

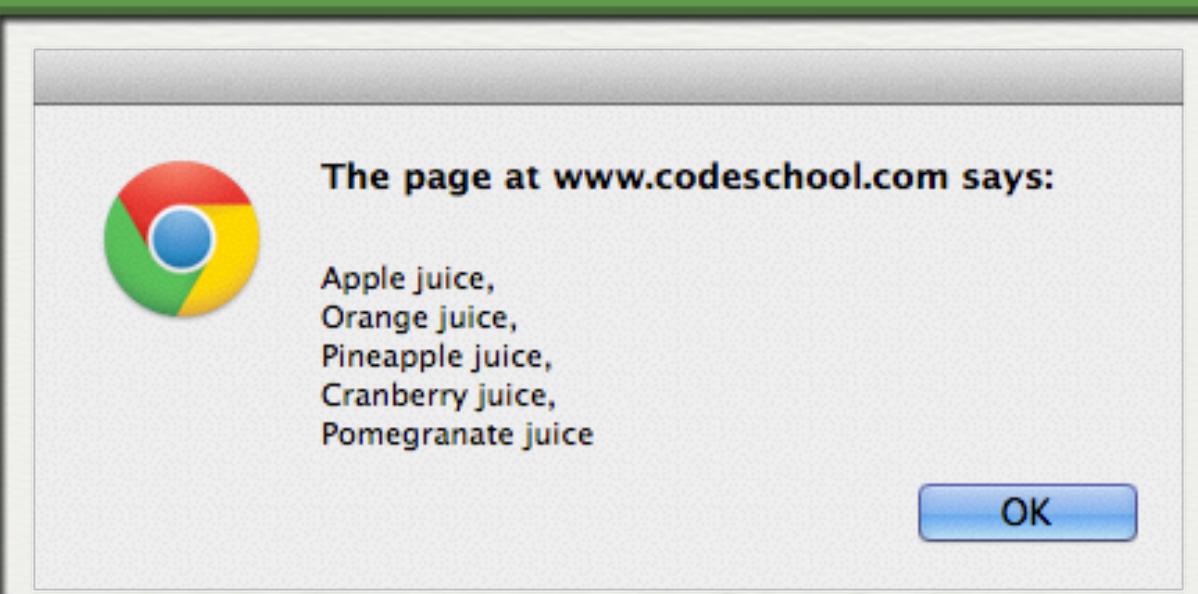


Visit the Wondrous
FOREST OF FUNCTION EXPRESSIONS

```
var sweetAnnouncement = function () { alert("ATTENTION!\n CUPCAKES.\n\n...THAT IS ALL."); };
sweetAnnouncement();
```



```
var fruits = [ "Apple", "Orange", "Pineapple", "Cranberry", "Pomegranate" ];
var fruitJuice = fruits.map( function (fruit) { return "\n" + fruit + " juice"; } );
alert(fruitJuice);
```



```
function mystery () {  
    *some mystery code...ooh, spooky.*  
    return *a function expression*  
}
```

A TICKET SYSTEM FOR THE FOREST THEME PARK

Using an array as a “queue” for Fast Pass delivery

```
var parkRides = [ ["Birch Bumpers", 40] , ["Pines Plunge", 55]  
    ["Cedar Coaster", 20] , ["Ferris Wheel of Firs", 90] ];
```

```
var fastPassQueue = [ "Cedar Coaster", "Pines Plunge", "Birch Bumpers", "Pines Plunge" ];
```

fastPassQueue

"Cedar Coaster"



New items in the Queue are added at
“the end of the line,” just like in real
life.

"Pines Plunge"

A TICKET SYSTEM FOR THE FOREST THEME PARK

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```
var parkRides = [ ["Birch Bumpers", 40] , ["Pines Plunge", 55]  
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```

```
var fastPassQueue = [ "Cedar Coaster", "Pines Plunge", "Birch Bumpers", "Pines Plunge" ];
```

fastPassQueue

"Cedar Coaster"	"Pines Plunge"
-----------------	----------------



New items in the Queue are added at
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"Birch Bumpers"

A TICKET SYSTEM FOR THE FOREST THEME PARK

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var parkRides = [ ["Birch Bumpers", 40] , ["Pines Plunge", 55]  
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var fastPassQueue = [ "Cedar Coaster", "Pines Plunge", "Birch Bumpers", "Pines Plunge" ];
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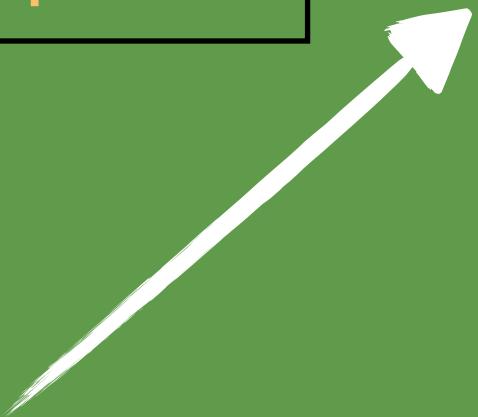
fastPassQueue

"Cedar Coaster"	"Pines Plunge"	"Birch Bumpers"
-----------------	----------------	-----------------

We know a method that adds
cells to the back of arrays,
right??

```
fastPassQueue.push("Pines Plunge");
```

"Pines Plunge"



A TICKET SYSTEM FOR THE FOREST THEME PARK

Using an array as a “queue” for Fast Pass delivery

```
var parkRides = [ ["Birch Bumpers", 40] , ["Pines Plunge", 55]  
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```

```
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```

fastPassQueue

"Cedar Coaster"	"Pines Plunge"	"Birch Bumpers"	"Pines Plunge"
-----------------	----------------	-----------------	----------------

We know a method that adds
cells to the back of arrays,
right??

```
fastPassQueue.push("Pines Plunge");
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A TICKET SYSTEM FOR THE FOREST THEME PARK

Using an array as a “queue” for Fast Pass delivery

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```

```
var fastPassQueue = [ "Cedar Coaster", "Pines Plunge", "Birch Bumpers", "Pines Plunge" ];
```

fastPassQueue

"Cedar Coaster"	'Pines Plunge"	"Birch Bumpers"	"Pines Plunge"
-----------------	----------------	-----------------	----------------

To empty the queue, however, we need a new method that removes cells from the front of the array!

A TICKET SYSTEM FOR THE FOREST THEME PARK

Using an array as a “queue” for Fast Pass delivery

```
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```

fastPassQueue

"Cedar Coaster"	"Pines Plunge"	"Birch Bumpers"	"Pines Plunge"
-----------------	----------------	-----------------	----------------

```
fastPassQueue.shift();
```

A TICKET SYSTEM FOR THE FOREST THEME PARK

Using an array as a “queue” for Fast Pass delivery

```
var parkRides = [ ["Birch Bumpers", 40] , ["Pines Plunge", 55]  
                 ["Cedar Coaster", 20] , ["Ferris Wheel of Firs", 90] ];
```

```
var fastPassQueue = [ "Cedar Coaster", "Pines Plunge", "Birch Bumpers", "Pines Plunge" ];
```

fastPassQueue

"Pines Plunge"	"Birch Bumpers"	"Pines Plunge"
----------------	-----------------	----------------

```
fastPassQueue.shift();
```

→ "Cedar Coaster"



The shift method will return the cell
that it removes from the front of the
array.

A TICKET SYSTEM FOR THE FOREST THEME PARK

Using an array as a “queue” for Fast Pass delivery

```
var parkRides = [ ["Birch Bumpers", 40] , ["Pines Plunge", 55]  
                 ["Cedar Coaster", 20] , ["Ferris Wheel of Firs", 90] ];
```

```
var fastPassQueue = [ "Cedar Coaster", "Pines Plunge", "Birch Bumpers", "Pines Plunge" ];
```

fastPassQueue

"Pines Plunge"	"Birch Bumpers"	"Pines Plunge"
----------------	-----------------	----------------

```
fastPassQueue.shift();
```

→ "Cedar Coaster"



The shift method will return the cell
that it removes from the front of the
array.

A TICKET SYSTEM FOR THE FOREST THEME PARK

Using an array as a “queue” for Fast Pass delivery

```
var parkRides = [ ["Birch Bumpers", 40] , ["Pines Plunge", 55]  
                 ["Cedar Coaster", 20] , ["Ferris Wheel of Firs", 90] ];
```

```
var fastPassQueue = [ "Cedar Coaster", "Pines Plunge", "Birch Bumpers", "Pines Plunge" ];
```

fastPassQueue

"Pines Plunge"	"Birch Bumpers"	"Pines Plunge"
----------------	-----------------	----------------

```
fastPassQueue.shift();
```

→ "Cedar Coaster"

```
fastPassQueue.length;
```

→ 3

Like pop and push, shift will automatically modify the array's length.

A TICKET SYSTEM FOR THE FOREST THEME PARK

Using an array as a “queue” for Fast Pass delivery

```
var parkRides = [ ["Birch Bumpers", 40] , ["Pines Plunge", 55]  
                 ["Cedar Coaster", 20] , ["Ferris Wheel of Firs", 90] ];
```

```
var fastPassQueue = [ "Cedar Coaster", "Pines Plunge", "Birch Bumpers", "Pines Plunge" ];
```

fastPassQueue

"Pines Plunge"	"Birch Bumpers"	"Pines Plunge"
----------------	-----------------	----------------

```
fastPassQueue.shift();
```

→ "Cedar Coaster"

```
var firstFastPass = fastPassQueue.shift();
```

A TICKET SYSTEM FOR THE FOREST THEME PARK

Using an array as a “queue” for Fast Pass delivery

```
var parkRides = [ ["Birch Bumpers", 40] , ["Pines Plunge", 55]  
                 ["Cedar Coaster", 20] , ["Ferris Wheel of Firs", 90] ];
```

```
var fastPassQueue = [ "Cedar Coaster", "Pines Plunge", "Birch Bumpers", "Pines Plunge" ];
```

fastPassQueue

"Birch Bumpers"	"Pines Plunge"
-----------------	----------------

```
fastPassQueue.shift();
```

→ "Cedar Coaster"

```
var firstFastPass = fastPassQueue.shift();
```

A TICKET SYSTEM FOR THE FOREST THEME PARK

Using an array as a “queue” for Fast Pass delivery

```
var parkRides = [ ["Birch Bumpers", 40] , ["Pines Plunge", 55]  
    ["Cedar Coaster", 20] , ["Ferris Wheel of Firs", 90] ];
```

```
var fastPassQueue = [ "Cedar Coaster", "Pines Plunge", "Birch Bumpers", "Pines Plunge" ];
```

fastPassQueue

"Birch Bumpers"	"Pines Plunge"
-----------------	----------------

```
fastPassQueue.shift();
```

→ "Cedar Coaster"

```
var firstFastPass = fastPassQueue.shift();  
console.log(firstFastPass);
```

shift always returns the first cell,
whether you use it in an expression,
store it in a variable, or don't even use it
at all.

→ "Pines Plunge"

A TICKET SYSTEM FOR THE FOREST THEME PARK

Using an array as a “queue” for Fast Pass delivery

```
var parkRides = [ ["Birch Bumpers", 40] , ["Pines Plunge", 55]  
                 ["Cedar Coaster", 20] , ["Ferris Wheel of Firs", 90] ];
```

```
var fastPassQueue = [ "Cedar Coaster", "Pines Plunge", "Birch Bumpers", "Pines Plunge" ];
```

fastPassQueue

"Birch Bumpers"	"Pines Plunge"
-----------------	----------------

```
fastPassQueue.shift();
```

→ "Cedar Coaster"

```
var firstFastPass = fastPassQueue.shift();  
console.log(firstFastPass);
```

→ "Pines Plunge"

Now, we'll build a simple ticket system using our queue!

LET'S MAKE SOME TICKETS!

Since functions can be treated as expressions, they can also be returned like values!

```
var parkRides = [ ["Birch Bumpers", 40], ["Pines Plunge", 55]  
                 ["Cedar Coaster", 20], ["Ferris Wheel of Firs", 90] ];
```

```
var fastPassQueue = [ "Cedar Coaster", "Pines Plunge", "Birch Bumpers", "Pines Plunge" ];
```

```
function buildTicket ( allRides, passRides, pick ) {
```

This parameter will be the array of
the rides and their wait times.

...and this will be the
array of the next
available Fast Pass
rides.

}

LET'S MAKE SOME TICKETS!

Since functions can be treated as expressions, they can also be returned like values!

```
var parkRides = [ ["Birch Bumpers", 40], ["Pines Plunge", 55]  
                 ["Cedar Coaster", 20], ["Ferris Wheel of Firs", 90] ];
```

```
var fastPassQueue = [ "Cedar Coaster", "Pines Plunge", "Birch Bumpers", "Pines Plunge" ];
```

```
function buildTicket ( allRides, passRides, pick ) {
```



This will be the actual ride
for which our customer would
like a ticket!

```
}
```

LET'S MAKE SOME TICKETS!

Since functions can be treated as expressions, they can also be returned like values!

```
var parkRides = [ ["Birch Bumpers", 40], ["Pines Plunge", 55]  
                 ["Cedar Coaster", 20], ["Ferris Wheel of Firs", 90] ];
```

```
var fastPassQueue = [ "Cedar Coaster", "Pines Plunge", "Birch Bumpers", "Pines Plunge" ];
```

```
function buildTicket ( allRides, passRides, pick ) {  
  if(passRides[0] == pick){
```



}

If the next available Fast Pass is
for the ride that the customer
seeks, we'll give them that pass.

}

LET'S MAKE SOME TICKETS!

Since functions can be treated as expressions, they can also be returned like values!

```
var parkRides = [ ["Birch Bumpers", 40] , ["Pines Plunge", 55]  
                 ["Cedar Coaster", 20] , ["Ferris Wheel of Firs", 90] ];
```

```
var fastPassQueue = [ "Cedar Coaster", "Pines Plunge", "Birch Bumpers", "Pines Plunge" ];
```

```
function buildTicket ( allRides, passRides, pick ) {  
  if(passRides[0] == pick){  
    var pass = passRides.shift();  
  }  
}
```



Here's our `shift!` It takes the front
cell off the array and stores it in
the `pass` variable.

LET'S MAKE SOME TICKETS!

Since functions can be treated as expressions, they can also be returned like values!

```
var parkRides = [ ["Birch Bumpers", 40], ["Pines Plunge", 55]  
                 ["Cedar Coaster", 20], ["Ferris Wheel of Firs", 90] ];
```

```
var fastPassQueue = [ "Cedar Coaster", "Pines Plunge", "Birch Bumpers", "Pines Plunge" ];
```

```
function buildTicket ( allRides, passRides, pick ) {  
  if(passRides[0] == pick){  
    var pass = passRides.shift();  
    return function () { alert("Quick! You've got a Fast Pass to " + pass + "!");  
  };  
}
```



Notice we are treating the function as
an expression and returning it directly.
No extra storage variable needed!

LET'S MAKE SOME TICKETS!

Since functions can be treated as expressions, they can also be returned like values!

```
var parkRides = [ ["Birch Bumpers", 40], ["Pines Plunge", 55]  
                 ["Cedar Coaster", 20], ["Ferris Wheel of Firs", 90] ];
```

```
var fastPassQueue = [ "Cedar Coaster", "Pines Plunge", "Birch Bumpers", "Pines Plunge" ];
```

```
function buildTicket ( allRides, passRides, pick ) {  
  if(passRides[0] == pick){  
    var pass = passRides.shift();  
    return function () { alert("Quick! You've got a Fast Pass to " + pass + "!");  
    };  
  } else {  
    for(var i = 0; i < allRides.length; i++){  
      }  
    }  
  }  
}
```



To search for the ride the customer wants,
we'll loop over the entire array of rides.

LET'S MAKE SOME TICKETS!

Since functions can be treated as expressions, they can also be returned like values!

```
var parkRides = [ ["Birch Bumpers", 40], ["Pines Plunge", 55]  
                 ["Cedar Coaster", 20], ["Ferris Wheel of Firs", 90] ];
```

```
var fastPassQueue = [ "Cedar Coaster", "Pines Plunge", "Birch Bumpers", "Pines Plunge" ];
```

```
function buildTicket ( allRides, passRides, pick ) {  
  if(passRides[0] == pick){  
    var pass = passRides.shift();  
    return function () { alert("Quick! You've got a Fast Pass to " + pass + "!");  
    };  
  } else {  
    for(var i = 0; i<allRides.length; i++){  
      if(allRides[i][0] == pick){  
        }  
      }  
    }  
  }  
}
```



The ride names are contained within the first index of each subarray, or [0].

LET'S MAKE SOME TICKETS!

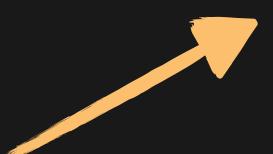
Since functions can be treated as expressions, they can also be returned like values!

```
var parkRides = [ ["Birch Bumpers", 40], ["Pines Plunge", 55]  
                 ["Cedar Coaster", 20], ["Ferris Wheel of Firs", 90] ];
```

```
var fastPassQueue = [ "Cedar Coaster", "Pines Plunge", "Birch Bumpers", "Pines Plunge" ];
```

```
function buildTicket ( allRides, passRides, pick ) {  
  if(passRides[0] == pick){  
    var pass = passRides.shift();  
    return function () { alert("Quick! You've got a Fast Pass to " + pass + "!");  
    };  
  } else {  
    for(var i = 0; i<allRides.length; i++){  
      if(allRides[i][0] == pick){  
        return function () { alert("A ticket is printing for " + pick + "!\n" +  
                               "Your wait time is about " + allRides[i][1] + " minutes.");  
        };  
      }  
    }  
  }  
}
```

The wait times are in the second index of the subarrays, or [1].



LET'S MAKE SOME TICKETS!

Since functions can be treated as expressions, they can also be returned like values!

```
var parkRides = [ ["Birch Bumpers", 40], ["Pines Plunge", 55]  
                 ["Cedar Coaster", 20], ["Ferris Wheel of Firs", 90] ];
```

```
var fastPassQueue = [ "Cedar Coaster", "Pines Plunge", "Birch Bumpers", "Pines Plunge" ];
```

```
function buildTicket ( allRides, passRides, pick ) {  
  if(passRides[0] == pick){  
    var pass = passRides.shift();  
    return function () { alert("Quick! You've got a Fast Pass to " + pass + "!");  
    };  
  } else {  
    for(var i = 0; i<allRides.length; i++){  
      if(allRides[i][0] == pick){  
        return function () { alert("A ticket is printing for " + pick + "!\n" +  
                               "Your wait time is about " + allRides[i][1] + " minutes.");  
        };  
      }  
    }  
  }  
}
```

LET'S MAKE SOME TICKETS!

Since functions can be treated as expressions, they can also be returned like values!

```
var parkRides = [ ["Birch Bumpers", 40], ["Pines Plunge", 55]  
                 ["Cedar Coaster", 20], ["Ferris Wheel of Firs", 90] ];
```

```
var fastPassQueue = [ "Cedar Coaster", "Pines Plunge", "Birch Bumpers", "Pines Plunge" ];
```

```
var wantsRide = "Birch Bumpers";
```

```
var ticket = buildTicket( parkRides, fastPassQueue, wantsRide );
```



When `buildTicket` returns the correct ticket function,
we'll store it in a `ticket` variable for later use!

```
function buildTicket ( allRides, passRides, pick ) {  
  ...  
}
```

LET'S MAKE SOME TICKETS!

Since functions can be treated as expressions, they can also be returned like values!

```
var parkRides = [ ["Birch Bumpers", 40], ["Pines Plunge", 55]  
                  ["Cedar Coaster", 20], ["Ferris Wheel of Firs", 90] ];
```

```
var fastPassQueue = [ "Cedar Coaster", "Pines Plunge", "Birch Bumpers", "Pines Plunge" ];
```

```
var wantsRide = "Birch Bumpers";
```

```
var ticket = buildTicket( parkRides, fastPassQueue, wantsRide );
```

```
ticket();
```

To call the function contained in
the ticket variable, we need a
set of parentheses and a
semicolon.

```
function buildTicket ( allRides, passRides, pick ) {  
  ...  
}
```

LET'S MAKE SOME TICKETS!

Since functions can be treated as expressions, they can also be returned like values!

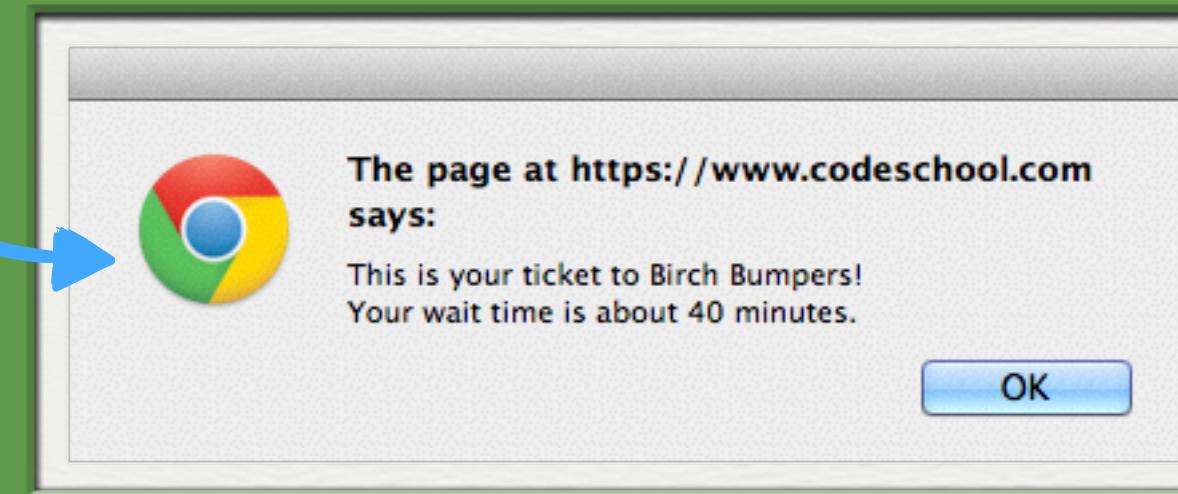
```
var parkRides = [ ["Birch Bumpers", 40], ["Pines Plunge", 55]  
                 ["Cedar Coaster", 20], ["Ferris Wheel of Firs", 90] ];
```

```
var fastPassQueue = [ "Cedar Coaster", "Pines Plunge", "Birch Bumpers", "Pines Plunge" ];
```

```
var wantsRide = "Birch Bumpers";
```

```
var ticket = buildTicket( parkRides, fastPassQueue, wantsRide );
```

```
ticket();
```



```
function buildTicket ( allRides, passRides, pick ) {  
  ...  
}
```

LET'S MAKE SOME TICKETS!

Since functions can be treated as expressions, they can also be returned like values!

```
var parkRides = [ ["Birch Bumpers", 40], ["Pines Plunge", 55]  
                 ["Cedar Coaster", 20], ["Ferris Wheel of Firs", 90] ];
```

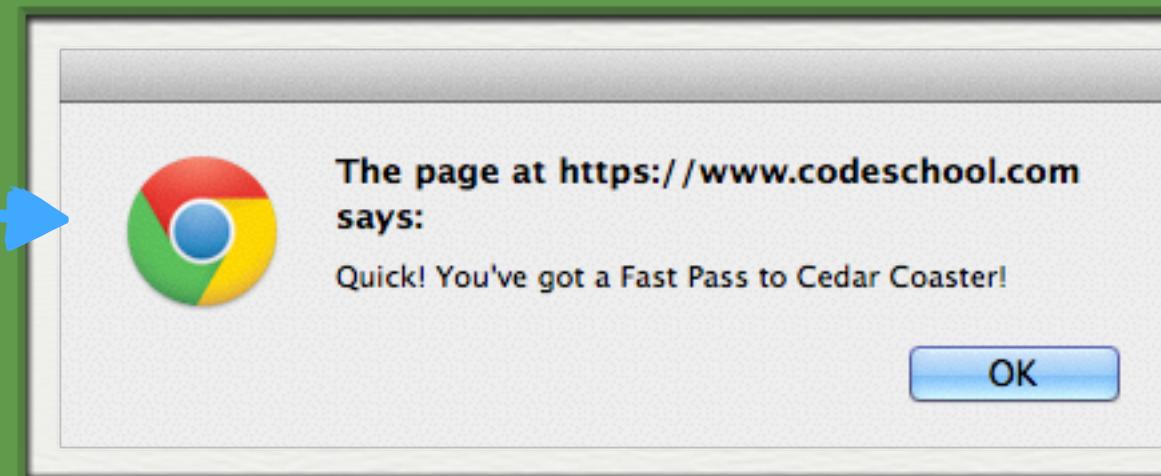
```
var fastPassQueue = [ "Cedar Coaster", "Pines Plunge", "Birch Bumpers", "Pines Plunge" ];
```

```
var wantsRide = "Cedar Coaster";
```

Now, the desired ride matches the first Fast Pass!

```
var ticket = buildTicket( parkRides, fastPassQueue, wantsRide );
```

```
ticket();
```



```
function buildTicket ( allRides, passRides, pick ) {  
  ...  
}
```

LET'S MAKE SOME TICKETS!

Since functions can be treated as expressions, they can also be returned like values!

```
var parkRides = [ ["Birch Bumpers", 40], ["Pines Plunge", 55]  
                 ["Cedar Coaster", 20], ["Ferris Wheel of Firs", 90] ];
```

```
var fastPassQueue = [ "Pines Plunge", "Birch Bumpers", "Pines Plunge" ];
```

```
var wantsRide = "Cedar Coaster";
```

```
var ticket = buildTicket( parkRides, fastPassQueue, wantsRide );
```

```
ticket();
```



```
function buildTicket ( allRides, passRides, pick ) {  
  ...  
}
```

LET'S MAKE SOME TICKETS!

Since functions can be treated as expressions, they can also be returned like values!

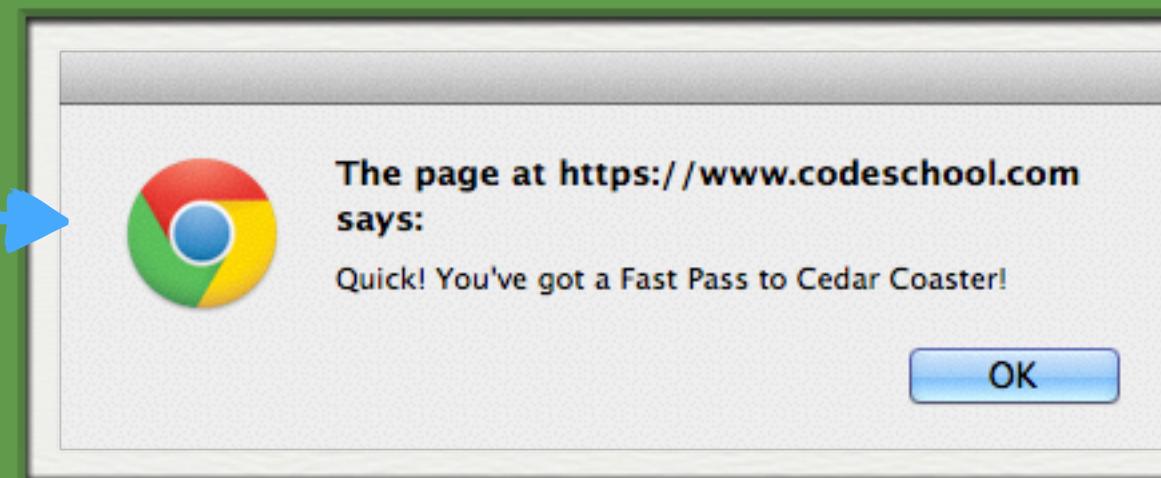
```
var parkRides = [ ["Birch Bumpers", 40], ["Pines Plunge", 55]  
                 ["Cedar Coaster", 20], ["Ferris Wheel of Firs", 90] ];
```

```
var fastPassQueue = [ "Pines Plunge", "Birch Bumpers", "Pines Plunge" ];
```

```
var wantsRide = "Cedar Coaster";
```

```
var ticket = buildTicket( parkRides, fastPassQueue, wantsRide );
```

```
ticket();
```



```
function buildTicket ( allRides, passRides, pick ) {  
  ...  
}
```

USING AN IMMEDIATELY-INVOKED FUNCTION

Calling returned functions instantly instead of variable storage

```
var parkRides = [ ["Birch Bumpers", 40] , ["Pines Plunge", 55]  
                 ["Cedar Coaster", 20] , ["Ferris Wheel of Firs", 90] ];
```

```
var fastPassQueue = [ "Pines Plunge", "Birch Bumpers", "Pines Plunge" ];
```

```
var wantsRide = "Pines Plunge";
```

```
var ticket = buildTicket( parkRides, fastPassQueue, wantsRide );
```

```
function buildTicket ( allRides, passRides, pick ) {  
    ...  
}
```

USING AN IMMEDIATELY-INVOKED FUNCTION

Calling returned functions instantly instead of variable storage

```
var parkRides = [ ["Birch Bumpers", 40] , ["Pines Plunge", 55]  
                 ["Cedar Coaster", 20] , ["Ferris Wheel of Firs", 90] ];
```

```
var fastPassQueue = [ "Pines Plunge", "Birch Bumpers", "Pines Plunge" ];
```

```
var wantsRide = "Pines Plunge";
```

```
buildTicket( parkRides, fastPassQueue, wantsRide );
```

```
function buildTicket ( allRides, passRides, pick ) {  
    ...  
}
```

USING AN IMMEDIATELY-INVOKED FUNCTION

Calling returned functions instantly instead of variable storage

```
var parkRides = [ ["Birch Bumpers", 40] , ["Pines Plunge", 55]  
                 ["Cedar Coaster", 20] , ["Ferris Wheel of Firs", 90] ];
```

```
var fastPassQueue = [ "Pines Plunge", "Birch Bumpers", "Pines Plunge" ];
```

```
var wantsRide = "Pines Plunge";
```

```
buildTicket( parkRides, fastPassQueue, wantsRide );
```

```
function buildTicket ( allRides, passRides, pick ) {  
    ...  
}
```

USING AN IMMEDIATELY-INVOKED FUNCTION

Calling returned functions instantly instead of variable storage

```
var parkRides = [ ["Birch Bumpers", 40], ["Pines Plunge", 55]  
  ["Cedar Coaster", 20], ["Ferris Wheel of Firs", 90] ];
```

```
var fastPassQueue = [ "Pines Plunge", "Birch Bumpers", "Pines Plunge" ];
```

```
var wantsRide = "Pines Plunge";
```

```
buildTicket( parkRides, fastPassQueue, wantsRide );
```

```
( function () {  
  alert("Quick! You've got a Fast Pass to " + pass + "!");  
} )
```

So far, all we get back is a function expression. Need more in order to call it!

```
function buildTicket ( allRides, passRides, pick ) {  
  ...  
}
```

The contents of pass are saved in a process called "closure," which we'll explore in the next level. For now, we know it's filled with the first available Fast Pass.

USING AN IMMEDIATELY-INVOKED FUNCTION

Calling returned functions instantly instead of variable storage

```
var parkRides = [ ["Birch Bumpers", 40] , ["Pines Plunge", 55]  
                 ["Cedar Coaster", 20] , ["Ferris Wheel of Firs", 90] ];
```

```
var fastPassQueue = [ "Pines Plunge", "Birch Bumpers", "Pines Plunge" ];
```

```
var wantsRide = "Pines Plunge";
```

```
buildTicket( parkRides, fastPassQueue, wantsRide );
```



```
( function () {  
    alert("Quick! You've got a Fast Pass to " + pass + "!");  
} )
```

```
function buildTicket ( allRides, passRides, pick ) {  
    ...  
}
```

USING AN IMMEDIATELY-INVOKED FUNCTION

Calling returned functions instantly instead of variable storage

```
var parkRides = [ ["Birch Bumpers", 40] , ["Pines Plunge", 55]  
                 ["Cedar Coaster", 20] , ["Ferris Wheel of Firs", 90] ];
```

```
var fastPassQueue = [ "Pines Plunge", "Birch Bumpers", "Pines Plunge" ];
```

```
var wantsRide = "Pines Plunge";
```

```
buildTicket( parkRides, fastPassQueue, wantsRide )();
```



```
( function () {  
  alert("Quick! You've got a Fast Pass to " + pass + "!");  
} )();
```

Okay, now we've given our expression some parameter parentheses. We're on the right track!

```
function buildTicket ( allRides, passRides, pick ) {  
  ...  
}
```

USING AN IMMEDIATELY-INVOKED FUNCTION

Calling returned functions instantly instead of variable storage

```
var parkRides = [ ["Birch Bumpers", 40] , ["Pines Plunge", 55]  
                 ["Cedar Coaster", 20] , ["Ferris Wheel of Firs", 90] ];
```

```
var fastPassQueue = [ "Pines Plunge", "Birch Bumpers", "Pines Plunge" ];
```

```
var wantsRide = "Pines Plunge";
```

```
buildTicket( parkRides, fastPassQueue, wantsRide )();
```



```
( function () {  
    alert("Quick! You've got a Fast Pass to " + pass + "!");  
} )();
```

```
function buildTicket ( allRides, passRides, pick ) {  
    ...  
}
```

USING AN IMMEDIATELY-INVOKED FUNCTION

Calling returned functions instantly instead of variable storage

```
var parkRides = [ ["Birch Bumpers", 40] , ["Pines Plunge", 55]  
                 ["Cedar Coaster", 20] , ["Ferris Wheel of Firs", 90] ];
```

```
var fastPassQueue = [ "Pines Plunge", "Birch Bumpers", "Pines Plunge" ];
```

```
var wantsRide = "Pines Plunge";
```

```
buildTicket( parkRides, fastPassQueue, wantsRide )();
```

```
( function () {  
    alert("Quick! You've got a Fast Pass to " + pass + "!");  
} )();
```

Yep, a semicolon gives the instruction to execute the function!

```
function buildTicket ( allRides, passRides, pick ) {  
    ...  
}
```

USING AN IMMEDIATELY-INVOKED FUNCTION

Calling returned functions instantly instead of variable storage

```
var parkRides = [ ["Birch Bumpers", 40], ["Pines Plunge", 55]  
                 ["Cedar Coaster", 20], ["Ferris Wheel of Firs", 90] ];
```

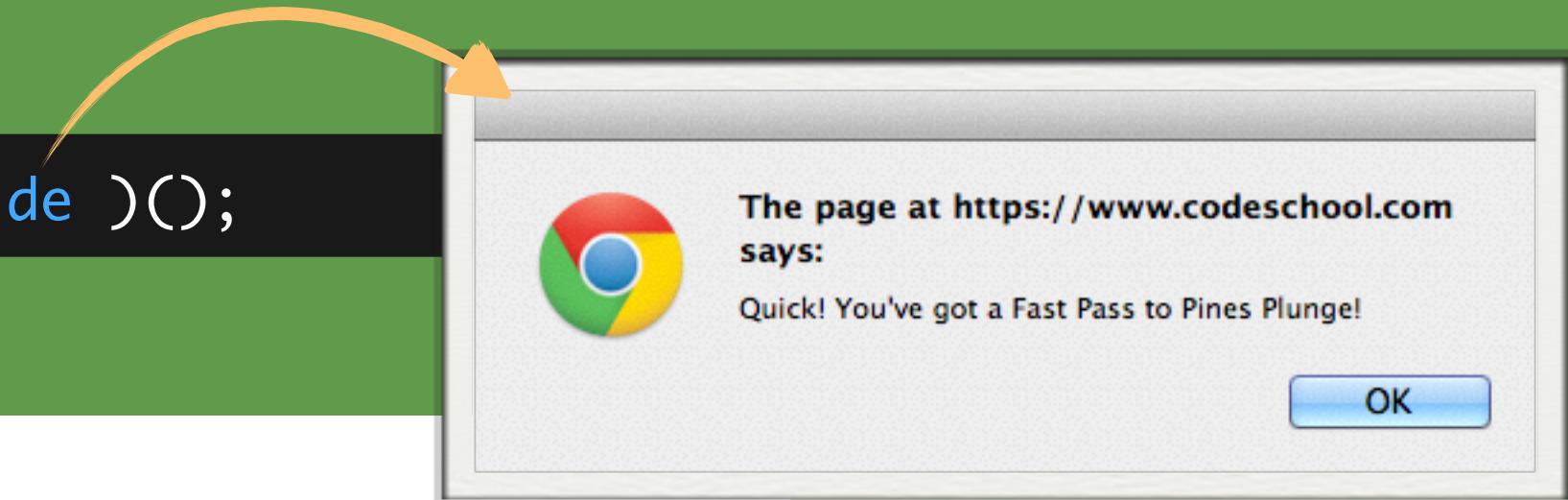
```
var fastPassQueue = [ "Pines Plunge", "Birch Bumpers", "Pines Plunge" ];
```

```
var wantsRide = "Pines Plunge";
```

```
buildTicket( parkRides, fastPassQueue, wantsRide )();
```

```
( function () {  
    alert("Quick! You've got a Fast Pass to " + pass + "!");  
} )();
```

```
function buildTicket ( allRides, passRides, pick ) {  
    ...  
}
```



USING AN IMMEDIATELY-INVOKED FUNCTION

Calling returned functions instantly instead of variable storage

```
var parkRides = [ ["Birch Bumpers", 40], ["Pines Plunge", 55]  
                 ["Cedar Coaster", 20], ["Ferris Wheel of Firs", 90] ];
```

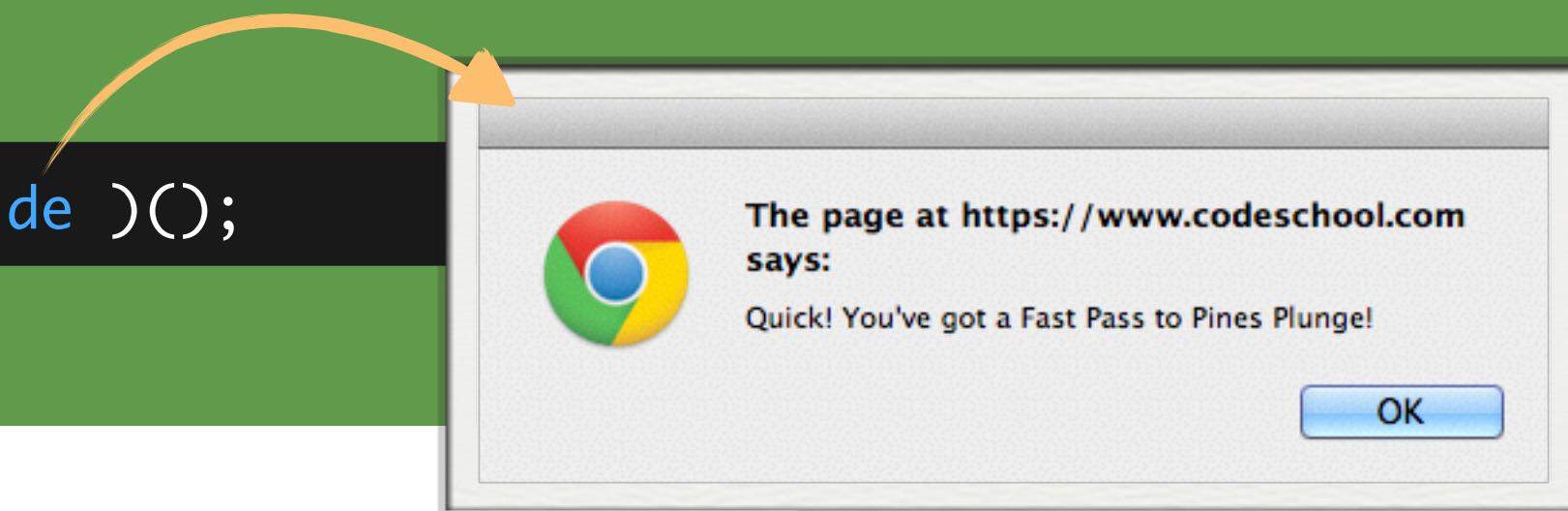
```
var fastPassQueue = [ "Birch Bumpers", "Pines Plunge" ];
```

```
var wantsRide = "Pines Plunge";
```

```
buildTicket( parkRides, fastPassQueue, wantsRide )();
```

```
( function () {  
    alert("Quick! You've got a Fast Pass to " + pass + "!");  
} )();
```

```
function buildTicket ( allRides, passRides, pick ) {  
    ...  
}
```



USING AN IMMEDIATELY-INVOKED FUNCTION

Calling returned functions instantly instead of variable storage

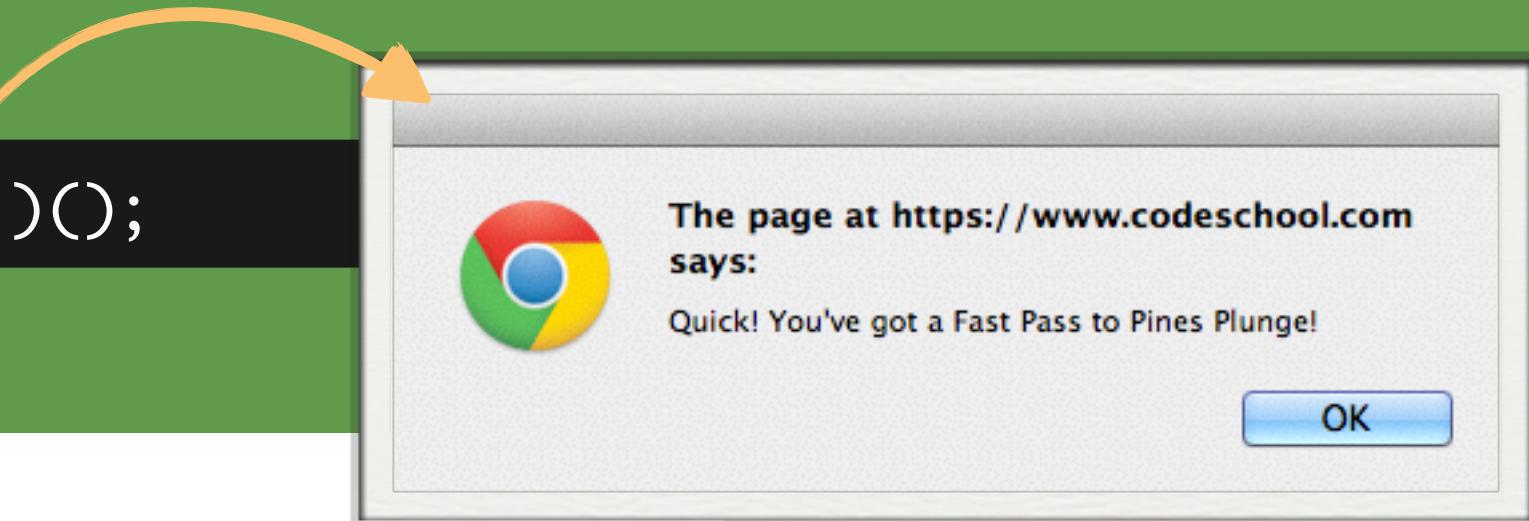
```
var parkRides = [ ["Birch Bumpers", 40] , ["Pines Plunge", 55]  
                 ["Cedar Coaster", 20] , ["Ferris Wheel of Firs", 90] ];
```

```
var fastPassQueue = [ "Birch Bumpers", "Pines Plunge" ];
```

```
var wantsRide = "Pines Plunge";
```

```
buildTicket( parkRides, fastPassQueue, wantsRide )();
```

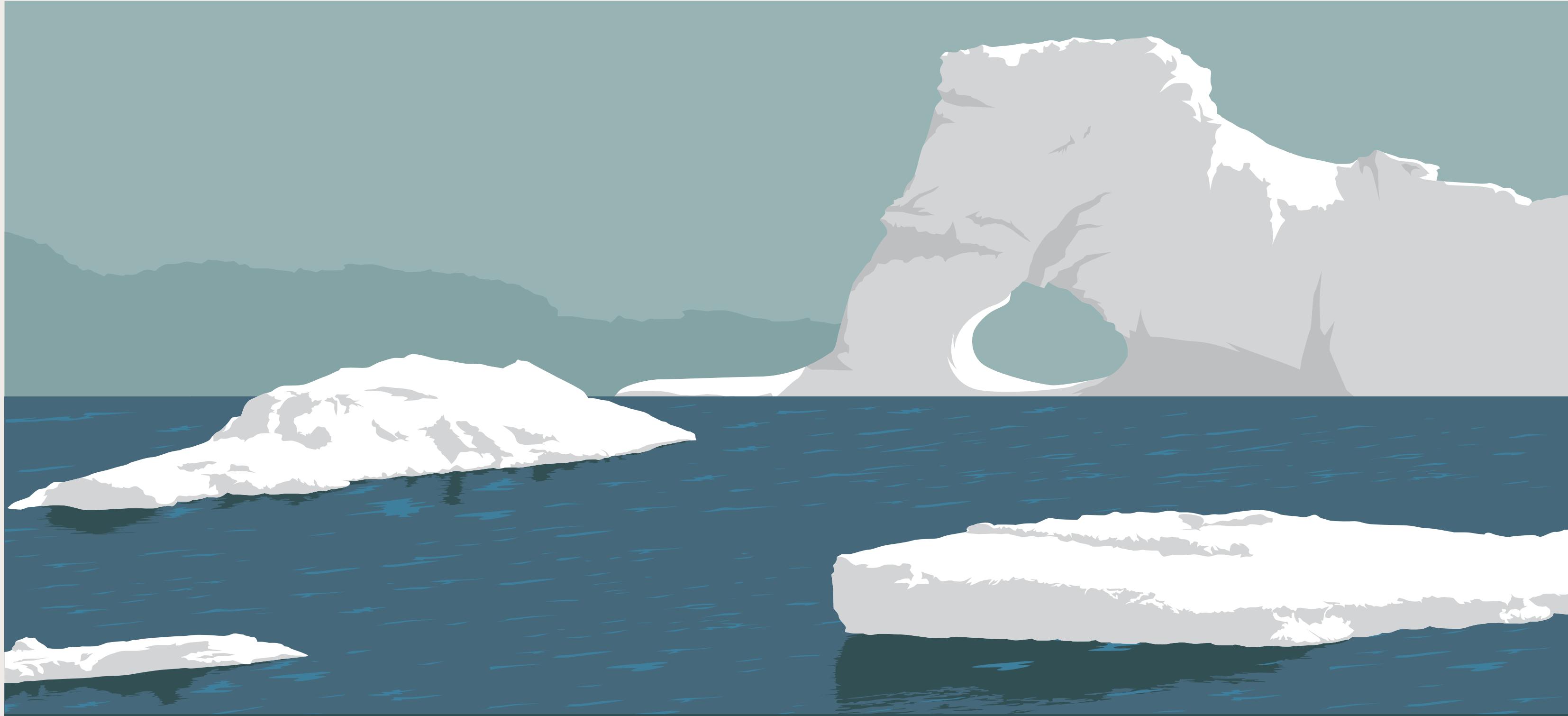
```
( function () {  
    alert("Quick! You've got a Fast Pass to " + pass + "!");  
} )();
```



```
function buildTicket ( allRides, passRides, pick ) {  
    ...  
}
```



Visit the Wondrous
FOREST OF FUNCTION EXPRESSIONS



Explore
COLD CLOSURES COVE



LEVEL 2

COLD CLOSURES COVE

A PACKAGE DEAL

Guess what? Congratulations! You've already made a basic closure!

```
function buildTicket ( allRides, passRides, pick ) {  
  if(passRides[0] == pick){  
    var pass = fastAvail.shift();  
    return function () { alert("Quick! You've got a Fast Pass to " + pass + "!");  
      };  
  } else {  
    for(var i = 0; i<allRides.length; i++){  
      if(allRides[i][0] == pick){  
        return function () { alert("A ticket is printing for " + pick + "!\n" +  
          "Your wait time is about " + allRides[i][1] + " minutes.");  
        };  
      }  
    }  
  }  
}
```

The entire contents of one of these inner functions will still be available OUTSIDE the outermost function.

Returning a function from a function, complete with variables from an external scope, is called a closure.

A PACKAGE DEAL

A closure wraps up an entire environment, binding necessary variables from other scopes.

```
function testClosure () {  
  var x = 4; ← Local Variable only!  
  return x;  
}
```

testClosure();

→ 4

x;

→ undefined

A function's local variables
aren't available once the
function's scope is closed!

A PACKAGE DEAL

A closure wraps up an entire environment, binding necessary variables from other scopes.

The inner function can access the outer function's variables, because they "feel" like global variables.

```
function testClosure () {  
    var x = 4;  
    function closeX () {  
        return x;  
    }  
    return closeX;  
}
```

Notice **x** does not need to be "stored" anywhere in **closeX**, not even as a parameter!

A PACKAGE DEAL

A closure wraps up an entire environment, binding necessary variables from other scopes.

```
function testClosure () {  
    var x = 4;  
    function closeX () {  
        return x;  
    }  
    return closeX;  
}
```

```
var checkLocalX = testClosure();
```

```
checkLocalX();
```

→ 4

Even though `testClosure` has finished operating, its local variable is now bound within `checkLocalX`.

CLOSURES HELP IN FUNCTION “CONSTRUCTION ZONES”

A closure can make the creation of very similar functions ultra-efficient.



```
function buildCoveTicketMaker( transport ) {  
  return function ( name ) {  
    alert("Here is your transportation ticket via the " + transport + ".\n" +  
      "Welcome to the Cold Closures Cove, " + name + "!");  
  }  
}
```

CLOSURES HELP IN FUNCTION “CONSTRUCTION ZONES”

A closure can make the creation of very similar functions ultra-efficient.

```
function buildCoveTicketMaker( transport ) {  
  return function ( name ) {  
    alert("Here is your transportation ticket via the " + transport + ".\n" +  
      "Welcome to the Cold Closures Cove, " + name + "!");  
  }  
}
```

```
var getSubmarineTicket = buildCoveTicketMaker("Submarine");
```



```
var getBattleshipTicket = buildCoveTicketMaker("Battleship");
```



```
var getGiantSeagullTicket = buildCoveTicketMaker("Giant Seagull");
```



We give
buildCoveTicketMaker
the mode of
transportation, which
is closed into the
returned anonymous
function.

CLOSURES HELP IN FUNCTION “CONSTRUCTION ZONES”

A closure can make the creation of very similar functions ultra-efficient.

```
var getSubmarineTicket = buildCoveTicketMaker("Submarine");
```



```
var getBattleshipTicket = buildCoveTicketMaker("Battleship");
```



```
var getGiantSeagullTicket = buildCoveTicketMaker("Giant Seagull");
```



CLOSURES HELP IN FUNCTION “CONSTRUCTION ZONES”

A closure can make the creation of very similar functions ultra-efficient.

getSubmarineTicket



getBattleshipTicket



getGiantSeagullTicket



BEWARE: BOUND VARIABLES WON'T BE EVIDENT IN THE STORED FUNCTION

Examining the contents of our new variables doesn't reveal closures.

```
getSubmarineTicket;
```

```
function ( name ) {  
  alert("Here is your transportation ticket via the " + transport + ".\n" +  
    "Welcome to the Cold Closures Cove, " + name + "!");  
}
```



Holds "Submarine"

```
getBattleshipTicket;
```

```
function ( name ) {  
  alert("Here is your transportation ticket via the " + transport + ".\n" +  
    "Welcome to the Cold Closures Cove, " + name + "!");  
}
```



Holds "Battleship"

```
getGiantSeagullTicket;
```

```
function ( name ) {  
  alert("Here is your transportation ticket via the " + transport + ".\n" +  
    "Welcome to the Cold Closures Cove, " + name + "!");  
}
```



Holds "Giant Seagull"

BEWARE: BOUND VARIABLES WON'T BE EVIDENT IN THE STORED FUNCTION

Examining the contents of our new variables doesn't reveal closures.

```
getSubmarineTicket;
```

```
function ( name ) {  
    alert("Here is your transportation ticket via the " + transport + ".\n" +  
        "Welcome to the Cold Closures Cove, " + name + "!");  
}
```

```
getBattleshipTicket;
```

```
function ( name ) {  
    alert("Here is your transportation ticket via the " + transport + ".\n" +  
        "Welcome to the Cold Closures Cove, " + name + "!");  
}
```

```
getGiantSeagullTicket;
```

```
function ( name ) {  
    alert("Here is your transportation ticket via the " + transport + ".\n" +  
        "Welcome to the Cold Closures Cove, " + name + "!");  
}
```



Until we call any of
these functions
with a parameter,
the **name** variable
is still undefined.

LET'S MAKE SOME TICKETS!

Passing a name to any of our ticket makers will complete our ticket-making process.

```
getSubmarineTicket;
```

```
function ( name ) {  
    alert("Here is your transportation ticket via the " + transport + ".\n" +  
        "Welcome to the Cold Closures Cove, " + name + "!");  
}
```



```
getBattleshipTicket;
```

```
function ( name ) {  
    alert("Here is your transportation ticket via the " + transport + ".\n" +  
        "Welcome to the Cold Closures Cove, " + name + "!");  
}
```



```
getGiantSeagullTicket;
```

```
function ( name ) {  
    alert("Here is your transportation ticket via the " + transport + ".\n" +  
        "Welcome to the Cold Closures Cove, " + name + "!");  
}
```



LET'S MAKE SOME TICKETS!

Passing a name to any of our ticket makers will complete our ticket-making process.

```
getSubmarineTicket;
```



```
getBattleshipTicket;
```



```
getGiantSeagullTicket;
```



LET'S MAKE SOME TICKETS!

Passing a name to any of our ticket makers will complete our ticket-making process.

```
getSubmarineTicket("Mario");
```



```
getBattleshipTicket("Luigi");
```



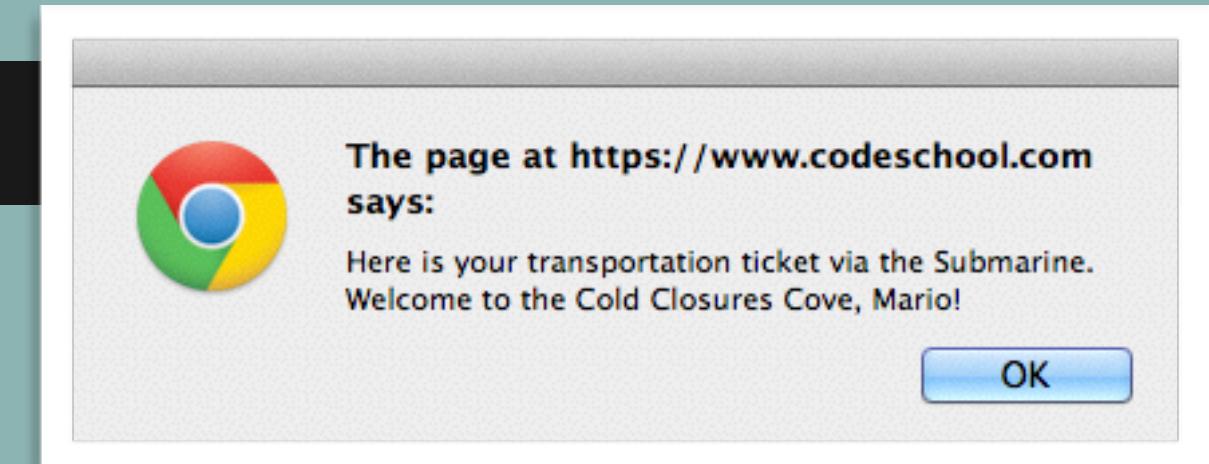
```
getGiantSeagullTicket("Bowser");
```



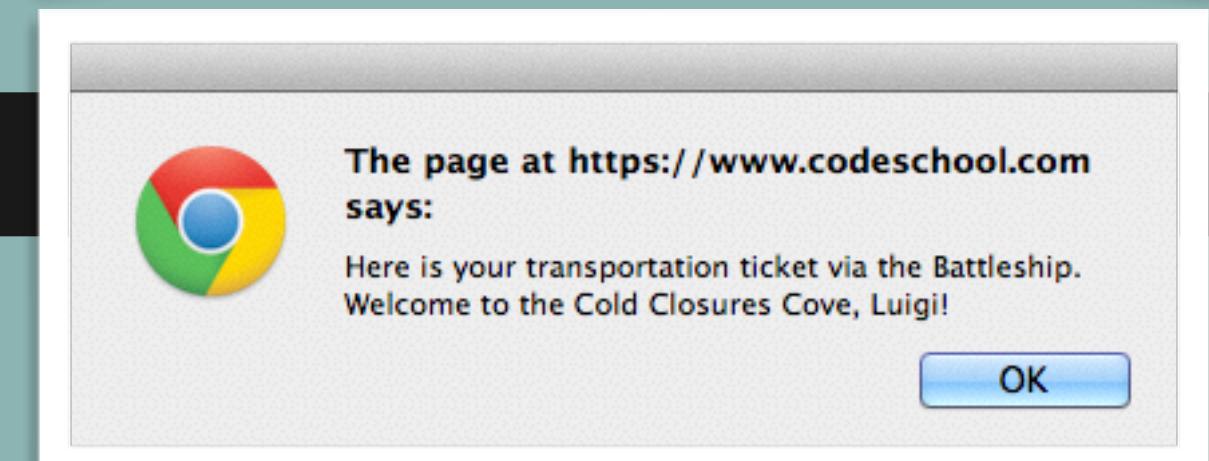
LET'S MAKE SOME TICKETS!

Passing a name to any of our ticket makers will complete our ticket-making process.

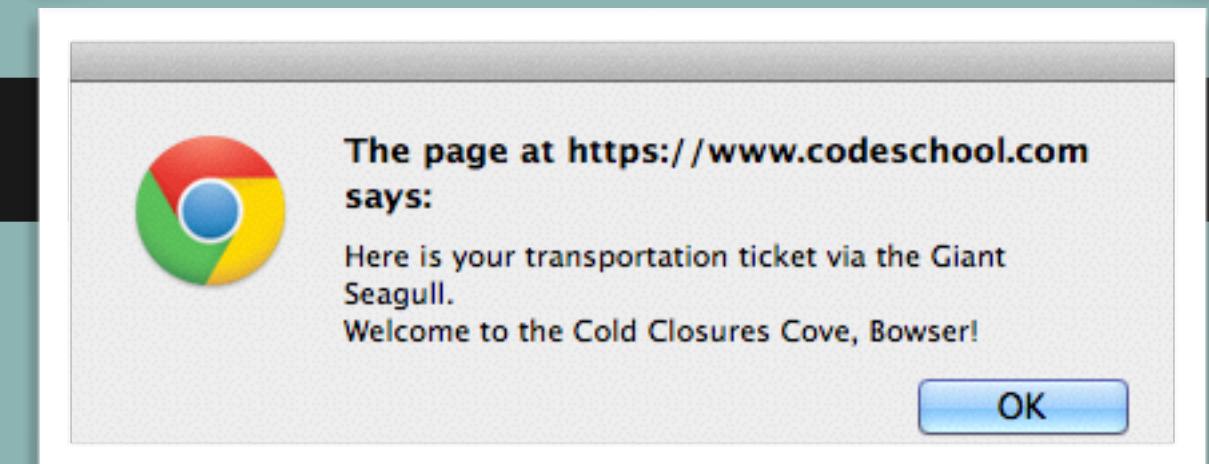
```
getSubmarineTicket("Mario");
```

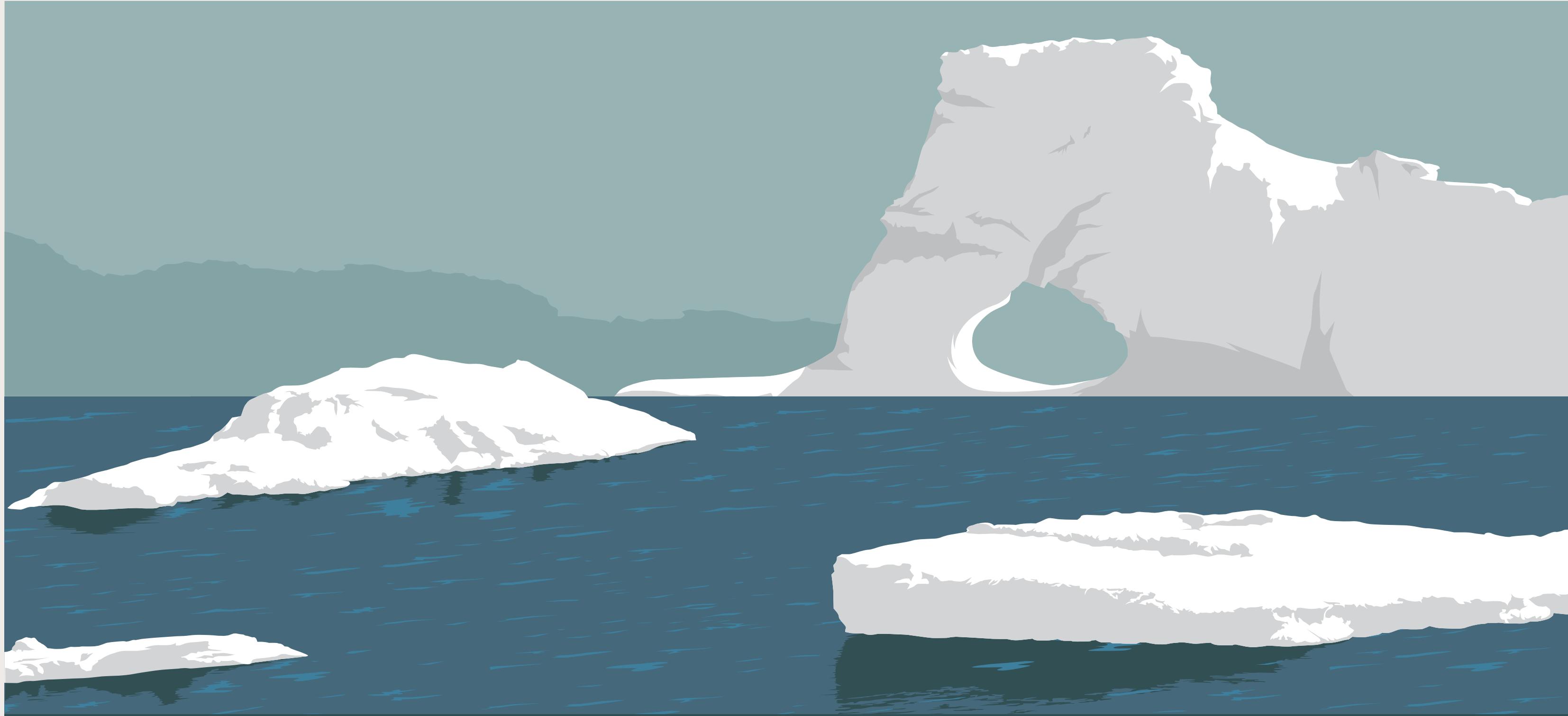


```
getBattleshipTicket("Luigi");
```



```
getGiantSeagullTicket("Bowser");
```





Explore
COLD CLOSURES COVE

ADDING A PASSENGER TRACKER

Closure functions can even modify bound variables in the background

```
function buildCoveTicketMaker( transport ) {  
  return function ( name ) {  
    alert("Here is your transportation ticket via the " + transport + ".\n" +  
      "Welcome to the Cold Closures Cove, " + name + "!");  
  }  
}
```



ADDING A PASSENGER TRACKER

Closure functions can even modify bound variables in the background

```
function buildCoveTicketMaker( transport ) {  
  var passengerNumber = 0; ← We'll start every ticket maker's  
  return function ( name ) {  
  
    alert("Here is your transportation ticket via the " + transport + ".\n" +  
          "Welcome to the Cold Closures Cove, " + name + "!" +  
          );  
  }  
}
```

ADDING A PASSENGER TRACKER

Closure functions can even modify bound variables in the background

```
function buildCoveTicketMaker( transport ) {  
    var passengerNumber = 0;  
    return function ( name ) {  
        passengerNumber++; ←  
        alert("Here is your transportation ticket via the " + transport + ".\n" +  
              "Welcome to the Cold Closures Cove, " + name + "!" +  
              );  
    }  
}
```

When a particular ticket maker is called,
we know a new passenger should be added,
so we'll increase the tracker.

ADDING A PASSENGER TRACKER

Closure functions can even modify bound variables in the background

```
function buildCoveTicketMaker( transport ) {  
  var passengerNumber = 0;  
  return function ( name ) {  
    passengerNumber++;  
    alert("Here is your transportation ticket via the " + transport + ".\n" +  
      "Welcome to the Cold Closures Cove, " + name + "!" +  
      "You are passenger #" + passengerNumber + ".");  
  }  
}
```



Each time a ticket is "printed," this **passengerNumber** will contain the precise amount of times this kind of ticket has been given.

ADDING A PASSENGER TRACKER

Closure functions can even modify bound variables in the background

```
function buildCoveTicketMaker( transport ) {  
  var passengerNumber = 0;  
  return function ( name ) {  
    passengerNumber++;  
    alert("Here is your transportation ticket via the " + transport + ".\n" +  
      "Welcome to the Cold Closures Cove, " + name + "!" +  
      "You are passenger #" + passengerNumber + ".");  
  }  
}
```

```
var getSubmarineTicket = buildCoveTicketMaker("Submarine");  
getSubmarineTicket;
```

```
function (name) {  
  passengerNumber++;  
  alert("Here is your transportation ticket via the " + transport + ".\n" +  
    "Welcome to the Cold Closures Cove, " + name + "!\n" +  
    "You are passenger #" + passengerNumber + ".");  
}
```



Notice that no initial value for **passengerNumber** is evident in our new function. It's value starts at **0** and is adjusted with each call to **getSubmarineTicket**.

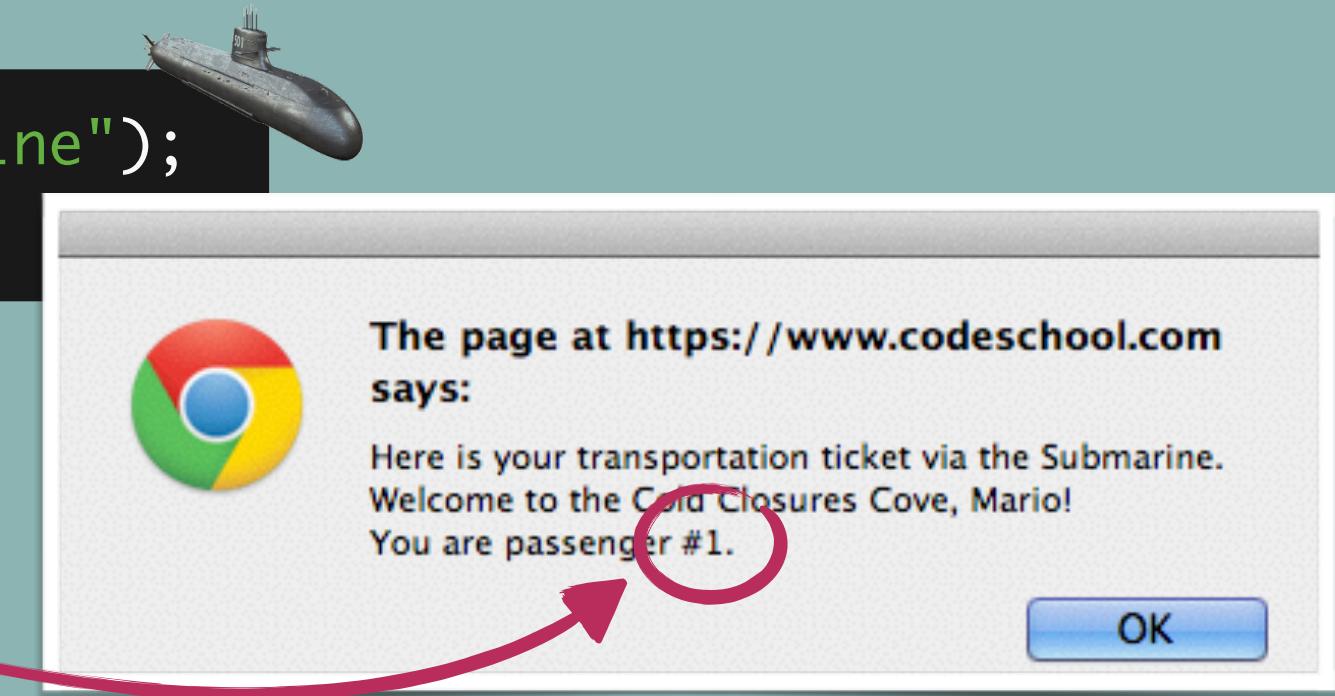
ADDING A PASSENGER TRACKER

Closure functions can even modify bound variables in the background

```
function buildCoveTicketMaker( transport ) {  
    var passengerNumber = 0;  
    return function ( name ) {  
        passengerNumber++;  
        alert("Here is your transportation ticket via the " + transport + ".\n" +  
              "Welcome to the Cold Closures Cove, " + name + "!" +  
              "You are passenger #" + passengerNumber + ".");  
    }  
}
```

```
var getSubmarineTicket = buildCoveTicketMaker("Submarine");  
getSubmarineTicket("Mario");
```

On our first call to the new `getSubmarineTicket`,
`passengerNumber` is incremented to 1.



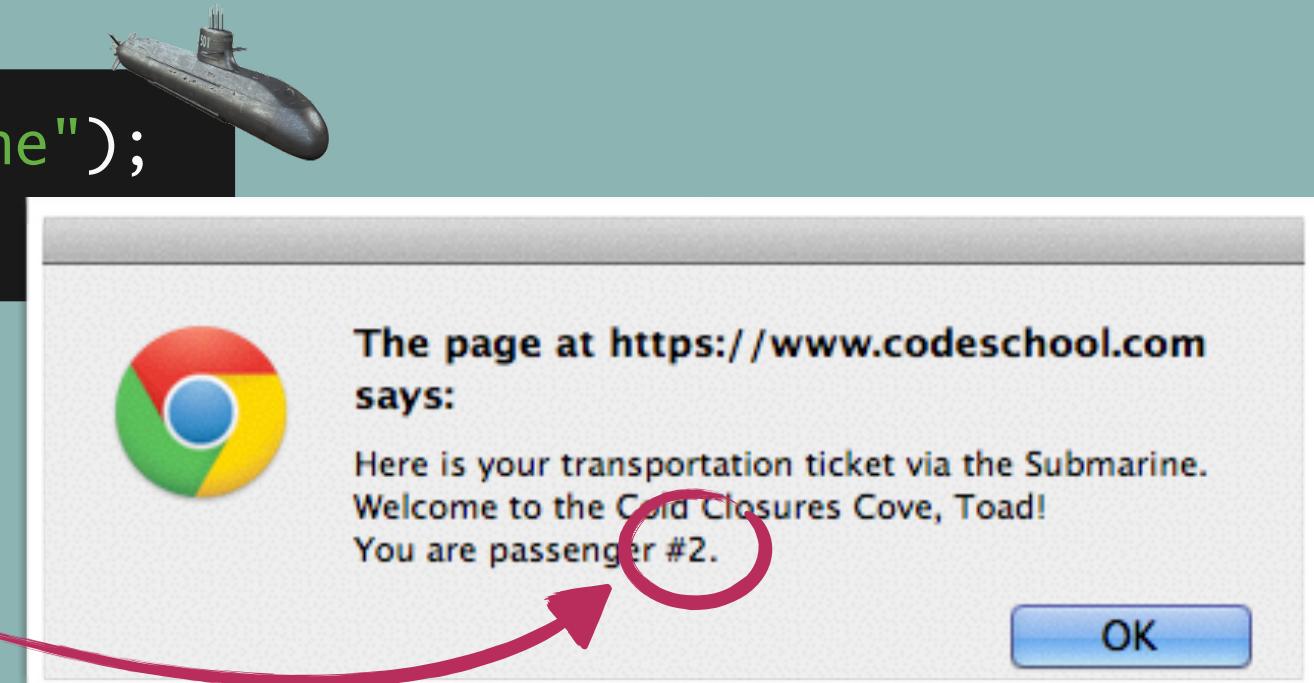
ADDING A PASSENGER TRACKER

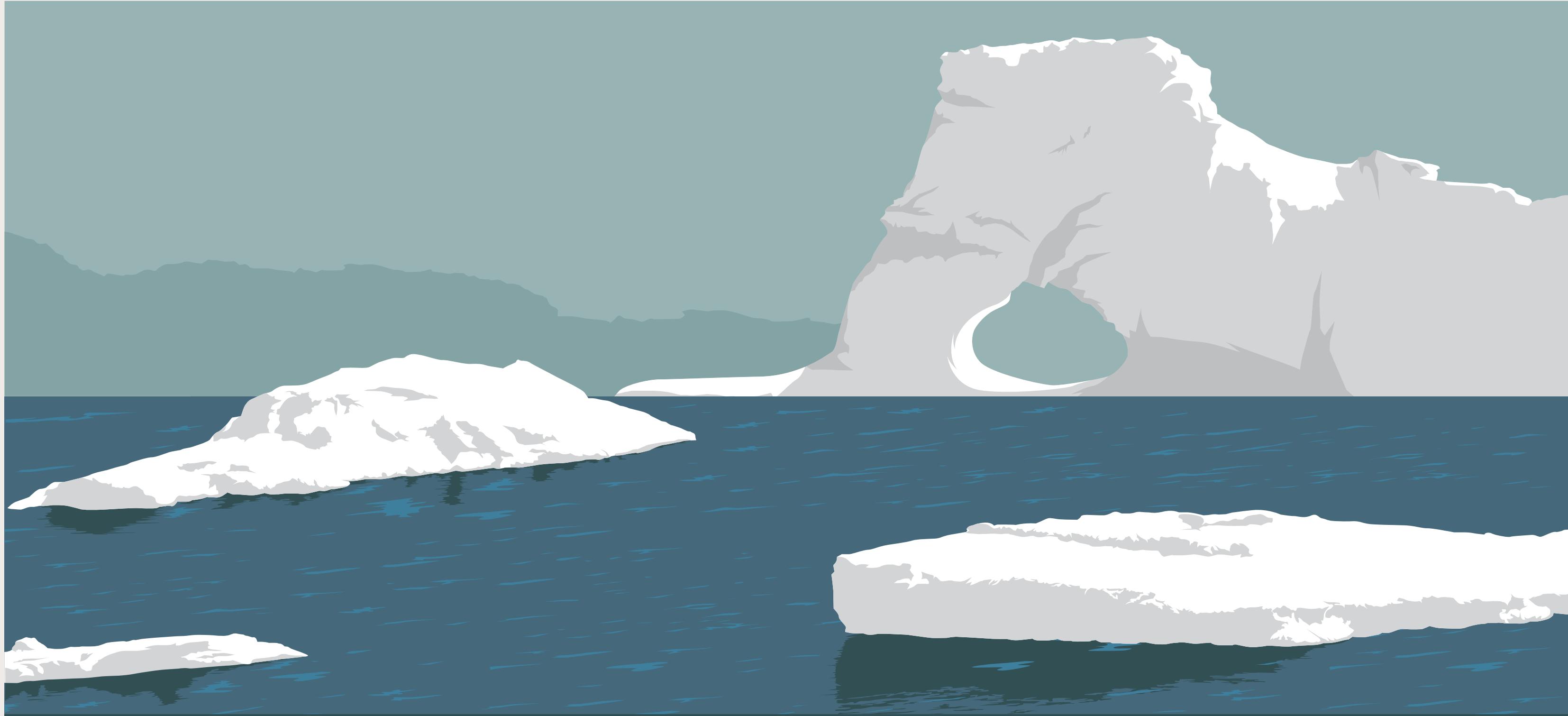
Closure functions can even modify bound variables in the background

```
function buildCoveTicketMaker( transport ) {  
    var passengerNumber = 0;  
    return function ( name ) {  
        passengerNumber++;  
        alert("Here is your transportation ticket via the " + transport + ".\n" +  
              "Welcome to the Cold Closures Cove, " + name + "!" +  
              "You are passenger #" + passengerNumber + ".");  
    }  
}
```

```
var getSubmarineTicket = buildCoveTicketMaker("Submarine");  
getSubmarineTicket("Toad");
```

Another call to `getSubmarineTicket` has `passengerNumber` incremented to 2! Wow, even though the function's local scope disappeared after Mario's ticket, it KEPT the progress of `passengerNumber`!





Explore
COLD CLOSURES COVE

LOOPS WITH CLOSURES: A CAUTIONARY TALE

Let's try to make a torpedo assigner for the Cove's Submarine

```
function assignTorpedo ( name, passengerArray ){
```



We'll pass in the name of a passenger, as well as a list of passengers.

```
}
```

LOOPS WITH CLOSURES: A CAUTIONARY TALE

Let's try to make a torpedo assigner for the Cove's Submarine

```
function assignTorpedo ( name, passengerArray ){
```

```
    var torpedoAssignment;
```



This variable will hold a function that alerts name's torpedo assignment.

```
}
```

LOOPS WITH CLOSURES: A CAUTIONARY TALE

Let's try to make a torpedo assigner for the Cove's Submarine

```
function assignTorpedo ( name, passengerArray ){  
  var torpedoAssignment;  
  for (var i = 0; i<passengerArray.length; i++) {  
    }  
  }  
}  
}
```



We'll loop over the list of passengers to find `name`.

LOOPS WITH CLOSURES: A CAUTIONARY TALE

Let's try to make a torpedo assigner for the Cove's Submarine

```
function assignTorpedo ( name, passengerArray ){  
    var torpedoAssignment;  
    for (var i = 0; i<passengerArray.length; i++) {  
        if (passengerArray[i] == name) {  
            torpedoAssignment = function () {  
                };  
            };  
        }  
    }  
}
```

When we find the right `name`, we'll
make a function that will hold our
torpedo assignment closure.

LOOPS WITH CLOSURES: A CAUTIONARY TALE

Let's try to make a torpedo assigner for the Cove's Submarine

```
function assignTorpedo ( name, passengerArray ){  
    var torpedoAssignment;  
    for (var i = 0; i<passengerArray.length; i++) {  
        if (passengerArray[i] == name) {  
            torpedoAssignment = function () {  
                alert("Ahoy, " + name + "!\\n" +  
                    "Man your post at Torpedo #" + (i+1) + "!");  
            };  
        }  
    }  
}
```

We'll close up the `name` variable and the loop counter `i`, and assign a person to the torpedo associated with their index value in the list (adjusted for zero).

LOOPS WITH CLOSURES: A CAUTIONARY TALE

Let's try to make a torpedo assigner for the Cove's Submarine

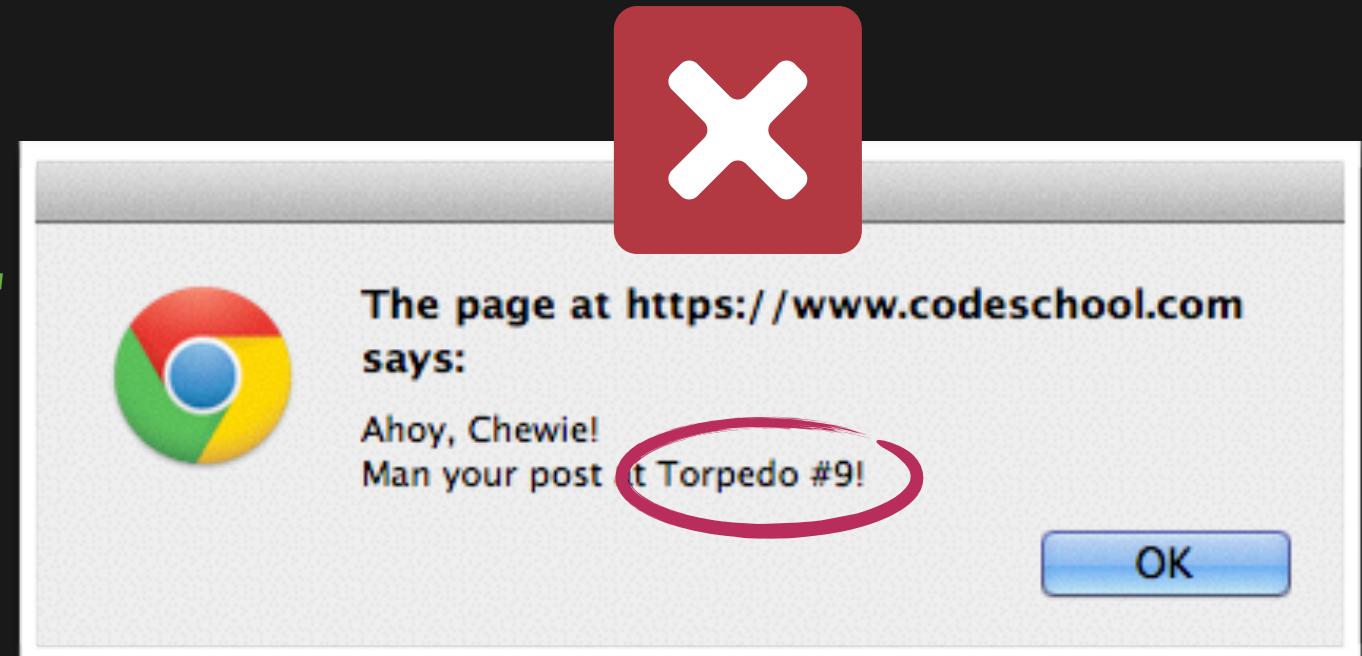
```
function assignTorpedo ( name, passengerArray ){  
    var torpedoAssignment;  
    for (var i = 0; i<passengerArray.length; i++) {  
        if (passengerArray[i] == name) {  
            torpedoAssignment = function () {  
                alert("Ahoy, " + name + "!\n" +  
                    "Man your post at Torpedo #" + (i+1) + "!");  
            };  
        }  
    }  
    return torpedoAssignment; ← Finally, we'll hand the correct assignment  
back over to the global scope.  
}
```

LOOPS WITH CLOSURES: A CAUTIONARY TALE

Let's try to make a torpedo assigner for the Cove's Submarine

```
function assignTorpedo ( name, passengerArray ){  
    var torpedoAssignment;  
    for (var i = 0; i<passengerArray.length; i++) {  
        if (passengerArray[i] == name) {  
            torpedoAssignment = function () {  
                alert("Ahoy, " + name + "!\n" +  
                    "Man your post at Torpedo #"  
            };  
        }  
    }  
    return torpedoAssignment;  
}
```

Should be Torpedo #4!
What happened?



```
var subPassengers = ["Luke", "Leia", "Han", "Chewie", "Yoda", "R2-D2", "C-3PO", "Boba"];
```

```
var giveAssignment = assignTorpedo("Chewie", subPassengers);
```

```
giveAssignment();
```

CLOSURES BIND VALUES AT THE VERY LAST MOMENT

We have to pay close attention to return times and final variable states

```
function assignTorpedo ( name, passengerArray ){  
    var torpedoAssignment;  
    for (var i = 0; i<passengerArray.length; i++){  
        if (passengerArray[i] == name) {  
            torpedoAssignment = function () {  
                alert("Ahoy, " + name + "!\n" +  
                    "Man your post at Torpedo #" + (i+1) + "!");  
            };  
        }  
    }  
    return torpedoAssignment;  
}
```

Way before `torpedoAssignment` is returned, the `i` loop counter has progressed in value to 8 and stopped the loop.

```
var subPassengers = ["Luke", "Leia", "Han", "Chewie", "Yoda", "R2-D2", "C-3PO", "Boba"];
```

```
var giveAssignment = assignTorpedo("Chewie", subPassengers);
```

```
giveAssignment();
```

CLOSURES BIND VALUES AT THE VERY LAST MOMENT

We have to pay close attention to return times and final variable states

```
function assignTorpedo ( name, passengerArray ){  
    var torpedoAssignment;  
    for (var i = 0; i<passengerArray.length; i++) {  
        if (passengerArray[i] == name) {  
            torpedoAssignment = function () {  
                alert("Ahoy, " + name + "!\n" +  
                    "Man your post at Torpedo #" + (i+1) + "!");  
            };  
        }  
    }  
    return torpedoAssignment;  
}
```

The function's actual `return` is the true "moment of closure," when the environment and all necessary variables are packaged up.

$8+1=9$

```
var subPassengers = ["Luke", "Leia", "Han", "Chewie", "Yoda", "R2-D2", "C-3PO", "Boba"];
```

```
var giveAssignment = assignTorpedo("Chewie", subPassengers);
```

```
giveAssignment();
```

WHAT CAN WE DO TO ENSURE THE CORRECT VALUE?

Several options exist for timing closures correctly

```
function assignTorpedo ( name, passengerArray ){  
    var torpedoAssignment;  
    for (var i = 0; i<passengerArray.length; i++) {  
        if (passengerArray[i] == name) {  
            torpedoAssignment = function () {  
                alert("Ahoy, " + name + "!\n" +  
                    "Man your post at Torpedo #" + (i+1) + "!");  
            };  
        }  
    }  
    return torpedoAssignment;  
}
```

```
var subPassengers = ["Luke", "Leia", "Han", "Chewie", "Yoda", "R2-D2", "C-3PO", "Boba"];
```

WHAT CAN WE DO TO ENSURE THE CORRECT VALUE?

Several options exist for timing closures correctly

```
function assignTorpedo ( name, passengerArray ){  
  
    for (var i = 0; i<passengerArray.length; i++) {  
        if (passengerArray[i] == name) {  
            function () {  
                alert("Ahoy, " + name + "!\n" +  
                    "Man your post at Torpedo #" + (i+1) + "!");  
            };  
        }  
    }  
}
```

```
var subPassengers = ["Luke", "Leia", "Han", "Chewie", "Yoda", "R2-D2", "C-3PO", "Boba"];
```

WHAT CAN WE DO TO ENSURE THE CORRECT VALUE?

Several options exist for timing closures correctly

```
function assignTorpedo ( name, passengerArray ){  
  
    for (var i = 0; i<passengerArray.length; i++) {  
        if (passengerArray[i] == name) {  
            return function () {  
                alert("Ahoy, " + name + "!\n" +  
                    "Man your post at Torpedo #" + (i+1) + "!");  
            };  
        }  
    }  
}
```

*Now the function will be immediately returned
when the right name is found, locking i in place.*



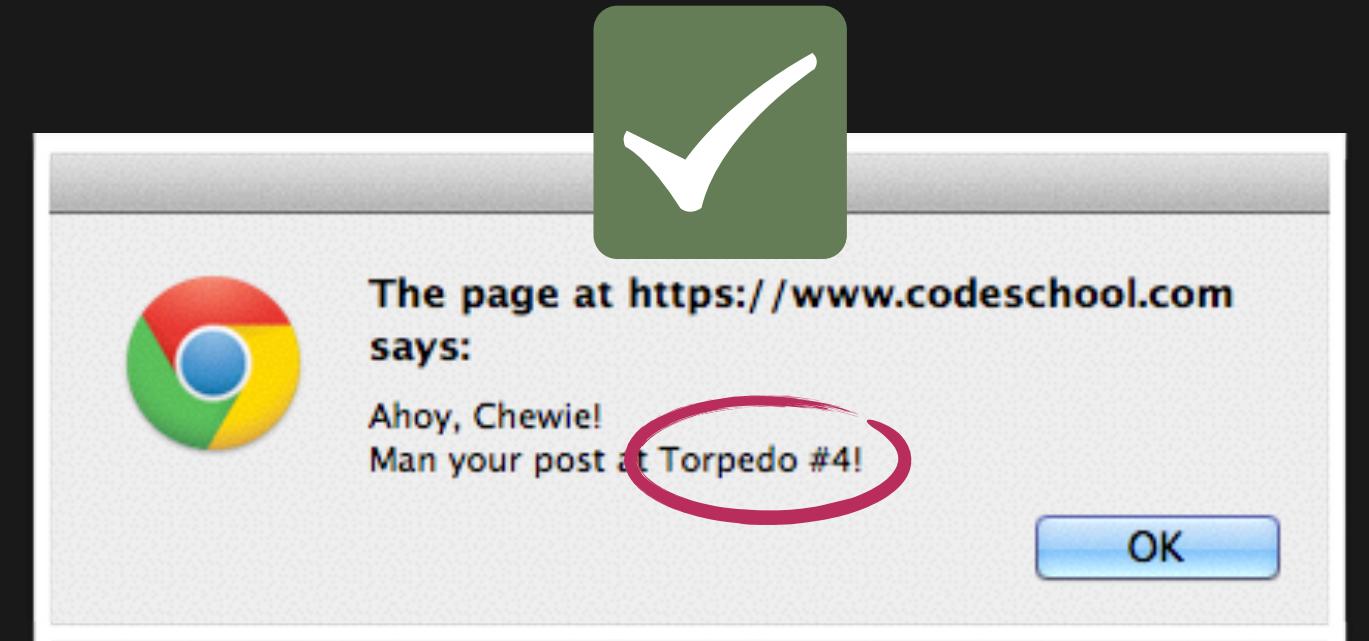
```
var subPassengers = ["Luke", "Leia", "Han", "Chewie", "Yoda", "R2-D2", "C-3PO", "Boba"];
```

WHAT CAN WE DO TO ENSURE THE CORRECT VALUE?

Several options exist for timing closures correctly

```
function assignTorpedo ( name, passengerArray ){  
    for (var i = 0; i<passengerArray.length; i++) {  
        if (passengerArray[i] == name) {  
            return function () {  
                alert("Ahoy, " + name + "!\n" +  
                    "Man your post at Torpedo #" +  
                    i);  
            };  
        }  
    }  
}
```

An immediate return has the expected effect, because *i* is not allowed to progress!



```
var subPassengers = ["Luke", "Leia", "Han", "Chewie", "Yoda", "R2-D2", "C-3PO", "Boba"];
```

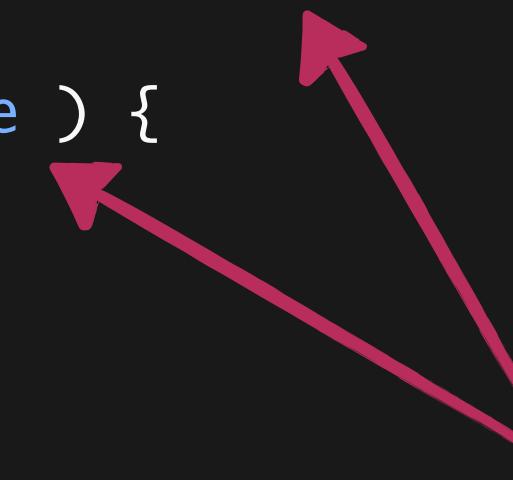
```
var giveAssignment = assignTorpedo("Chewie", subPassengers);
```

```
giveAssignment();
```

WHAT CAN WE DO TO ENSURE THE CORRECT VALUE?

We could also design the torpedo assigners a bit more like our ticket makers

```
function makeTorpedoAssigner ( passengerArray ) {  
  return function ( name ) {  
    };  
}  
};
```



This time our external function will only take in the `passengerArray`, and we'll let the returned function deal with a specific name.

```
var subPassengers = ["Luke", "Leia", "Han", "Chewie", "Yoda", "R2-D2", "C-3PO", "Boba"];
```

WHAT CAN WE DO TO ENSURE THE CORRECT VALUE?

We could also design the torpedo assigners a bit more like our ticket makers

```
function makeTorpedoAssigner ( passengerArray ) {  
  
    return function ( name ) {  
        for (var i = 0; i<passengerArray.length; i++) {  
              
        }; }  
    };
```

At this point, whatever `passengerArray` got passed in to `makeTorpedoAssigner` will be bound into the closure.
Parameters are part of the environment, too!

```
var subPassengers = ["Luke", "Leia", "Han", "Chewie", "Yoda", "R2-D2", "C-3PO", "Boba"];
```

WHAT CAN WE DO TO ENSURE THE CORRECT VALUE?

We could also design the torpedo assigners a bit more like our ticket makers

```
function makeTorpedoAssigner ( passengerArray ) {  
  return function ( name ) {  
    for (var i = 0; i<passengerArray.length; i++) {  
      if (passengerArray[i] == name) {  
        alert("Ahoy, " + name + "!\n" +  
          "Man your post at Torpedo #" + (i+1) + "!");  
      }  
    };  
  };  
}
```

The only closed variable from the external scope is `passengerArray`, which never changes.

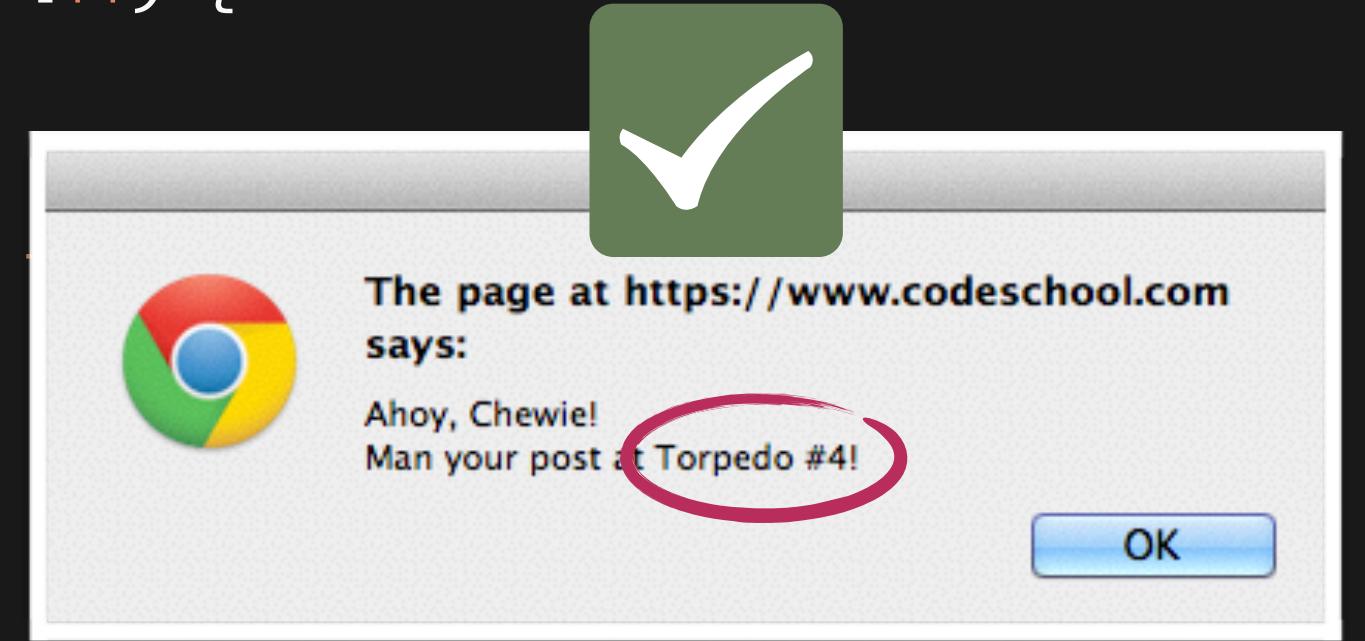
Since we've put the loop inside the returned function, `i` will come directly from that local scope.

```
var subPassengers = ["Luke", "Leia", "Han", "Chewie", "Yoda", "R2-D2", "C-3PO", "Boba"];
```

NOW WE CAN PASS OUT TORPEDOES LIKE CANDY

TIE Fighter, dead ahead!...Er, underwater...

```
function makeTorpedoAssigner ( passengerArray ) {  
  
    return function ( name ) {  
        for (var i = 0; i<passengerArray.length; i++) {  
            if (passengerArray[i] == name) {  
                alert("Ahoy, " + name + "!\n" +  
                    "Man your post at Torpedo #"  
            }  
        }  
    };  
}
```



```
var subPassengers = ["Luke", "Leia", "Han", "Chewie", "Yoda", "R2-D2", "C-3PO", "Boba"];
```

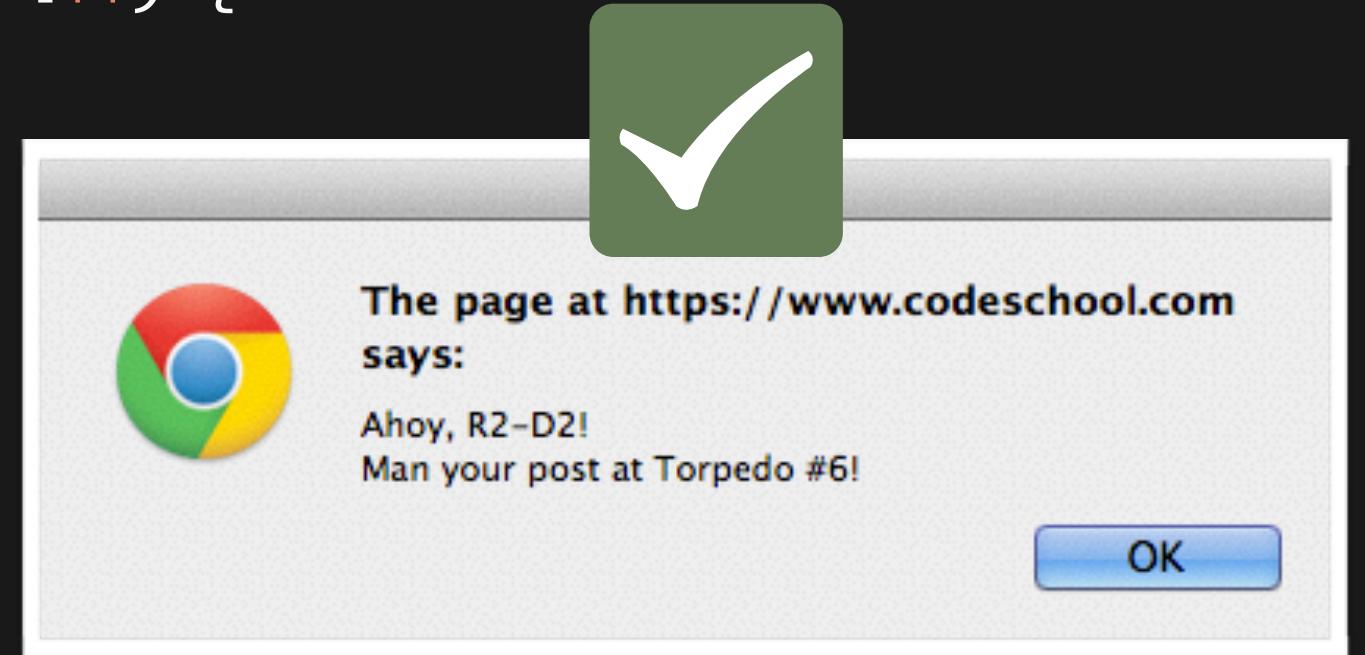
```
var getTorpedoFor = makeTorpedoAssigner(subPassengers);
```

```
getTorpedoFor("Chewie");
```

NOW WE CAN PASS OUT TORPEDOES LIKE CANDY

TIE Fighter, dead ahead!...Er, underwater...

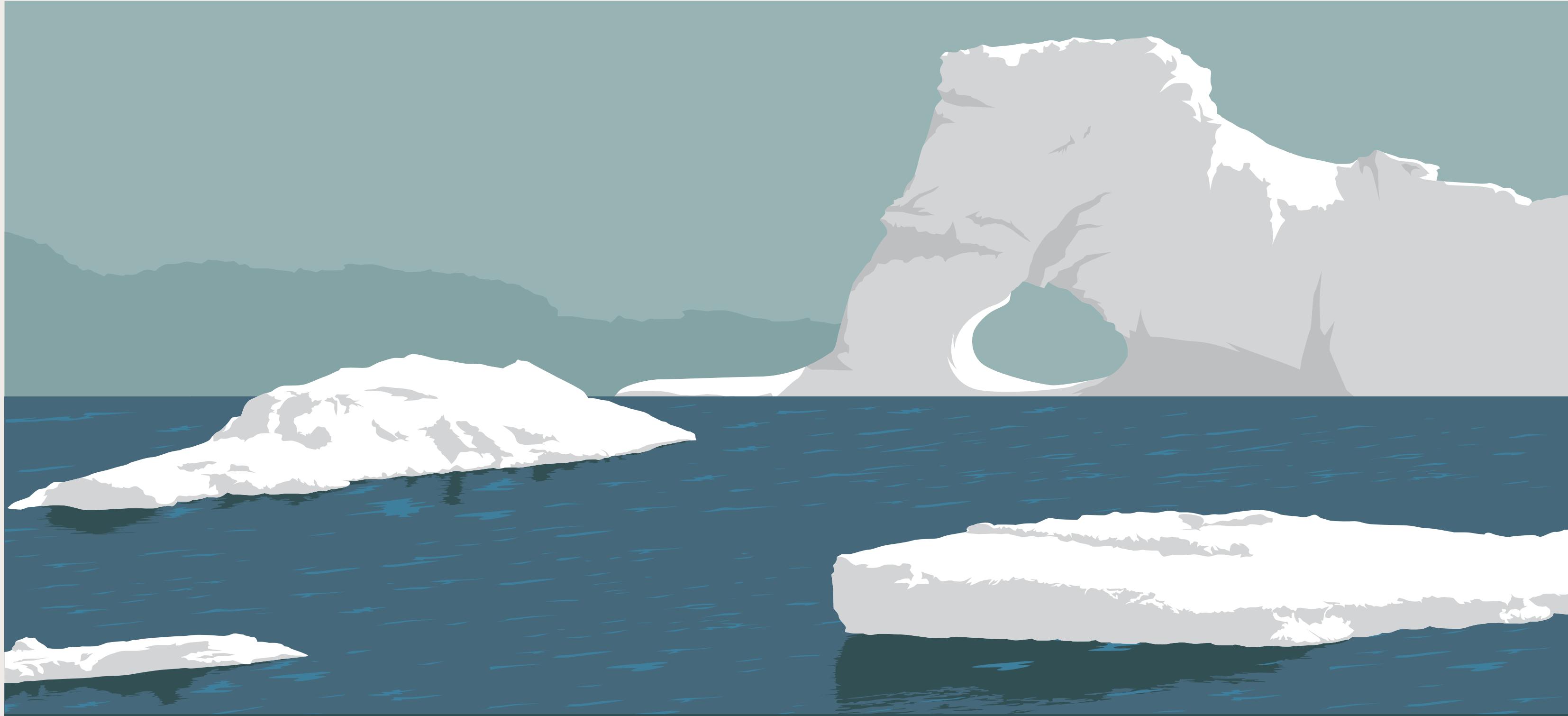
```
function makeTorpedoAssigner ( passengerArray ) {  
  
    return function ( name ) {  
        for (var i = 0; i<passengerArray.length; i++) {  
            if (passengerArray[i] == name) {  
                alert("Ahoy, " + name + "!\n" +  
                    "Man your post at Torpedo #"  
            }  
        }  
    };  
}
```



```
var subPassengers = ["Luke", "Leia", "Han", "Chewie", "Yoda", "R2-D2", "C-3PO", "Boba"];
```

```
var getTorpedoFor = makeTorpedoAssigner(subPassengers);
```

```
getTorpedoFor( "R2-D2" );
```



Explore
COLD CLOSURES COVE



Climb

THE HOISTING HILLS

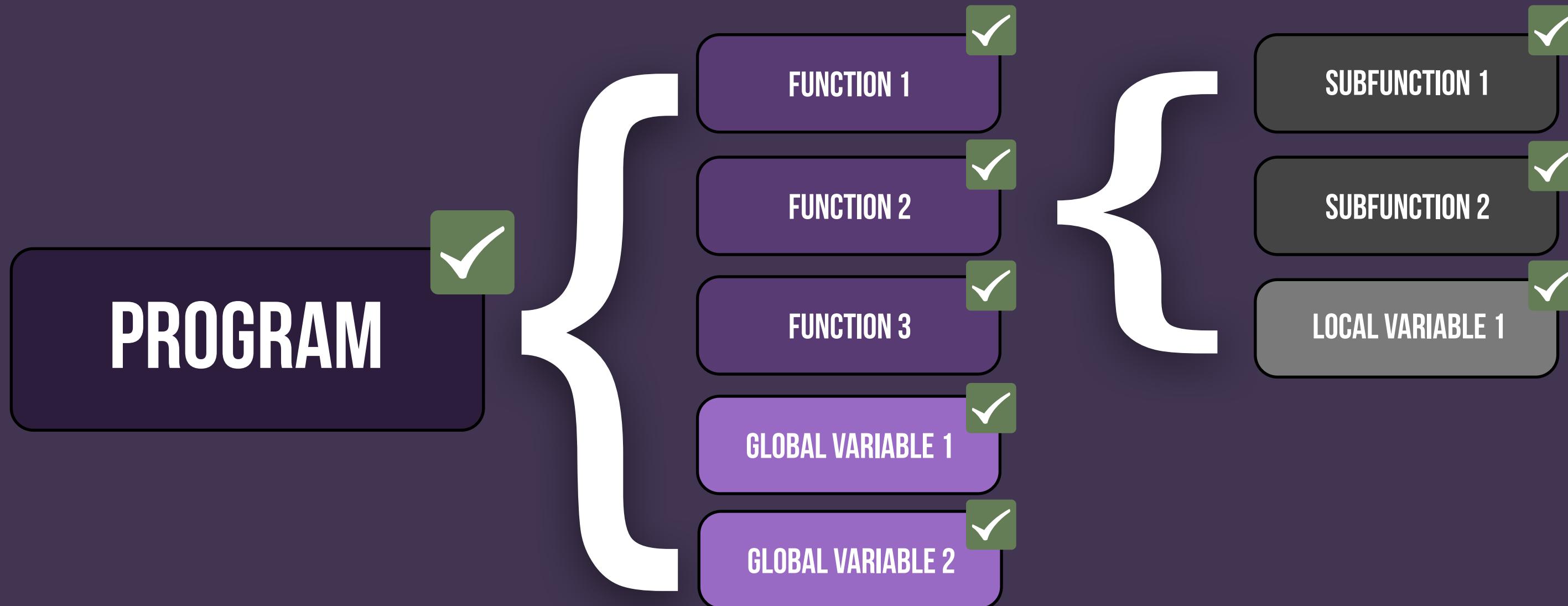


LEVEL 3

THE HOISTING HILLS

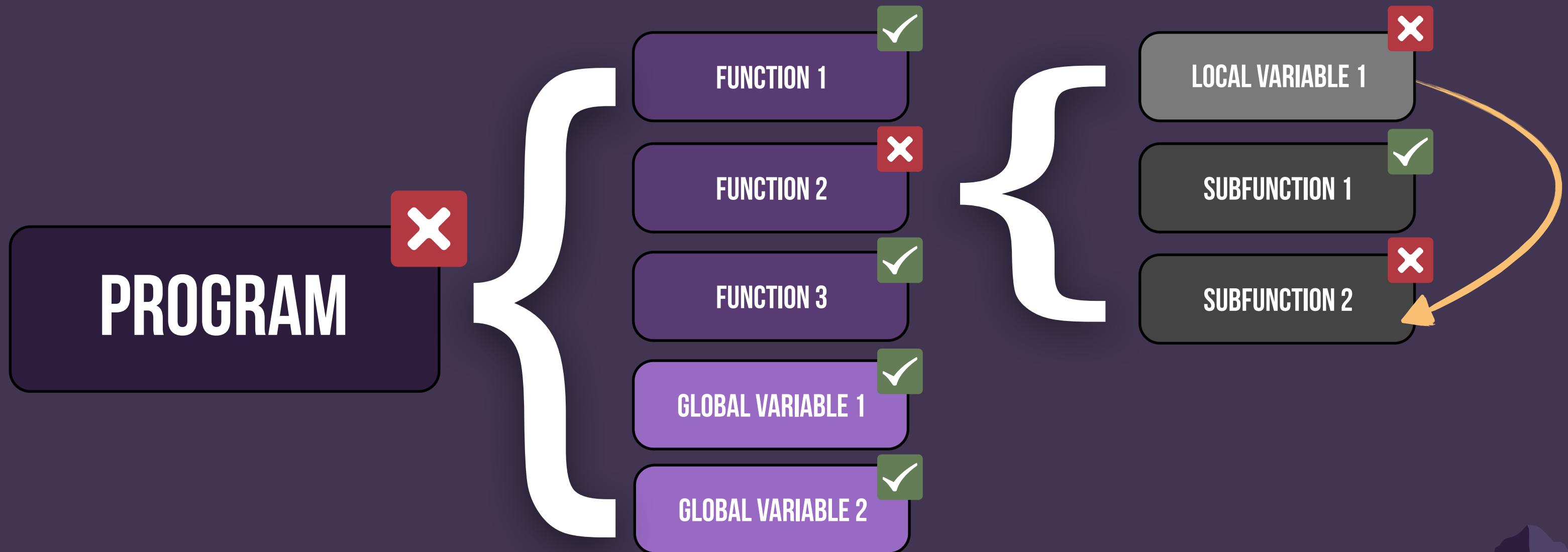
THE IMPORTANCE OF LOAD ORDER

Ensuring that every line of code can execute when it's needed



THE IMPORTANCE OF LOAD ORDER

Ensuring that every line of code can execute when it's needed



“HOISTING” WITHIN A JAVASCRIPT SCOPE

First, memory is set aside for all necessary variables and declared functions.

We build it like this...

```
function sumOfSquares (a, b){  
    var x = add(a*a, b*b);  
    return x;  
  
    function add (c, d){  
        var a = c + d;  
        return a;  
    }  
}
```

...but JavaScript loads it like this.

```
function sumOfSquares (a, b){  
    var x = undefined;  
    function add (c, d){  
        var a = c + d;  
        return a;  
    }  
    x = add(a*a, b*b);  
    return x;  
}
```

Declared stuff that needs space in memory is first “hoisted” to the top of scope before any operational code is run.

CODING CAREFULLY FOR SMOOTH EXECUTION

Some examples of the impact of hoisting

```
function getMysteryNumber () {  
    function chooseMystery() {  
        return 12;  
    }  
  
    return chooseMystery();  
  
    function chooseMystery() {  
        return 7;  
    }  
  
}
```

```
getMysteryNumber( );
```

→ ?

Loads like this

```
function getMysteryNumber () {  
    function chooseMystery() {  
        return 12;  
    }  
  
    ✓ function chooseMystery() {  
        return 7;  
    }  
  
    return chooseMystery();  
}
```

```
getMysteryNumber( );
```

The `chooseMystery` function is redefined by the time all hoisting is finished!

→ 7

CODING CAREFULLY FOR SMOOTH EXECUTION

Function Expressions are never hoisted! They are treated as assignments.

```
function getMysteryNumber () {  
    var chooseMystery = function() {  
        return 12;  
    }  
  
    return chooseMystery();  
  
    var chooseMystery = function() {  
        return 7;  
    }  
}
```

```
getMysteryNumber( );
```

Loads like this

Unreachable!

```
function getMysteryNumber () {  
    var chooseMystery = undefined;  
    var chooseMystery = undefined;  
    ✓ chooseMystery = function () {  
        return 12;  
    };  
  
    return chooseMystery();  
    ✗ chooseMystery = function () {  
        return 7;  
    }  
}
```

```
getMysteryNumber( );
```

→ ?

→ 12

CODING CAREFULLY FOR SMOOTH EXECUTION

Function Expressions are never hoisted! They are treated as assignments.

```
function getMysteryNumber () {  
    return chooseMystery();  
  
    var chooseMystery = function() {  
        return 12;  
    }  
  
    var chooseMystery = function() {  
        return 7;  
    }  
}
```

```
getMysteryNumber( );
```

Loads like this

Unreachable!

```
function getMysteryNumber () {  
    var chooseMystery = undefined;  
    var chooseMystery = undefined;  
    return chooseMystery();  
  
    chooseMystery = function () {  
        return 12;  
    };  
    chooseMystery = function () {  
        return 7;  
    };
```

```
getMysteryNumber( );
```

→ ?

→ ERROR

HOW MIGHT THIS AFFECT OUR EARLIER TRAIN SYSTEM?

Hoisting in a function that returns a capacity status for the JavaScript Express

```
function capacityStatus (numPassengers, capacity) {
```

if the train is full

execute a function that alerts a message
that no seats remain and then returns false.

if the train is NOT full

execute a function that alerts a message with
how many seats remain, and then returns true.

```
}
```

HOW MIGHT THIS AFFECT OUR EARLIER TRAIN SYSTEM?

Hoisting in a function that returns a capacity status for the JavaScript Express

```
function capacityStatus (numPassengers, capacity) {  
  
    if (numPassengers == capacity)  
        execute a function that alerts a message  
        that no seats remain and then returns false.  
  
    *if the train is NOT full*  
        execute a function that alerts a message with  
        how many seats remain, and then returns true.  
}
```

HOW MIGHT THIS AFFECT OUR EARLIER TRAIN SYSTEM?

Hoisting in a function that returns a capacity status for the JavaScript Express

```
function capacityStatus (numPassengers, capacity) {  
  
    if (numPassengers == capacity) {  
        noSeats();  
    }  
}
```

if the train is NOT full

execute a function that alerts a message with
how many seats remain, and then returns true.

```
}
```

HOW MIGHT THIS AFFECT OUR EARLIER TRAIN SYSTEM?

Hoisting in a function that returns a capacity status for the JavaScript Express

```
function capacityStatus (numPassengers, capacity) {  
  
    if (numPassengers == capacity) {  
        noSeats();  
    } else {  
  
    }  
}
```

*execute a function that alerts a message with
how many seats remain, and then returns true.*

```
}
```

HOW MIGHT THIS AFFECT OUR EARLIER TRAIN SYSTEM?

Hoisting in a function that returns a capacity status for the JavaScript Express

```
function capacityStatus (numPassengers, capacity) {  
  
    if (numPassengers == capacity) {  
        noSeats();  
    } else {  
        seatsAvail();  
    }  
  
}  
  
}
```

HOW MIGHT THIS AFFECT OUR EARLIER TRAIN SYSTEM?

Hoisting in a function that returns a capacity status for the JavaScript Express

```
function capacityStatus (numPassengers, capacity) {  
  
    if (numPassengers == capacity) {  
        noSeats();  
    } else {  
        seatsAvail();  
    }  
  
    var noSeats = function (){  
        alert("No seats left!");  
        return false;  
    }  
}
```

HOW MIGHT THIS AFFECT OUR EARLIER TRAIN SYSTEM?

Hoisting in a function that returns a capacity status for the JavaScript Express

```
function capacityStatus (numPassengers, capacity) {  
  
    if (numPassengers == capacity) {  
        noSeats();  
    } else {  
        seatsAvail();  
    }  
  
    var noSeats = function (){  
        alert("No seats left!");  
        return false;  
    }  
    var seatsAvail = function(){  
        alert("There are " + (capacity - numPassengers) + " seats left!");  
        return true;  
    }  
}
```

HOW MIGHT THIS AFFECT OUR EARLIER TRAIN SYSTEM?

Hoisting in a function that returns a capacity status for the JavaScript Express

```
function capacityStatus (numPassengers, capacity) {  
  
    if (numPassengers == capacity) {  
        noSeats();  
    } else {  
        seatsAvail();  
    }  
  
    var noSeats = function (){  
        alert("No seats left!");  
        return false;  
    }  
    var seatsAvail = function(){  
        alert("There are " + (capacity - numPassengers) + " seats left!");  
        return true;  
    }  
}
```

capacityStatus(60, 60);



HOW MIGHT THIS AFFECT OUR EARLIER TRAIN SYSTEM?

Hoisting in a function that returns a capacity status for the JavaScript Express

```
function capacityStatus (numPassengers, capacity) {  
  
    if (numPassengers == capacity) {  
        noSeats();  
    } else {  
        seatsAvail();  
    }  
  
    var noSeats = function (){  
        alert("No seats left!");  
        return false;  
    }  
    var seatsAvail = function(){  
        alert("There are " + (capacity - numPassengers) + " seats left!");  
        return true;  
    }  
}
```

capacityStatus(60, 60);



HOW MIGHT THIS AFFECT OUR EARLIER TRAIN SYSTEM?

Hoisting in a function that returns a capacity status for the JavaScript Express

```
function capacityStatus (numPassengers, capacity) {  
    var noSeats = undefined;  
    var seatsAvail = undefined;  
    if (numPassengers == capacity) {  
        ✓ → noSeats();  
        ✗ → seatsAvail();  
    } else {  
        seatsAvail();  
    }  
    noSeats = function (){  
        alert("No seats left!");  
        return false;  
    }  
    seatsAvail = function(){  
        alert("There are " + (capacity - numPassengers) + " seats left!");  
        return true;  
    }  
}
```

Doesn't exist yet!

capacityStatus(60, 60);



HOW MIGHT THIS AFFECT OUR EARLIER TRAIN SYSTEM?

Hoisting in a function that returns a capacity status for the JavaScript Express

```
function capacityStatus (numPassengers, capacity) {  
    var noSeats = undefined;  
    var seatsAvail = undefined;  
    if (numPassengers == capacity) {  
        ✅ → noSeats();  
    } else {  
        ✗ → seatsAvail();  
    }  
    noSeats = function (){  
        alert("No seats left!");  
        return false;  
    }  
    seatsAvail = function(){  
        alert("There are " + (capacity - numPassengers) + " seats left!");  
        return true;  
    }  
}
```

Doesn't exist yet!

capacityStatus(60, 60); → ERROR

HOW MIGHT THIS AFFECT OUR EARLIER TRAIN SYSTEM?

Hoisting in a function that returns a capacity status for the JavaScript Express

```
function capacityStatus (numPassengers, capacity) {  
  
    if (numPassengers == capacity) {  
        noSeats();  
    } else {  
        seatsAvail();  
    }  
  
    var noSeats = function (){  
        alert("No seats left!");  
        return false;  
    }  
    var seatsAvail = function(){  
        alert("There are " + (capacity - numPassengers) + " seats left!");  
        return true;  
    }  
}
```

HOW MIGHT THIS AFFECT OUR EARLIER TRAIN SYSTEM?

Hoisting in a function that returns a capacity status for the JavaScript Express

```
function capacityStatus (numPassengers, capacity) {  
  
    var noSeats = function (){  
        alert("No seats left!");  
        return false;  
    }  
    var seatsAvail = function(){  
        alert("There are " + (capacity - numPassengers) + " seats left!");  
        return true;  
    }  
  
    if (numPassengers == capacity) {  
        noSeats();  
    } else {  
        seatsAvail();  
    }  
}
```

capacityStatus(60, 60);



HOW MIGHT THIS AFFECT OUR EARLIER TRAIN SYSTEM?

Hoisting in a function that returns a capacity status for the JavaScript Express

```
function capacityStatus (numPassengers, capacity) {  
    var noSeats = undefined;  
    var seatsAvail = undefined;  
    noSeats = function (){  
        alert("No seats left!");  
        return false;  
    }  
    seatsAvail = function(){  
        alert("There are " + (capacity - numPassengers) + " seats left!");  
        return true;  
    }  
    if (numPassengers == capacity) {  
        noSeats();  
    } else {  
        seatsAvail();  
    }  
}
```

capacityStatus(60, 60);

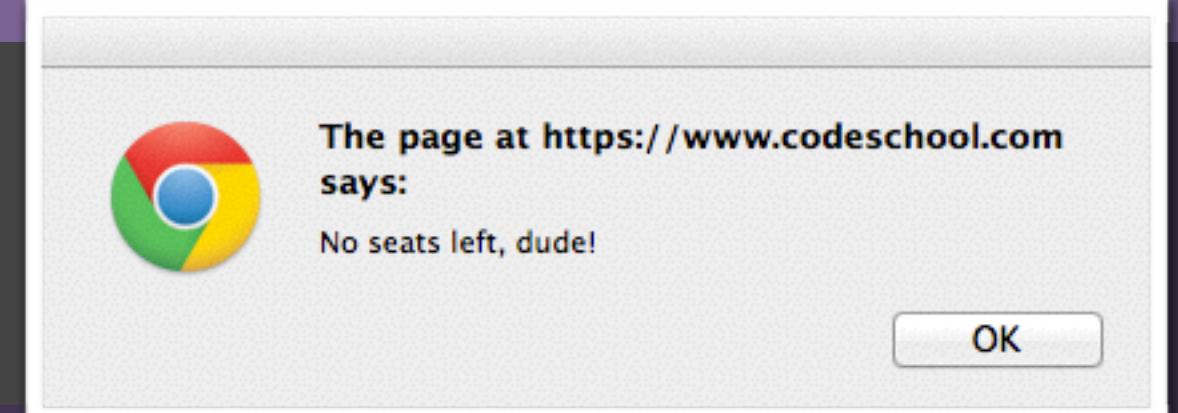


HOW MIGHT THIS AFFECT OUR EARLIER TRAIN SYSTEM?

Hoisting in a function that returns a capacity status for the JavaScript Express

```
function capacityStatus (numPassengers, capacity) {  
    var noSeats = undefined;  
    var seatsAvail = undefined;  
    noSeats = function (){  
        alert("No seats left!");  
        return false;  
    }  
    seatsAvail = function(){  
        alert("There are " + (capacity - numPassengers) + " seats left!");  
        return true;  
    }  
    if (numPassengers == capacity) {  
        noSeats();  
    } else {  
        seatsAvail();  
    }  
}
```

capacityStatus(60, 60);



HOW MIGHT THIS AFFECT OUR EARLIER TRAIN SYSTEM?

Hoisting in a function that returns a capacity status for the JavaScript Express

```
function capacityStatus (numPassengers, capacity) {  
  
    if (numPassengers == capacity) {  
        noSeats();  
    } else {  
        seatsAvail();  
    }  
  
    var noSeats = function (){  
        alert("No seats left!");  
        return false;  
    }  
    var seatsAvail = function (){  
        alert("There are " + (capacity - numPassengers) + " seats left!");  
        return true;  
    }  
}
```

HOW MIGHT THIS AFFECT OUR EARLIER TRAIN SYSTEM?

Hoisting in a function that returns a capacity status for the JavaScript Express

```
function capacityStatus (numPassengers, capacity) {  
  
    if (numPassengers == capacity) {  
        noSeats();  
    } else {  
        seatsAvail();  
    }  
  
    function noSeats (){  
        alert("No seats left!");  
        return false;  
    }  
    function seatsAvail (){  
        alert("There are " + (capacity - numPassengers) + " seats left!");  
        return true;  
    }  
}
```

capacityStatus(20, 60);



HOW MIGHT THIS AFFECT OUR EARLIER TRAIN SYSTEM?

Hoisting in a function that returns a capacity status for the JavaScript Express

```
function capacityStatus (numPassengers, capacity) {  
    function noSeats (){  
        alert("No seats left!");  
        return false;  
    }  
    function seatsAvail (){  
        alert("There are " + (capacity - numPassengers) + " seats left!");  
        return true;  
    }  
    if (numPassengers == capacity) {  
        noSeats();  
    } else {  
        seatsAvail();  
    }  
}
```

capacityStatus(20, 60);

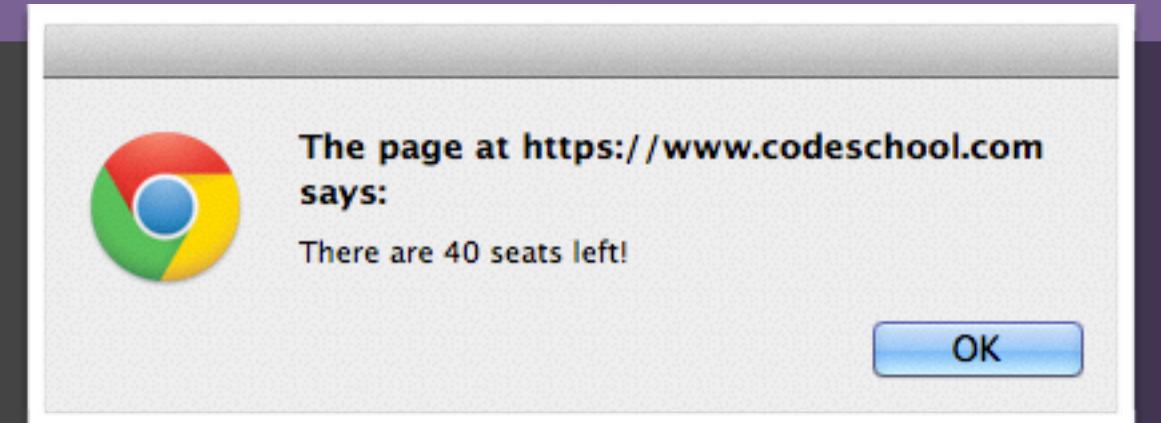


HOW MIGHT THIS AFFECT OUR EARLIER TRAIN SYSTEM?

Hoisting in a function that returns a capacity status for the JavaScript Express

```
function capacityStatus (numPassengers, capacity) {  
    function noSeats (){  
        alert("No seats left!");  
        return false;  
    }  
    function seatsAvail (){  
        alert("There are " + (capacity - numPassengers) + " seats left!");  
        return true;  
    }  
    if (numPassengers == capacity) {  
        noSeats();  
    } else {  
        seatsAvail();  
    }  
}
```

capacityStatus(20, 60);



The page at <https://www.codeschool.com> says:
There are 40 seats left!

OK



Climb

THE HOISTING HILLS



See the Shimmering
OCEAN OF OBJECTS



LEVEL 4
OCEAN OF OBJECTS

OBJECTS ARE “CONTAINERS” OF RELATED INFORMATION

Multiple pieces of data, called properties, are grouped within an Object

OBJECT

property 1

property 2

property 3

property 4

property 5

property 6

All of these properties “belong” to this
Object.



WE CAN REPRESENT EVERYDAY STUFF WITH JS OBJECTS

Since common things have “bits” of related info, they make good Object examples

OBJECT

property 1
property 2
property 3

property 4
property 5
property 6



WE CAN REPRESENT EVERYDAY STUFF WITH JS OBJECTS

Since common things have “bits” of related info, they make good Object examples

BOOK

property 1
property 2
property 3

property 4
property 5
property 6



WE CAN REPRESENT EVERYDAY STUFF WITH JS OBJECTS

Since common things have “bits” of related info, they make good Object examples



BOOK

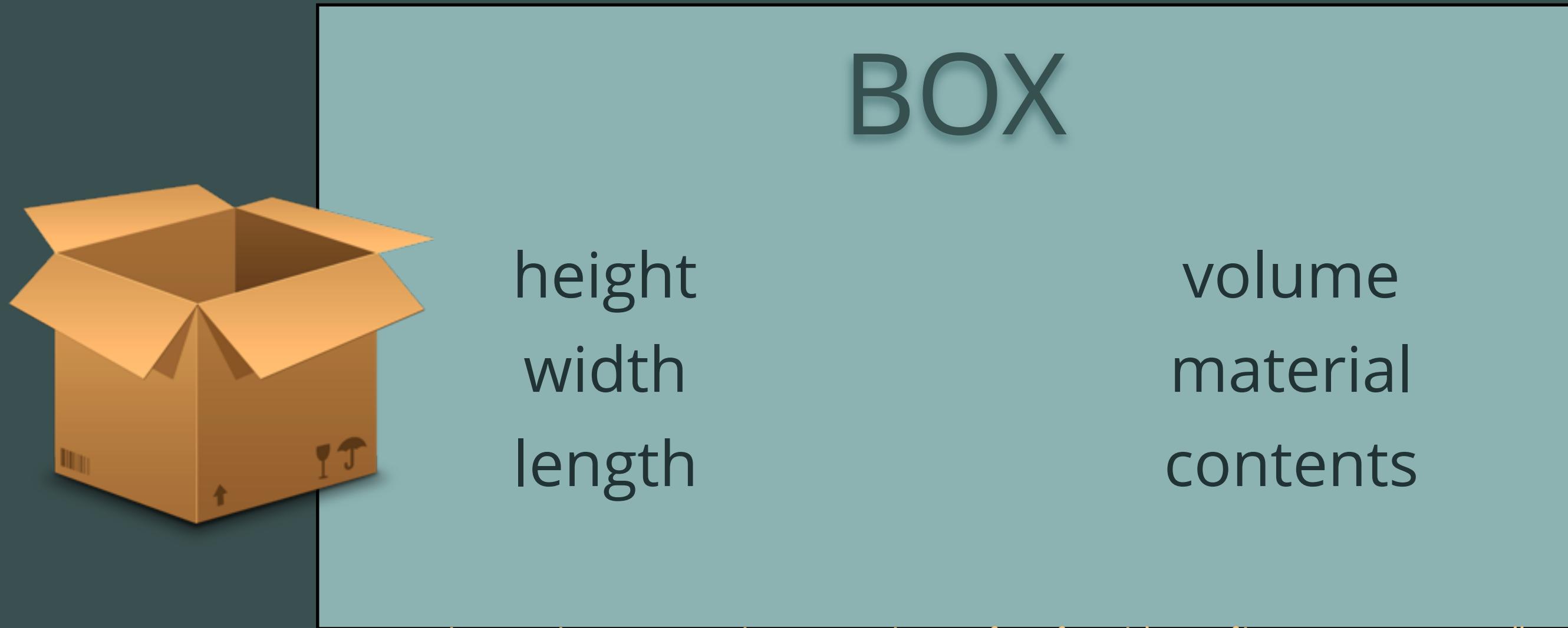
title
author
publisher

numChapters
numPages
illustrator

Each property is an important bit of data associated with a book.

WE CAN REPRESENT EVERYDAY STUFF WITH JS OBJECTS

Since common things have “bits” of related info, they make good Object examples



Because an Object contains multiple bits of info, it's often called a "composite value."

AN OBJECT'S PROPERTIES CAN BE ASSIGNED VALUES

Like with everyday objects, properties can point to specific amounts or qualities



BOX

height : 6

width : 8

length : 10

volume : 480

material : "cardboard"

contents : booksArray

Properties can refer to numbers, strings, arrays, functions, and even other Objects!

CREATING AN OBJECT WITH JAVASCRIPT

There are multiple ways to build Objects...let's look first at the "Object literal."



BOX

height : 6	volume : 480
width : 8	material : "cardboard"
length : 10	contents : booksArray

```
var myBox = { };
```



A set of curly brackets says to make a new object...in this case, however, it's an empty one with no properties.

CREATING AN OBJECT WITH JAVASCRIPT

There are multiple ways to build Objects...let's look first at the "Object literal."



BOX

height : 6	volume : 480
width : 8	material : "cardboard"
length : 10	contents : booksArray

```
var myBox = { height: 6 };
```



Adding a property involves creating a name for the property using a string, and then assigning a value to it using a :.

CREATING AN OBJECT WITH JAVASCRIPT

There are multiple ways to build Objects...let's look first at the "Object literal."



BOX

height : 6	volume : 480
width : 8	material : "cardboard"
length : 10	contents : booksArray

```
var myBox = { height: 6, width: 8, length: 10, volume: 480 };
```



Multiple properties are separated by commas.

CREATING AN OBJECT WITH JAVASCRIPT

There are multiple ways to build Objects...let's look first at the "Object literal."



BOX

height : 6	volume : 480
width : 8	material : "cardboard"
length : 10	contents : booksArray

```
var myBox = { height: 6, width: 8, length: 10, volume: 480,  
    material: "cardboard",  
    contents: ["Great Expectations", "The Remains of the Day", "Peter Pan"]  
};
```

Sweet, a box Object complete with properties!

OBJECT PROPERTIES WILL ALSO ACCEPT VARIABLES

We can initialize the 'contents' property with a booksArray variable



BOX

height : 6	volume : 480
width : 8	material : "cardboard"
length : 10	contents : booksArray

```
var myBox = { height: 6, width: 8, length: 10, volume: 480,  
    material: "cardboard",  
    contents: ["Great Expectations", "The Remains of the Day", "Peter Pan"]  
};
```

OBJECT PROPERTIES WILL ALSO ACCEPT VARIABLES

We can initialize the 'contents' property with a booksArray variable



BOX

height : 6	volume : 480
width : 8	material : "cardboard"
length : 10	contents : booksArray

```
var booksArray = ["Great Expectations", "The Remains of the Day", "Peter Pan"];
var myBox = { height: 6, width: 8, length: 10, volume: 480,
    material: "cardboard",
    contents: ["Great Expectations", "The Remains of the Day", "Peter Pan"]
};
```

OBJECT PROPERTIES WILL ALSO ACCEPT VARIABLES

We can initialize the 'contents' property with a booksArray variable



BOX

height : 6	volume : 480
width : 8	material : "cardboard"
length : 10	contents : booksArray

```
var booksArray = ["Great Expectations", "The Remains of the Day", "Peter Pan"];
var myBox = { height: 6, width: 8, length: 10, volume: 480,
             material: "cardboard",
             contents: booksArray
           };
```

REFERENCING AN OBJECT'S PROPERTIES

We can take a peek at any particular property of an object using the dot operator

```
var booksArray = ["Great Expectations", "The Remains of the Day", "Peter Pan"];  
var myBox = { height: 6, width: 8, length: 10, volume: 480,  
             material: "cardboard",  
             contents: booksArray  
           };
```



```
myBox.width;
```

→ 8

```
myBox.materials;
```

→ "cardboard"

```
myBox.contents;
```

→ ["Great Expectations", "The Remains of the Day", "Peter Pan"]

CHANGING PROPERTY VALUES

The dot operator also allows modification of properties, even using methods

booksArray

```
["Great Expectations", "The Remains of the Day", "Peter Pan"]
```



myBox

```
height: 6  
width: 8  
length: 10  
volume: 480  
material: "cardboard"  
contents: booksArray
```

```
myBox.width = 12;
```

CHANGING PROPERTY VALUES

The dot operator also allows modification of properties, even using methods

booksArray

```
["Great Expectations", "The Remains of the Day", "Peter Pan"]
```



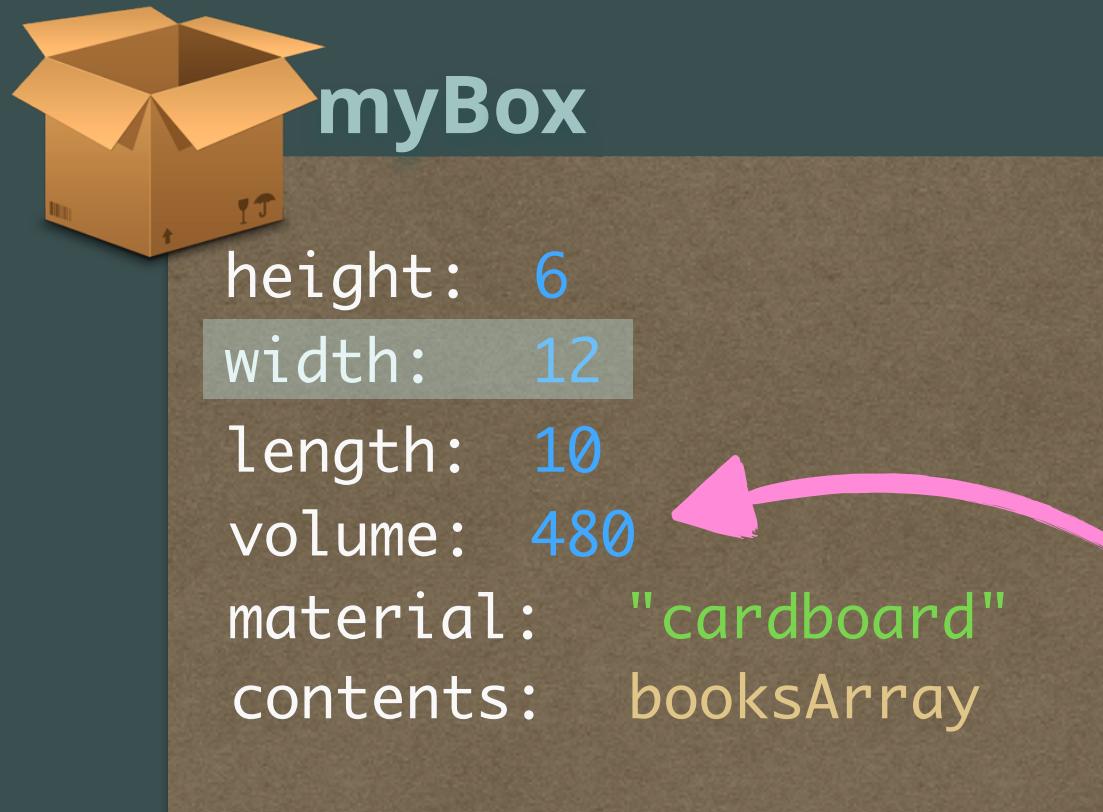
```
myBox.width = 12;
```

CHANGING PROPERTY VALUES

The dot operator also allows modification of properties, even using methods

booksArray

```
["Great Expectations", "The Remains of the Day", "Peter Pan"]
```



```
myBox.width = 12;  
console.log( myBox.width );
```

→ 12

Oops, that makes our volume incorrect!

CHANGING PROPERTY VALUES

The dot operator also allows modification of properties, even using methods

booksArray

```
["Great Expectations", "The Remains of the Day", "Peter Pan"]
```



```
myBox.width = 12;  
console.log( myBox.width );
```

→ 12

```
myBox.volume = myBox.length * myBox.width * myBox.height;
```

CHANGING PROPERTY VALUES

The dot operator also allows modification of properties, even using methods

booksArray

```
["Great Expectations", "The Remains of the Day", "Peter Pan"]
```



```
myBox.width = 12;  
console.log( myBox.width );
```

→ 12

```
myBox.volume = myBox.length * myBox.width * myBox.height;
```

CHANGING PROPERTY VALUES

The dot operator also allows modification of properties, even using methods

booksArray

```
["Great Expectations", "The Remains of the Day", "Peter Pan"]
```



```
myBox.width = 12;  
console.log( myBox.width );
```

→ 12

```
myBox.volume = myBox.length * myBox.width * myBox.height;  
console.log( myBox.volume );
```

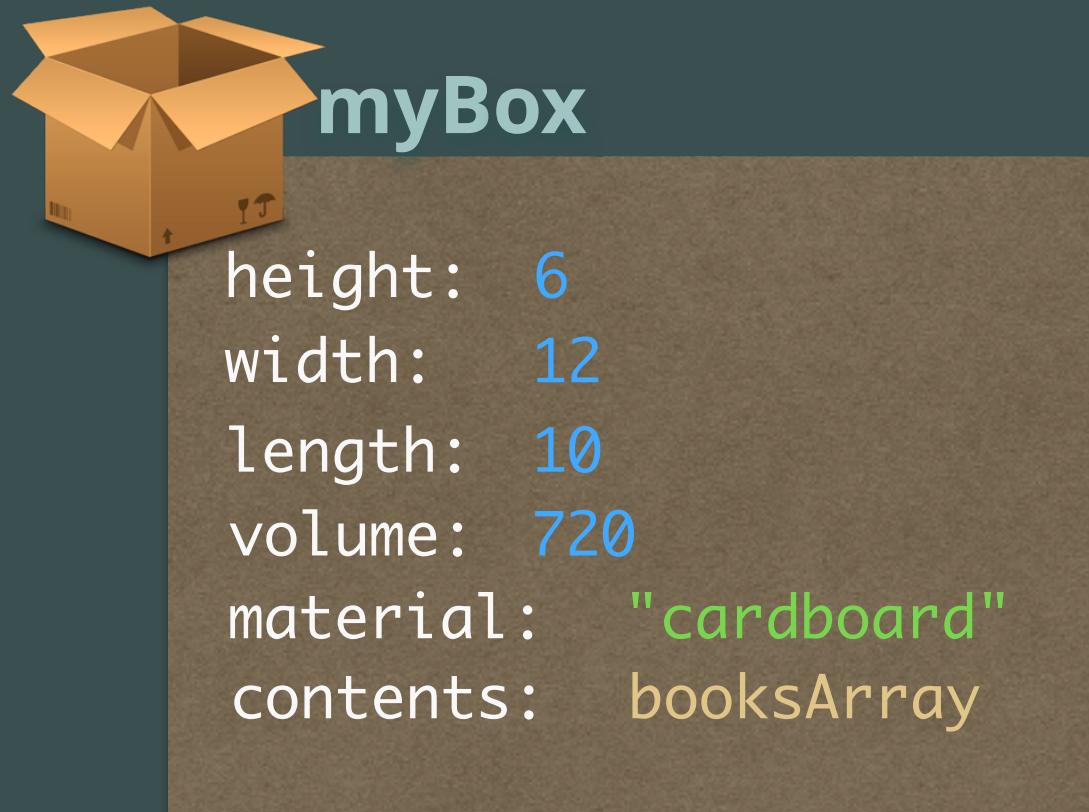
→ 720

CHANGING PROPERTY VALUES

The dot operator also allows modification of properties, even using methods

booksArray

```
["Great Expectations", "The Remains of the Day", "Peter Pan"]
```



```
myBox.contents.push("On The Road");
```

↑
myBox.contents returns an entire Array,
to which we can easily apply Array
methods.

CHANGING PROPERTY VALUES

The dot operator also allows modification of properties, even using methods

booksArray

```
["Great Expectations", "The Remains of the Day", "Peter Pan"]
```



myBox

height: 6

width: 12

length: 10

volume: 720

material: "cardboard"

contents: booksArray

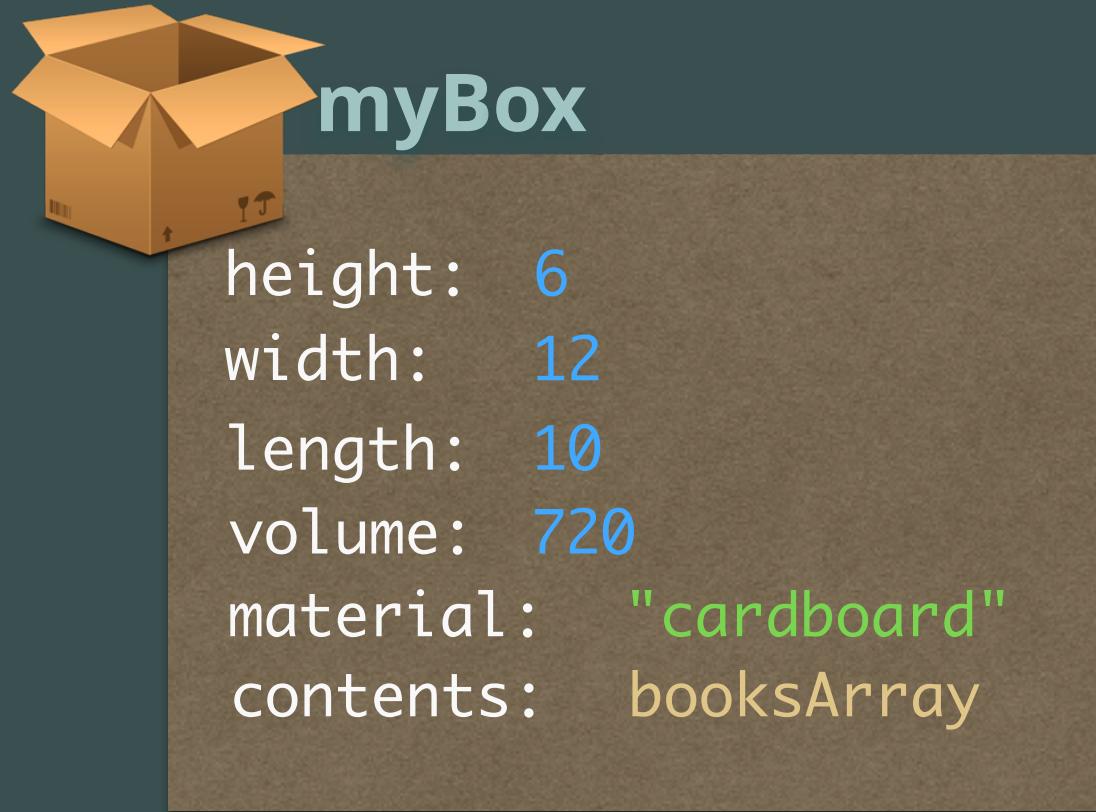
```
myBox.contents.push("On The Road");
```

CHANGING PROPERTY VALUES

The dot operator also allows modification of properties, even using methods

booksArray

```
["Great Expectations", "The Remains of the Day", "Peter Pan", "On The Road"]
```



```
myBox.contents.push("On The Road");
```

Whoa, we modified the external array outside of myBox ? How'd we do that?

CHANGING PROPERTY VALUES

The dot operator also allows modification of properties, even using methods

booksArray

```
["Great Expectations", "The Remains of the Day", "Peter Pan", "On The Road"]
```



```
myBox.contents.push("On The Road");
```

Passing in **booksArray** only makes a REFERENCE to the external Array contained in the variable, and doesn't create a brand new copied Array.

CHANGING PROPERTY VALUES

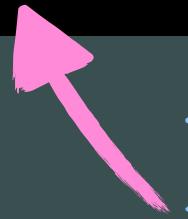
The dot operator also allows modification of properties, even using methods

booksArray

```
["Great Expectations", "The Remains of the Day", "Peter Pan", "On The Road"]
```



```
myBox.contents.push("On The Road");
```



Since we're only referring to **booksArray**, pushing to **myBox.contents** (or using any Array method) will just modify **booksArray**!

```
console.log( myBox.contents );
```

→ ["Great Expectations", "The Remains of the Day",
"Peter Pan", "On The Road"]

CHANGING PROPERTY VALUES

The dot operator also allows modification of properties, even using methods

booksArray

```
["Great Expectations", "The Remains of the Day", "Peter Pan", "On The Road"]
```



myBox

```
height: 6  
width: 12  
length: 10  
volume: 720  
material: "cardboard"  
contents: booksArray
```

```
myBox.contents.push("On The Road");
```

```
console.log( myBox.contents );
```

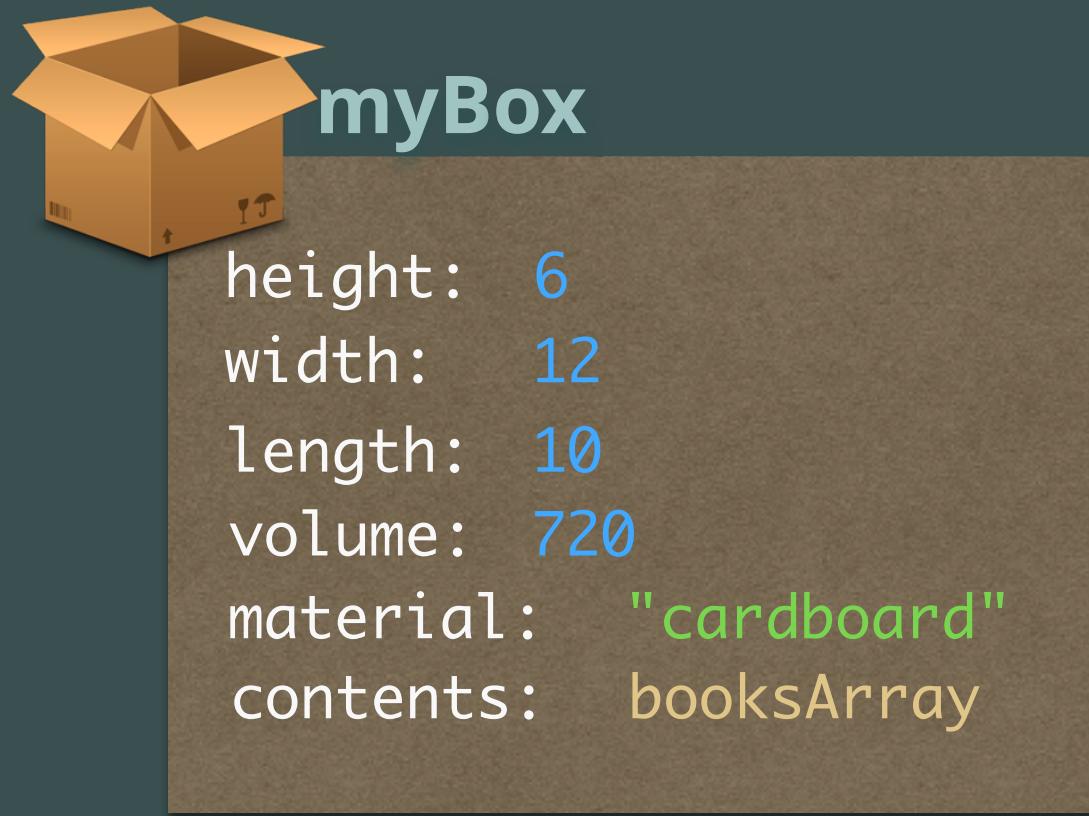
→ ["Great Expectations", "The Remains of the Day",
"Peter Pan", "On The Road"]

CHANGING PROPERTY VALUES

The dot operator also allows modification of properties, even using methods

booksArray

```
["Great Expectations", "The Remains of the Day", "Peter Pan", "On The Road"]
```



```
myBox.contents.push("On The Road");
```

```
console.log( myBox.contents );
```

→ ["Great Expectations", "The Remains of the Day",
"Peter Pan", "On The Road"]

```
console.log( booksArray );
```

→ ["Great Expectations", "The Remains of the Day",
"Peter Pan", "On The Road"]

ADDING PROPERTY VALUES POST-CREATION

Even after an object has been created, properties can continue to be added

booksArray

```
["Great Expectations", "The Remains of the Day", "Peter Pan", "On The Road"]
```



myBox

```
height: 6
width: 12
length: 10
volume: 720
material: "cardboard"
contents: booksArray
```

```
myBox.weight = 24;
```

ADDING PROPERTY VALUES POST-CREATION

Even after an object has been created, properties can continue to be added

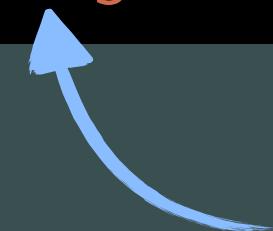
booksArray

```
["Great Expectations", "The Remains of the Day", "Peter Pan", "On The Road"]
```



```
height: 6  
width: 12  
length: 10  
volume: 720  
material: "cardboard"  
contents: booksArray  
weight: 24
```

```
myBox.weight = 24;
```



The myBox Object looks around for a weight property. Finding none, it creates one!

ADDING PROPERTY VALUES POST-CREATION

Even after an object has been created, properties can continue to be added

booksArray

```
["Great Expectations", "The Remains of the Day", "Peter Pan", "On The Road"]
```



myBox

```
height: 6
width: 12
length: 10
volume: 720
material: "cardboard"
contents: booksArray
weight: 24
destination1: "Orlando"
destination2: "Miami"
```

```
myBox.weight = 24;
```

```
myBox.destination1 = "Orlando";
```

```
myBox.destination2 = "Miami";
```

A SECOND WAY OF ACCESSING OR CREATING PROPERTIES

We can use brackets on Objects in similar fashion to accessing array indices

booksArray

```
[ "Great Expectations", "The Remains of the Day", "Peter Pan", "On The Road" ]
```



```
myBox["volume"];
```

→ 720

```
myBox["material"];
```

→ "cardboard"

An object is like an Array whose indices can be accessed with strings (with quotes) instead of numbers.

A SECOND WAY OF ACCESSING OR CREATING PROPERTIES

We can use brackets on Objects in similar fashion to accessing array indices

booksArray

```
["Great Expectations", "The Remains of the Day", "Peter Pan", "On The Road"]
```



```
myBox["# of stops"] = 2;
```



Since the brackets use or "check for" an exactly matching string, we can also create properties with spaces and characters in their names.

A SECOND WAY OF ACCESSING OR CREATING PROPERTIES

We can use brackets on Objects in similar fashion to accessing array indices

booksArray

```
["Great Expectations", "The Remains of the Day", "Peter Pan", "On The Road"]
```



```
height: 6   width: 12
length: 10  volume: 720
material: "cardboard"
contents: booksArray
weight: 24
destination1: "Orlando"
destination2: "Miami"
"# of stops": 2
```

```
myBox["# of stops"] = 2;
```



Since the brackets use or "check for" an exactly matching string, we can also create properties with spaces and characters in their names.

A SECOND WAY OF ACCESSING OR CREATING PROPERTIES

We can use brackets on Objects in similar fashion to accessing array indices

booksArray

```
["Great Expectations", "The Remains of the Day", "Peter Pan", "On The Road"]
```



myBox

```
height: 6    width: 12
length: 10   volume: 720
material: "cardboard"
contents: booksArray
weight: 24
destination1: "Orlando"
destination2: "Miami"
"# of stops": 2
```

```
myBox["# of stops"] = 2;
```

```
console.log( myBox.# of stops );
```

→ **ERROR**



No such syntax. Can't put a string after a dot. Beware!

A SECOND WAY OF ACCESSING OR CREATING PROPERTIES

We can use brackets on Objects in similar fashion to accessing array indices

booksArray

```
["Great Expectations", "The Remains of the Day", "Peter Pan", "On The Road"]
```



```
myBox["# of stops"] = 2;
```

```
console.log( myBox.# of stops );
```

→ ERROR

```
console.log( myBox["# of stops"] );
```

→ 2

Thus, key names with spaces can only be accessed with brackets!



BRACKETS ENABLE DYNAMIC PROPERTY ACCESS

Since brackets take expressions, we can avoid hard-coding every property access

booksArray

```
["Great Expectations", "The Remains of the Day", "Peter Pan", "On The Road"]
```



```
for(var i = 1, i <= myBox["# of stops"]; i++){  
    console.log( myBox["destination" + i] );  
}
```

→ Orlando
→ Miami

We can place string-based
expressions in the brackets to
construct specific property
names.

CHANGING OUR CONTENTS TO INDIVIDUAL OBJECTS

Each book in our 'contents' property could be a Book object

booksArray

```
["Great Expectations", "The Remains of the Day", "Peter Pan", "On The Road"]
```



myBox

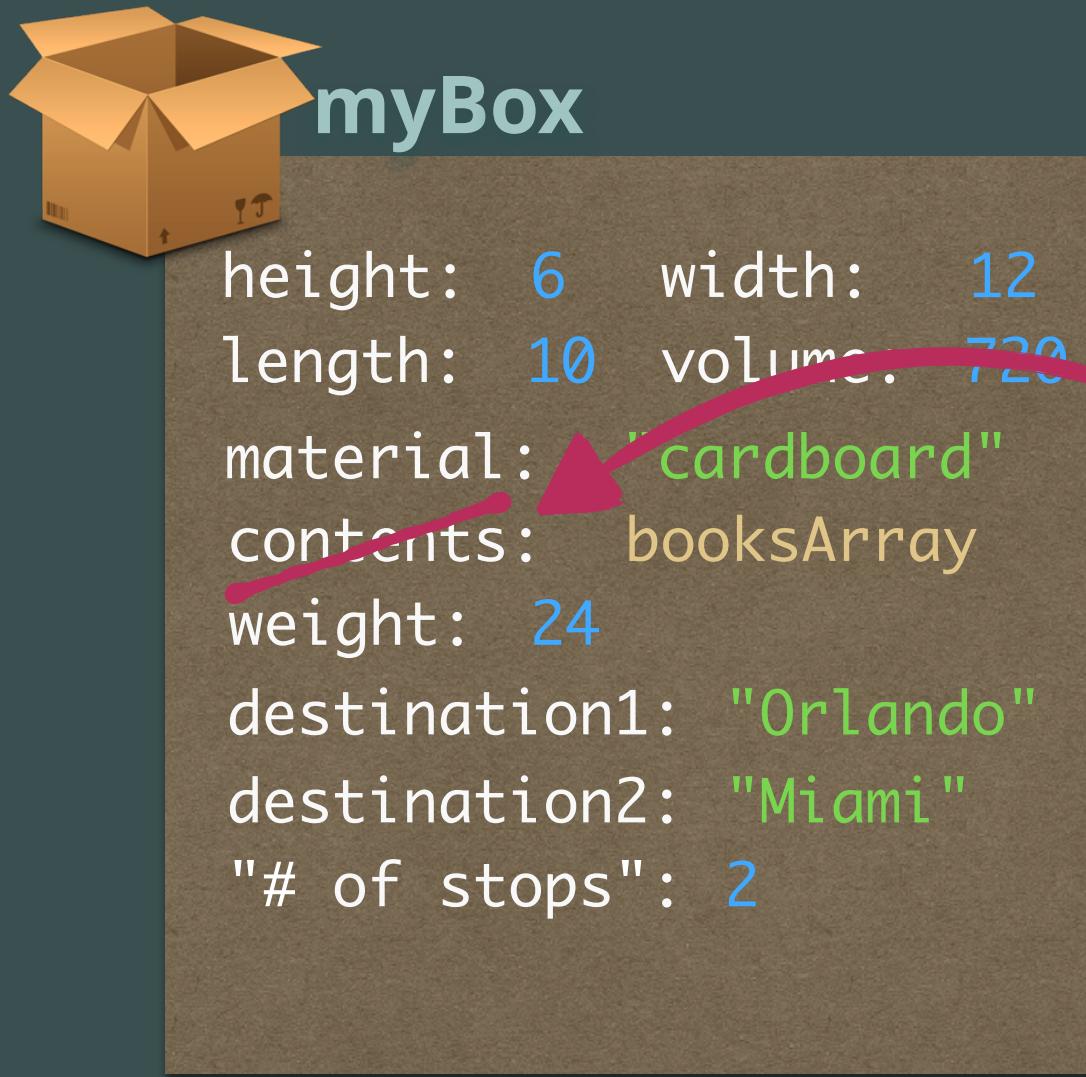
```
height: 6 width: 12
length: 10 volume: 720
material: "cardboard"
contents: booksArray
weight: 24
destination1: "Orlando"
destination2: "Miami"
"# of stops": 2
```

CHANGING OUR CONTENTS TO INDIVIDUAL OBJECTS

First, we'll delete our contents property with the delete keyword.

booksArray

```
[ "Great Expectations", "The Remains of the Day", "Peter Pan", "On The Road" ]
```



```
delete myBox.contents;
```

The **delete** keyword will completely delete the entire **contents** property...not just the value associated with that property.

CHANGING OUR CONTENTS TO INDIVIDUAL OBJECTS

First, we'll delete our contents property with the delete keyword.

booksArray

```
["Great Expectations", "The Remains of the Day", "Peter Pan", "On The Road"]
```



myBox

```
height: 6    width: 12  
length: 10   volume: 720  
material: "cardboard"
```

```
weight: 24  
destination1: "Orlando"  
destination2: "Miami"  
"# of stops": 2
```

```
delete myBox.contents;
```

→ true

CHANGING OUR CONTENTS TO INDIVIDUAL OBJECTS

First, we'll delete our contents property with the delete keyword.

booksArray

```
["Great Expectations", "The Remains of the Day", "Peter Pan", "On The Road"]
```



```
height: 6   width: 12  
length: 10  volume: 720  
material: "cardboard"  
weight: 24  
destination1: "Orlando"  
destination2: "Miami"  
"# of stops": 2
```

```
delete myBox.contents;
```

→ true

```
console.log( booksArray );
```

→ ["Great Expectations", "The Remains of the Day",
"Peter Pan", "On The Road"]

Additionally, we've only deleted the property name and the reference, but not the original booksArray outside the Box.

CHANGING OUR CONTENTS TO INDIVIDUAL OBJECTS

First, we'll delete our contents property with the delete keyword.

booksArray

```
["Great Expectations", "The Remains of the Day", "Peter Pan", "On The Road"]
```



myBox

```
height: 6    width: 12
length: 10   volume: 720
material: "cardboard"
weight: 24
destination1: "Orlando"
destination2: "Miami"
"# of stops": 2
```

```
delete myBox.contents;
```

→ true

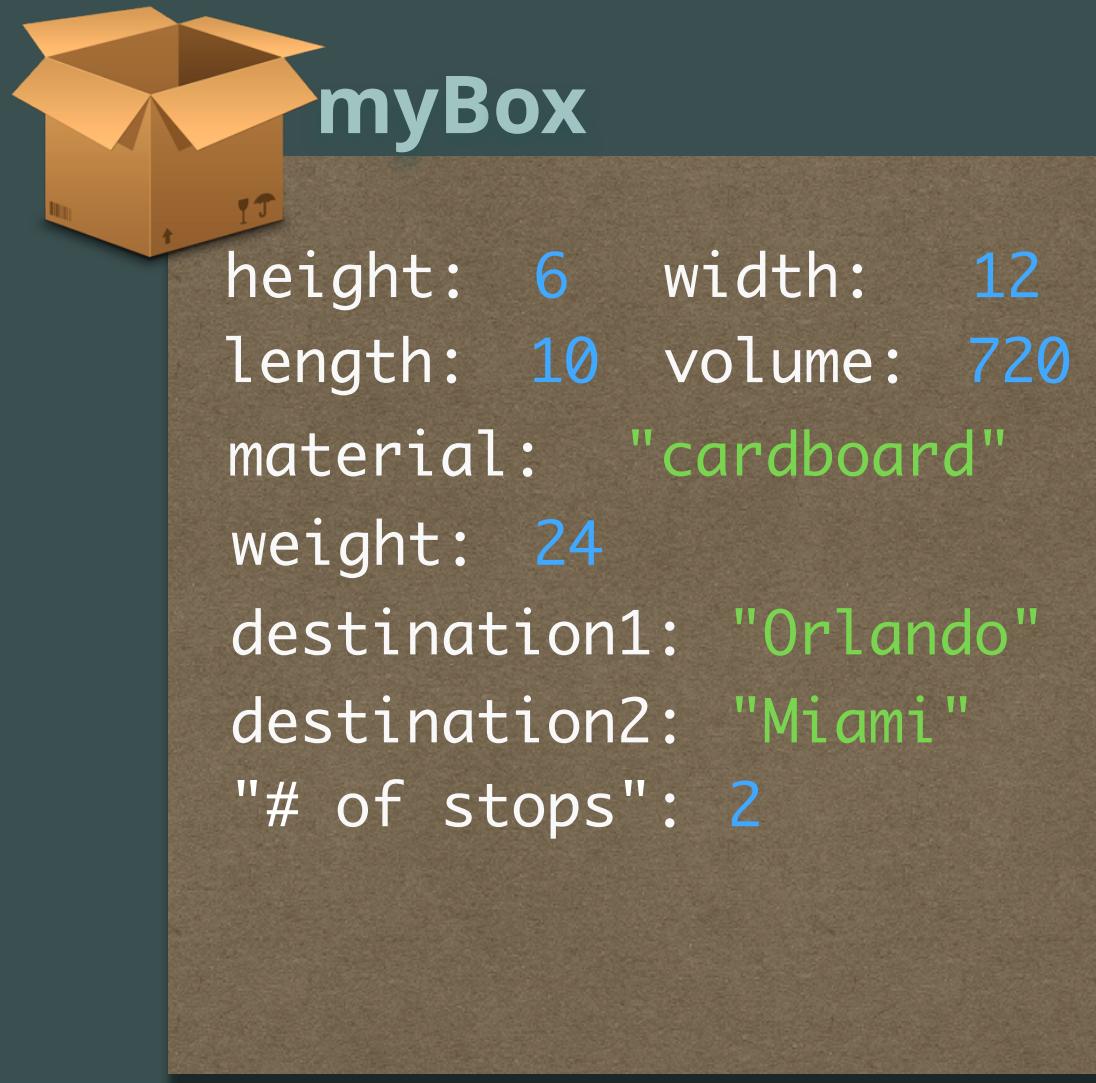
```
delete myBox.nonexistentProperty;
```

→ true

Watch out, though...`delete` will return `true` each time, regardless of whether the property existed or not! Think of it as asking: is this property gone?

CHANGING OUR CONTENTS TO INDIVIDUAL OBJECTS

Now, we'll build a function that creates Book objects and adds them to our Box



```
height: 6    width: 12
length: 10   volume: 720
material: "cardboard"
weight: 24
destination1: "Orlando"
destination2: "Miami"
"# of stops": 2
```

CHANGING OUR CONTENTS TO INDIVIDUAL OBJECTS

Now, we'll build a function that creates Book objects and adds them to our Box



myBox

```
height: 6   width: 12
length: 10  volume: 720
material: "cardboard"
weight: 24
destination1: "Orlando"
destination2: "Miami"
"# of stops": 2
```

CHANGING OUR CONTENTS TO INDIVIDUAL OBJECTS

Now, we'll build a function that creates Book objects and adds them to our Box

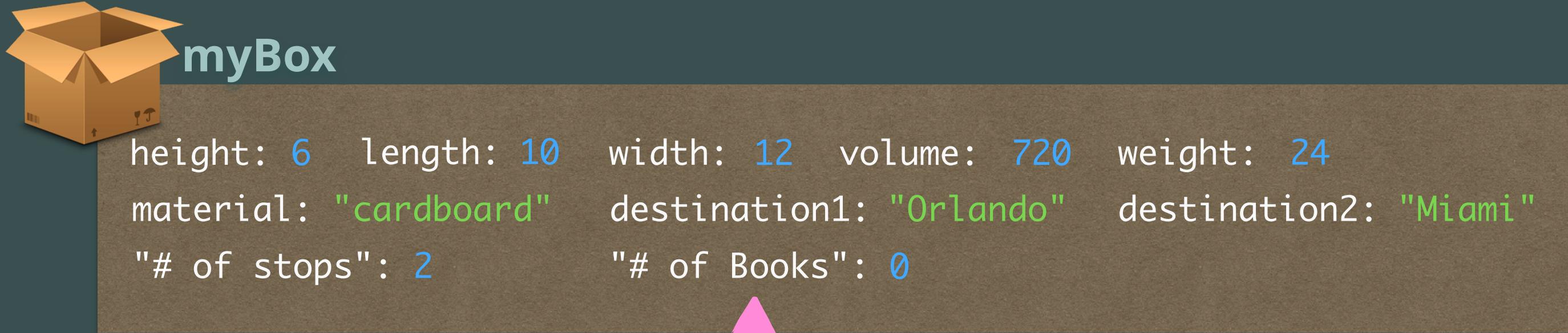


myBox

```
height: 6    length: 10    width: 12    volume: 720    weight: 24  
material: "cardboard"    destination1: "Orlando"    destination2: "Miami"  
"# of stops": 2
```

CHANGING OUR CONTENTS TO INDIVIDUAL OBJECTS

Now, we'll build a function that creates Book objects and adds them to our Box




We'll create a property that tracks the number of books, set initially to zero. Our function will use this value to dynamically assign property names.

CHANGING OUR CONTENTS TO INDIVIDUAL OBJECTS

Now, we'll build a function that creates Book objects and adds them to our Box



```
height: 6    length: 10    width: 12    volume: 720    weight: 24  
material: "cardboard"    destination1: "Orlando"    destination2: "Miami"  
"# of stops": 2        "# of Books": 0
```

Each time we create and add a Book object,
we'll increase the number of books in our Box.

```
function addBook (box, name, writer){  
  box["# of Books"]++;  
  box["book" + box["# of Books"]] = {title: name, author: writer};  
}
```

We'll concatenate the current book #
with "book" to get our property name.

Our Book's properties will come from
the function parameters we've passed
in.

CHANGING OUR CONTENTS TO INDIVIDUAL OBJECTS

Now, we'll build a function that creates Book objects and adds them to our Box



```
height: 6  length: 10  width: 12  volume: 720  weight: 24  
material: "cardboard"  destination1: "Orlando"  destination2: "Miami"  
"# of stops": 2  "# of Books": 0
```

```
function addBook (box, name, writer){  
  box["# of Books"]++;  
  box["book" + box["# of Books"]] = {title: name, author: writer};  
}
```

CHANGING OUR CONTENTS TO INDIVIDUAL OBJECTS

Let's add some books!



myBox

```
height: 6    length: 10    width: 12    volume: 720    weight: 24  
material: "cardboard"    destination1: "Orlando"    destination2: "Miami"  
"# of stops": 2        "# of Books": 0
```

```
addBook(myBox, "Great Expectations", "Charles Dickens");
```

```
function addBook (box, name, writer){  
  box["# of Books"]++;  
  box["book" + box["# of Books"]] = {title: name, author: writer};  
}
```

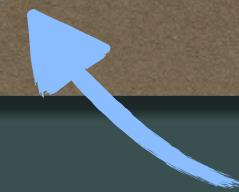
CHANGING OUR CONTENTS TO INDIVIDUAL OBJECTS

Let's add some books!



myBox

```
height: 6    length: 10    width: 12    volume: 720    weight: 24  
material: "cardboard"    destination1: "Orlando"    destination2: "Miami"  
"# of stops": 2    "# of Books": 1
```



New book, new number of books.

```
addBook(myBox, "Great Expectations", "Charles Dickens");
```

```
function addBook (box, name, writer){  
  box["# of Books"]++;  
  box["book" + box["# of Books"]] = {title: name, author: writer};  
}
```

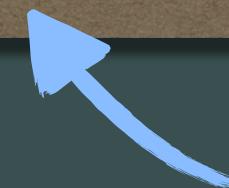
CHANGING OUR CONTENTS TO INDIVIDUAL OBJECTS

Let's add some books!



myBox

```
height: 6    length: 10    width: 12    volume: 720    weight: 24  
material: "cardboard"    destination1: "Orlando"    destination2: "Miami"  
"# of stops": 2        "# of Books": 1  
book1: { title: "Great Expectations", author: "Charles Dickens"}
```



The correct book number in the property name has been dynamically assigned.

```
addBook(myBox, "Great Expectations", "Charles Dickens");
```

```
function addBook (box, name, writer){  
  box["# of Books"]++;  
  box["book" + box["# of Books"]] = {title: name, author: writer};  
}
```

CHANGING OUR CONTENTS TO INDIVIDUAL OBJECTS

Let's add some books!



myBox

```
height: 6    length: 10    width: 12    volume: 720    weight: 24  
material: "cardboard"    destination1: "Orlando"    destination2: "Miami"  
"# of stops": 2        "# of Books": 1  
book1: { title: "Great Expectations", author: "Charles Dickens"}
```

```
addBook(myBox, "Great Expectations", "Charles Dickens");
```

```
function addBook (box, name, writer){  
  box["# of Books"]++;  
  box["book" + box["# of Books"]] = {title: name, author: writer};  
}
```

CHANGING OUR CONTENTS TO INDIVIDUAL OBJECTS

Let's add some books!



myBox

```
height: 6    length: 10    width: 12    volume: 720    weight: 24  
material: "cardboard"    destination1: "Orlando"    destination2: "Miami"  
"# of stops": 2        "# of Books": 1  
book1: { title: "Great Expectations", author: "Charles Dickens"}
```

```
addBook(myBox, "The Remains of the Day", "Kazuo Ishiguro");
```

```
function addBook (box, name, writer){  
  box["# of Books"]++;  
  box["book" + box["# of Books"]] = {title: name, author: writer};  
}
```

CHANGING OUR CONTENTS TO INDIVIDUAL OBJECTS

Let's add some books!



myBox

```
height: 6    length: 10    width: 12    volume: 720    weight: 24  
material: "cardboard"    destination1: "Orlando"    destination2: "Miami"  
"# of stops": 2        "# of Books": 2  
book1: { title: "Great Expectations", author: "Charles Dickens"}
```

```
addBook(myBox, "The Remains of the Day", "Kazuo Ishiguro");
```

```
function addBook (box, name, writer){  
  box["# of Books"]++;  
  box["book" + box["# of Books"]] = {title: name, author: writer};  
}
```

CHANGING OUR CONTENTS TO INDIVIDUAL OBJECTS

Let's add some books!



myBox

```
height: 6    length: 10    width: 12    volume: 720    weight: 24  
material: "cardboard"    destination1: "Orlando"    destination2: "Miami"  
"# of stops": 2        "# of Books": 2  
    book1: { title: "Great Expectations", author: "Charles Dickens"}  
    book2: { title: "The Remains of the Day", author: "Kazuo Ishiguro"}
```

```
addBook(myBox, "The Remains of the Day", "Kazuo Ishiguro");
```

```
function addBook (box, name, writer){  
    box["# of Books"]++;  
    box["book" + box["# of Books"]] = {title: name, author: writer};  
}
```

CHANGING OUR CONTENTS TO INDIVIDUAL OBJECTS

Let's add some books!



myBox

```
height: 6    length: 10    width: 12    volume: 720    weight: 24
material: "cardboard"    destination1: "Orlando"    destination2: "Miami"
"# of stops": 2          "# of Books": 2
 book1: { title: "Great Expectations", author: "Charles Dickens" }
 book2: { title: "The Remains of the Day", author: "Kazuo Ishiguro" }
```

```
addBook(myBox, "Peter Pan", "J. M. Barrie");
```

```
function addBook (box, name, writer){
  box["# of Books"]++;
  box["book" + box["# of Books"]] = {title: name, author: writer};
}
```

CHANGING OUR CONTENTS TO INDIVIDUAL OBJECTS

Let's add some books!



myBox

```
height: 6    length: 10    width: 12    volume: 720    weight: 24
material: "cardboard"    destination1: "Orlando"    destination2: "Miami"
"# of stops": 2          "# of Books": 3
 book1: { title: "Great Expectations", author: "Charles Dickens" }
 book2: { title: "The Remains of the Day", author: "Kazuo Ishiguro" }
```

```
addBook(myBox, "Peter Pan", "J. M. Barrie");
```

```
function addBook (box, name, writer){
  box["# of Books"]++;
  box["book" + box["# of Books"]] = {title: name, author: writer};
}
```

CHANGING OUR CONTENTS TO INDIVIDUAL OBJECTS

Let's add some books!



```
height: 6    length: 10    width: 12    volume: 720    weight: 24  
material: "cardboard"    destination1: "Orlando"    destination2: "Miami"  
"# of stops": 2          "# of Books": 3  
  book1: { title: "Great Expectations", author: "Charles Dickens"}  
  book2: { title: "The Remains of the Day", author: "Kazuo Ishiguro"}  
  book3: { title: "Peter Pan", author: "J. M. Barrie"}
```

```
addBook(myBox, "Peter Pan", "J. M. Barrie");
```

```
function addBook (box, name, writer){  
  box["# of Books"]++;  
  box["book" + box["# of Books"]] = {title: name, author: writer};  
}
```

CHANGING OUR CONTENTS TO INDIVIDUAL OBJECTS

Let's add some books!



myBox

```
height: 6    length: 10    width: 12    volume: 720    weight: 24
material: "cardboard"    destination1: "Orlando"    destination2: "Miami"
"# of stops": 2          "# of Books": 3
 book1: { title: "Great Expectations", author: "Charles Dickens" }
 book2: { title: "The Remains of the Day", author: "Kazuo Ishiguro" }
 book3: { title: "Peter Pan", author: "J. M. Barrie" }
```

```
addBook(myBox, "On the Road", "Jack Kerouac");
```

```
function addBook (box, name, writer){
  box["# of Books"]++;
  box["book" + box["# of Books"]] = {title: name, author: writer};
}
```

CHANGING OUR CONTENTS TO INDIVIDUAL OBJECTS

Let's add some books!



myBox

```
height: 6    length: 10    width: 12    volume: 720    weight: 24
material: "cardboard"    destination1: "Orlando"    destination2: "Miami"
"# of stops": 2          "# of Books": 4
 book1: { title: "Great Expectations", author: "Charles Dickens" }
 book2: { title: "The Remains of the Day", author: "Kazuo Ishiguro" }
 book3: { title: "Peter Pan", author: "J. M. Barrie" }
```

```
addBook(myBox, "On the Road", "Jack Kerouac");
```

```
function addBook (box, name, writer){
  box["# of Books"]++;
  box["book" + box["# of Books"]] = {title: name, author: writer};
}
```

CHANGING OUR CONTENTS TO INDIVIDUAL OBJECTS

Let's add some books!



myBox

```
height: 6    length: 10    width: 12    volume: 720    weight: 24
material: "cardboard"    destination1: "Orlando"    destination2: "Miami"
"# of stops": 2          "# of Books": 4
 book1: { title: "Great Expectations", author: "Charles Dickens" }
 book2: { title: "The Remains of the Day", author: "Kazuo Ishiguro" }
 book3: { title: "Peter Pan", author: "J. M. Barrie" }
 book4: { title: "On the Road", author: "Jack Kerouac" }
```

```
addBook(myBox, "On the Road", "Jack Kerouac");
```

```
function addBook (box, name, writer){
  box["# of Books"]++;
  box["book" + box["# of Books"]] = {title: name, author: writer};
}
```

REFERENCING OBJECTS WITHIN OBJECTS

Use the dot extension or subsequent bracket notation to get to deeper properties



myBox

```
height: 6    length: 10    width: 12    volume: 720    weight: 24
material: "cardboard"    destination1: "Orlando"    destination2: "Miami"
"# of stops": 2          "# of Books": 4
 book1: { title: "Great Expectations", author: "Charles Dickens" }
 book2: { title: "The Remains of the Day", author: "Kazuo Ishiguro" }
 book3: { title: "Peter Pan", author: "J. M. Barrie" }
 book4: { title: "On the Road", author: "Jack Kerouac" }
```

```
console.log( myBox.book1.title );
```

→ Great Expectations

```
console.log( myBox["book4"]["author"] );
```

→ Jack Kerouac



See the Shimmering
OCEAN OF OBJECTS

AN AQUARIUM OBJECT FILLED WITH OTHER OBJECTS

Let's first build some add/remove functionality for creatures and environment toys

```
var aquarium = {  
    Nemo: { type: "fish", species: "clownfish", length: 3.7 },  
    Marlin: { type: "fish", species: "clownfish", length: 4.1 },  
    Dory: { type: "fish", species: "blue tang", length: 6.2 },  
    Peach: { type: "echinoderm", species: "starfish", length: 5.3 },  
    "Coral Castle": { type: "environment", material: "coquina", moves: false },  
    "Dragon Statue": { type: "environment", material: "plastic", moves: false }  
};
```



```
function addCritter( container, name, type, species, length ){  
    container[name] = {type: type, species: species, length: length};  
}
```

```
function addToy( container, name, type, material, moves ){  
    container[name] = {type: type, material: material, moves: moves};  
}
```

Wouldn't it be nice if
these functions
belonged only to the
aquarium instead of
an entire program?
Let's try adding one.

AN AQUARIUM OBJECT FILLED WITH OTHER OBJECTS

Let's first build some add/remove functionality for creatures and environment toys

```
var aquarium = {  
    Nemo: { type: "fish", species: "clownfish", length: 3.7 },  
    Marlin: { type: "fish", species: "clownfish", length: 4.1 },  
    Dory: { type: "fish", species: "blue tang", length: 6.2 },  
    Peach: { type: "echinoderm", species: "starfish", length: 5.3 },  
    "Coral Castle": { type: "environment", material: "coquina", moves: false },  
    "Dragon Statue": { type: "environment", material: "plastic", moves: false }  
};
```



```
function addCritter( container, name, type, species, length ){  
    container[name] = {type: type, species: species, length: length};  
}
```

PROPERTIES CAN ALSO BE FUNCTIONS

An Object's function properties are often called its "methods"



```
var aquarium = {  
    Nemo: { type: "fish", species: "clownfish", length: 3.7 },  
    Marlin: { type: "fish", species: "clownfish", length: 4.1 },  
    Dory: { type: "fish", species: "blue tang", length: 6.2 },  
    Peach: { type: "echinoderm", species: "starfish", length: 5.3 },  
    "Coral Castle": { type: "environment", material: "coquina", moves: false },  
    "Dragon Statue": { type: "environment", material: "plastic", moves: false },  
    addCritter: function ( name, type, species, length ){  
    }  
};
```

We add a new property to our aquarium that takes the name of our addCritter function. Then we build an anonymous function.

```
function addCritter( container, name, type, species, length ){  
    container[name] = {type: type, species: species, length: length};  
}
```

PROPERTIES CAN ALSO BE FUNCTIONS

An Object's function properties are often called its "methods"



```
var aquarium = {  
    Nemo: { type: "fish", species: "clownfish", length: 3.7 },  
    Marlin: { type: "fish", species: "clownfish", length: 4.1 },  
    Dory: { type: "fish", species: "blue tang", length: 6.2 },  
    Peach: { type: "echinoderm", species: "starfish", length: 5.3 },  
    "Coral Castle": { type: "environment", material: "coquina", moves: false },  
    "Dragon Statue": { type: "environment", material: "plastic", moves: false },  
    addCritter: function ( name, type, species, length ){  
    }  
};
```

A pink arrow points from the word "container" in the explanatory text below to the parameter "container" in the code above.

Our container parameter now disappears, since we are making the function BELONG TO that very container.

```
function addCritter( container, name, type, species, length ){  
    container[name] = {type: type, species: species, length: length};  
}
```

THE VERY USEFUL “THIS” KEYWORD

“This” always refers to the owner Object of the function in which the “this” is used.

```
var aquarium = {  
    Nemo: { type: "fish", species: "clownfish", length: 3.7 },  
    Marlin: { type: "fish", species: "clownfish", length: 4.1 },  
    Dory: { type: "fish", species: "blue tang", length: 6.2 },  
    Peach: { type: "echinoderm", species: "starfish", length: 5.3 },  
    "Coral Castle": { type: "environment", material: "coquina", moves: false },  
    "Dragon Statue": { type: "environment", material: "plastic", moves: false },  
    addCritter: function ( name, type, species, length ){  
        this[name] = {type: type, species: species, length: length};  
    }  
};  
  
When called with this, addCritter says: Hey, aquarium! Make a new  
property called name and assign to it a new Object with these properties!
```

```
function addCritter( container, name, type, species, length ){  
    container[name] = {type: type, species: species, length: length};  
}
```



WOOHOO, A PROPERTY THAT HOLDS A FUNCTION!

Our addCritter function is now available as a property on the aquarium Object



```
var aquarium = {  
    Nemo: { type: "fish", species: "clownfish", length: 3.7 },  
    Marlin: { type: "fish", species: "clownfish", length: 4.1 },  
    Dory: { type: "fish", species: "blue tang", length: 6.2 },  
    Peach: { type: "echinoderm", species: "starfish", length: 5.3 },  
    "Coral Castle": { type: "environment", material: "coquina", moves: false },  
    "Dragon Statue": { type: "environment", material: "plastic", moves: false },  
    addCritter: function ( name, type, species, length ){  
        this[name] = {type: type, species: species, length: length};  
    }  
};
```

Let's add a creature!

WOOHOO, A PROPERTY THAT HOLDS A FUNCTION!

Our addCritter function is now available as a property on the aquarium Object



```
var aquarium = {  
    Nemo: { type: "fish", species: "clownfish", length: 3.7 },  
    Marlin: { type: "fish", species: "clownfish", length: 4.1 },  
    Dory: { type: "fish", species: "blue tang", length: 6.2 },  
    Peach: { type: "echinoderm", species: "starfish", length: 5.3 },  
    "Coral Castle": { type: "environment", material: "coquina", moves: false },  
    "Dragon Statue": { type: "environment", material: "plastic", moves: false },  
    addCritter: function ( name, type, species, length ){  
        this[name] = {type: type, species: species, length: length};  
    }  
};
```

```
aquarium.addCritter("Bubbles", "fish", "yellow tang", 5.6);
```

We call the function just like referencing any other property in aquarium, but we also pass it a set of appropriate parameters.

WOOHOO, A PROPERTY THAT HOLDS A FUNCTION!

Our addCritter function is now available as a property on the aquarium Object



```
var aquarium = {  
    Nemo: { type: "fish", species: "clownfish", length: 3.7 },  
    Marlin: { type: "fish", species: "clownfish", length: 4.1 },  
    Dory: { type: "fish", species: "blue tang", length: 6.2 },  
    Peach: { type: "echinoderm", species: "starfish", length: 5.3 },  
    "Coral Castle": { type: "environment", material: "coquina", moves: false },  
    "Dragon Statue": { type: "environment", material: "plastic", moves: false },  
    addCritter: function ( name, type, species, length ){  
        this[name] = {type: type, species: species, length: length};  
    },  
    Bubbles: { type: "fish", species: "yellow tang", length: 5.6 }  
};
```

```
aquarium.addCritter("Bubbles", "fish", "yellow tang", 5.6);
```

HMM...OUR TANK'S A LITTLE FULL

Let's build another method that removes any object from our aquarium



```
var aquarium = {  
    Nemo: { type: "fish", species: "clownfish", length: 3.7 },  
    Marlin: { type: "fish", species: "clownfish", length: 4.1 },  
    Dory: { type: "fish", species: "blue tang", length: 6.2 },  
    Peach: { type: "echinoderm", species: "starfish", length: 5.3 },  
    "Coral Castle": { type: "environment", material: "coquina", moves: false },  
    "Dragon Statue": { type: "environment", material: "plastic", moves: false },  
    addCritter: function ( name, type, species, length ){  
        this[name] = {type: type, species: species, length: length};  
    },  
    Bubbles: { type: "fish", species: "yellow tang", length: 5.6 }  
};
```

```
aquarium.addCritter("Bubbles", "fish", "yellow tang", 5.6);
```

HMM...OUR TANK'S A LITTLE FULL

Let's build another method that removes any object from our aquarium



```
var aquarium = {  
    Nemo: { type: "fish", species: "clownfish", length: 3.7 },  
    Marlin: { type: "fish", species: "clownfish", length: 4.1 },  
    Dory: { type: "fish", species: "blue tang", length: 6.2 },  
    Peach: { type: "echinoderm", species: "starfish", length: 5.3 },  
    "Coral Castle": { type: "environment", material: "coquina", moves: false },  
    "Dragon Statue": { type: "environment", material: "plastic", moves: false },  
    addCritter: function ( name, type, species, length ){  
        this[name] = {type: type, species: species, length: length};  
    },  
    Bubbles: { type: "fish", species: "yellow tang", length: 5.6 }  
};
```

HMM...OUR TANK'S A LITTLE FULL

Let's build another method that removes any object from our aquarium



```
var aquarium = {  
    Nemo: { type: "fish", species: "clownfish", length: 3.7 },  
    Marlin: { type: "fish", species: "clownfish", length: 4.1 },  
    Dory: { type: "fish", species: "blue tang", length: 6.2 },  
    Peach: { type: "echinoderm", species: "starfish", length: 5.3 },  
    "Coral Castle": { type: "environment", material: "coquina", moves: false },  
    "Dragon Statue": { type: "environment", material: "plastic", moves: false },  
    addCritter: function ( name, type, species, length ){  
        this[name] = {type: type, species: species, length: length};  
    },  
    Bubbles: { type: "fish", species: "yellow tang", length: 5.6 }  
};
```

```
aquarium.takeOut = function ( name ) {  
};
```

All we will need to delete any property, whether creature or toy, is its name.

HMM...OUR TANK'S A LITTLE FULL

Let's build another method that removes any object from our aquarium



```
var aquarium = {  
    Nemo: { type: "fish", species: "clownfish", length: 3.7 },  
    Marlin: { type: "fish", species: "clownfish", length: 4.1 },  
    Dory: { type: "fish", species: "blue tang", length: 6.2 },  
    Peach: { type: "echinoderm", species: "starfish", length: 5.3 },  
    "Coral Castle": { type: "environment", material: "coquina", moves: false },  
    "Dragon Statue": { type: "environment", material: "plastic", moves: false },  
    addCritter: function ( name, type, species, length ){  
        this[name] = {type: type, species: species, length: length};  
    },  
    Bubbles: { type: "fish", species: "yellow tang", length: 5.6 }  
};
```

```
aquarium.takeOut = function ( name ) {  
    var temp = this[name];  
};
```

A `temp` variable will help us hold on to the Object that we remove. This way we'll still have access to it outside the aquarium.

HMM...OUR TANK'S A LITTLE FULL

Let's build another method that removes any object from our aquarium



```
var aquarium = {  
    Nemo: { type: "fish", species: "clownfish", length: 3.7 },  
    Marlin: { type: "fish", species: "clownfish", length: 4.1 },  
    Dory: { type: "fish", species: "blue tang", length: 6.2 },  
    Peach: { type: "echinoderm", species: "starfish", length: 5.3 },  
    "Coral Castle": { type: "environment", material: "coquina", moves: false },  
    "Dragon Statue": { type: "environment", material: "plastic", moves: false },  
    addCritter: function ( name, type, species, length ){  
        this[name] = {type: type, species: species, length: length};  
    },  
    Bubbles: { type: "fish", species: "yellow tang", length: 5.6 }  
};
```

```
aquarium.takeOut = function ( name ) {  
    var temp = this[name];  
    delete this[name];  
};
```

Next we remove the property from the Owner object, in this case, the aquarium.

HMM...OUR TANK'S A LITTLE FULL

Let's build another method that removes any object from our aquarium



```
var aquarium = {  
    Nemo: { type: "fish", species: "clownfish", length: 3.7 },  
    Marlin: { type: "fish", species: "clownfish", length: 4.1 },  
    Dory: { type: "fish", species: "blue tang", length: 6.2 },  
    Peach: { type: "echinoderm", species: "starfish", length: 5.3 },  
    "Coral Castle": { type: "environment", material: "coquina", moves: false },  
    "Dragon Statue": { type: "environment", material: "plastic", moves: false },  
    addCritter: function ( name, type, species, length ){  
        this[name] = {type: type, species: species, length: length};  
    },  
    Bubbles: { type: "fish", species: "yellow tang", length: 5.6 }  
};
```

```
aquarium.takeOut = function ( name ) {  
    var temp = this[name];  
    delete this[name];  
    return temp;  
};
```

Finally we return the `temp` variable, so that we can still have a reference to the removed Object.

HMM...OUR TANK'S A LITTLE FULL

Let's build another method that removes any object from our aquarium



```
var aquarium = {  
    Nemo: { type: "fish", species: "clownfish", length: 3.7 },  
    Marlin: { type: "fish", species: "clownfish", length: 4.1 },  
    Dory: { type: "fish", species: "blue tang", length: 6.2 },  
    Peach: { type: "echinoderm", species: "starfish", length: 5.3 },  
    "Coral Castle": { type: "environment", material: "coquina", moves: false },  
    "Dragon Statue": { type: "environment", material: "plastic", moves: false },  
    addCritter: function ( name, type, species, length ){  
        this[name] = {type: type, species: species, length: length};  
    },  
    Bubbles: { type: "fish", species: "yellow tang", length: 5.6 }  
};
```

```
aquarium.takeOut = function ( name ) {  
    var temp = this[name];  
    delete this[name];  
    return temp;  
};
```

```
var fishOutOfWater = aquarium.takeOut("Marlin");
```

HMM...OUR TANK'S A LITTLE FULL

Let's build another method that removes any object from our aquarium



```
var aquarium = {  
    Nemo: { type: "fish", species: "clownfish", length: 3.7 },  
    Dory: { type: "fish", species: "blue tang", length: 6.2 },  
    Peach: { type: "echinoderm", species: "starfish", length: 5.3 },  
    "Coral Castle": { type: "environment", material: "coquina", moves: false },  
    "Dragon Statue": { type: "environment", material: "plastic", moves: false },  
    addCritter: function ( name, type, species, length ){  
        this[name] = {type: type, species: species, length: length};  
    },  
    Bubbles: { type: "fish", species: "yellow tang", length: 5.6 }  
};
```

```
aquarium.takeOut = function ( name ) {  
    var temp = this[name];  
    delete this[name];  
    return temp;  
};
```

```
var fishOutOfWater = aquarium.takeOut("Marlin");
```

HMM...OUR TANK'S A LITTLE FULL

Let's build another method that removes any object from our aquarium



```
var aquarium = {  
    Nemo: { type: "fish", species: "clownfish", length: 3.7 },  
    Dory: { type: "fish", species: "blue tang", length: 6.2 },  
    Peach: { type: "echinoderm", species: "starfish", length: 5.3 },  
    "Coral Castle": { type: "environment", material: "coquina", moves: false },  
    "Dragon Statue": { type: "environment", material: "plastic", moves: false },  
    addCritter: function ( name, type, species, length ){  
        this[name] = {type: type, species: species, length: length};  
    },  
    Bubbles: { type: "fish", species: "yellow tang", length: 5.6 }  
};
```

```
aquarium.takeOut = function ( name ) {  
    var temp = this[name];  
    delete this[name];  
    return temp;  
};
```



```
var fishOutOfWater = aquarium.takeOut("Marlin");
```

HMM...OUR TANK'S A LITTLE FULL

Let's build another method that removes any object from our aquarium

```
var aquarium = {  
    Nemo: { type: "fish", species: "clownfish", length: 3.7 },  
    Dory: { type: "fish", species: "blue tang", length: 6.2 },  
    Peach: { type: "echinoderm", species: "starfish", length: 5.3 },  
    "Coral Castle": { type: "environment", material: "coquina", moves: false },  
    "Dragon Statue": { type: "environment", material: "plastic", moves: false },  
    addCritter: function ( name, type, species, length ){  
        this[name] = {type: type, species: species, length: length};  
    },  
    Bubbles: { type: "fish", species: "yellow tang", length: 5.6 }  
};
```

Uh oh! Notice that we lost Marlin's name! Let's fix that problem with some property trickery.

```
aquarium.takeOut = function ( name ) {  
    var temp = this[name];  
    delete this[name];  
    return temp;  
};
```



```
var fishOutOfWater = aquarium.takeOut("Marlin");  
console.log( fishOutOfWater );
```

→ Object {type: "fish", species: "clownfish", length: 4.1}

HMM...OUR TANK'S A LITTLE FULL

Let's build another method that removes any object from our aquarium



```
var aquarium = {  
    Nemo: { type: "fish", species: "clownfish", length: 3.7 },  
    Dory: { type: "fish", species: "blue tang", length: 6.2 },  
    Peach: { type: "echinoderm", species: "starfish", length: 5.3 },  
    "Coral Castle": { type: "environment", material: "coquina", moves: false },  
    "Dragon Statue": { type: "environment", material: "plastic", moves: false },  
    addCritter: function ( name, type, species, length ){  
        this[name] = {type: type, species: species, length: length};  
    },  
    Bubbles: { type: "fish", species: "yellow tang", length: 5.6 }  
};
```

```
aquarium.takeOut = function ( name ) {  
    var temp = this[name];  
    delete this[name];  
    return temp;  
};
```

HMM...OUR TANK'S A LITTLE FULL

Let's build another method that removes any object from our aquarium



```
var aquarium = {  
    Nemo: { type: "fish", species: "clownfish", length: 3.7 },  
    Dory: { type: "fish", species: "blue tang", length: 6.2 },  
    Peach: { type: "echinoderm", species: "starfish", length: 5.3 },  
    "Coral Castle": { type: "environment", material: "coquina", moves: false },  
    "Dragon Statue": { type: "environment", material: "plastic", moves: false },  
    addCritter: function ( name, type, species, length ){  
        this[name] = {type: type, species: species, length: length};  
    },  
    Bubbles: { type: "fish", species: "yellow tang", length: 5.6 }  
};
```

```
aquarium.takeOut = function ( name ) {  
    this[name].temp = name;  
    var temp = this[name];  
    delete this[name];  
    return temp;  
};
```

The first name in this line of code finds the desired Object in the aquarium using the parameter as a property name.

HMM...OUR TANK'S A LITTLE FULL

Let's build another method that removes any object from our aquarium



```
var aquarium = {  
    Nemo: { type: "fish", species: "clownfish", length: 3.7 },  
    Dory: { type: "fish", species: "blue tang", length: 6.2 },  
    Peach: { type: "echinoderm", species: "starfish", length: 5.3 },  
    "Coral Castle": { type: "environment", material: "coquina", moves: false },  
    "Dragon Statue": { type: "environment", material: "plastic", moves: false },  
    addCritter: function ( name, type, species, length ){  
        this[name] = {type: type, species: species, length: length};  
    },  
    Bubbles: { type: "fish", species: "yellow tang", length: 5.6 }  
};
```

```
aquarium.takeOut = function ( name ) {  
    this[name].name ← name;  
    var temp = this[name];  
    delete this[name];  
    return temp;  
};
```

Coming after a dot, the second `name` creates a new property IN the Object we want to remove! Notice that this is NOT the same as the function's parameter!

HMM...OUR TANK'S A LITTLE FULL

Let's build another method that removes any object from our aquarium



```
var aquarium = {  
    Nemo: { type: "fish", species: "clownfish", length: 3.7 },  
    Dory: { type: "fish", species: "blue tang", length: 6.2 },  
    Peach: { type: "echinoderm", species: "starfish", length: 5.3 },  
    "Coral Castle": { type: "environment", material: "coquina", moves: false },  
    "Dragon Statue": { type: "environment", material: "plastic", moves: false },  
    addCritter: function ( name, type, species, length ){  
        this[name] = {type: type, species: species, length: length};  
    },  
    Bubbles: { type: "fish", species: "yellow tang", length: 5.6 }  
};
```

```
aquarium.takeOut = function ( name ) {  
    this[name].name = name;  
    var temp = this[name];  
    delete this[name];  
    return temp;  
};
```

The third `name` assigns the old `property` `name` to the newly created `name` `property` in the removed `Object`. Sneaky!

HMM...OUR TANK'S A LITTLE FULL

Let's build another method that removes any object from our aquarium

```
var aquarium = {  
    Nemo: { type: "fish", species: "clownfish", length: 3.7 },  
    Dory: { type: "fish", species: "blue tang", length: 6.2 },  
    Peach: { type: "echinoderm", species: "starfish", length: 5.3 },  
    "Coral Castle": { type: "environment", material: "coquina", moves: false },  
    "Dragon Statue": { type: "environment", material: "plastic", moves: false },  
    addCritter: function ( name, type, species, length ){  
        this[name] = {type: type, species: species, length: length};  
    },  
    Bubbles: { type: "fish", species: "yellow tang", length: 5.6 }  
};
```



Woohoo, no identity crisis for Marlin!

```
aquarium.takeOut = function ( name ) {  
    this[name].name = name;  
    var temp = this[name];  
    delete this[name];  
    return temp;  
};
```



```
var fishOutOfWater = aquarium.takeOut("Marlin");  
console.log( fishOutOfWater );
```



→ Object {type: "fish", species: "clownfish", length: 4.1, name: "Marlin"}

HMM...OUR TANK'S A LITTLE FULL

Let's build another method that removes any object from our aquarium



```
var aquarium = {  
    Nemo: { type: "fish", species: "clownfish", length: 3.7 },  
    Dory: { type: "fish", species: "blue tang", length: 6.2 },  
    Peach: { type: "echinoderm", species: "starfish", length: 5.3 },  
    "Coral Castle": { type: "environment", material: "coquina", moves: false },  
    "Dragon Statue": { type: "environment", material: "plastic", moves: false },  
    addCritter: function ( name, type, species, length ){  
        this[name] = {type: type, species: species, length: length};  
    },  
    Bubbles: { type: "fish", species: "yellow tang", length: 5.6 }  
};
```

```
aquarium.takeOut = function ( name ) {  
    this[name].name = name;  
    var temp = this[name];  
    delete this[name];  
    return temp;  
};
```

```
var toy = aquarium.takeOut("Dragon Statue");
```

Our removal method works for toy Objects too!

HMM...OUR TANK'S A LITTLE FULL

Let's build another method that removes any object from our aquarium

```
var aquarium = {  
    Nemo: { type: "fish", species: "clownfish", length: 3.7 },  
    Dory: { type: "fish", species: "blue tang", length: 6.2 },  
    Peach: { type: "echinoderm", species: "starfish", length: 5.3 },  
    "Coral Castle": { type: "environment", material: "coquina", moves: false },  
    Dragon Statue: {  
        addCritter: function ( name, type, species, length ){  
            this[name] = {type: type, species: species, length: length};  
        },  
        Bubbles: { type: "fish", species: "yellow tang", length: 5.6 }  
    };  
};
```

```
aquarium.takeOut = function ( name ) {  
    this[name].name = name;  
    var temp = this[name];  
    delete this[name];  
    return temp;  
};
```

```
var toy = aquarium.takeOut("Dragon Statue");
```

Our removal method works for toy Objects too!

HMM...OUR TANK'S A LITTLE FULL

Let's build another method that removes any object from our aquarium

```
var aquarium = {  
    Nemo: { type: "fish", species: "clownfish", length: 3.7 },  
    Dory: { type: "fish", species: "blue tang", length: 6.2 },  
    Peach: { type: "echinoderm", species: "starfish", length: 5.3 },  
    "Coral Castle": { type: "environment", material: "coquina", moves: false },  
};
```



```
    addCritter: function ( name, type, species, length ){  
        this[name] = {type: type, species: species, length: length};  
    },  
    Bubbles: { type: "fish", species: "yellow tang", length: 5.6 }  
};
```



```
aquarium.takeOut = function ( name ) {  
    this[name].name = name;  
    var temp = this[name];  
    delete this[name];  
    return temp;  
};
```

```
var toy = aquarium.takeOut("Dragon Statue");
```

Our removal method works for toy Objects too!

HMM...OUR TANK'S A LITTLE FULL

Let's build another method that removes any object from our aquarium

```
var aquarium = {  
    Nemo: { type: "fish", species: "clownfish", length: 3.7 },  
    Dory: { type: "fish", species: "blue tang", length: 6.2 },  
    Peach: { type: "echinoderm", species: "starfish", length: 5.3 },  
    "Coral Castle": { type: "environment", material: "coquina", moves: false },  
    addCritter: function ( name, type, species, length ){  
        this[name] = {type: type, species: species, length: length};  
    },  
    Bubbles: { type: "fish", species: "yellow tang", length: 5.6 }  
};
```



```
aquarium.takeOut = function ( name ) {  
    this[name].name = name;  
    var temp = this[name];  
    delete this[name];  
    return temp;  
};
```



```
var toy = aquarium.takeOut("Dragon Statue");  
console.log( toy );
```

→ Object {type: "environment", material: "coquina", moves: false, name: "Dragon Statue"}



See the Shimmering
OCEAN OF OBJECTS

COUNTING FISH IN OUR TANK

What if we wanted to know how many fish our tank has at any given time?

```
var aquarium = {  ,  ,  ,  ,  , addCritter, takeOut };
```



```
Nemo: { type: "fish", species: "clownfish", length: 3.7 }
```



COUNTING FISH IN OUR TANK

What if we wanted to know how many fish our tank has at any given time?

```
var aquarium = { , , , , , addCritter, takeOut };
```



```
Nemo: { type: "fish", species: "clownfish", length: 3.7 }
Dory: { type: "fish", species: "blue tang", length: 6.2 }
```

COUNTING FISH IN OUR TANK

What if we wanted to know how many fish our tank has at any given time?

```
var aquarium = { , , , , , addCritter, takeOut };
```

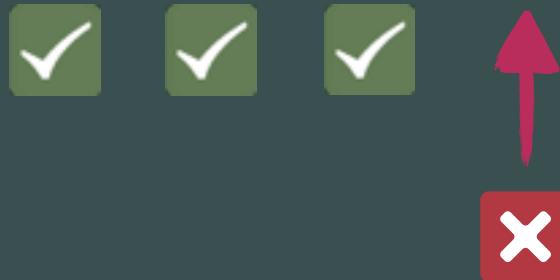


```
Nemo: { type: "fish", species: "clownfish", length: 3.7 }
Dory: { type: "fish", species: "blue tang", length: 6.2 }
Bubbles: { type: "fish", species: "yellow tang", length: 5.6 }
```

COUNTING FISH IN OUR TANK

What if we wanted to know how many fish our tank has at any given time?

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Peach: { type: "echinoderm", species: "starfish", length: 5.3 }
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Peach: { type: "echinoderm", species: "starfish", length: 5.3 }
"Coral Castle": { type: "environment", material: "coquina", moves: false }
```

COUNTING FISH IN OUR TANK

What if we wanted to know how many fish our tank has at any given time?

```
var aquarium = {  ,  ,  ,  ,  , addCritter, takeOut };
```



```
addCritter: function ( name, type, species, length ){
    this[name] = {type: type, species: species, length: length};
}
```

COUNTING FISH IN OUR TANK

What if we wanted to know how many fish our tank has at any given time?

```
var aquarium = { , , , , , addCritter, takeOut};
```



```
addCritter: function ( name, type, species, length ){
    this[name] = {type: type, species: species, length: length};
}

takeOut: function ( name ){
    this[name].name = name;
    var temp = this[name];
    delete this[name];
    return temp;
}
```

COUNTING FISH IN OUR TANK

What if we wanted to know how many fish our tank has at any given time?

```
var aquarium = [  ,  ,  ,  ,  , addCritter, takeOut];
```



= 3 fish total



COUNTING FISH IN OUR TANK

What if we wanted to know how many fish our tank has at any given time?

```
var aquarium = [ , , , , , addCritter, takeOut ];
```



= 3 fish total



```
aquarium.length;
```

→ undefined

Hmm, uh oh. Generic Objects don't have a native length like Arrays and Strings do, so we can't use that in a loop format in order to get to each property.

ENUMERATION WITH THE FOR-IN LOOP

The for-in loop allows us to access each enumerable property in turn.

```
var aquarium = { , , , , , addCritter, takeOut };
```

```
for ( var key in aquarium ) {  
}
```



The `in` keyword looks "in" the Object to its right and finds each enumerable property in turn. Think of it like accessing each index of an Array.

ENUMERATION WITH THE FOR-IN LOOP

The for-in loop allows us to access each enumerable property in turn.

```
var aquarium = { , , , , , addCritter, takeOut };
```

```
for ( var key in aquarium ) {  
    console.log(key);  
}
```

Logging out each
property produces only
their names as strings.

- Nemo
- Dory
- Bubbles
- Peach
- Coral Castle
- addCritter
- takeOut

key in aquarium



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- addCritter
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key in aquarium



ENUMERATION WITH THE FOR-IN LOOP

Now we need a way to determine which properties in 'aquarium' are fish!

```
var aquarium = { , , , , , addCritter, takeOut };
```

```
for ( var key in aquarium ) {  
}  
}
```



ENUMERATION WITH THE FOR-IN LOOP

Now we need a way to determine which properties in 'aquarium' are fish!

```
var aquarium = { , , , , , addCritter, takeOut };
```



```
var numFish = 0;
for ( var key in aquarium ) {
  if ( aquarium[key].type == "fish" ) {
    }
}

```

Since `key` contains the string name
of a property, we can use it in a
set of brackets as an expression.

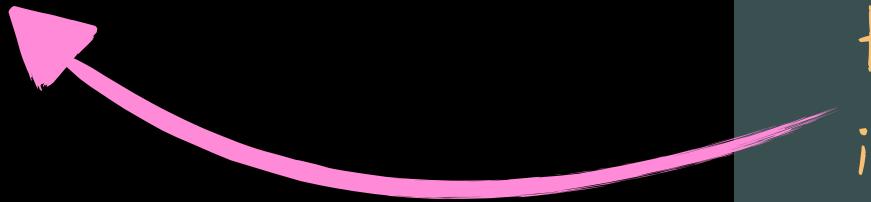
ENUMERATION WITH THE FOR-IN LOOP

Now we need a way to determine which properties in 'aquarium' are fish!

```
var aquarium = { , , , , , addCritter, takeOut };
```



```
var numFish = 0;  
for ( var key in aquarium ) {  
    if ( aquarium[key].type == "fish" ) {  
        numFish++;  
    }  
}
```



Once we've accessed the Object that key refers to, we can seek its own type property, and check to see if the current Object is a fish.

ENUMERATION WITH THE FOR-IN LOOP

Now we need a way to determine which properties in 'aquarium' are fish!

```
var aquarium = { , , , , , addCritter, takeOut };
```

```
var numFish = 0;
for ( var key in aquarium ) {
  if ( aquarium[key].type == "fish" ) {
    numFish++;
  }
}
```

```
aquarium["addCritter"].type;
```

→ undefined

```
undefined == "fish";
```

→ false



ENUMERATION WITH THE FOR-IN LOOP

Now we need a way to determine which properties in 'aquarium' are fish!

```
var aquarium = { , , , , , addCritter, takeOut };
```



```
var numFish = 0;  
for ( var key in aquarium ) {  
    if ( aquarium[key].type == "fish" ) {  
        numFish++;  
    }  
}  
console.log(numFish);
```

→ 3

Current Property	aquarium[property]	has .type?	aquarium[property].type	type == fish?	numFish
Nemo	aquarium["Nemo"]	YES	"fish"	TRUE	1
Dory	aquarium["Dory"]	YES	"fish"	TRUE	2
Bubbles	aquarium["Bubbles"]	YES	"fish"	TRUE	3
Peach	aquarium["Peach"]	YES	"echinoderm"	FALSE	3
Coral	aquarium["Coral Castle"]	YES	"environment"	FALSE	3
addCritter	aquarium["addCritter"]	no	undefined	FALSE	3
takeOut	aquarium["takeOut"]	no	undefined	FALSE	3

ADDING OUR FISH COUNTER TO THE AQUARIUM

We'll need to build a function property using our loop

```
var aquarium = { , , , , , addCritter, takeOut };
```

```
var numFish = 0;
for ( var key in aquarium ) {
  if ( aquarium[key].type == "fish" ) {
    numFish++;
  }
}
```



ADDING OUR FISH COUNTER TO THE AQUARIUM

We'll need to build a function property using our loop

```
var aquarium = {  ,  ,  ,  ,  , addCritter, takeOut};
```

```
aquarium.countFish = function () {
  var numFish = 0;
  for ( var key in aquarium ) {
    if ( aquarium[key].type == "fish" ) {
      numFish++;
    }
  }
}
```



ADDING OUR FISH COUNTER TO THE AQUARIUM

We'll need to build a function property using our loop

```
var aquarium = {  ,  ,  ,  ,  , addCritter, takeOut};
```

```
aquarium.countFish = function () {
  var numFish = 0;
  for ( var key in ) {
    if ( [key].type == "fish" ) {
      numFish++;
    }
  }
}
```



ADDING OUR FISH COUNTER TO THE AQUARIUM

We'll need to build a function property using our loop

```
var aquarium = { , , , , , addCritter, takeOut };
```



```
aquarium.countFish = function () {
  var numFish = 0;
  for ( var key in this ) {
    if ( this[key].type == "fish" ) {
      numFish++;
    }
  }
}
```

Remember, since `countFish` will be "owned" by `aquarium`, it will use the `this` keyword to refer to it as an owner Object.

ADDING OUR FISH COUNTER TO THE AQUARIUM

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```
var aquarium = {  ,  ,  ,  ,  , addCritter, takeOut};
```

```
aquarium.countFish = function () {
  var numFish = 0;
  for ( var key in this) {
    if ( this[key].type == "fish" ) {
      numFish++;
    }
  }
  return numFish;
}
```



ADDING OUR FISH COUNTER TO THE AQUARIUM

We'll need to build a function property using our loop

```
var aquarium = {  ,  ,  ,  ,  , addCritter, takeOut, countFish};
```



```
aquarium.countFish = function () {
  var numFish = 0;
  for ( var key in this ) {
    if ( this[key].type == "fish" ) {
      numFish++;
    }
  }
  return numFish;
}
```

```
aquarium.countFish();
```

→ 3

ADDING OUR FISH COUNTER TO THE AQUARIUM

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```
var aquarium = {  ,  ,  ,  ,  , addCritter, takeOut, countFish};
```

```
aquarium.countFish = function () {
  var numFish = 0;
  for ( var key in this ) {
    if ( this[key].type == "fish" ) {
      numFish++;
    }
  }
  return numFish;
}
```

```
var poorDory = aquarium.takeOut("Dory");
```

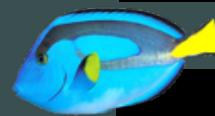


ADDING OUR FISH COUNTER TO THE AQUARIUM

We'll need to build a function property using our loop

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var aquarium = { , , , , addCritter, takeOut, countFish};
```

```
aquarium.countFish = function () {
  var numFish = 0;
  for ( var key in this ) {
    if ( this[key].type == "fish" ) {
      numFish++;
    }
  }
  return numFish;
}
```



```
var poorDory = aquarium.takeOut("Dory");
```



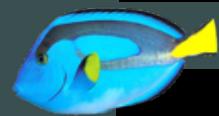
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aquarium.countFish = function () {
  var numFish = 0;
  for ( var key in this ) {
    if ( this[key].type == "fish" ) {
      numFish++;
    }
  }
  return numFish;
}
```



```
var poorDory = aquarium.takeOut("Dory");
```

→ true

```
aquarium.countFish();
```

→ 2