Javascript

Because ECMAScript sounds horrible

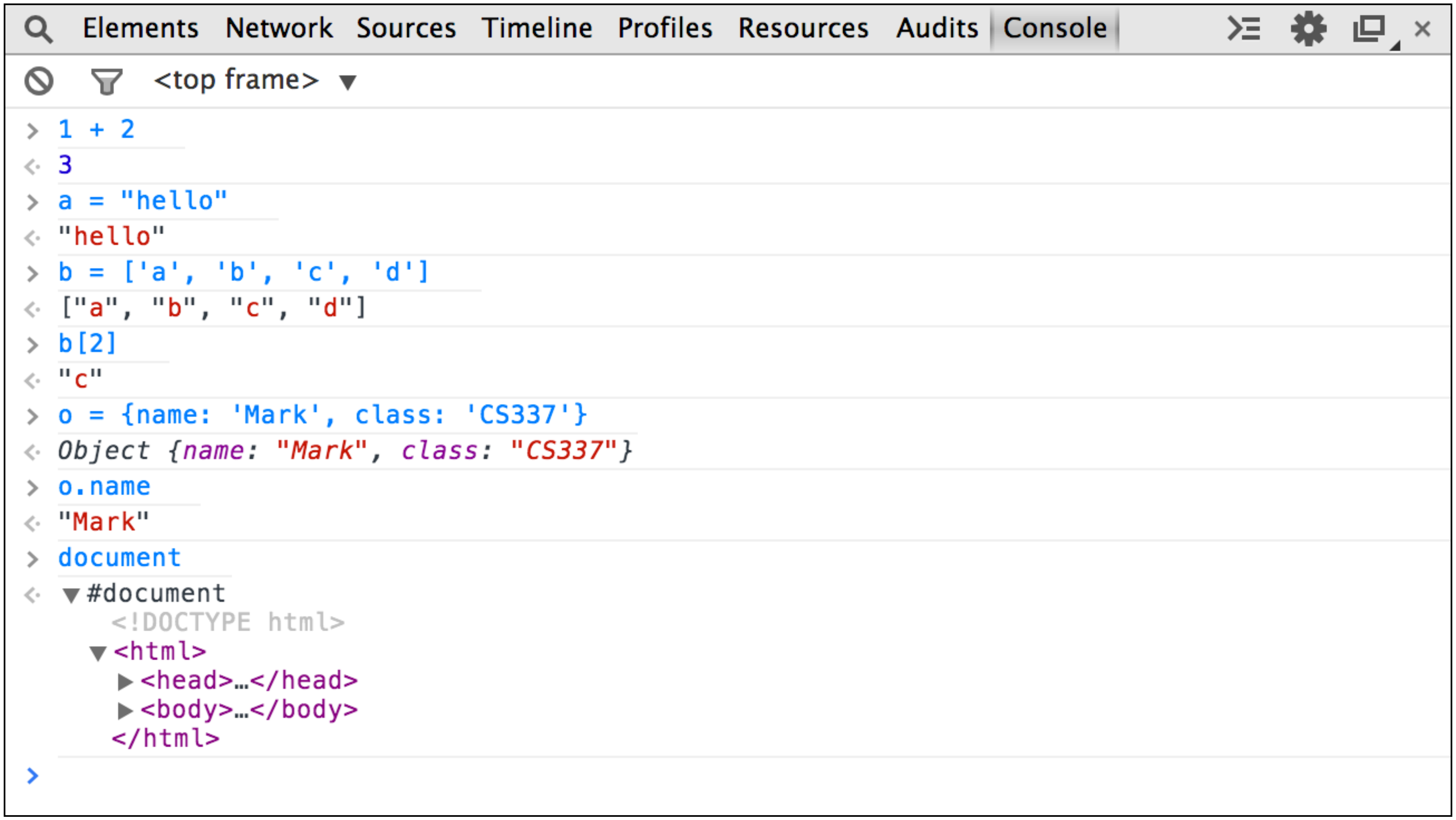
Javascript

- Javascript is a general purpose programming language.
- It usually runs within a browser
    - Node.js runs Javascript in a server / application context
- Developed in the mid nineties as a simple way to provide interactivity to web pages.
- Originally developed by Brendan Eich working at Netscape
- Submitted to ECMA standards body in 1996
- ECMAScript 5.1 released in 2011

Javascript In A Browser

- REPL
    - Read-Eval-Print Loop
- All major browsers have a Javascript REPL system in the console

Javascript In A Browser



```
> 1 + 2
<· 3
> a = "hello"
<· "hello"
> b = ['a', 'b', 'c', 'd']
<· ["a", "b", "c", "d"]
> b[2]
<· "c"
> o = {name: 'Mark', class: 'CS337'}
<· Object {name: "Mark", class: "CS337"}
> o.name
<· "Mark"
> document
<· ▼#document
      <!DOCTYPE html>
    ▼<html>
      ▶<head>…</head>
      ▶<body>…</body>
     </html>
>
```

Documentation

http://ecma262-5.com/ELS5_HTML.htm

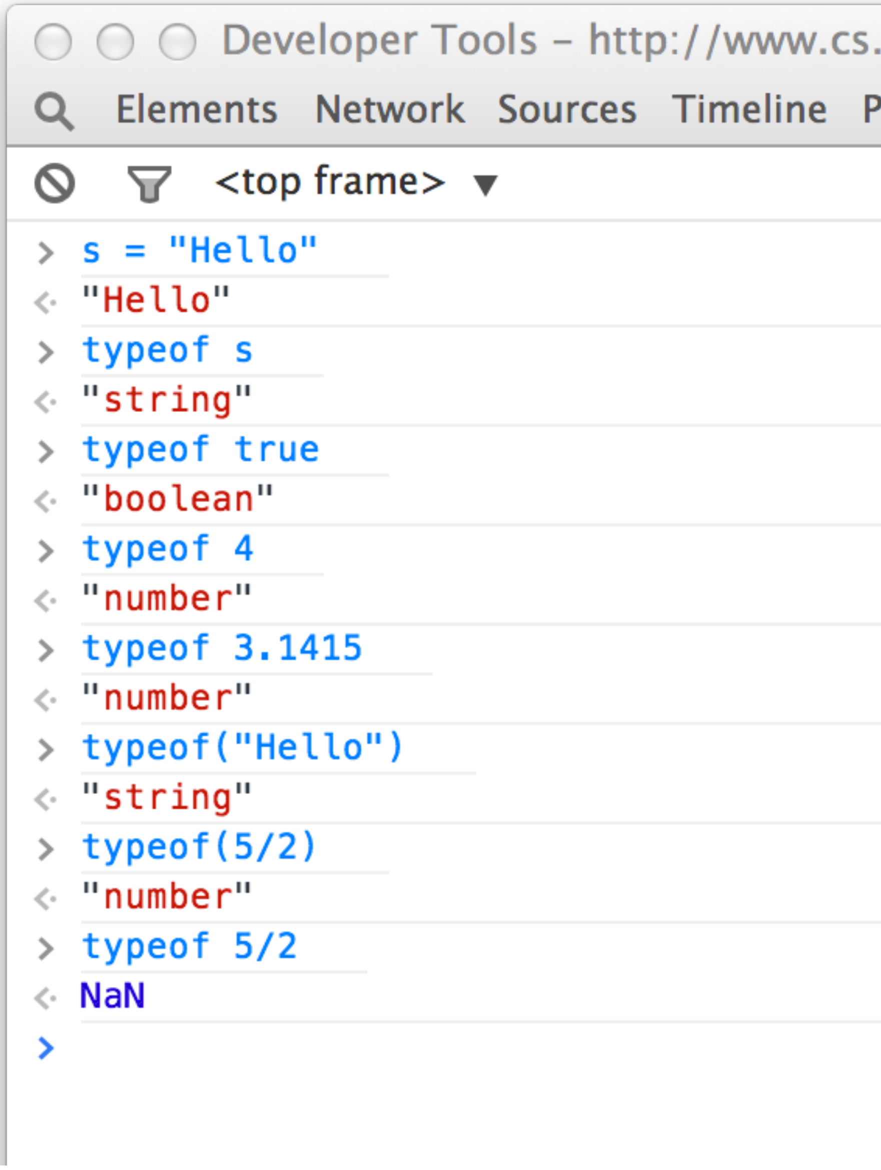
https://developer.mozilla.org/en-US/docs/Web/JavaScript/Reference

Data Types

- Basic Data Types
  - number
  - boolean
  - string
  - object

Data Types

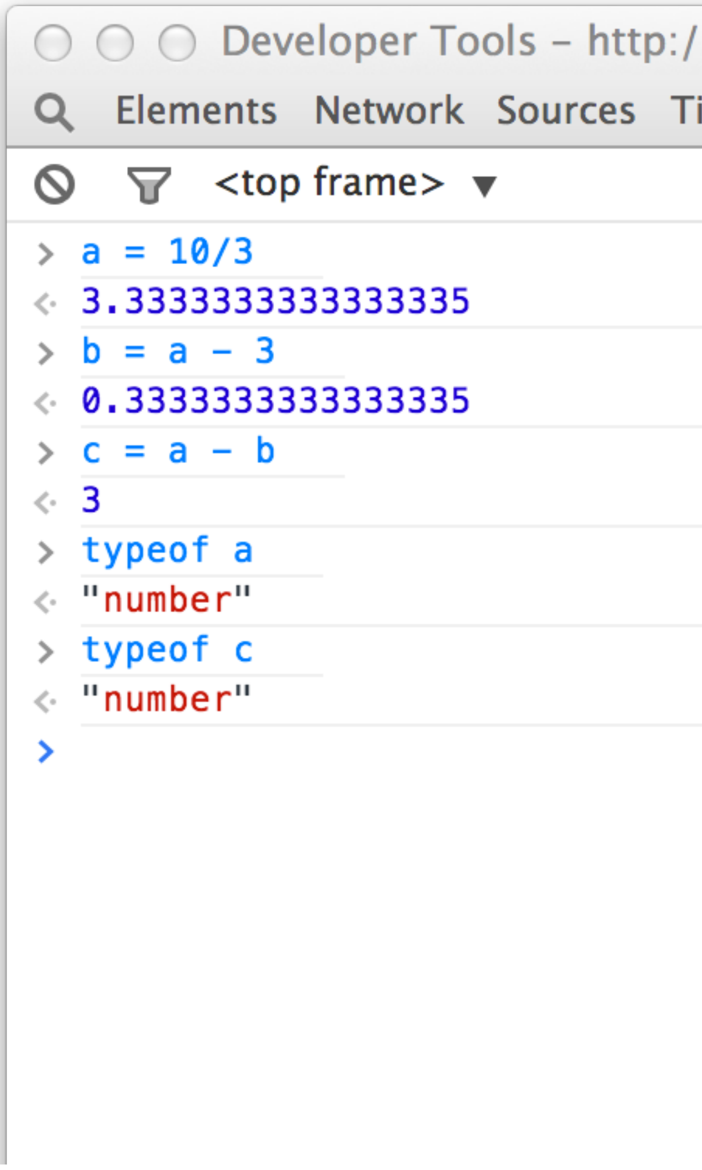
- **`typeof`** unary operator
- lets us know what we're dealing with
- If you're evaluating a complex operation, you need parenthesis. Not because **`typeof`** is a function, but to make sure that there's only one argument to **`typeof`**



```
> s = "Hello"
<· "Hello"
> typeof s
<· "string"
> typeof true
<· "boolean"
> typeof 4
<· "number"
> typeof 3.1415
<· "number"
> typeof("Hello")
<· "string"
> typeof(5/2)
<· "number"
> typeof 5/2
<· NaN
>
```

Numbers

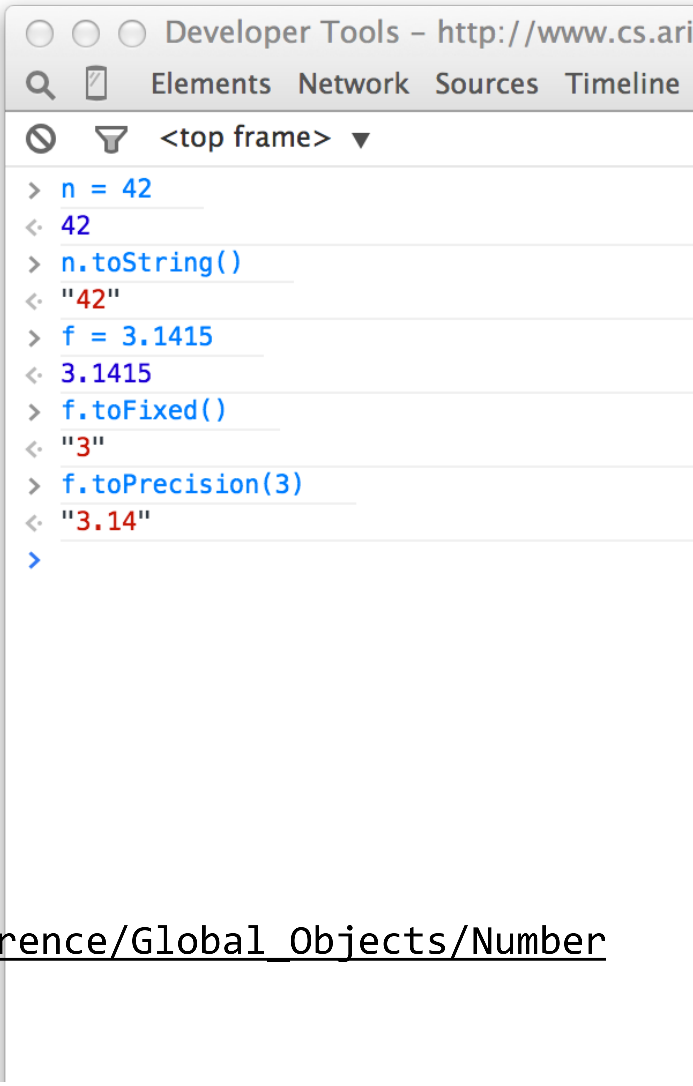
- Javascript has a single number datatype to deal with all numbers.
- No distinction between integers, floats, doubles, etc.
- All numbers are represented as floating point numbers, but if the fractional part is zero, they're shown as integers.



```
> a = 10/3
<· 3.3333333333333335
> b = a - 3
<· 0.3333333333333335
> c = a - b
<· 3
> typeof a
<· "number"
> typeof c
<· "number"
>
```

Numbers

- Numbers stored in variables are converted objects when needed, to have methods and properties
- Number.toString()
- Number.toPrecision()



```
> n = 42
<· 42
> n.toString()
<· "42"
> f = 3.1415
<· 3.1415
> f.toFixed()
<· "3"
> f.toPrecision(3)
<· "3.14"
>
```

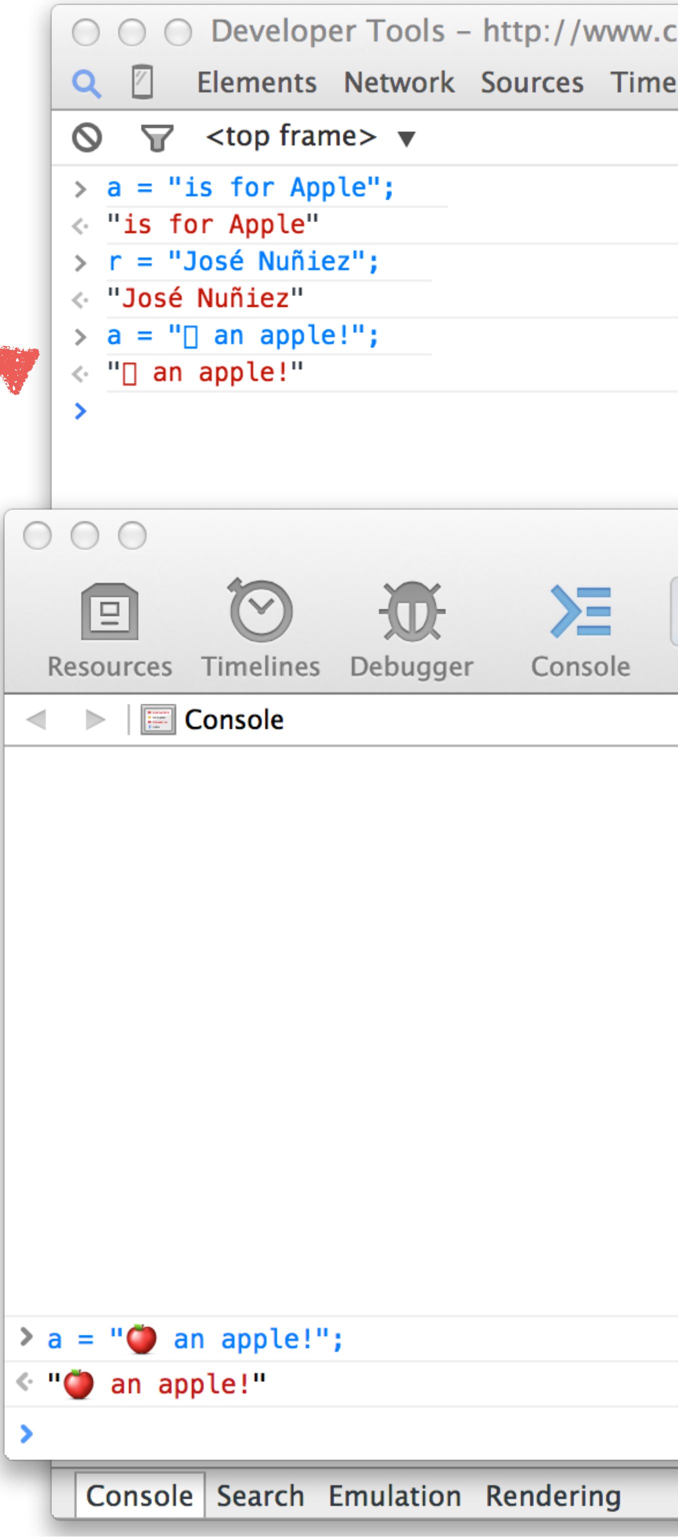
https://developer.mozilla.org/en-US/docs/Web/JavaScript/Reference/Global_Objects/Number

Strings

- A series of zero or more characters.
- Unicode support is pretty good.
- Browser support for full unicode support is spotty.

Chrome

Safari

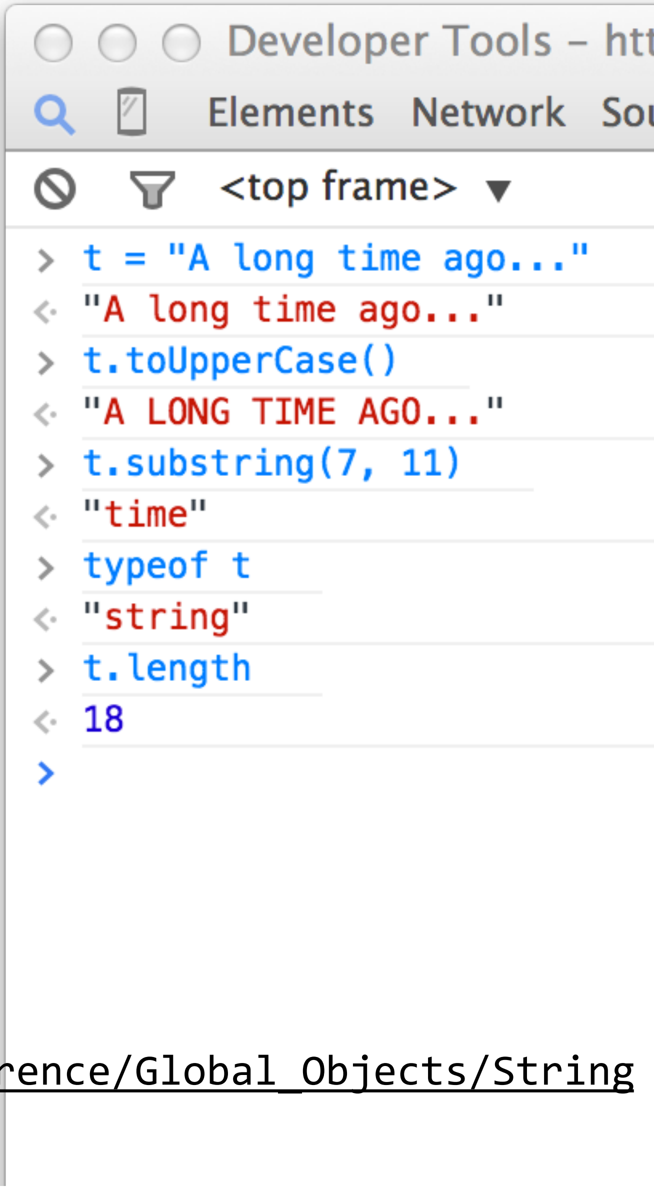


```
> a = "is for Apple";
< "is for Apple"
> r = "José Nuñiez";
< "José Nuñiez"
> a = "□ an apple!";
< "□ an apple!"
>
```

```
> a = "🍎 an apple!";
< "🍎 an apple!"
>
```

Strings

- String variables are also converted to objects as needed.
- `String.toUpperCase()`
- `String.substring(start, end)`
- Note the difference between `.substring()` and `.length`
    - One is a method, one is a property

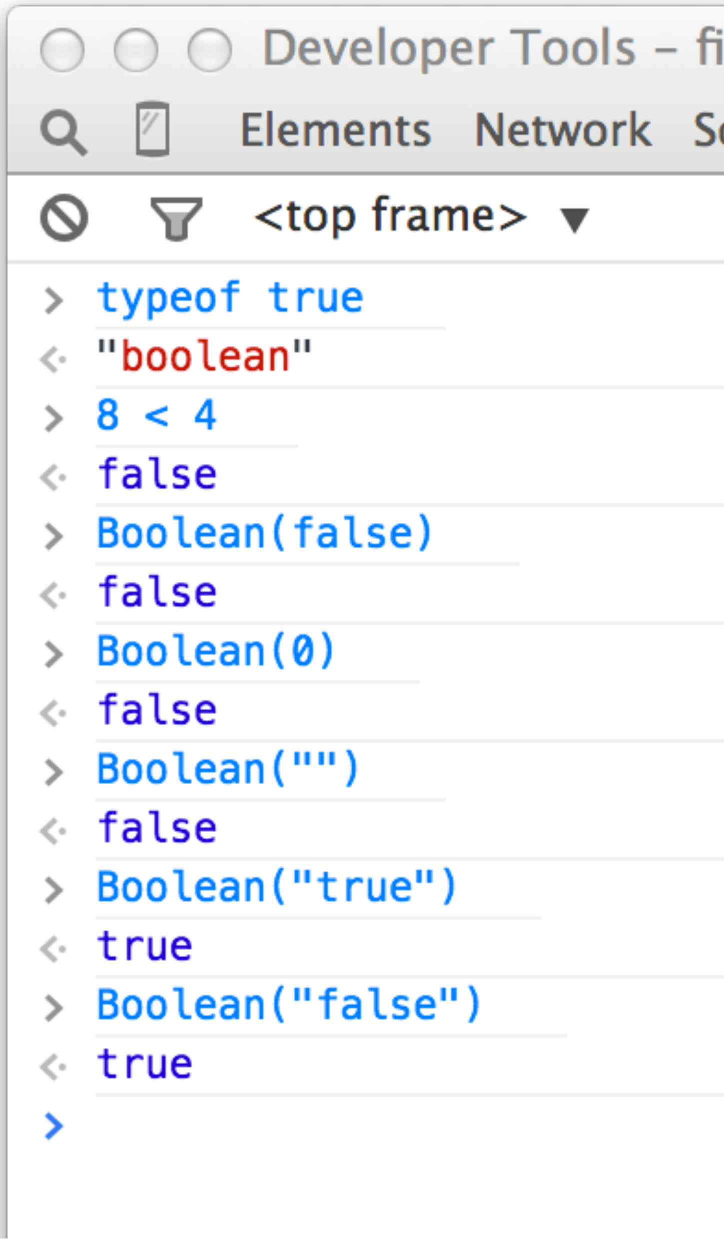


```
> t = "A long time ago..."
<· "A long time ago..."
> t.toUpperCase()
<· "A LONG TIME AGO..."
> t.substring(7, 11)
<· "time"
> typeof t
<· "string"
> t.length
<· 18
>
```

https://developer.mozilla.org/en-US/docs/Web/JavaScript/Reference/Global_Objects/String

Boolean

- Boolean for `true` and `false`.
- Comparisons
- Coerce other datatypes into Boolean.
- Note the behavior of the Boolean value for strings.
  - Empty string is `false`
  - Other strings are `true`. Even “false”!



```
> typeof true
<· "boolean"
> 8 < 4
<· false
> Boolean(false)
<· false
> Boolean(0)
<· false
> Boolean("")
<· false
> Boolean("true")
<· true
> Boolean("false")
<· true
>
```

Variables

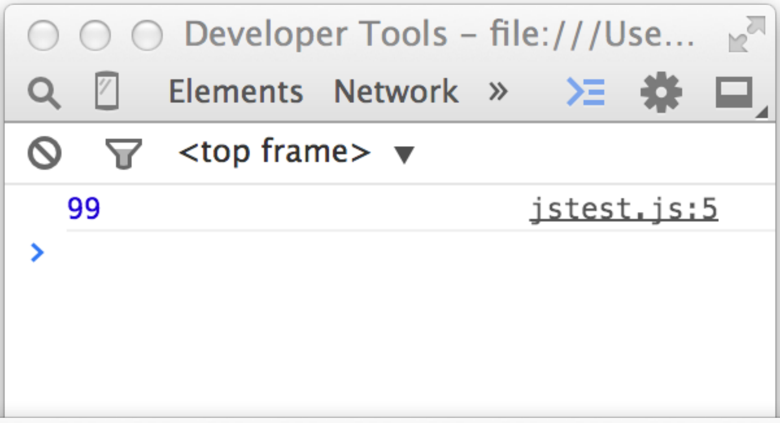
- Variable names can be any combination of letters, numbers, an underscore (_), or $
- Variable names cannot start with a number.
- Variables do not need to be declared.
- The `var` keyword can be used to declare and scope variables.

https://developer.mozilla.org/en-US/docs/Web/JavaScript/Reference/Statements/var

Variables

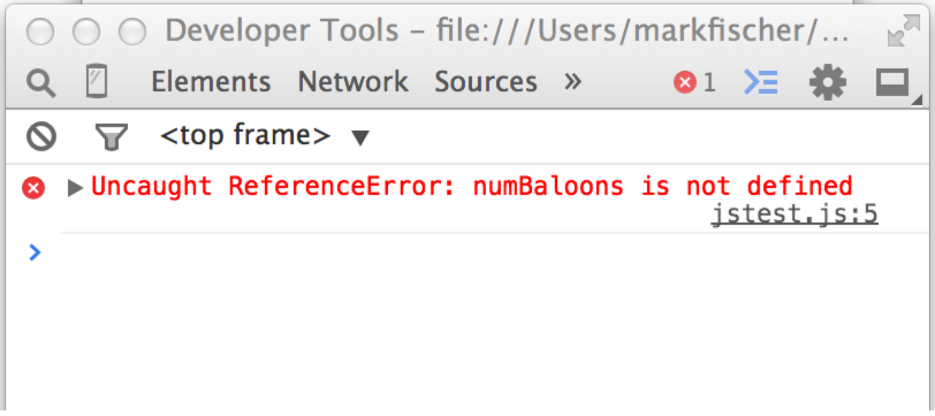
- Variables have global scope unless **`var`** is used to declare a variable.

```
var foo = function() {
  numBaloons = 99;
}
foo();
console.log(numBaloons);
```



```
99                                   jstest.js:5
>
```

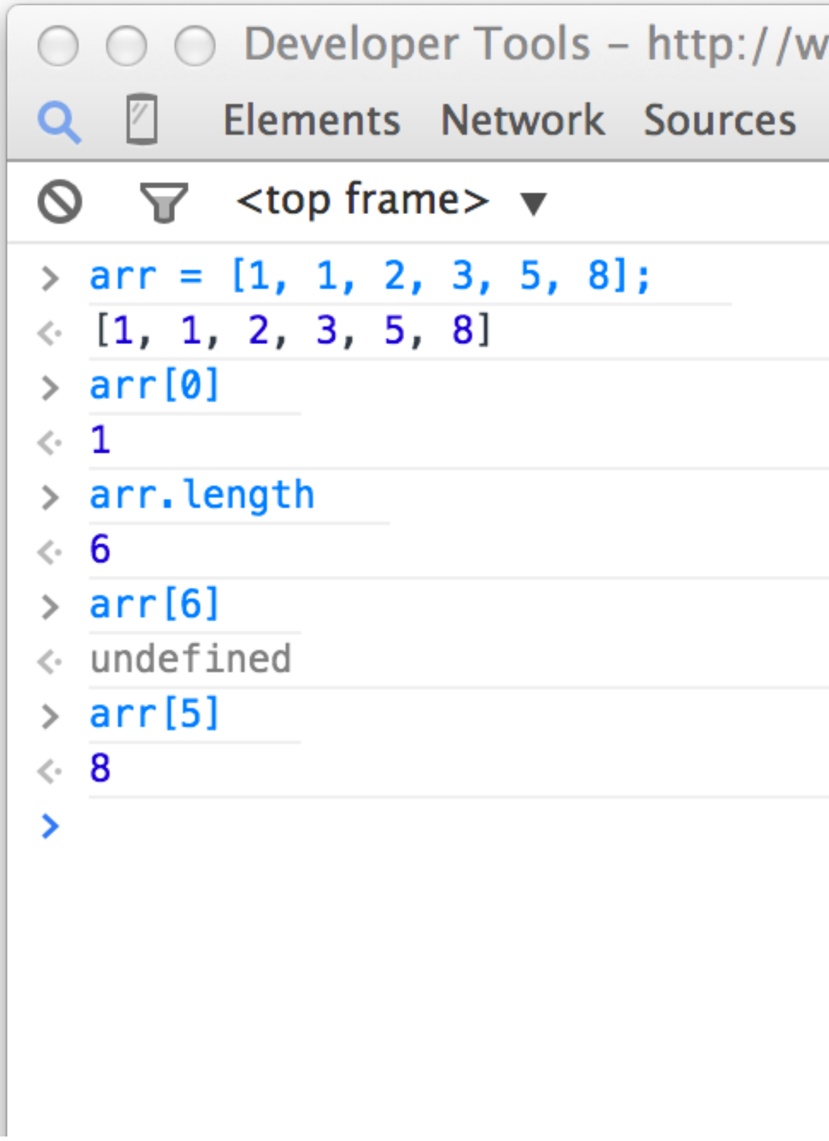
```
var foo = function() {
  var numBaloons = 99;
}
foo();
console.log(numBaloons);
```



```
▶Uncaught ReferenceError: numBaloons is not defined
                                              jstest.js:5
>
```

Arrays

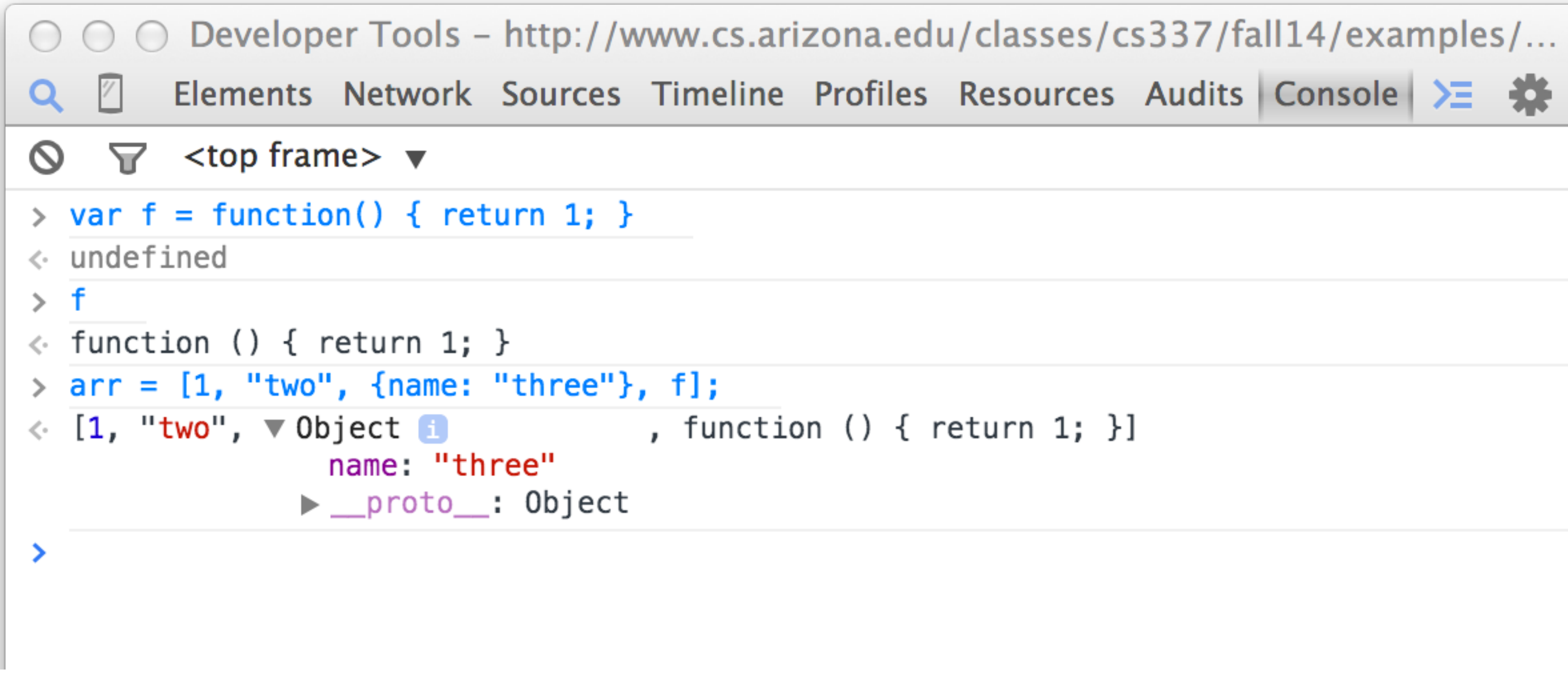
- Collection of values
- Created with `[n, n+1,…k-1]` syntax
- Array access with brackets: `n[ ]`
- Length property
- Standard Zero based indexing



```
> arr = [1, 1, 2, 3, 5, 8];
<· [1, 1, 2, 3, 5, 8]
> arr[0]
<· 1
> arr.length
<· 6
> arr[6]
<· undefined
> arr[5]
<· 8
>
```

Arrays

- Arrays can be collections of many different datatypes.


Developer Tools – http://www.cs.arizona.edu/classes/cs337/fall14/examples/...
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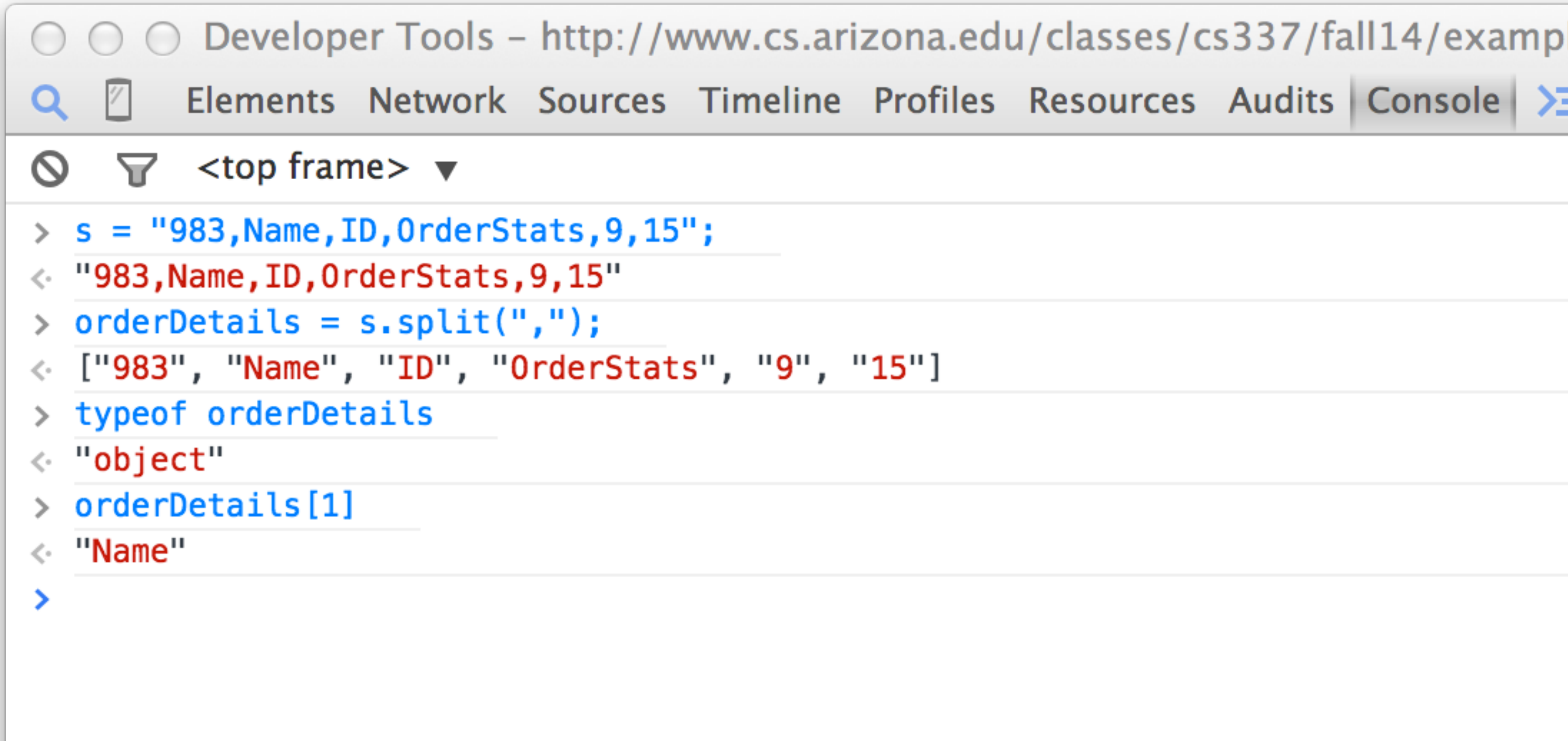
```
> var f = function() { return 1; }
<· undefined
> f
<· function () { return 1; }
> arr = [1, "two", {name: "three"}, f];
<· [1, "two", ▼Object                , function () { return 1; }]
                name: "three"
              ▶ __proto__: Object
>
```

Arrays From Strings

- `String.split()` to create an array from a string.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```
> s = "983,Name,ID,OrderStats,9,15";
<· "983,Name,ID,OrderStats,9,15"
> orderDetails = s.split(",");
<· ["983", "Name", "ID", "OrderStats", "9", "15"]
> typeof orderDetails
<· "object"
> orderDetails[1]
<· "Name"
>
```

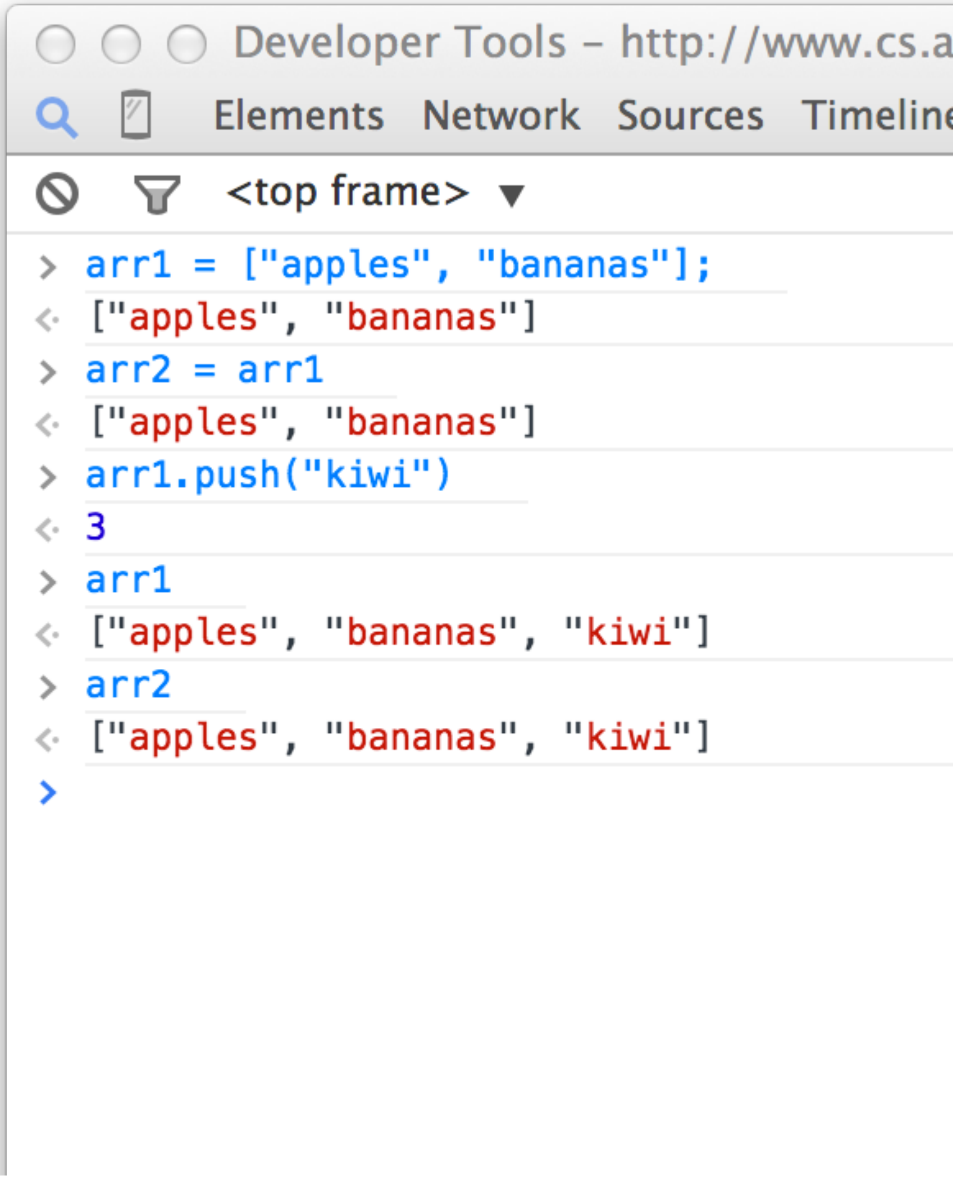
Array Methods

https://developer.mozilla.org/en-US/docs/Web/JavaScript/Reference/Global_Objects/Array

- Lots of useful array methods.
- `.contains(<some value>)` // returns true or false
- `.join(<glue string>)` // joins all elements together with glue and returns a string.
- `.toString()` // Quick string representation of the array
- `.pop()  .push()  .shift()  .unshift()` // Standard array methods
- `.sort()` // Sorts elements according to criteria
- `.splice()` // Adds or removes elements from an array

Array Assignment

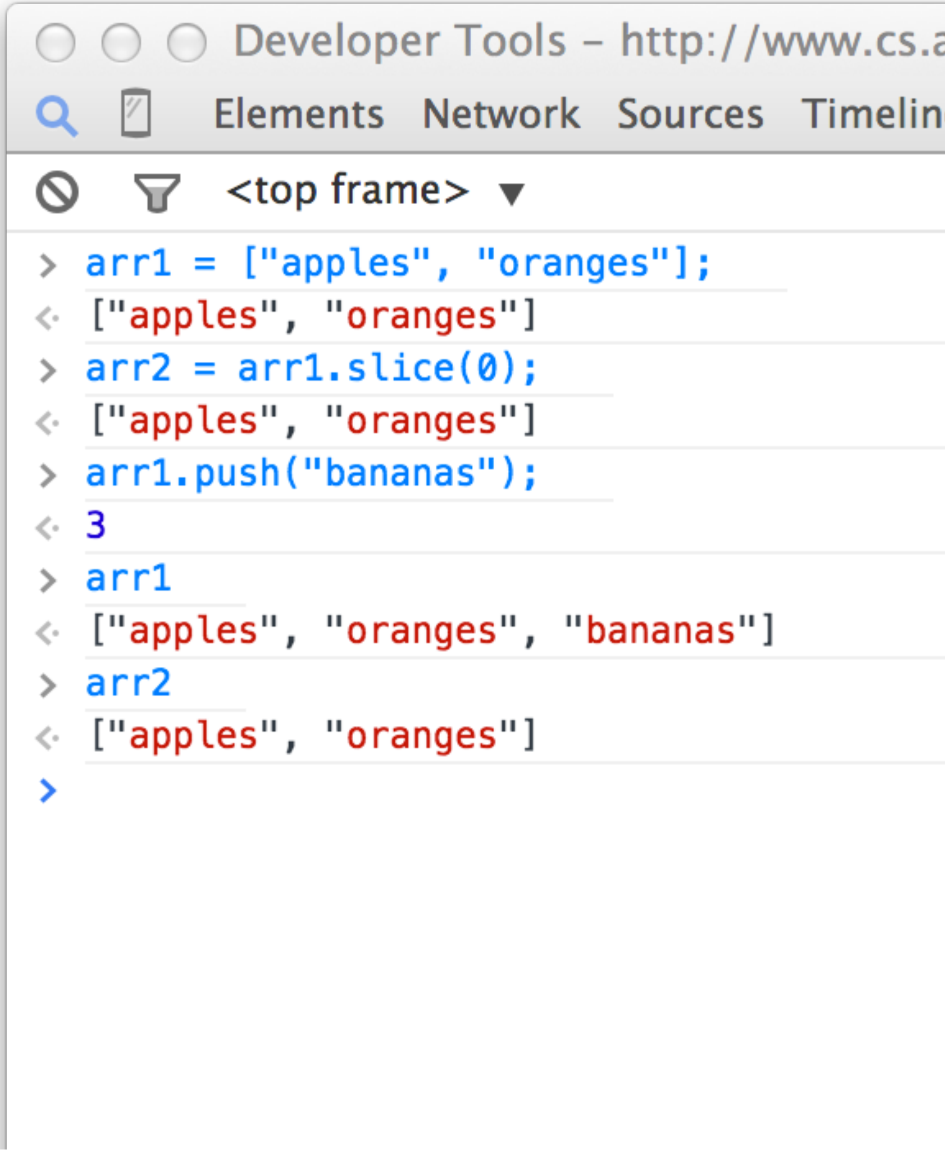
- Assigning an array to another variable assigns a reference of the array to the variable, not a copy.



```
> arr1 = ["apples", "bananas"];
<· ["apples", "bananas"]
> arr2 = arr1
<· ["apples", "bananas"]
> arr1.push("kiwi")
<· 3
> arr1
<· ["apples", "bananas", "kiwi"]
> arr2
<· ["apples", "bananas", "kiwi"]
>
```

Array Assignment

- To make a copy of an array, use the `.slice(0)` method.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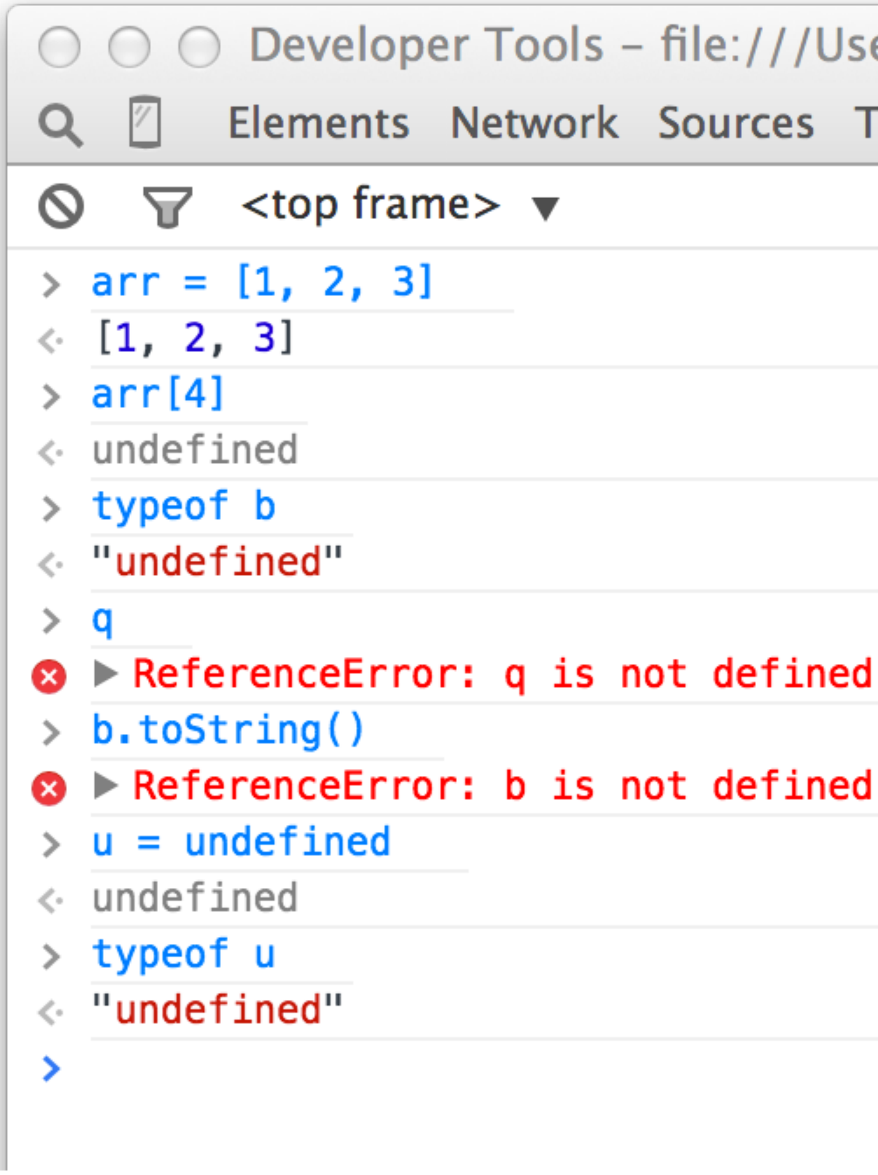
```
> arr1 = ["apples", "oranges"];
<· ["apples", "oranges"]
> arr2 = arr1.slice(0);
<· ["apples", "oranges"]
> arr1.push("bananas");
<· 3
> arr1
<· ["apples", "oranges", "bananas"]
> arr2
<· ["apples", "oranges"]
>
```

undefined

developer.mozilla.org/en-US/docs/Web/JavaScript/Reference/Global_Objects/undefined

- Javascript has a special value for things that are not defined: **`undefined`**
- Out of bounds requests
- Un-initialized variables
- **`undefined`** is a property of the *global object*. Its type is undefined.



```
> arr = [1, 2, 3]
<· [1, 2, 3]
> arr[4]
<· undefined
> typeof b
<· "undefined"
> q
⊗ ▶ReferenceError: q is not defined
> b.toString()
⊗ ▶ReferenceError: b is not defined
> u = undefined
<· undefined
> typeof u
<· "undefined"
>
```

Objects

- Objects are very flexible data structures.
- A basic object:

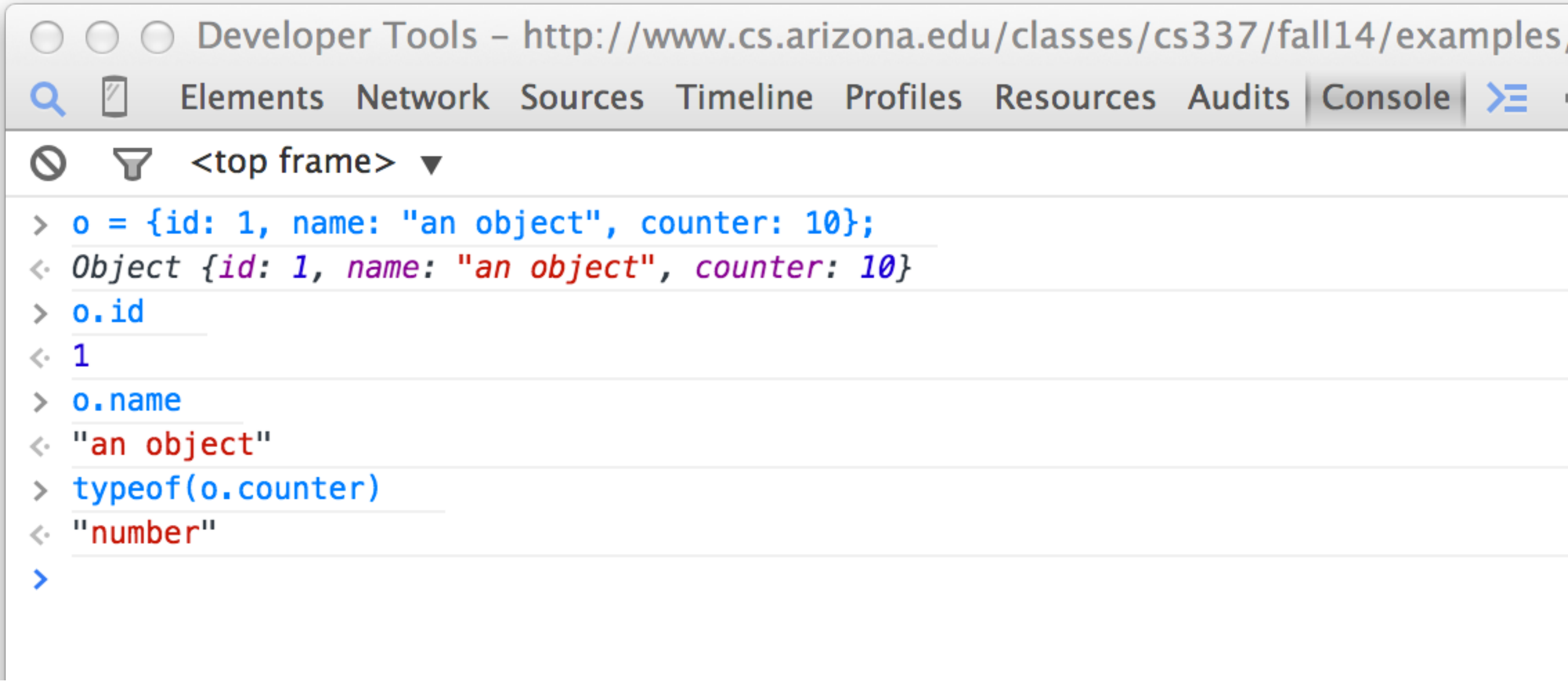
```
o = {id: 1, name: "an object", counter: 10};
```

- Create property names and values using `key: value` syntax.
- Separate multiple properties by commas.

Objects

```
o = {id: 1, name: "an object", counter: 10};
```

- Access properties via dot syntax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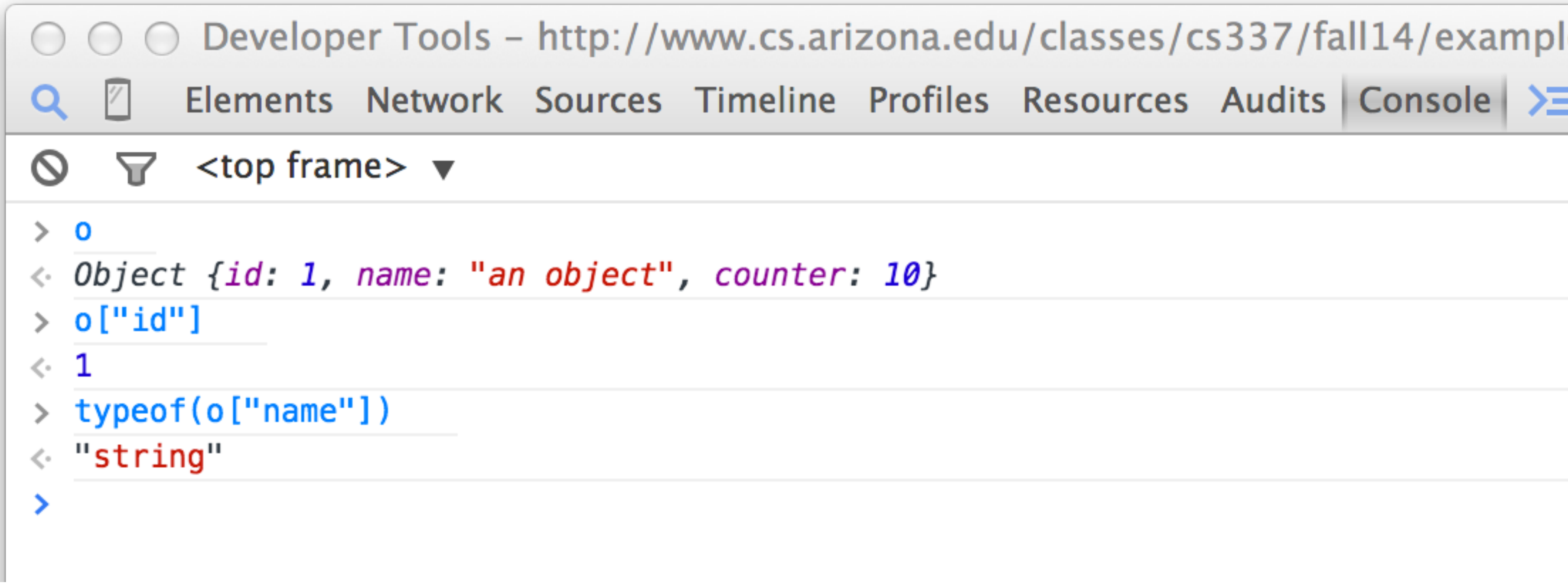
```
> o = {id: 1, name: "an object", counter: 10};
<· Object {id: 1, name: "an object", counter: 10}
> o.id
<· 1
> o.name
<· "an object"
> typeof(o.counter)
<· "number"
>
```

Objects

```
o = {id: 1, name: "an object", counter: 10};
```

- Act as “Associative Arrays” or “Key / Value” arrays, or “Dictionary” array
- `arr["key"]` syntax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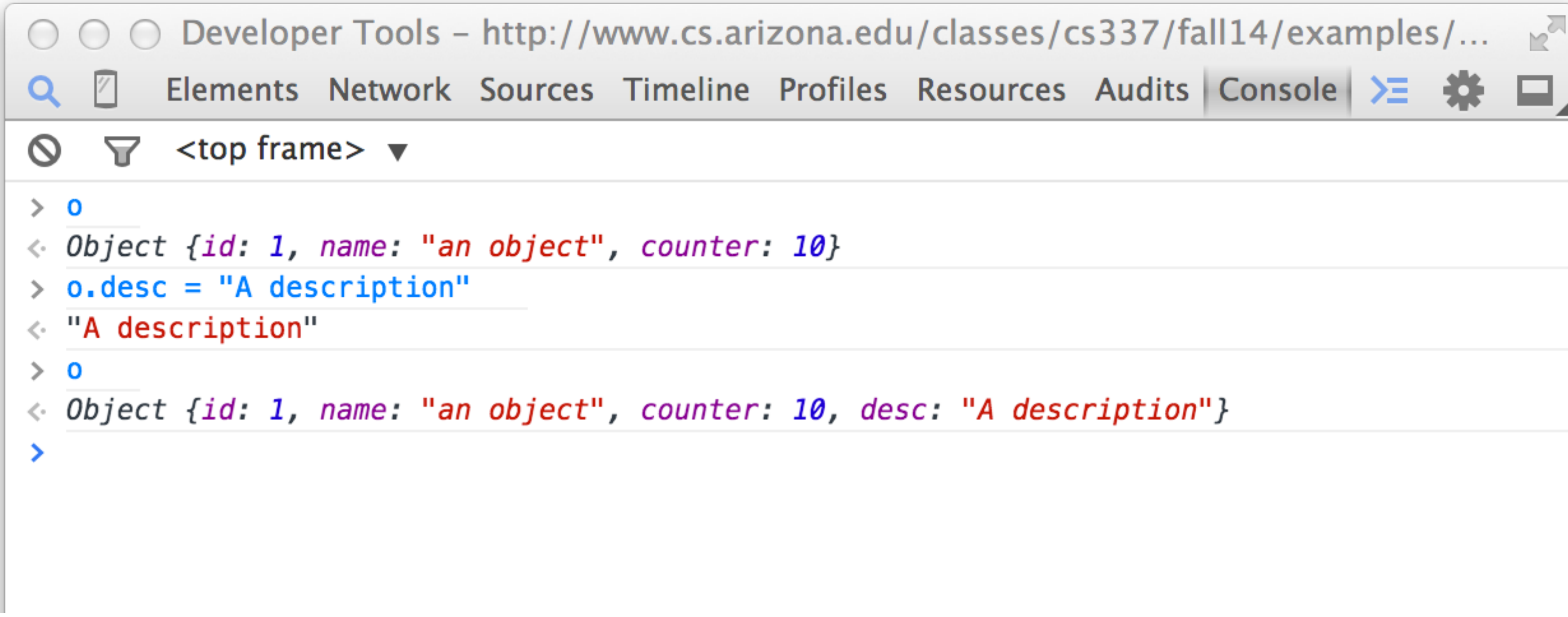
```
> o
<· Object {id: 1, name: "an object", counter: 10}
> o["id"]
<· 1
> typeof(o["name"])
<· "string"
>
```

Objects

- Assigning to undefined properties creates them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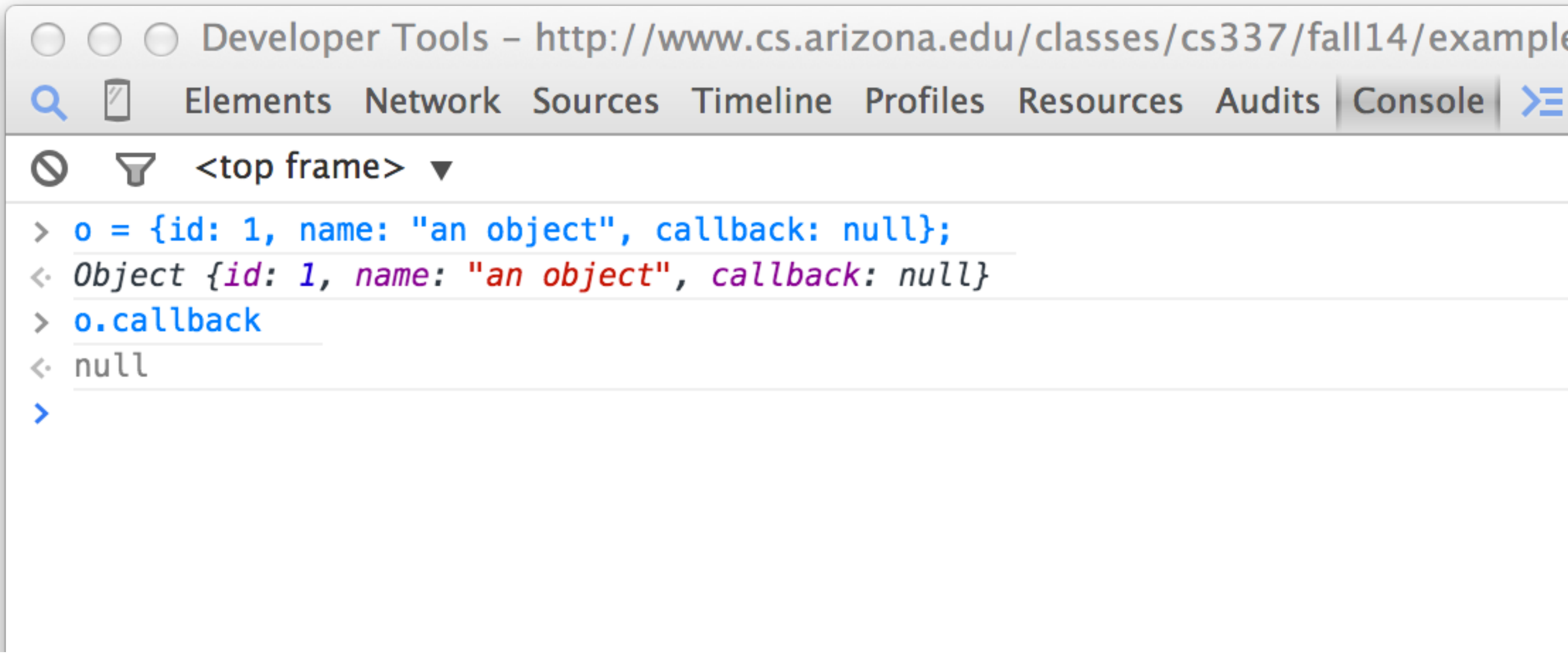
```
> o
<· Object {id: 1, name: "an object", counter: 10}
> o.desc = "A description"
<· "A description"
> o
<· Object {id: 1, name: "an object", counter: 10, desc: "A description"}
>
```

null

developer.mozilla.org/en-US/docs/Web/JavaScript/Reference/Global_Objects/null

- Null is a literal value representing an “empty” or non-existent value.


Developer Tools – http://www.cs.arizona.edu/classes/cs337/fall14/example
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Sources
Timeline
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Resources
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```
> o = {id: 1, name: "an object", callback: null};
<· Object {id: 1, name: "an object", callback: null}
> o.callback
<· null
>
```

Operators

- Arithmetic Operators: `+ - / * % ++ --`
- String concatenation: `+`
- Logical Operators: `&& || !`
- Comparisons: `<   >  <=  >=`
- Ternary Operator: `condition ? true expr : false expr`
- Bitwise Operators: `<<  >>  ^  ~`

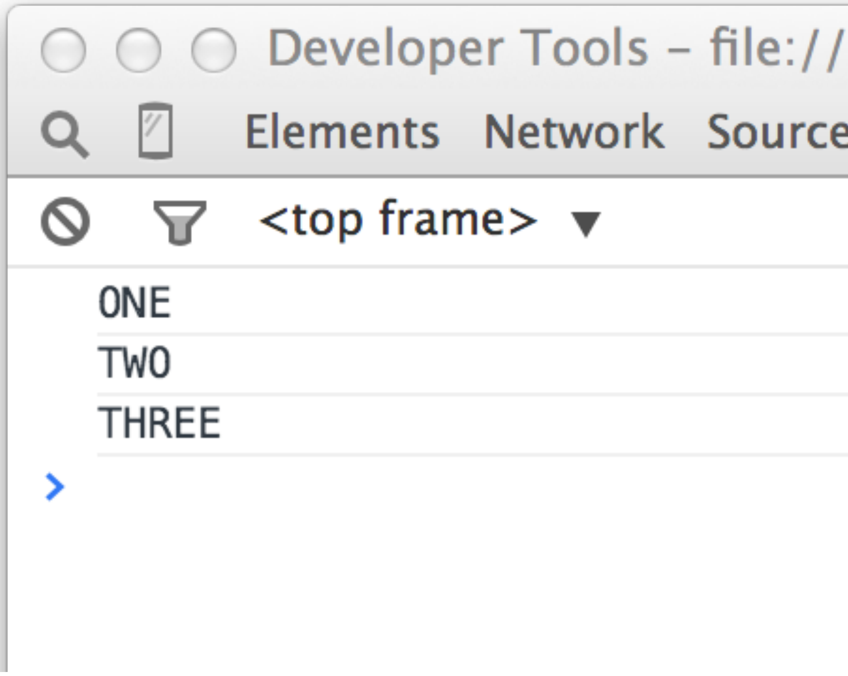
Control Structures

- `if (condition) { stmt1 } else { stmt2 }`
- `while (condition) { statements }`
- `for (i = 0; i < 10; i++) { statements }`
- Pretty much work like every other C or Java style language

Control Structures: forEach

```
a = ["one", "two", "three"];
a.forEach(function(element, index, arr) {
  console.log( element.toUpperCase() );
});
```

- Arrays have a special **`forEach`** method for performing some action relating to each element of the array
- The **`forEach`** method takes a *function* as an argument.



```
ONE
TWO
THREE
>
```

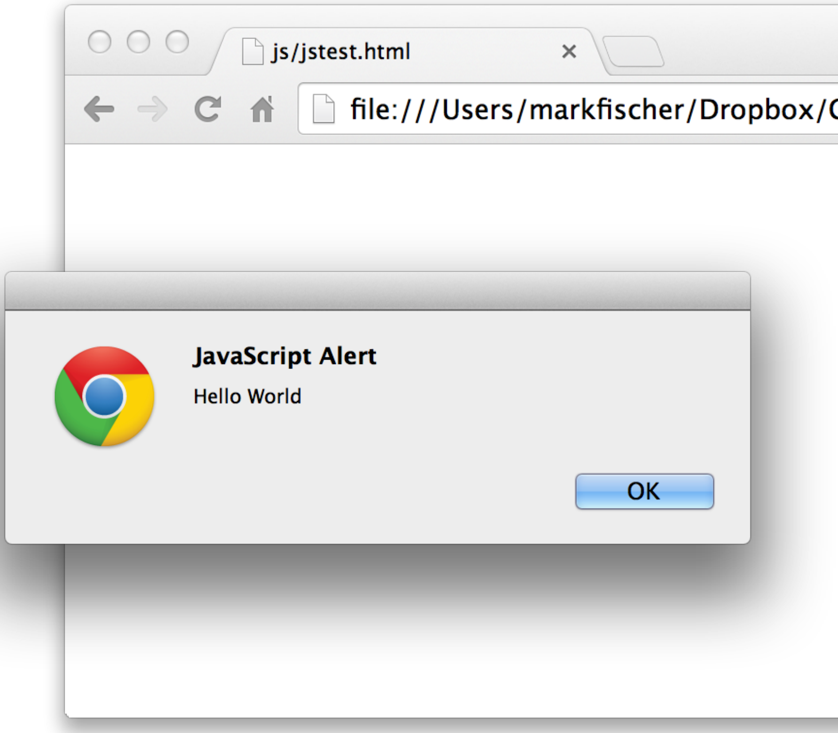
Basic I/O

- Alerts
- Log to Console
- Confirms
- Prompt
- DOM Manipulation
- Debugger
- No Direct Local File I/O!

alert( )

```
alert("Hello World");
```

- Display a modal dialog box with the specified text.
- Pauses execution of Javascript until dialog is dismissed.

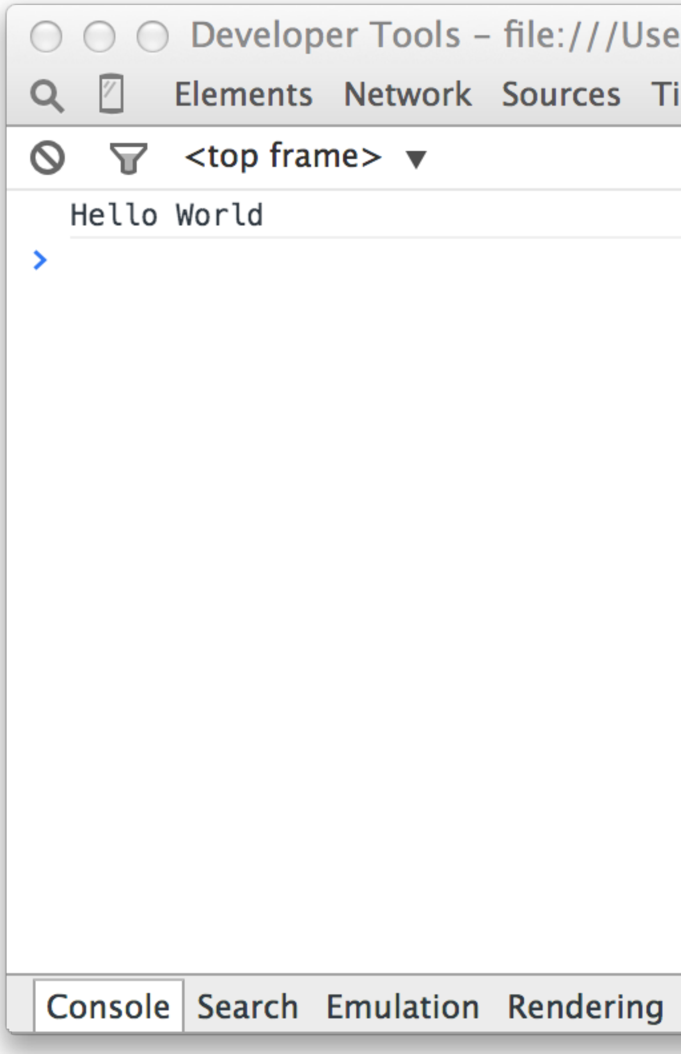


console.log( )

```
console.log("Hello World");
```

- Quick way to get some debugging out.

- Doesn't block execution, so usually a better choice for debugging and testing than **`alert()`**.

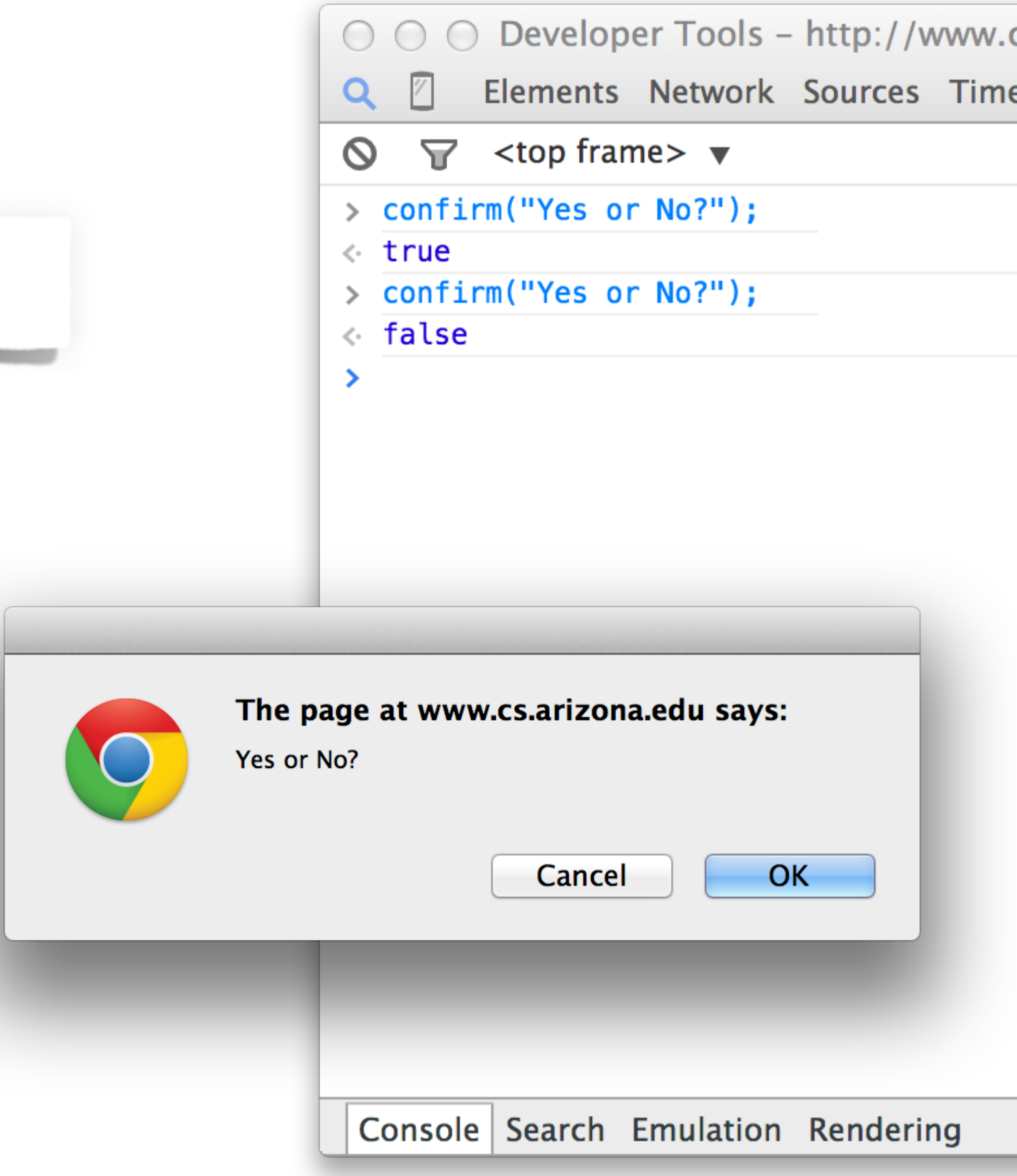


```
Hello World
```

`confirm( )`

```
confirm("Yes or No?");
```

- Ask for a `true` or `false` response from the user.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Console Search Emulation Rendering
Cancel
OK

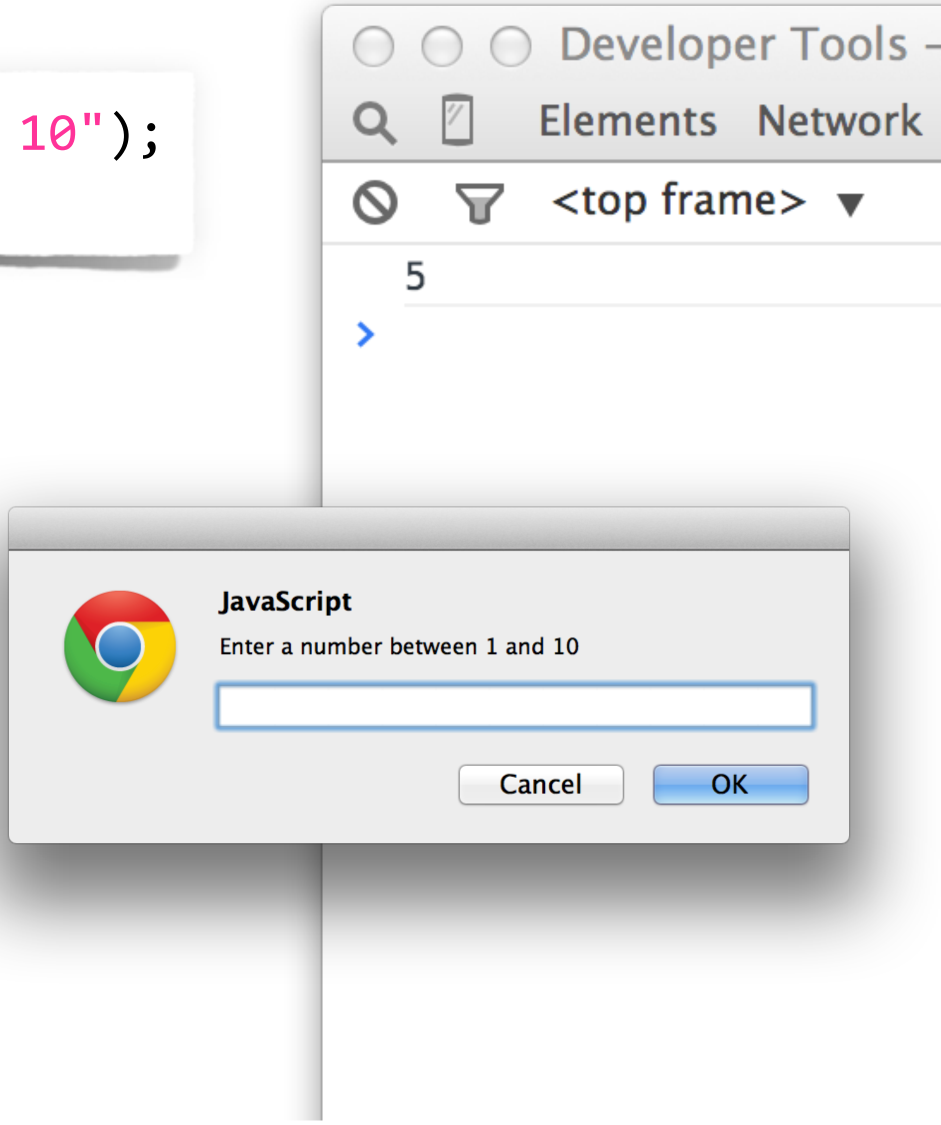
```
> confirm("Yes or No?");
<· true
> confirm("Yes or No?");
<· false
>
```

The page at www.cs.arizona.edu says:

Yes or No?

prompt( )

```
prompt("Enter a number between 1 and 10");
console.log(i);
```



```
5
>
```

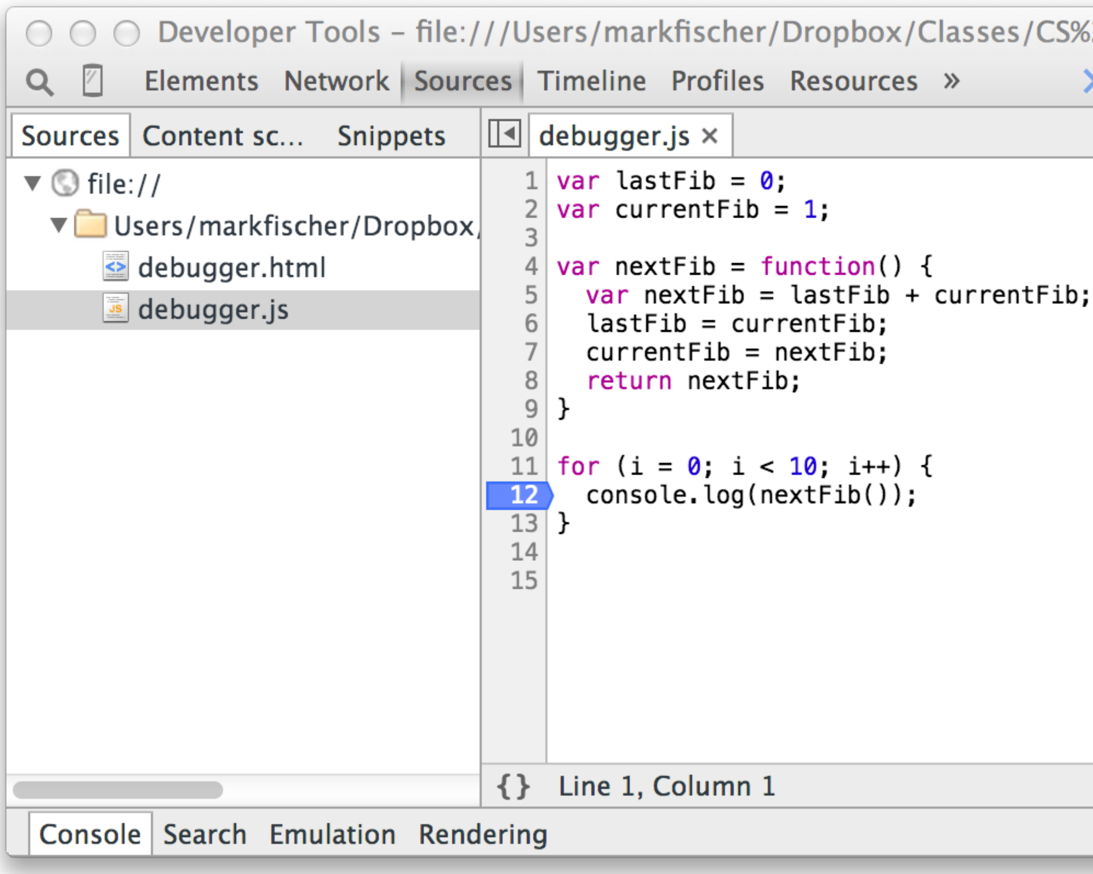
JavaScript

Enter a number between 1 and 10

- Ask for user input as a text string.

Debugger

- Most browsers have a full featured interactive debugger built in.
- Breakpoints, watched expressions, step through execution, etc.
- Example.



```
var lastFib = 0;
var currentFib = 1;

var nextFib = function() {
  var nextFib = lastFib + currentFib;
  lastFib = currentFib;
  currentFib = nextFib;
  return nextFib;
}

for (i = 0; i < 10; i++) {
  console.log(nextFib());
}
```

Functions

- Multiple ways to define a function

```
function echo(a) {
  return a;
}

echoTwo = function(a) {
  return a;
}

var echoThree = function(a) {
  return a;
}

console.log( echo("one") );
console.log( echoTwo("two") );
console.log( echoThree("three") );
```

Functions

Declares a named function without requiring assignment

Declares a *global* variable **`echoTwo`** and assigns an anonymous function to it

Declares a *local* variable **`echoThree`** and assigns an anonymous function to it

```
function echo(a) {
  return a;
}

echoTwo = function(a) {
  return a;
}

var echoThree = function(a) {
  return a;
}

console.log( echo("one") );
console.log( echoTwo("two") );
console.log( echoThree("three") );
```

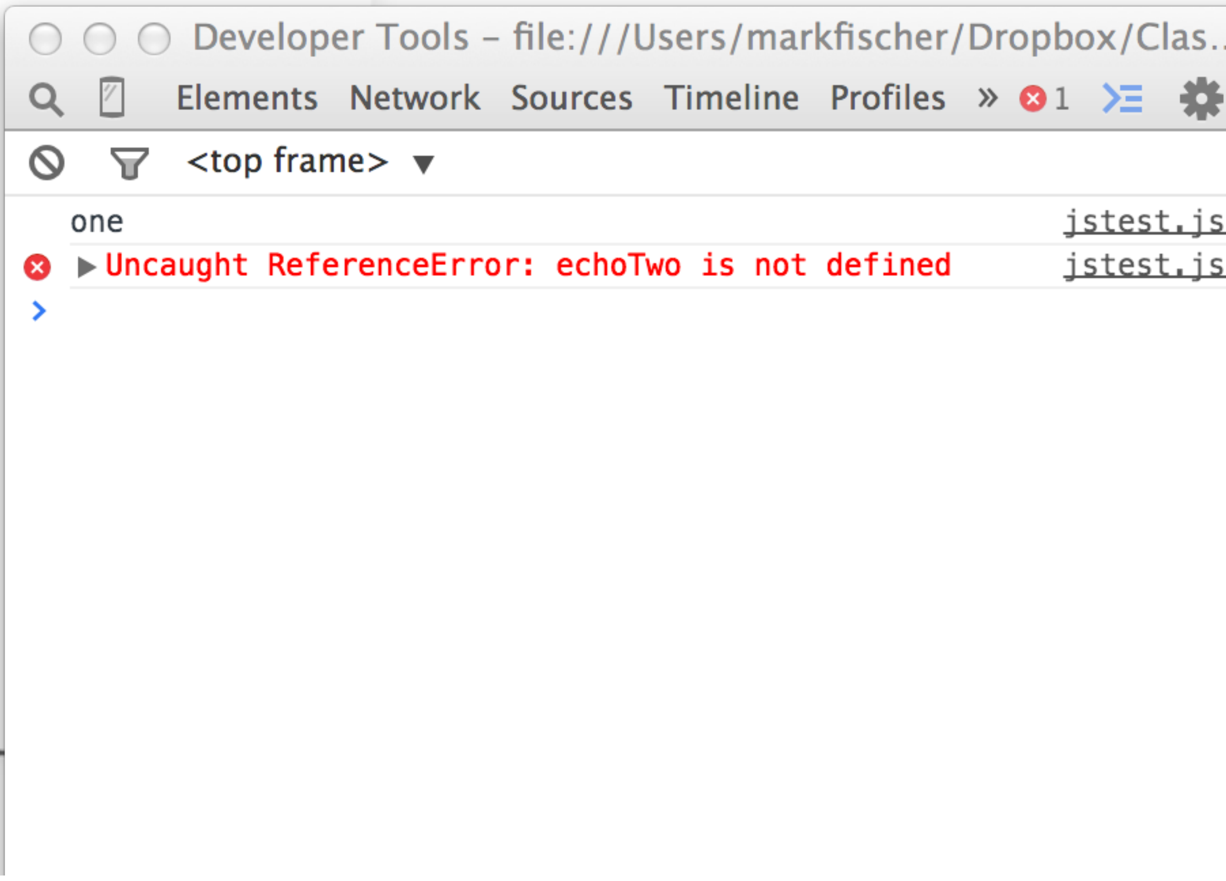
Functions

- Does any of this matter?
- What if we call the functions before they're declared?

```
console.log( echo("one") );
console.log( echoTwo("two") );
console.log( echoThree("three") );

function echo(a) {
  return a;
}

echoTwo = function(a) {
  return a;
}

var echoThree = function(a) {
  return a;
}
```

Functions

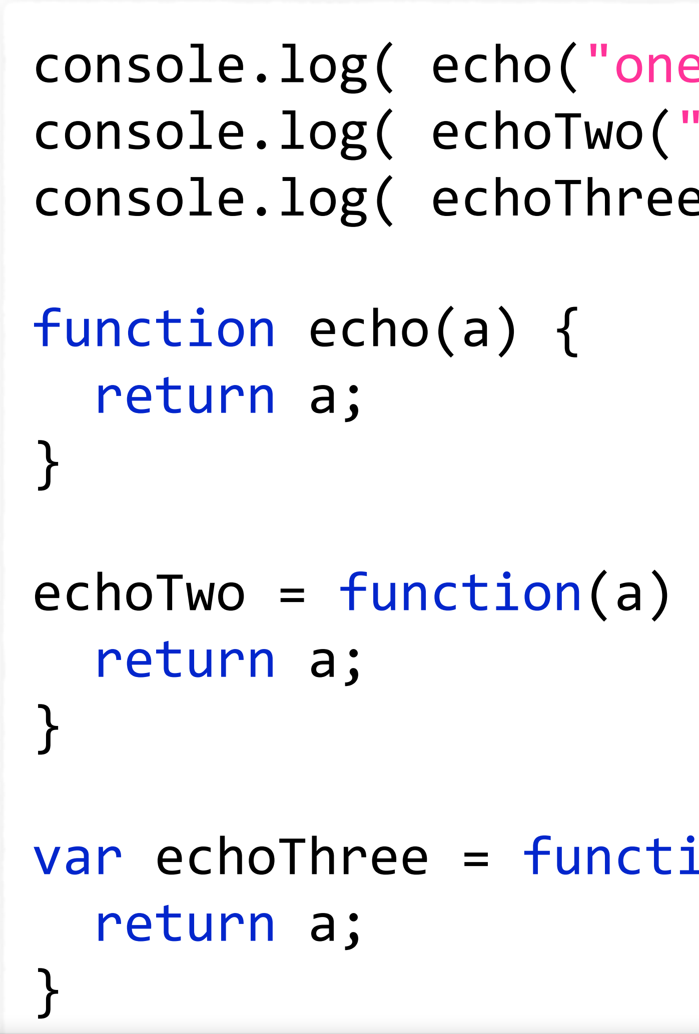
```
console.log( echo("one") );
console.log( echoTwo("two") );
console.log( echoThree("three") );

function echo(a) {
  return a;
}

echoTwo = function(a) {
  return a;
}

var echoThree = function(
  return a;
}
```



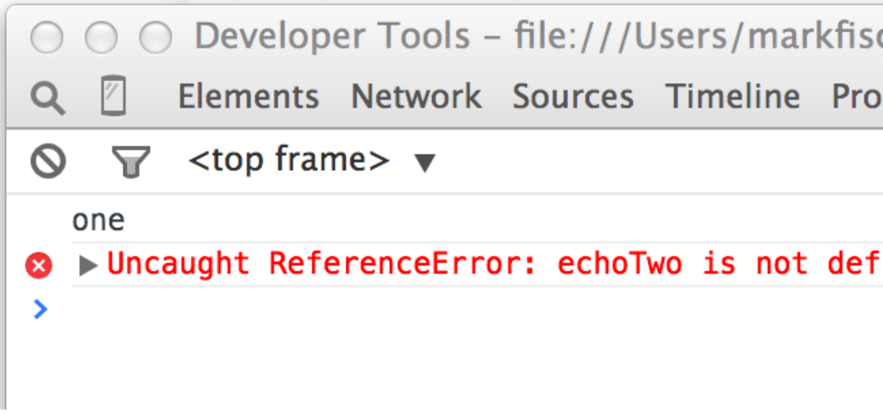
```
one                                                   jstest.js
▶ Uncaught ReferenceError: echoTwo is not defined     jstest.js
>
```

Functions

- The first style has a symbol table entry created for it at parse time. So it can be referenced immediately during runtime.
- The other two have symbol table entries created at runtime, so aren't available until after they've been executed.



```
console.log( echo("one
console.log( echoTwo("
console.log( echoThree

function echo(a) {
  return a;
}

echoTwo = function(a)
  return a;
}

var echoThree = functi
  return a;
}
```



```
one
▶Uncaught ReferenceError: echoTwo is not def
>
```

javascriptweblog.wordpress.com/2010/07/06/function-declarations-vs-function-expressions/

Functions

```
//Function Declaration
function add(a,b) {return a + b};
//Function Expression
var add = function(a,b) {return a + b};
```

- So should we always use Function Declarations?
  - Well, it depends…

Functions

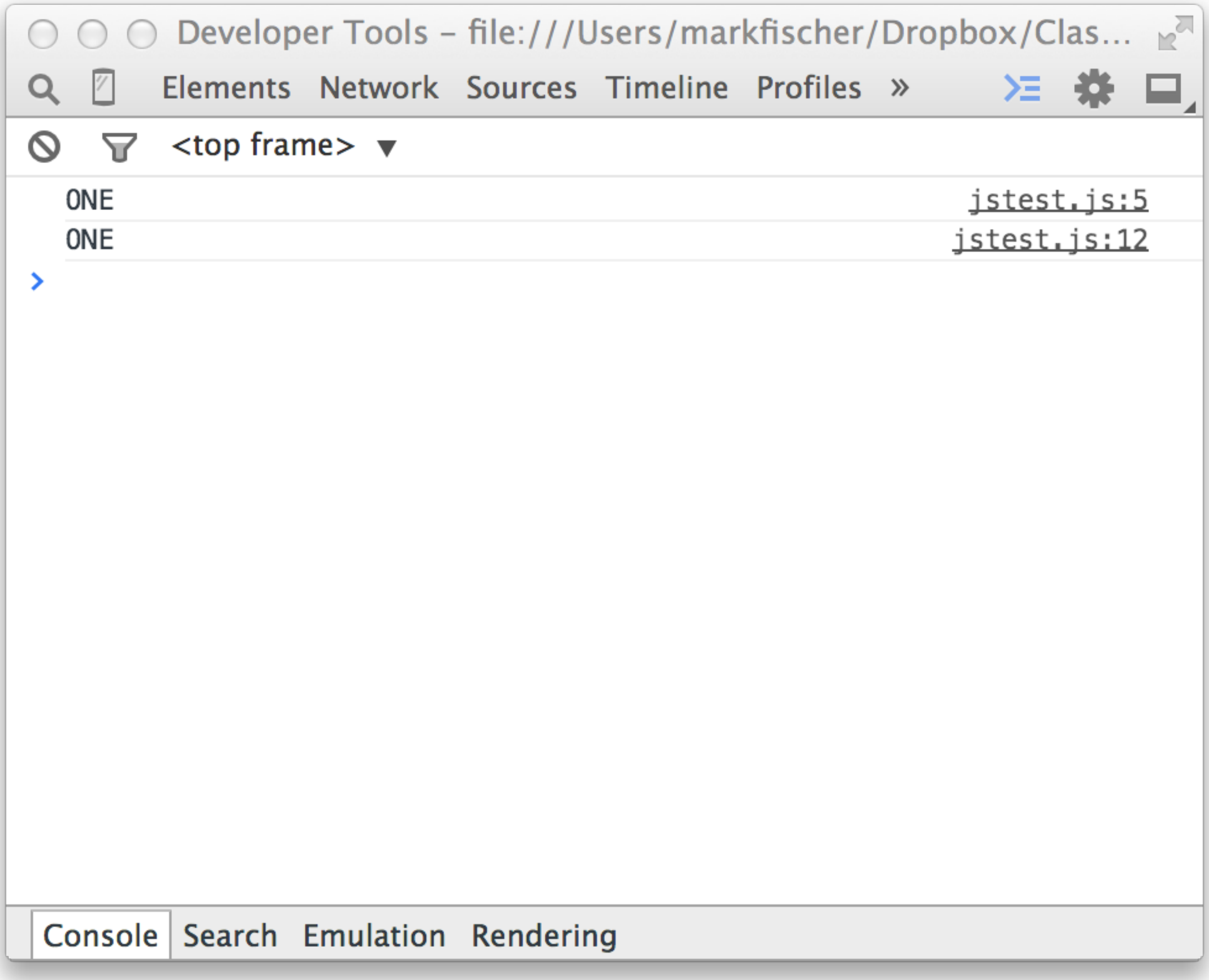
- What is the console output here?

```
function echo(a) {
  return a;
}

console.log( echo("one") );


function echo(a) {
  return a.toUpperCase();
}

console.log( echo("one") );
```

Functions

- Hmm, maybe not what we were expecting.

- Function Declarations are ‘hoisted’ to the top at parse time, so when executed, the last declared version wins.



```
ONE                                                  jstest.js:5
ONE                                                  jstest.js:12
>
```

Function Declarations

- Can only appear as block level elements.
- Are ‘hoisted’ to the top at parse time, before run time.
- Cannot be nested within non-function blocks.
- Are scoped by where they are declared, like `var`

Function Expressions

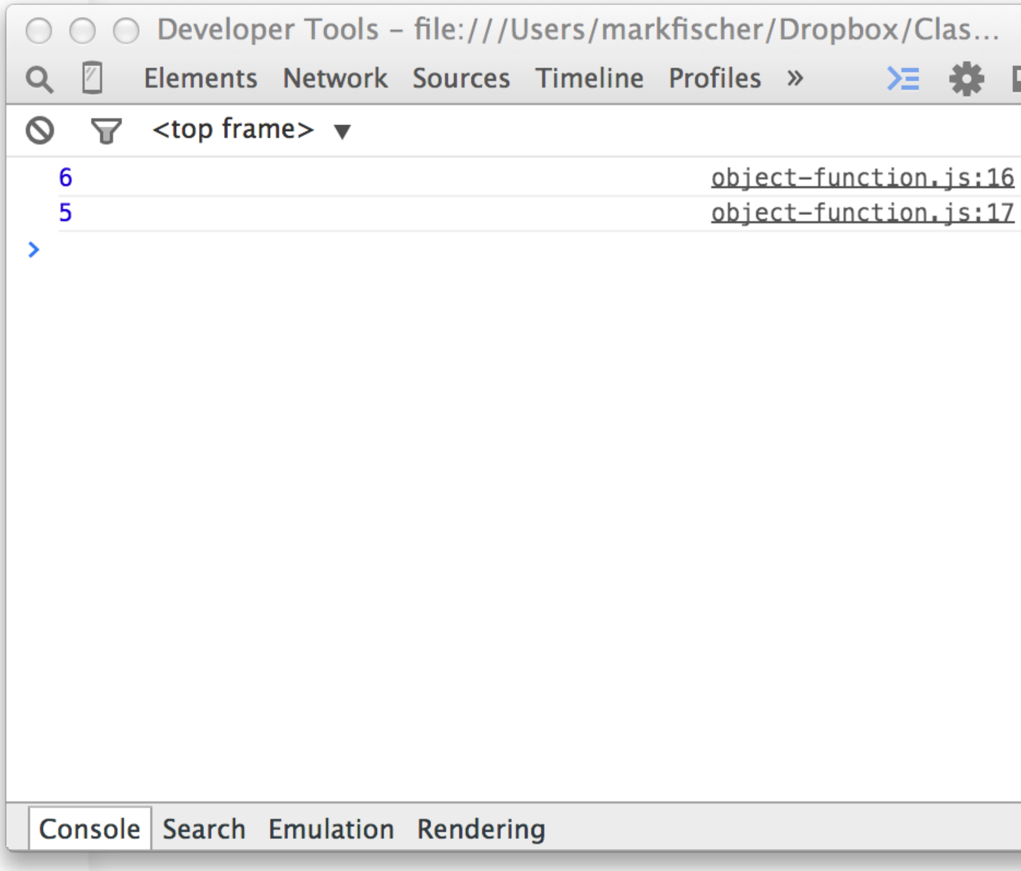
- Can be used anywhere an expression is valid.
  - Can be more flexible because of this.
- Are evaluated and assigned at run time.

Objects and Functions

- Functions can be added to objects as property variables.
- Many object “methods” are really properties with functions assigned to them.

Objects and Functions

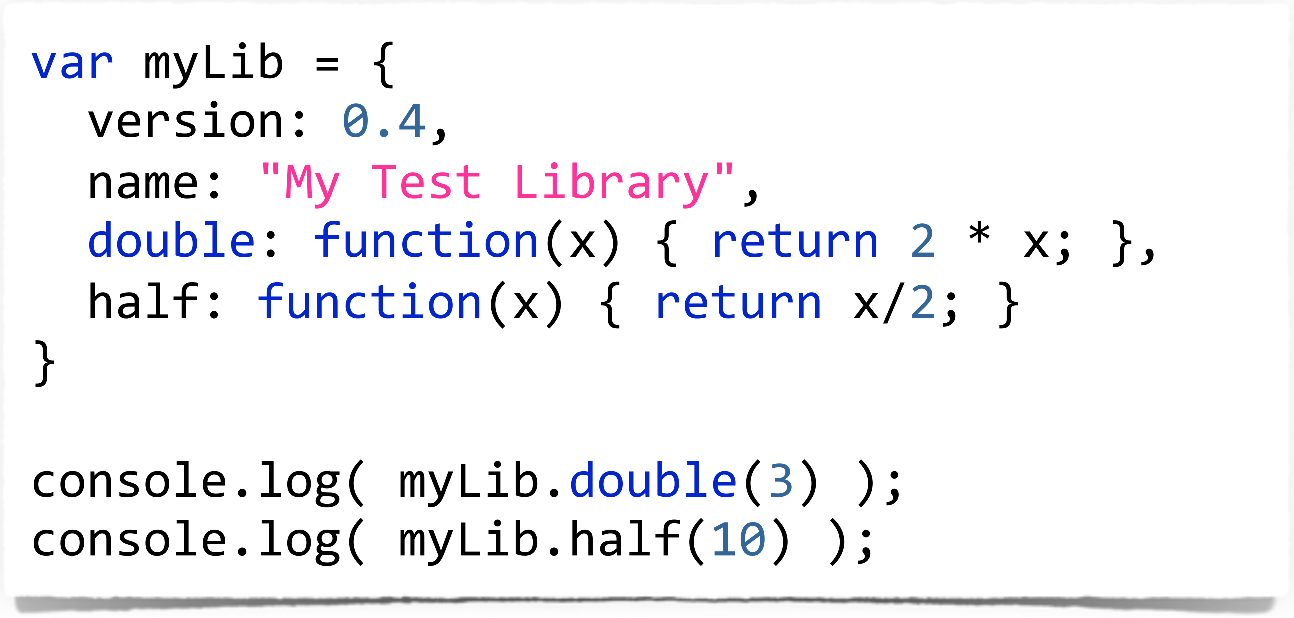
```
var doubleMe = function(x) {
  return 2 * x;
}

var halveMe = function(x) {
  return x/2;
}

var myLib = {
  version: 0.3,
  name: "My Test Library",
  double: doubleMe,
  half: halveMe
}

console.log( myLib.double(3) );
console.log( myLib.half(10) );
```



```
6                                   object-function.js:16
5                                   object-function.js:17
>
```

Objects and Functions

- Using anonymous function expressions instead.



```
var myLib = {
  version: 0.4,
  name: "My Test Library",
  double: function(x) { return 2 * x; },
  half: function(x) { return x/2; }
}

console.log( myLib.double(3) );
console.log( myLib.half(10) );
```

Javascript in HTML

- Where does our Javascript live?
- Inline in an HTML document inside a `<script>` element
- Included in an external file via a `<script>` element.

Javascript in HTML

- The `<script>` element with inline content
- Within the `<script>` element, we're parsing Javascript, not HTML

```
<!doctype html>
<head>
  <title>js/jstest.html</title>

  <script>
    var answer = 42;
    function calculateAnswer() {
      return answer;
    }
    console.log( calculateAnswer() );
  </script>
</head>

<body>
  <div></div>
  <div></div>
</body>
</html>
```

Javascript in HTML

- The `<script>` element with src attribute.
- Includes an external file with Javascript in it.
- No wrapping `<script>` tags within external files.

```html
<!doctype html>
<html>
<head>
  <title>js/jstest.html</title>
  <script src="jstest.js"></script>
</head>

<body>
  <div></div>
</body>
</html>
```

```javascript
var answer = 42;
function calculateAnswer() {
  return answer;
}
console.log( calculateAnswer() );
```

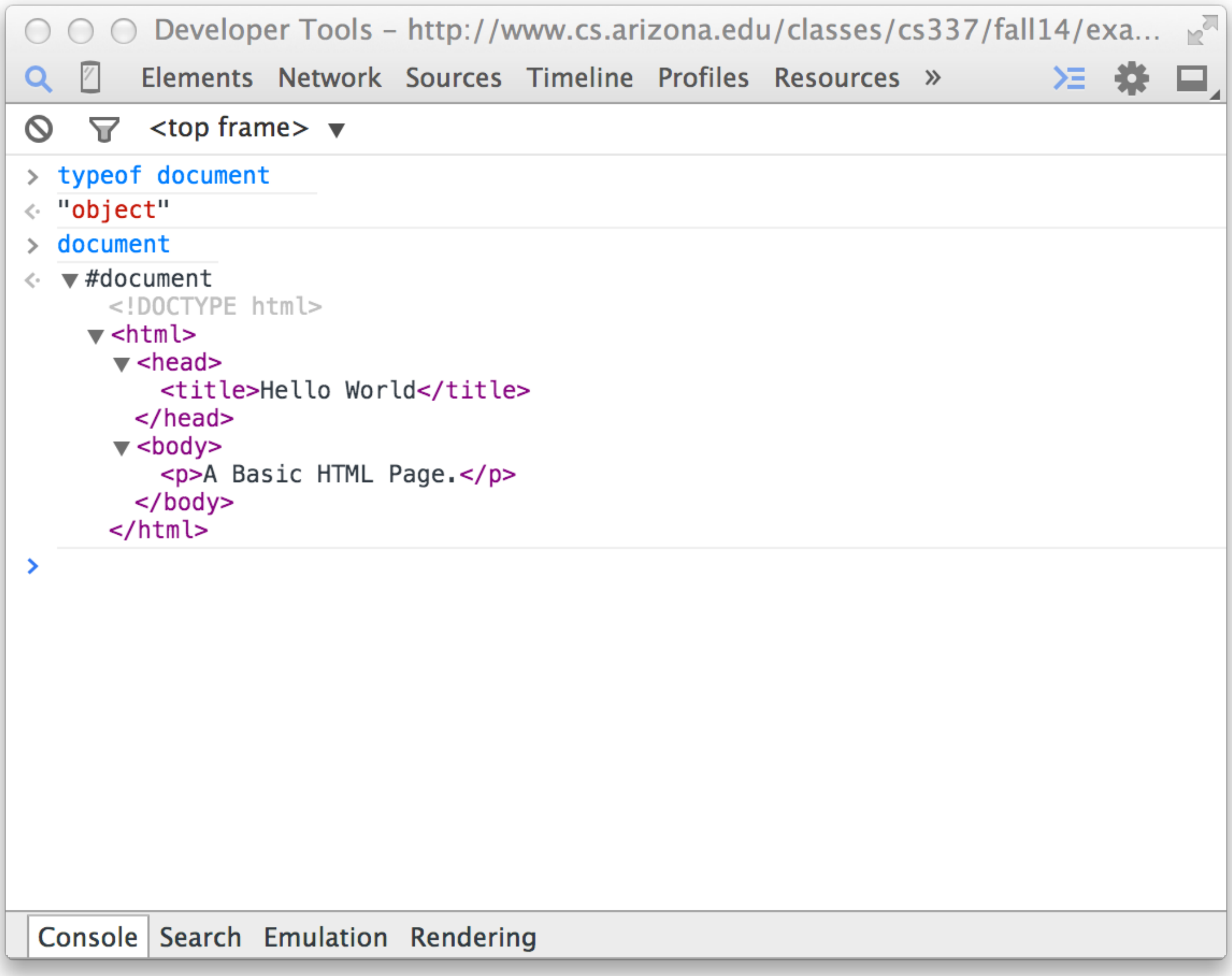
The `document` Object

This is all well and good, but how about something involving a web page?

The `document` Object

- Browsers parse the HTML and CSS of a page, and build an object model in memory.
- The browser exposes this object to us for use with our Javascript as the `document` object.

The `document` Object

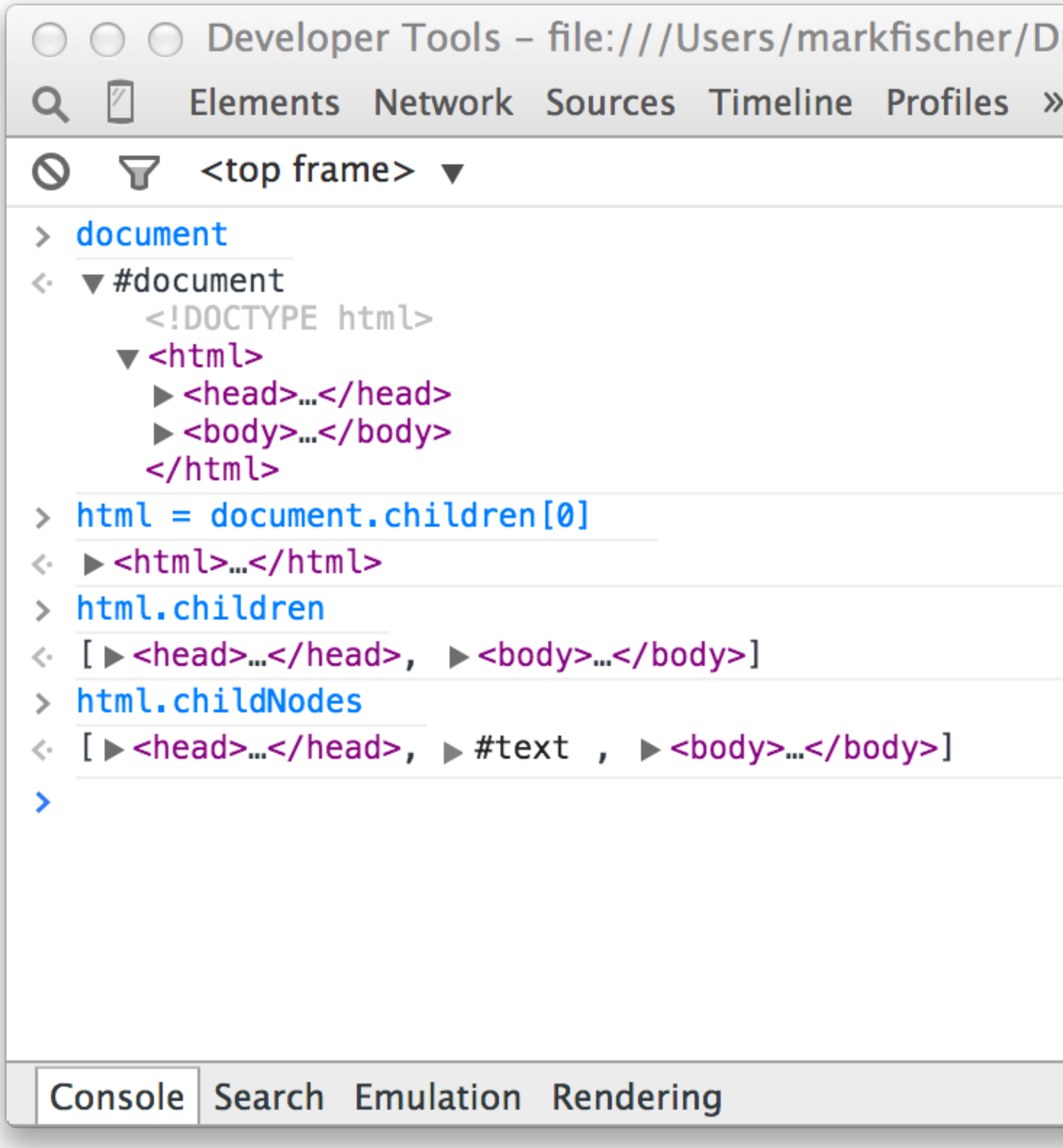


Developer Tools – http://www.cs.arizona.edu/classes/cs337/fall14/exa...
Elements Network Sources Timeline Profiles Resources »
<top frame> ▼
Console Search Emulation Rendering

```
> typeof document
<· "object"
> document
<· ▼#document
      <!DOCTYPE html>
    ▼<html>
      ▼<head>
         <title>Hello World</title>
       </head>
      ▼<body>
         <p>A Basic HTML Page.</p>
       </body>
     </html>
>
```

The `document` Object

- The document object represents the root element of our DOM tree.
- It has child nodes, and each node has various attributes.
- Note the difference between .children and .childNodes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Elements Network Sources Timeline Profiles »
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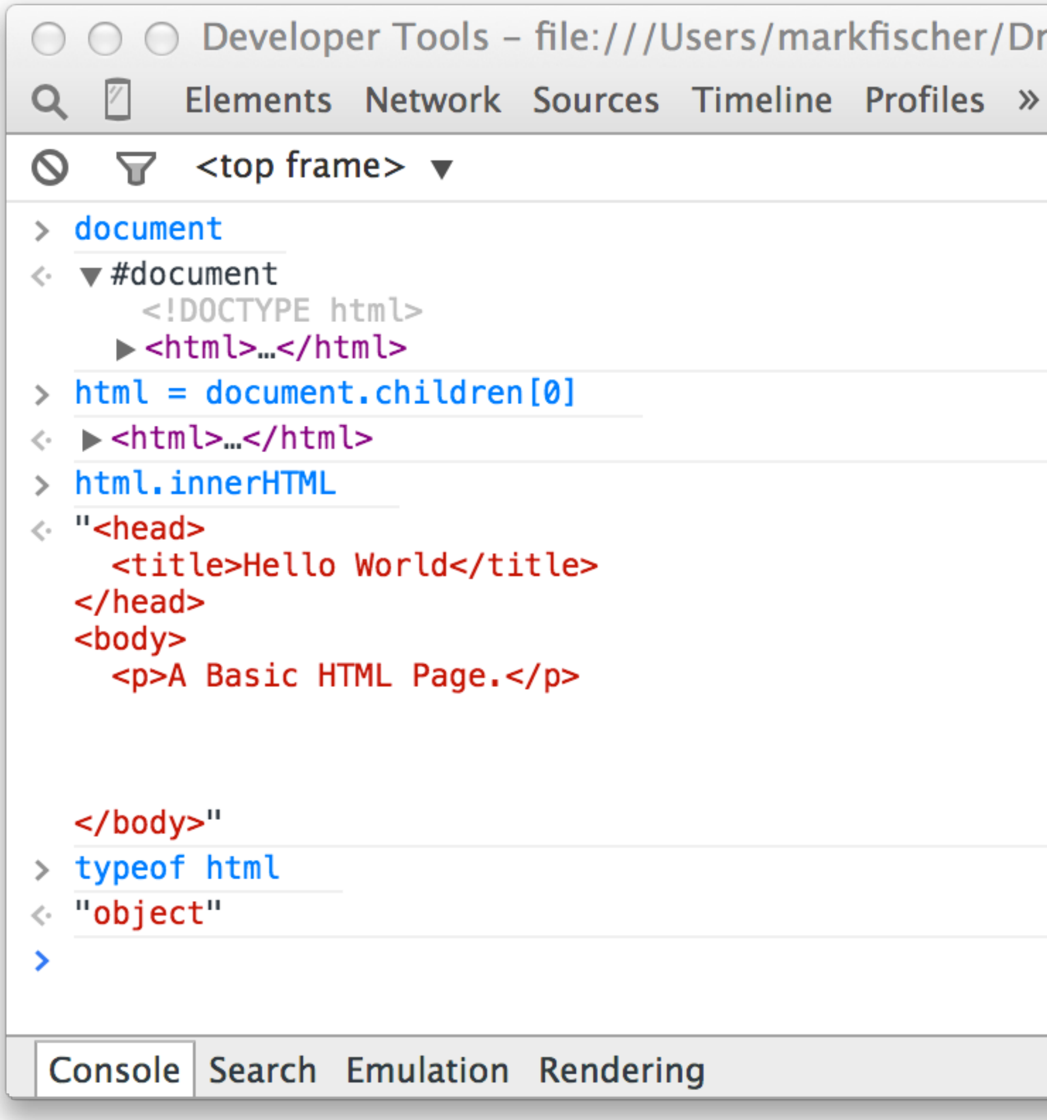
Console Search Emulation Rendering

```
> document
<· ▼#document
      <!DOCTYPE html>
    ▼<html>
      ▶<head>…</head>
      ▶<body>…</body>
     </html>
> html = document.children[0]
<· ▶<html>…</html>
> html.children
<· [▶<head>…</head>, ▶<body>…</body>]
> html.childNodes
<· [▶<head>…</head>, ▶#text , ▶<body>…</body>]
>
```

The `document` Object

- `document` elements are *objects*, so accessing their properties is done with the dot syntax
- `object.property`
- `html.innerHTML` for example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Elements Network Sources Timeline Profiles »
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Console Search Emulation Rendering

```
> document
<· ▼#document
      <!DOCTYPE html>
    ▶<html>…</html>
> html = document.children[0]
<· ▶<html>…</html>
> html.innerHTML
<· "<head>
     <title>Hello World</title>
   </head>
   <body>
     <p>A Basic HTML Page.</p>



   </body>"
> typeof html
<· "object"
>
```

The `document` Object

- The `document` object is *NOT* part of the Javascript language.
- It is an API defined by the W3C to interact with HTML and XML documents.

https://developer.mozilla.org/en-US/docs/Web/API/Document_Object_Model

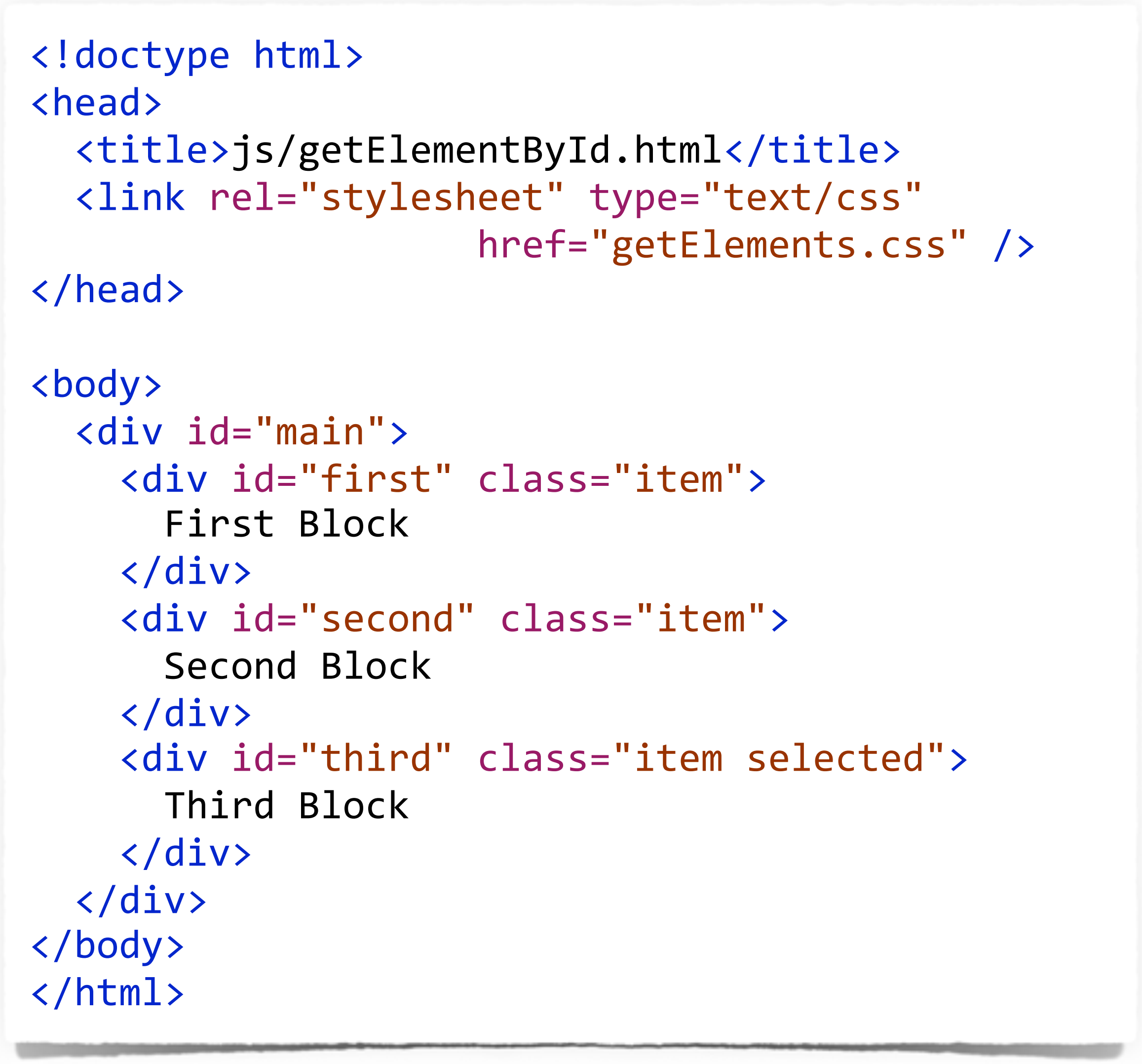
DOM Selection

- Starting with the `document` root and drilling down via `.children` is tedious. Can we get at elements some other way?
- `document.getElementById("main")`
- `document.getElementsByTagName("p")`
- `document.getElementsByClassName("error")`

getElementById

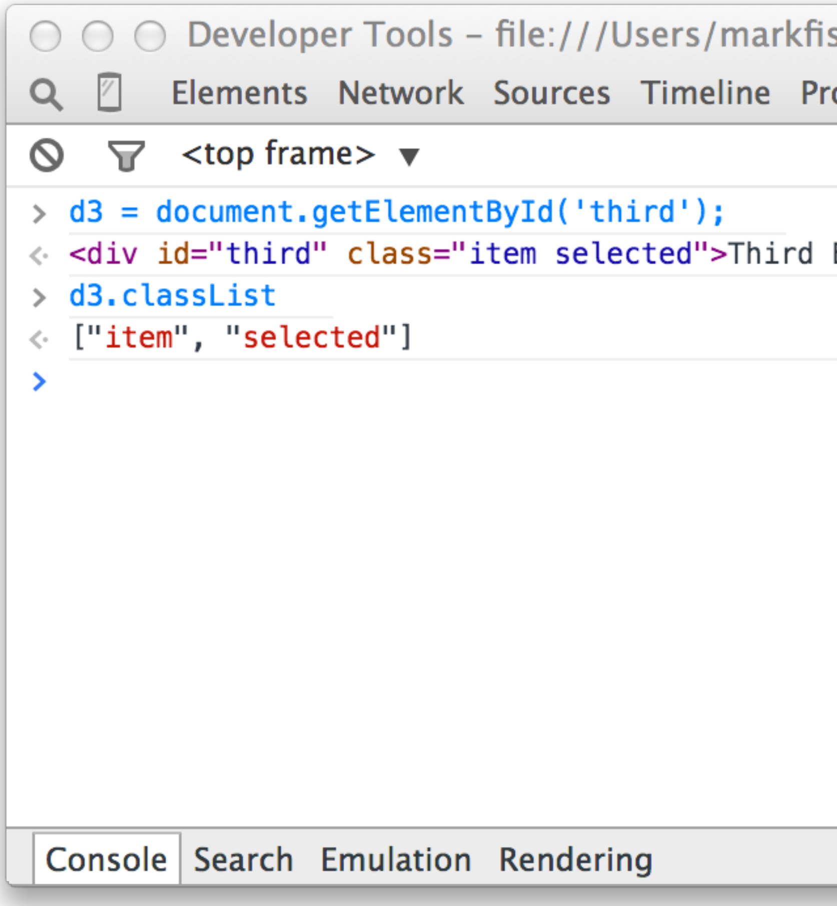
- Gets an HTMLElement object from the document based on an ID.
- Since ID must be unique, this method returns a single element, not an array of elements.

getElementById



```
<!doctype html>
<head>
  <title>js/getElementById.html</title>
  <link rel="stylesheet" type="text/css"
                    href="getElements.css" />
</head>

<body>
  <div id="main">
    <div id="first" class="item">
      First Block
    </div>
    <div id="second" class="item">
      Second Block
    </div>
    <div id="third" class="item selected">
      Third Block
    </div>
  </div>
</body>
</html>
```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Console Search Emulation Rendering

```
> d3 = document.getElementById('third');
<· <div id="third" class="item selected">Third
> d3.classList
<· ["item", "selected"]
>
```

Updating the DOM

- Now that we can get an element, can we do something with it?

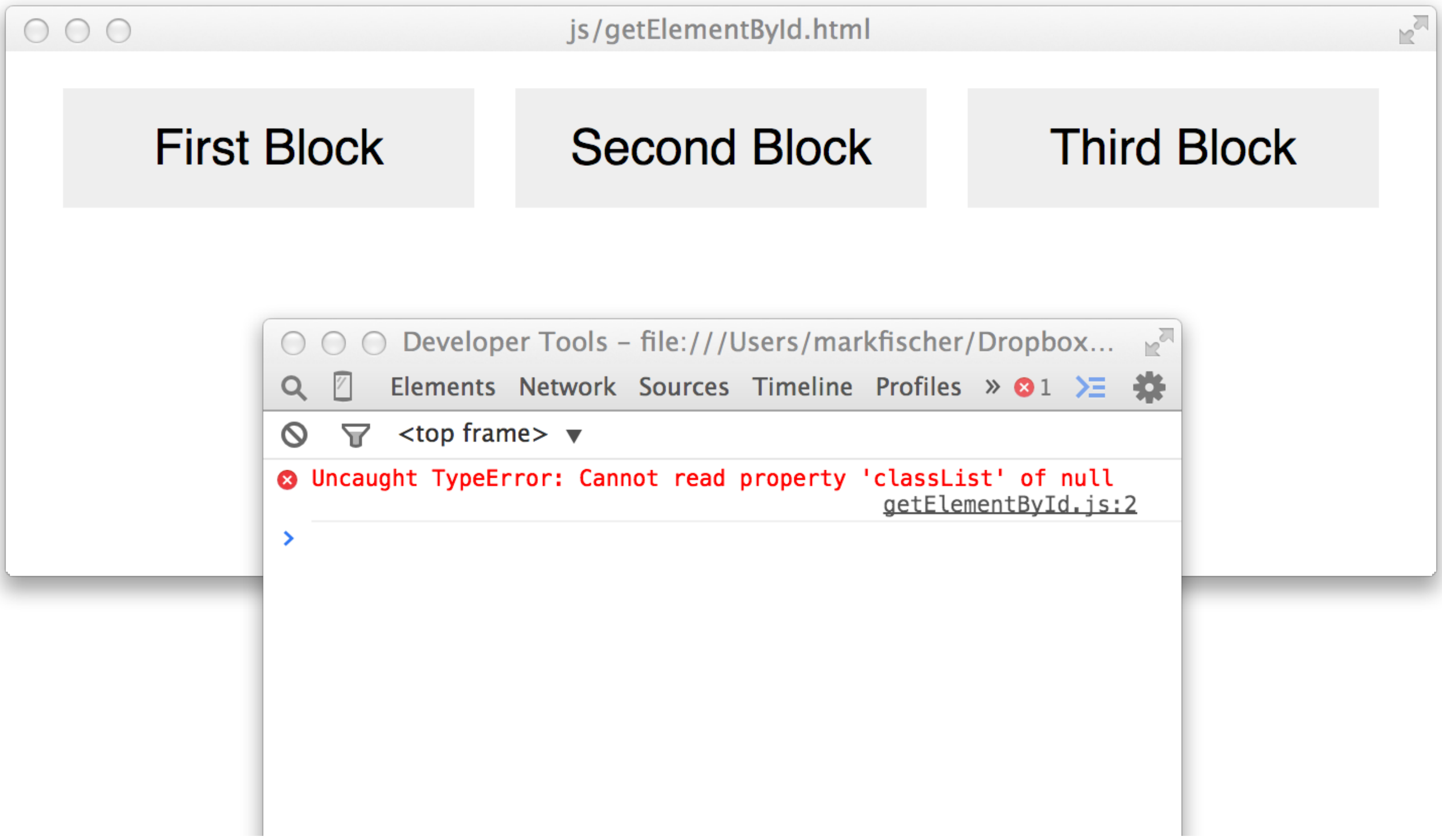
```html
<!doctype html>
<head>
  <title>js/getElementById.html</title>
  <link rel="stylesheet" type="text/css"
                    href="getElements.css" />
  <script src="getElementById.js"></script>
</head>

<body>
  <div id="main">
    <div id="first" class="item">First Block</div>
    <div id="second" class="item">Second Block</div>
    <div id="third" class="item">Third Block</div>
  </div>
</body>
</html>
```

```javascript
d2 = document.getElementById('second');
d2.classList.add("selected");
```

Updating the DOM

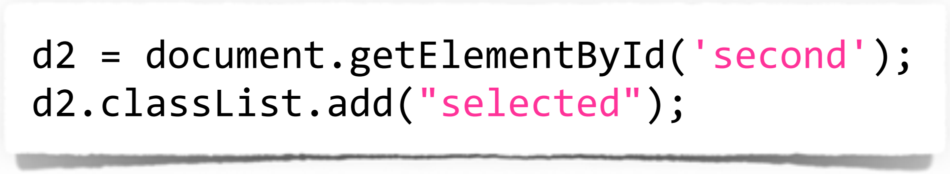
- Hmm nothing happened. Why? Check the console.



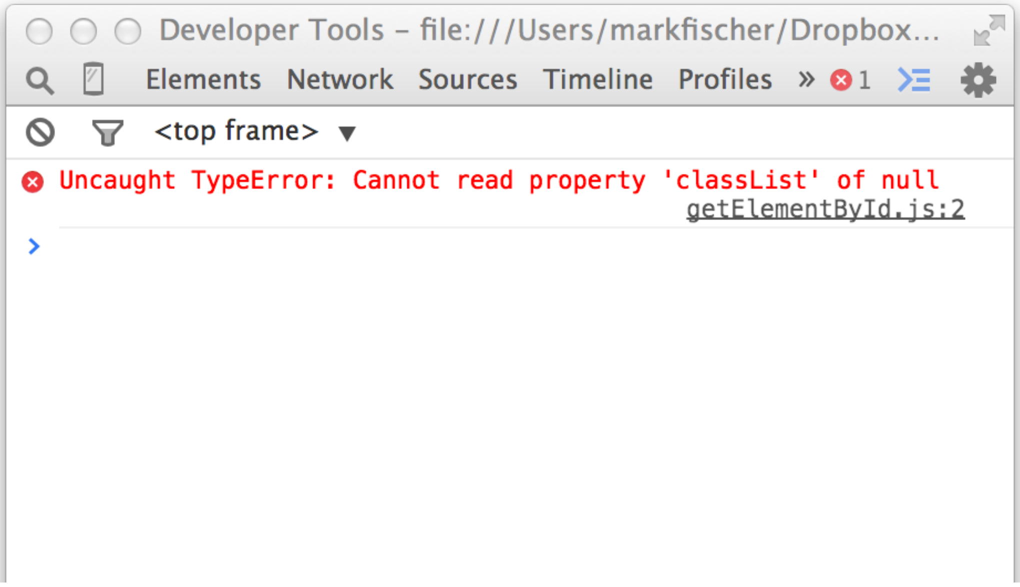
```
Uncaught TypeError: Cannot read property 'classList' of null
                                          getElementById.js:2
```

Updating the DOM

- Uncaught TypeError: Cannot read property 'classList' of null?? But how can d2 be null?



```
d2 = document.getElementById('second');
d2.classList.add("selected");
```



Developer Tools – file:///Users/markfischer/Dropbox…
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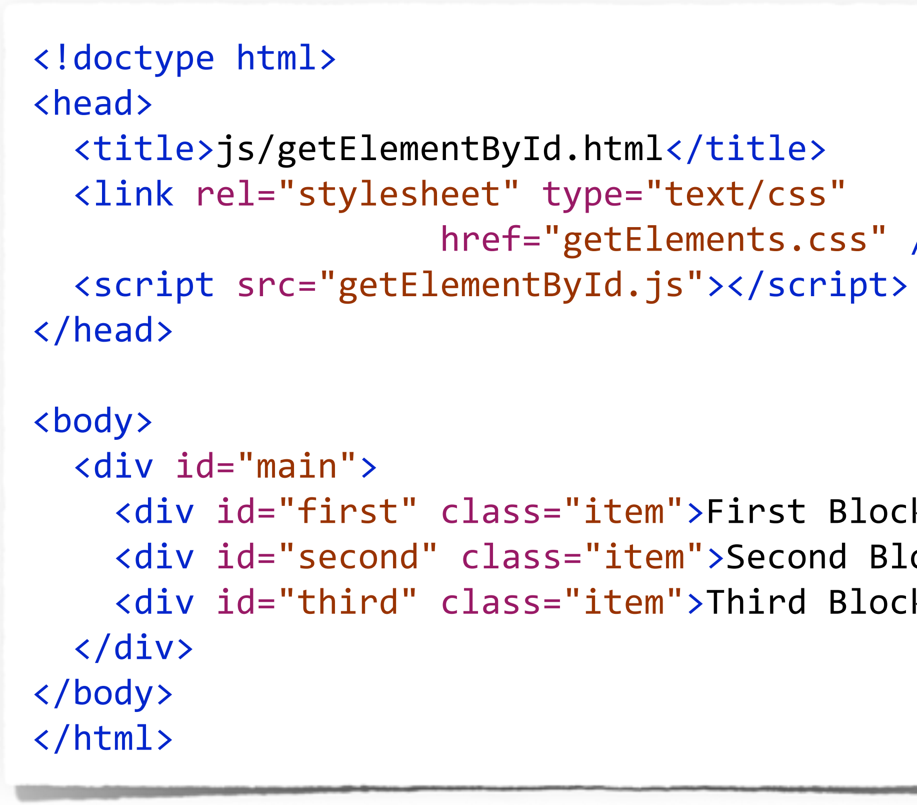
```
Uncaught TypeError: Cannot read property 'classList' of null
                                           getElementById.js:2
>
```



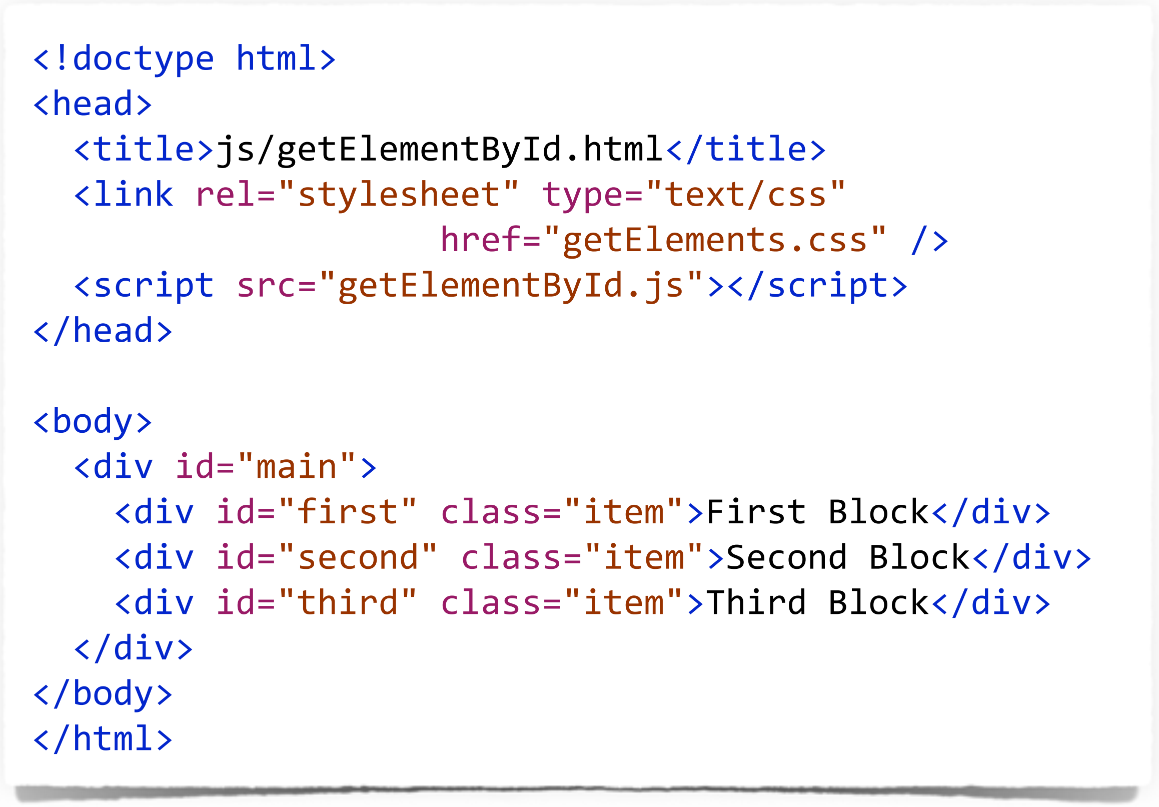
```
<!doctype html>
<head>
  <title>js/getElementById.html</title>
  <link rel="stylesheet" type="text/css"
                  href="getElements.css" /
  <script src="getElementById.js"></script>
</head>

<body>
  <div id="main">
    <div id="first" class="item">First Block
    <div id="second" class="item">Second Bl
    <div id="third" class="item">Third Block
  </div>
</body>
</html>
```

Waiting for the DOM to load

- The browser waits for no DOM

- The browser parses the file, loads the **`getElementById.js`** file, and executes it all before the rest of the HTML is parsed and the DOM is created.

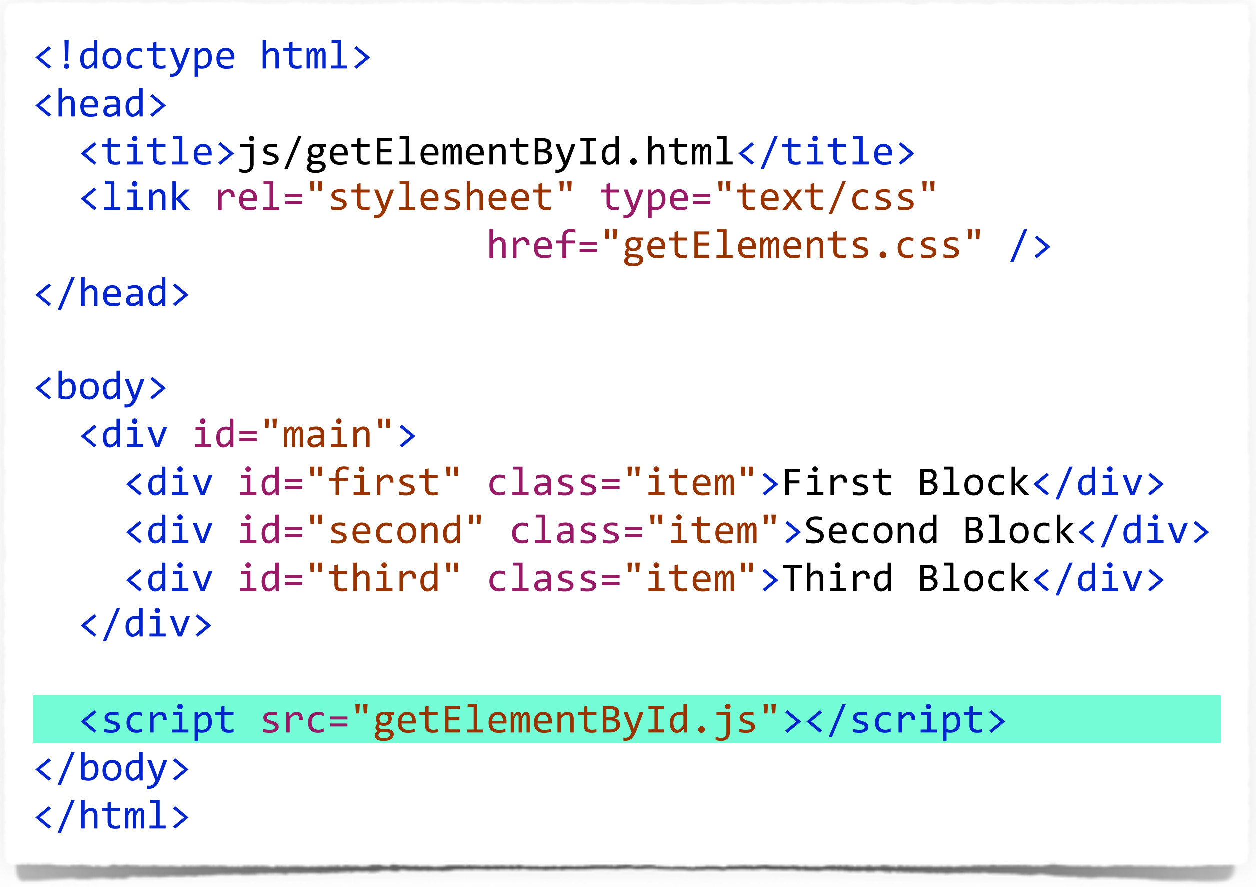


```
<!doctype html>
<head>
  <title>js/getElementById.html</title>
  <link rel="stylesheet" type="text/css"
                    href="getElements.css" />
  <script src="getElementById.js"></script>
</head>

<body>
  <div id="main">
    <div id="first" class="item">First Block</div>
    <div id="second" class="item">Second Block</div>
    <div id="third" class="item">Third Block</div>
  </div>
</body>
</html>
```

Waiting for the DOM to load

- What if we just move the `<script>` element down to the bottom?



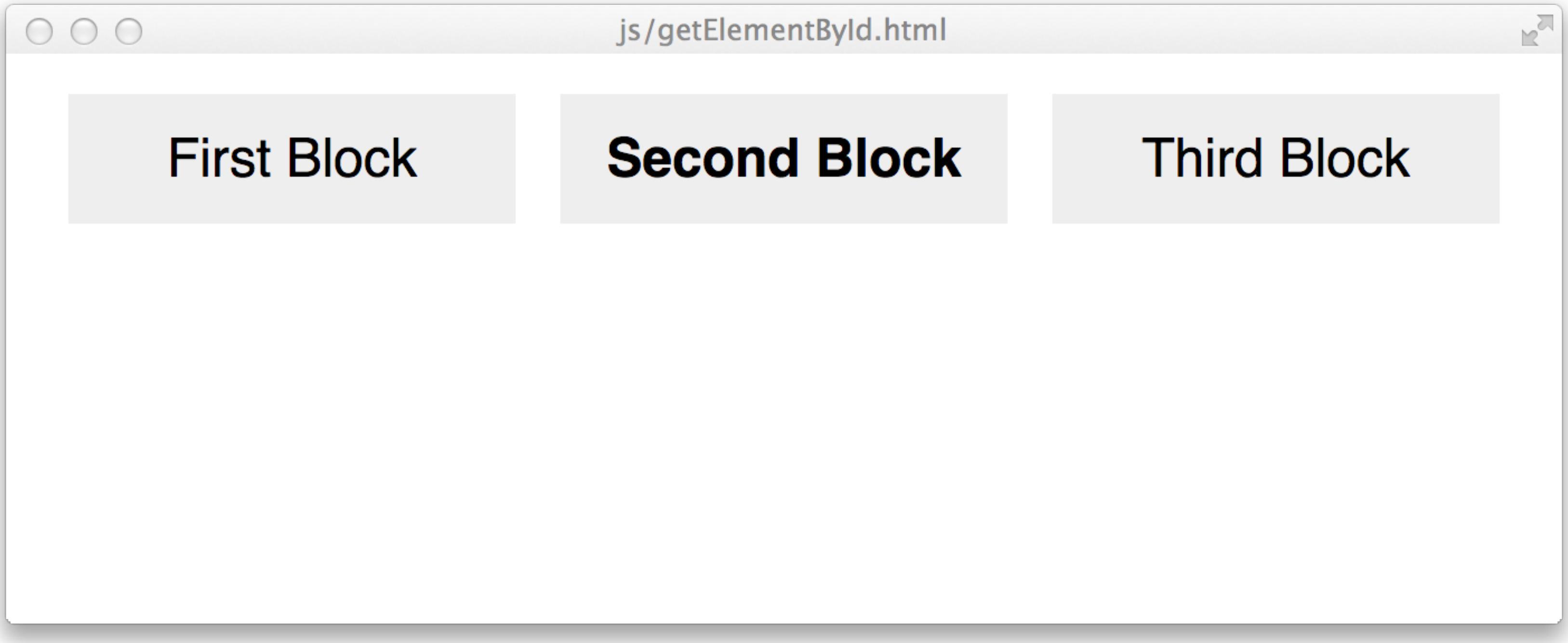
```
<!doctype html>
<head>
  <title>js/getElementById.html</title>
  <link rel="stylesheet" type="text/css"
                  href="getElements.css" />
</head>

<body>
  <div id="main">
    <div id="first" class="item">First Block</div>
    <div id="second" class="item">Second Block</div>
    <div id="third" class="item">Third Block</div>
  </div>

  <script src="getElementById.js"></script>
</body>
</html>
```

Waiting for the DOM to load

- Works!



Waiting for the DOM to load

- That seems… hackish. Isn't there a "right" way to do this?

- Well, its perfectly valid. `<script>` elements do not have to go in the `<head>`, although they frequently do.

- However, `<script>` elements that aren't in the `<head>` tend to get overlooked later, so we try to put them there if we can.

Events

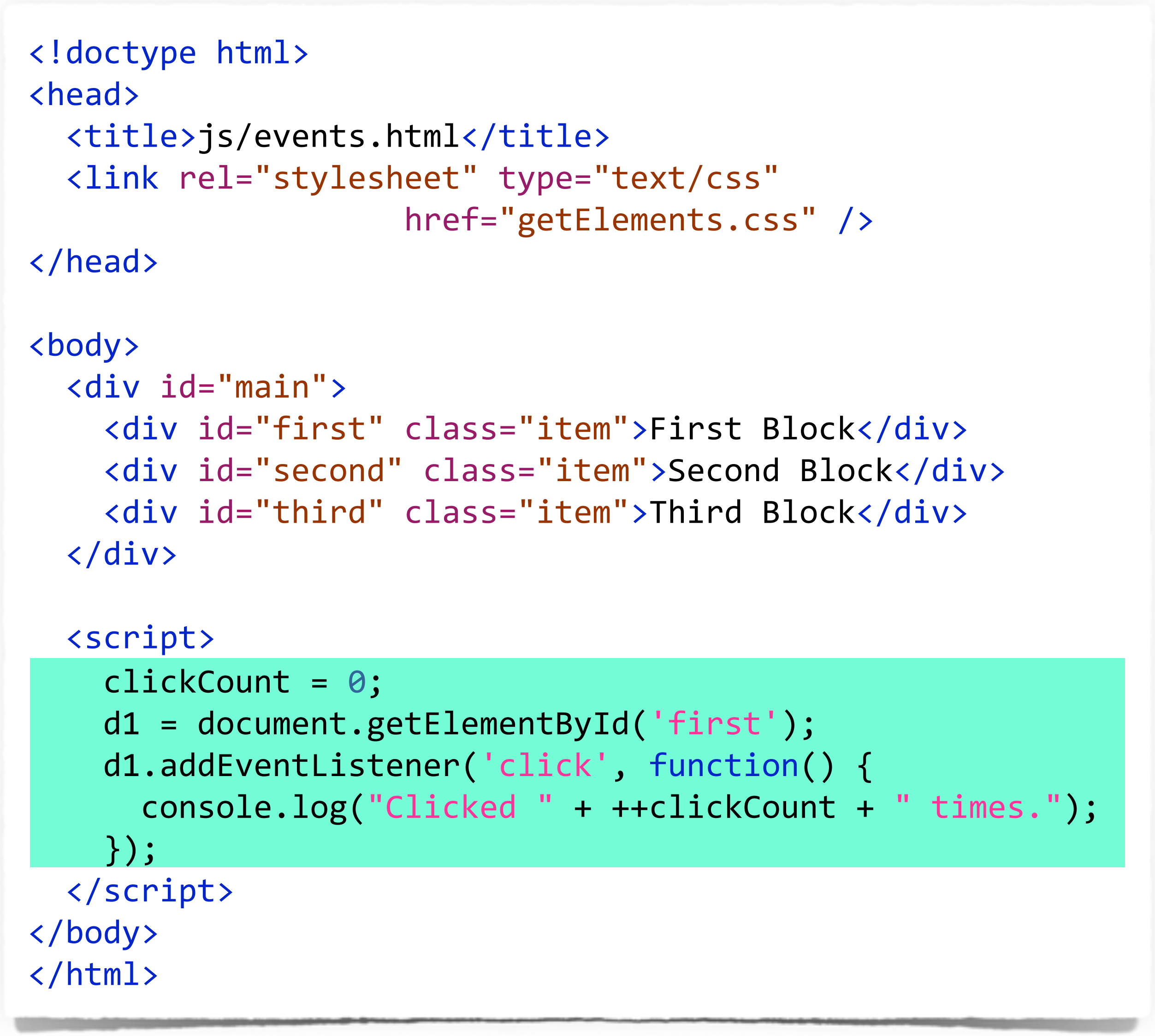
- The web browser is an Event Driven application.
- Documents load, links are clicked, HTTP requests are made and completed.
- Each of these is an event, and we can register event listeners (function) which will be called as these events occur.
- These are called *callbacks.*

Events

- *object*.`addEventListener('event', callback);`
- The object can be any object that responds to event listeners, such as an Element, the Document, or maybe the Window.

Events

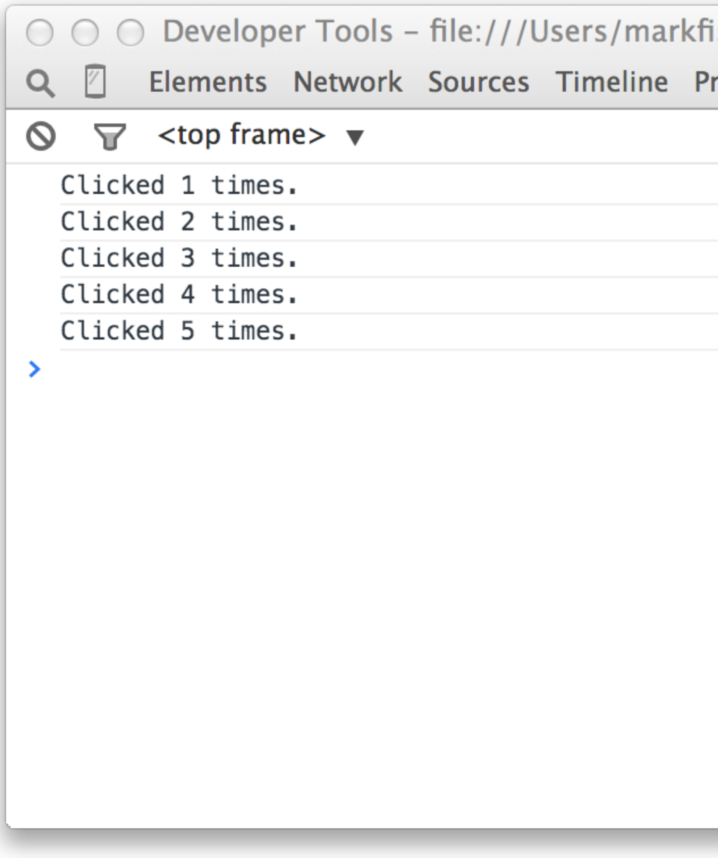
- A basic example of a ‘click’ event handler.



```
<!doctype html>
<head>
  <title>js/events.html</title>
  <link rel="stylesheet" type="text/css"
                  href="getElements.css" />
</head>

<body>
  <div id="main">
    <div id="first" class="item">First Block</div>
    <div id="second" class="item">Second Block</div>
    <div id="third" class="item">Third Block</div>
  </div>

  <script>
    clickCount = 0;
    d1 = document.getElementById('first');
    d1.addEventListener('click', function() {
      console.log("Clicked " + ++clickCount + " times.");
    });
  </script>
</body>
</html>
```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```
Clicked 1 times.
Clicked 2 times.
Clicked 3 times.
Clicked 4 times.
Clicked 5 times.
>
```

Events

- Is it really that simple? What about IE, doesn't that always mess us up?
- Well, yes. Of course it does.
- *object*.`addEventListener()` didn't come to IE until 9
- Earlier methods for adding event listeners were directly in markup, or via *object.event* = callback;

```
<a href="#" onclick="callbackName">Link</a>
```

`window load` Event

- There's also a **`window`** object that the DOM API provides for us.
- The Window object supports the **`load`** event, and we can register our own callback with this.
- The **`load`** event fires once the DOM has completed loading.

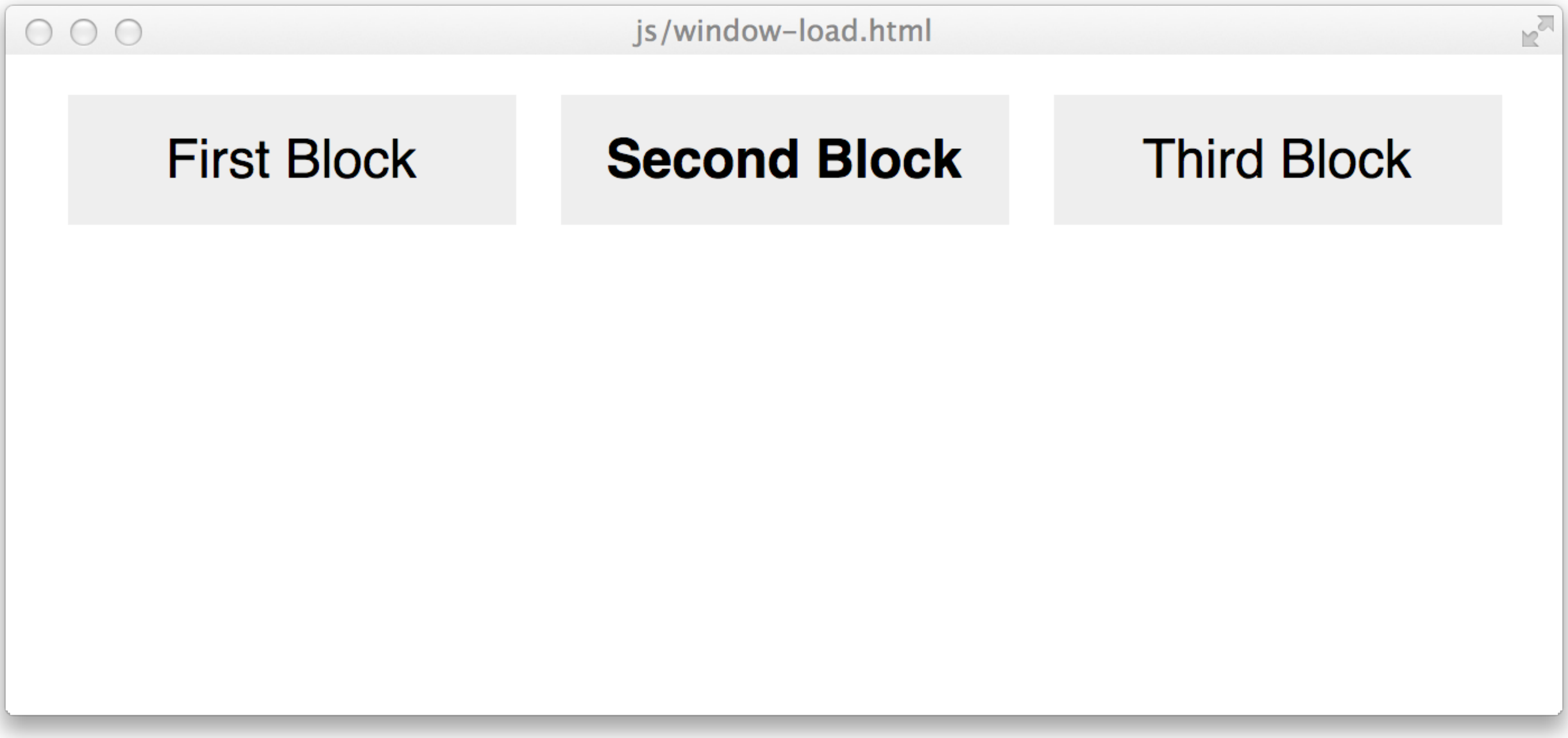
window load Event

```html
<!doctype html>
<head>
  <title>js/window-load.html</title>
  <link rel="stylesheet" type="text/css"
                  href="getElements.css" />
  <script src="window-load.js"></script>
</head>

<body>
  <div id="main">
    <div id="first" class="item">First Block</div>
    <div id="second" class="item">Second Block</div>
    <div id="third" class="item">Third Block</div>
  </div>

</body>
</html>
```

```javascript
window.addEventListener('load', function()
{
  d2 = document.getElementById('second');
  d2.classList.add('selected');
});
```

`window load` Event

- Works!



window load Event

- Since addEventListener doesn't work with IE 8 or older, to provide a more robust solution you'd have to do browser capabilities detection.

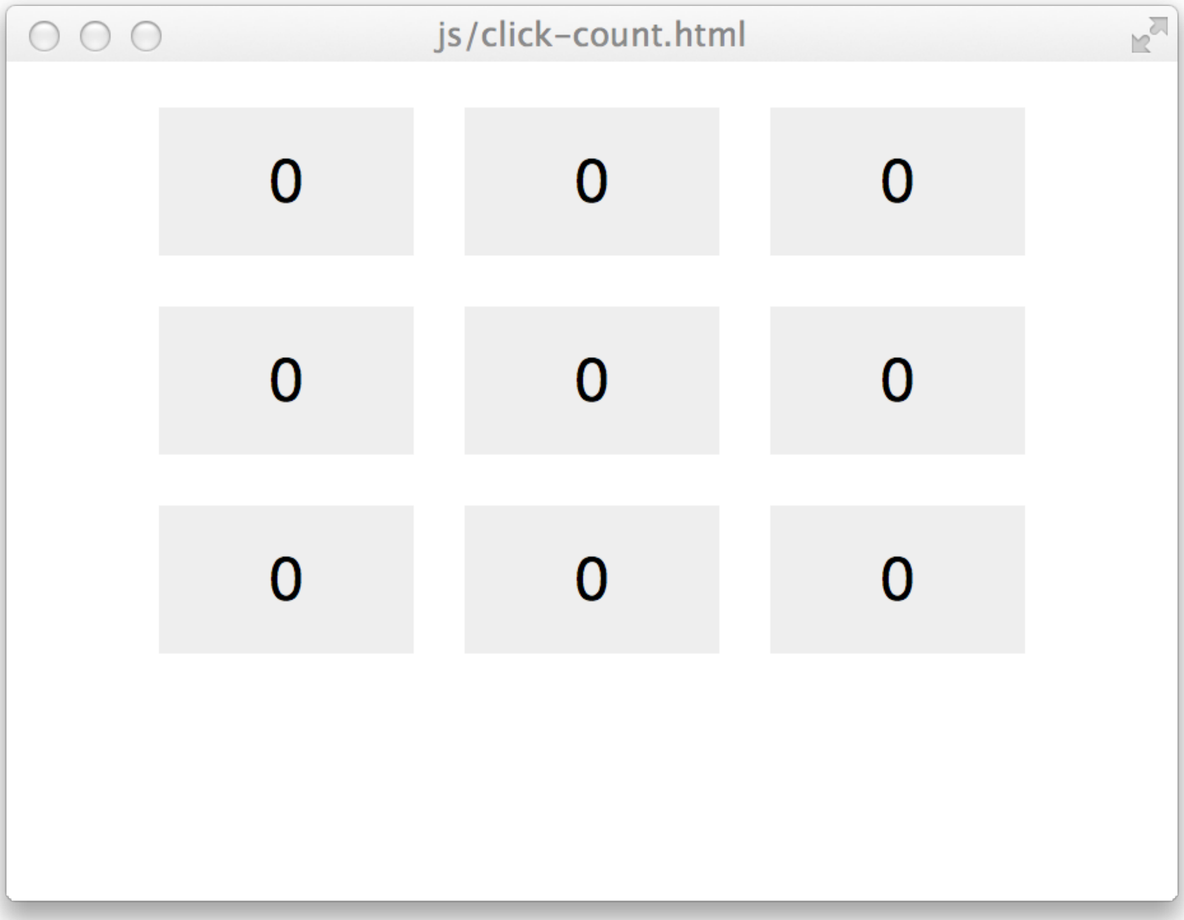
```
window.addEventListener('load', function()
{
  d2 = document.getElementById('second');
  d2.classList.add('selected');
});
```

`window load` Event

- IE 8 supported a different method, the *object*.`attachEvent` method.
- Even older browsers only support a single “onload” property.
- If only someone would write a library that did all this for us…

```
var ready = function(myFunciton) {
    if (window.attachEvent) {
        window.attachEvent('onload', myFunciton);
        console.log("IE");
    } else if (window.addEventListener) {
        window.addEventListener('load', myFunciton);
        console.log("Modern");
    } else {
        console.log("Legacy");
        if(window.onload) {
            var curronload = window.onload;
            var newonload = function() {
                curronload();
                myFunciton();
            };
            window.onload = newonload;
        } else {
            window.onload = myFunciton;
        }
    }
}
```

Putting Pieces Together



Demo

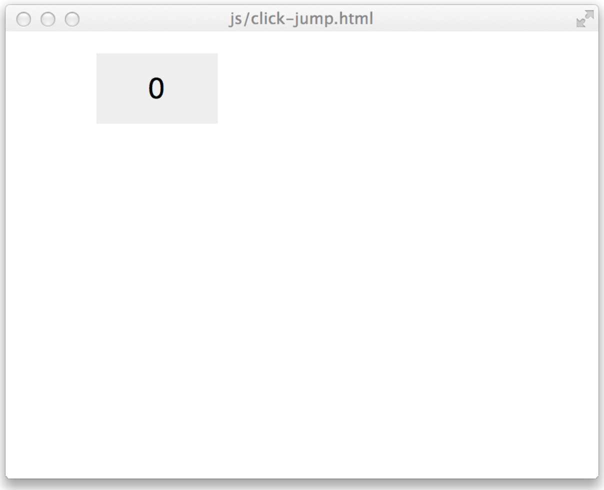
click-count.html

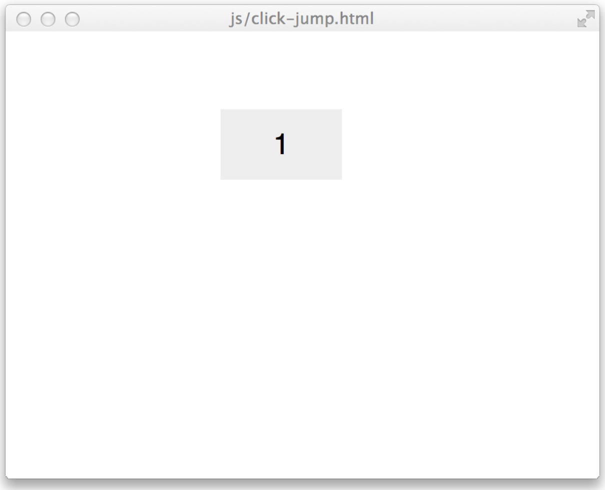
```html
<!doctype html>
<head>
  <title>js/click-count.html</title>
  <link rel="stylesheet" type="text/css"
                   href="click-count.css"/>
  <script src="click-count.js"></script>
</head>

<body>
  <div id="main">
  </div>
</body>
</html>
```

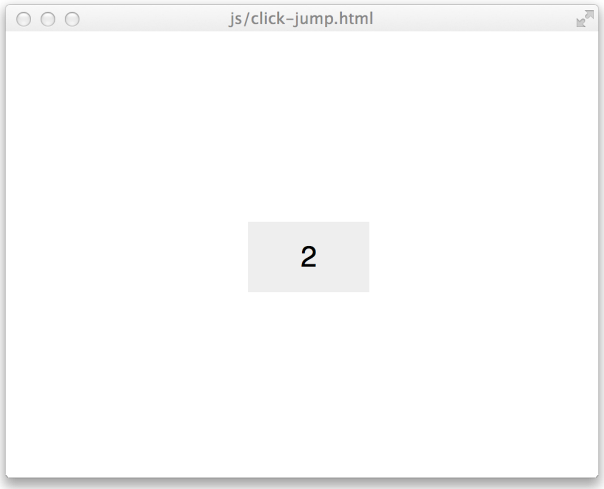
click-count.html

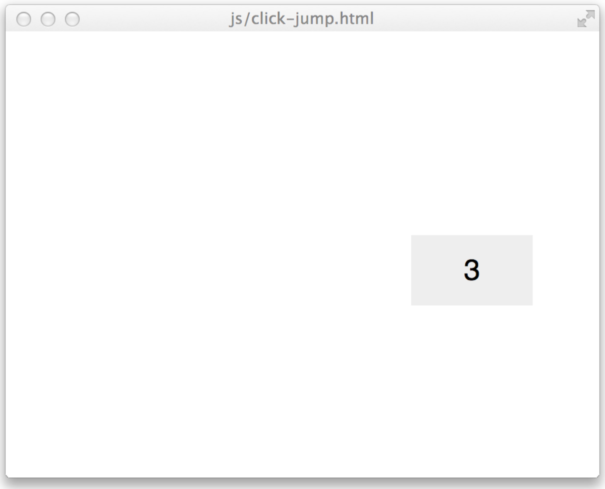
```
var addCount = function(event) {
  var curCount = Number(this.textContent);
  curCount++;
  this.textContent = curCount.toString();
}

window.addEventListener('load', function() {
  var numBoxes = 9;
  main = document.getElementById('main');
  for (i = 0; i < numBoxes; i++) {
    var newBox = document.createElement("div");
    newBox.textContent = "0";
    newBox.addEventListener('click', addCount);
    main.appendChild(newBox);
  }
});
```

click-jump.html









click-jump.html

```
var addCount = function(event) {
  var curCount = Number(this.textContent);
  curCount++;
  this.textContent = curCount.toString();

  if (curCount == 1) {
    this.style.position = "absolute";
  }

  var max_x = window.innerWidth - 110;
  var max_y = window.innerHeight - 60;
  var newX = Math.random() * max_x;
  var newY = Math.random() * max_y;
  newX = Math.floor(newX);
  newY = Math.floor(newY);

  this.style.top = newY.toString() + "px";
  this.style.left = newX.toString() + "px";
}
```

Inspiration

- Case study on copying stuff from other people.
- https://account.arizona.edu/welcome

Updating Styles

- Many ways of updating DOM elements involves changing its CSS Style Attributes
    - Positioning an element somewhere
    - Changing font styles
    - Changing colors, borders, etc

element.style

```
element.style.color = "#cccccc";
```

- An HTMLElement object has a style property
- The style property is itself an object, having properties for all the CSS properties appropriate to that element

element.style

```
size = 2;
element.style.fontSize = size.toString() + "em";
```

- All values are strings. If you have to assign numerical values, you need to convert them to strings.

- You also need to make sure the value is a complete and valid value for the property, including any units

element.style

```
element.style.fontSize = "2em";
```

- You can't have javascript variable names that contain a dash… its the subtraction operator.
- CSS properties with dashes in their name become camelCased

```
font-size    —>    fontSize
```

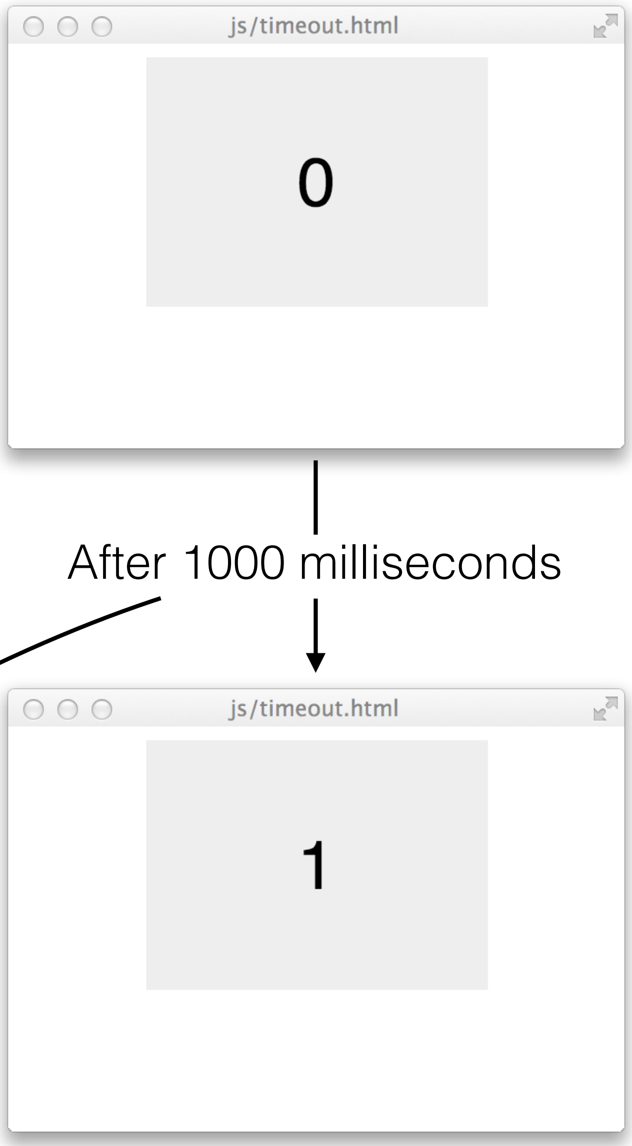
Timing Events

- Browsers implement Javascript in a threaded environment.
- Events can be queued to fire at a later time.
- *window*.`setTimeout()`
- *window*.`setInterval()`

https://developer.mozilla.org/en-US/docs/Web/API/WindowTimers

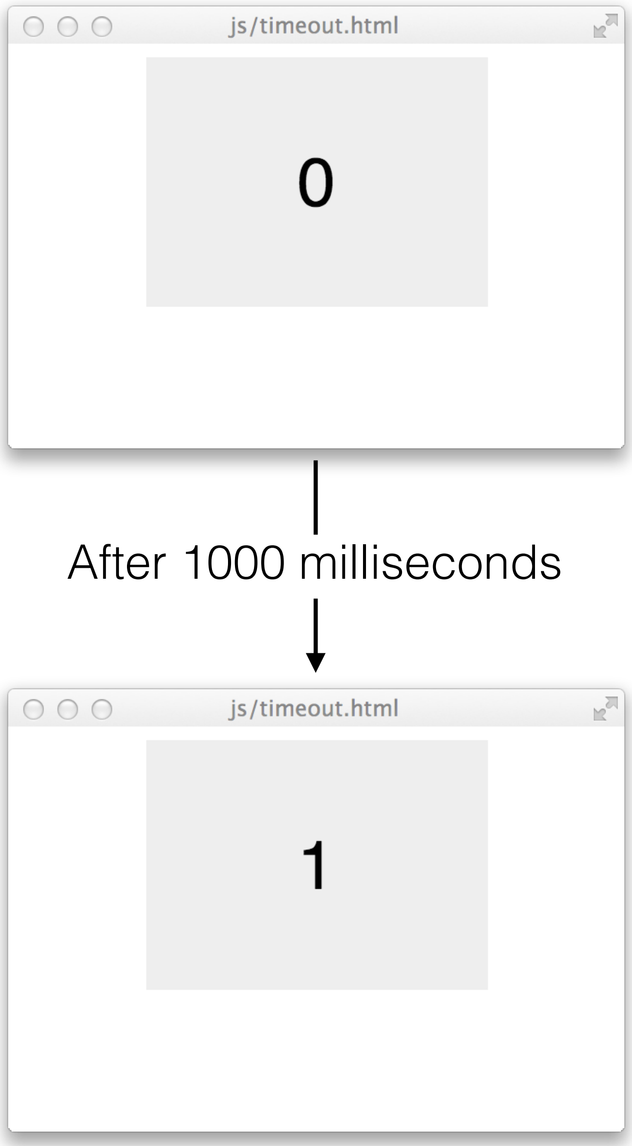
setTimeout()

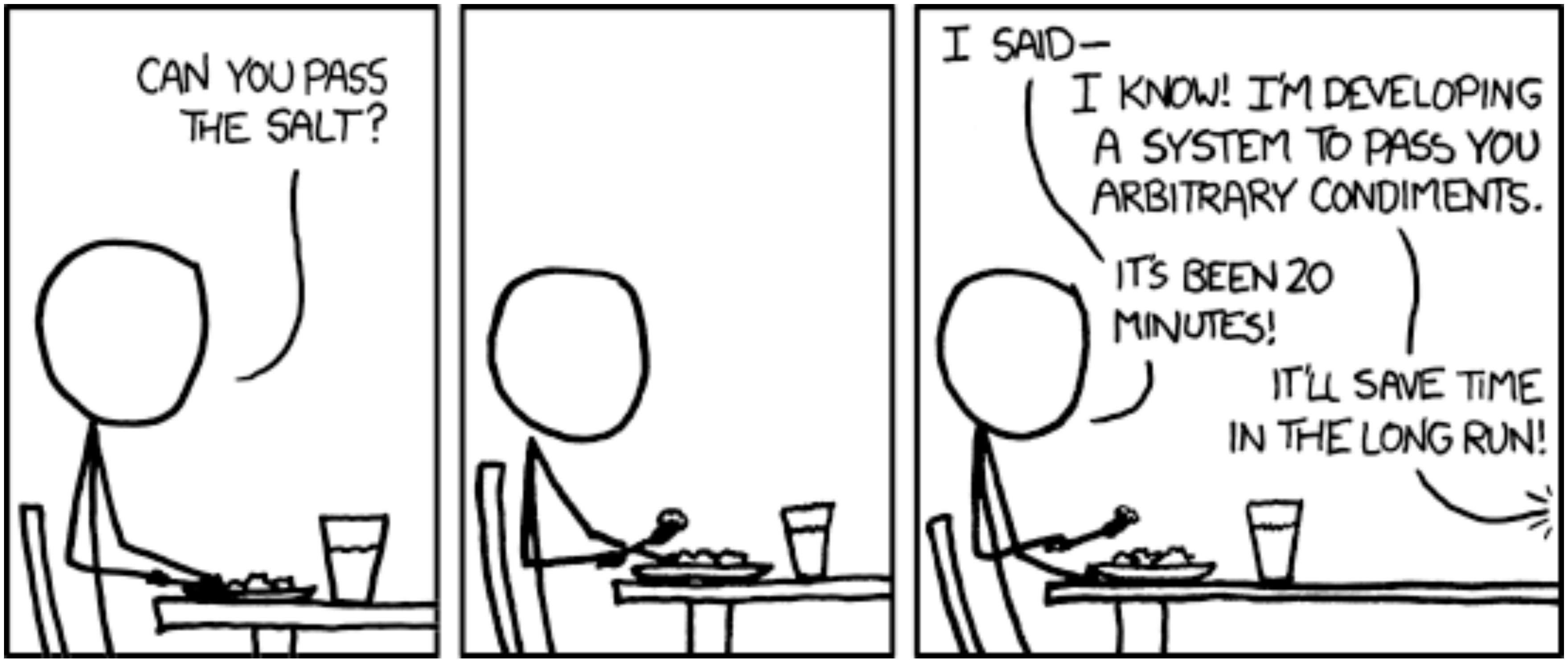
```
<!doctype html>
<head>
  <title>js/timeout.html</title>
  <link rel="stylesheet" type="text/css"
                    href="timeout.css" />
</head>

<body>
  <div id="main">0</div>

  <script>
    var counter = function() {
      var d = document.getElementById('main');
      var curCount = Number(d.textContent);
      curCount++;
      d.textContent = curCount.toString();
    }

    window.setTimeout(counter, 1000);
  </script>
</body>
</html>
```



`setInterval()`

- `setTimeout()` only fires a single time.
- To fire on an interval, use `setInterval()`, or continually call `setTimeout()`.
- Demo




CAN YOU PASS THE SALT?
I SAID—
I KNOW! I'M DEVELOPING A SYSTEM TO PASS YOU ARBITRARY CONDIMENTS.
IT'S BEEN 20 MINUTES!
IT'LL SAVE TIME IN THE LONG RUN!

Classes

Oops, sorry, there are no classes.

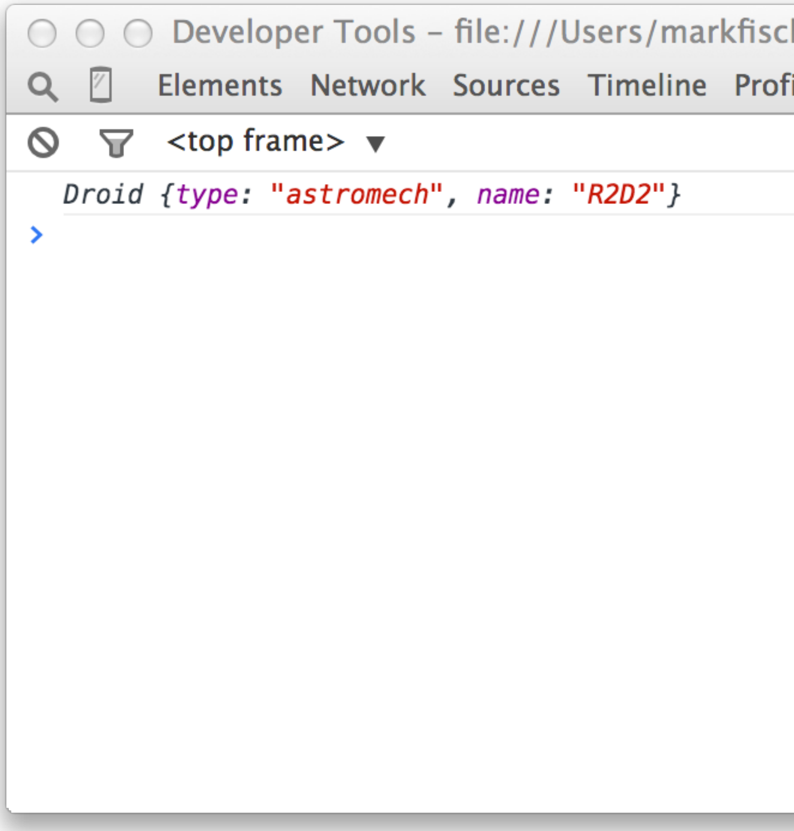
Class Like Thingies

- Javascript has no “Class” concept.
- Objects are based on building on a prototype.
- “Instances” are not tied to a particular static Class definition.
- funcitons?

functions and new

- Classes are just functions!
- Create new instances with the new keyword.

```
function Droid(type, name) {
  this.type = type;
  this.name = name;
}

var r2 = new Droid('astromech', 'R2D2');
var c3 = new Droid('protocol', 'C3PO');

console.log(r2);
```

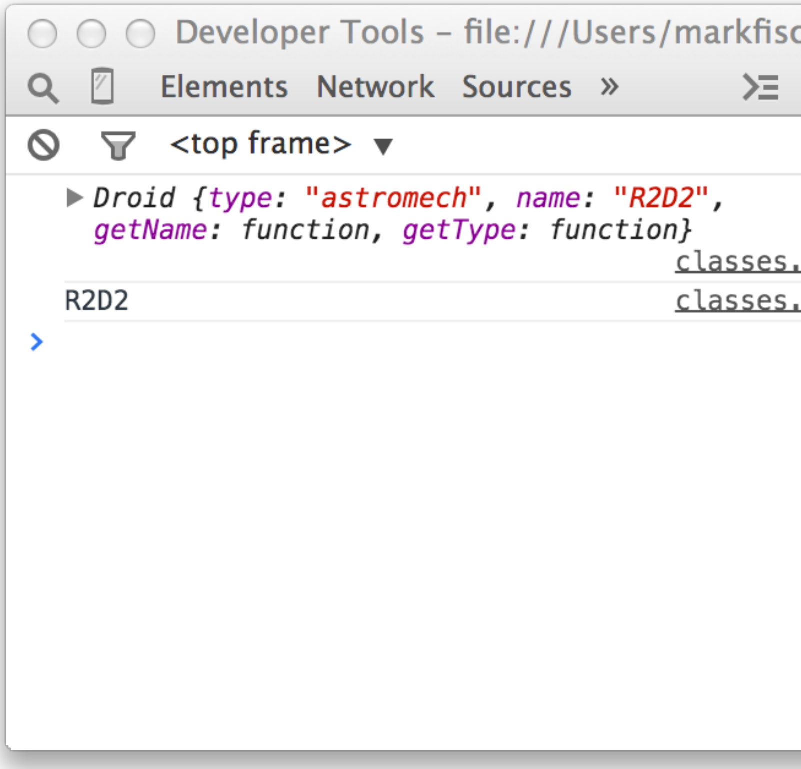


```
Droid {type: "astromech", name: "R2D2"}
>
```

prototypes

- Methods can be added through the special `.prototype` property of objects.

```
function Droid(type, name) {
  this.type = type;
  this.name = name;
}

Droid.prototype = {
  getName: function() { return this.name },
  getType: function() { return this.type }
}

var r2 = new Droid('astromech', 'R2D2');
var c3 = new Droid('protocol', 'C3PO');

console.log(r2);
console.log(r2.getName());
```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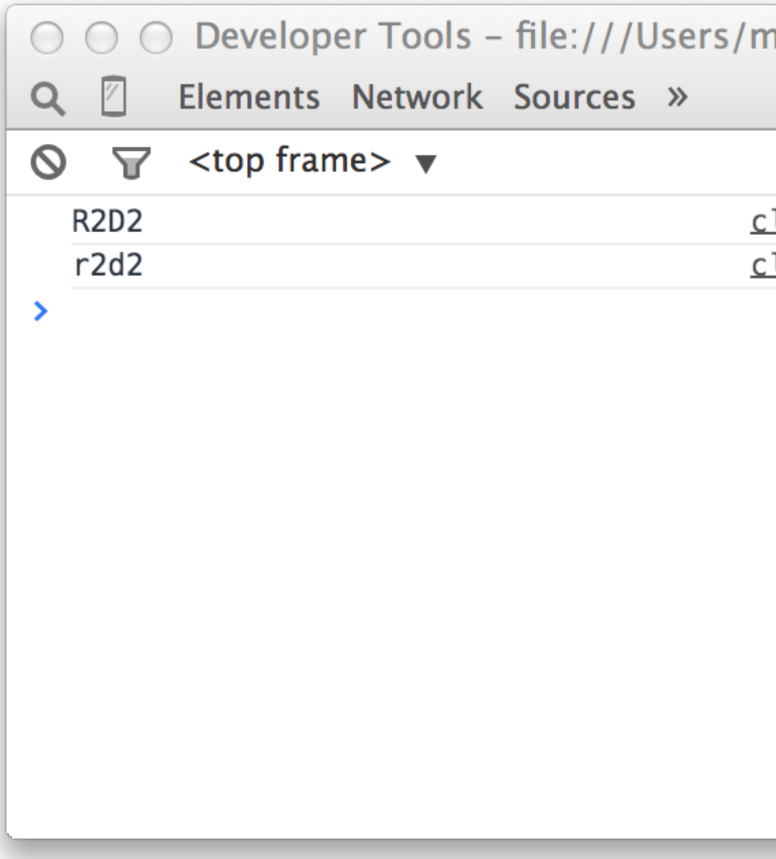
```
▶ Droid {type: "astromech", name: "R2D2",
  getName: function, getType: function}
                                          classes.
R2D2                                      classes.
>
```

prototypes

- Don’t like the behavior of something? Re-define it on the fly

```
function Droid(type, name) {
  this.type = type;
  this.name = name;
}

Droid.prototype = {
  getName: function() { return this.name },
  getType: function() { return this.type }
}

var r2 = new Droid('astromech', 'R2D2');
var c3 = new Droid('protocol', 'C3PO');

console.log(r2.getName());

Droid.prototype.getName =
    function() { return this.name.toLowerCase() };

console.log(r2.getName());
```



```
R2D2
r2d2
>
```

myQuery

- jQuery is a very popular Javascript toolkit which abstracts away some of the underlying complexity.
- Can we build our own simple toolkit?
- Of course we can…
- jQuery doesn’t own $

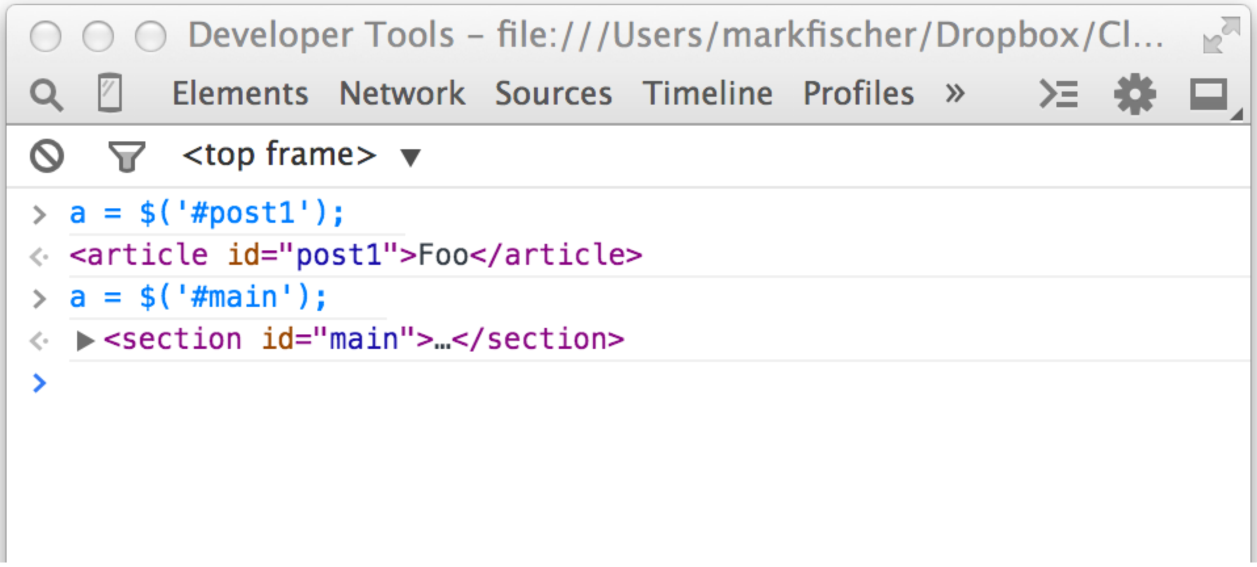
Basic Selection

- Using `document.getElementById()` isn’t too bad, but it sure is a lot of typing.
- Can we use the `$('selector')` pattern?

```
var $ = function myQuery(selector) {
  // See if selector starts with a #. If so we're looking for an ID
  if (selector[0] == '#') {
    // Strip off the # sign
    var selector = selector.substring(1, selector.length);
    var element = document.getElementById(selector);
    return element;
  }
}
```

Basic Selection

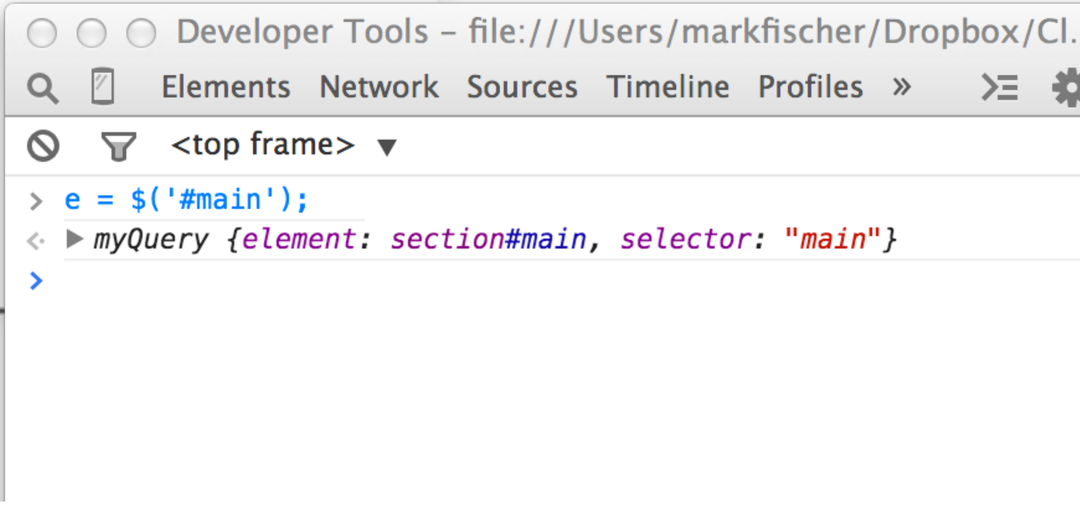
```
var $ = function myQuery(selector) {
  // See if selector starts with a #. If so we're looking for an ID
  if (selector[0] == '#') {
    // Strip off the # sign
    var selector = selector.substring(1, selector.length);
    var element = document.getElementById(selector);
    return element;
  }
}
```



```
> a = $('#post1');
<· <article id="post1">Foo</article>
> a = $('#main');
<· ▶<section id="main">…</section>
>
```

Returning Objects

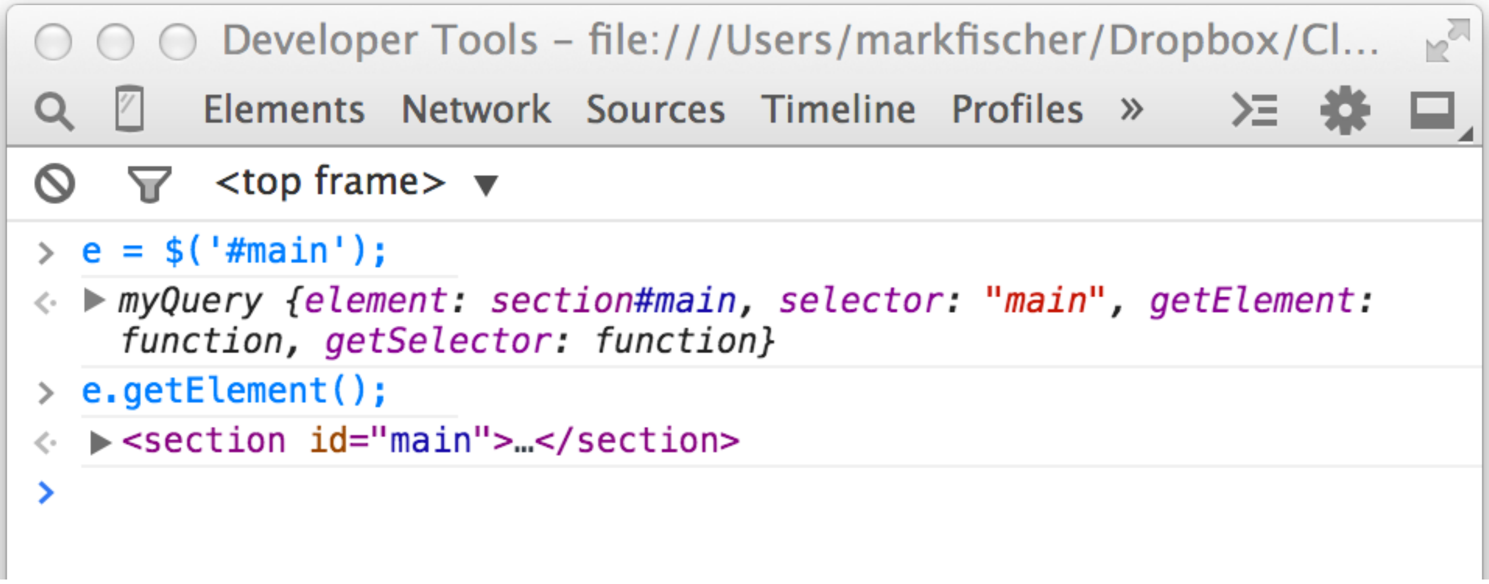
```
function myQuery(selector) {
  this.element = null;
  this.selector = selector;

  // See if selector starts with a #.
  // If so we're looking for an ID
  if (selector[0] == '#') {
    // Strip off the # sign
    var selector = selector.substring(1, selector.length);
    var element = document.getElementById(selector);

    myQobj = new myQuery(selector);
    myQobj.element = element;
    return myQobj;
  }
}

var $ = myQuery;
```



```
> e = $('#main');
<· ▶ myQuery {element: section#main, selector: "main"}
>
```

prototype Methods

```
myQuery.prototype = {
  getElement:       function() {
                      return this.element;
                    },
  getSelector:      function() {
                      return this.selector;
                    },
}
```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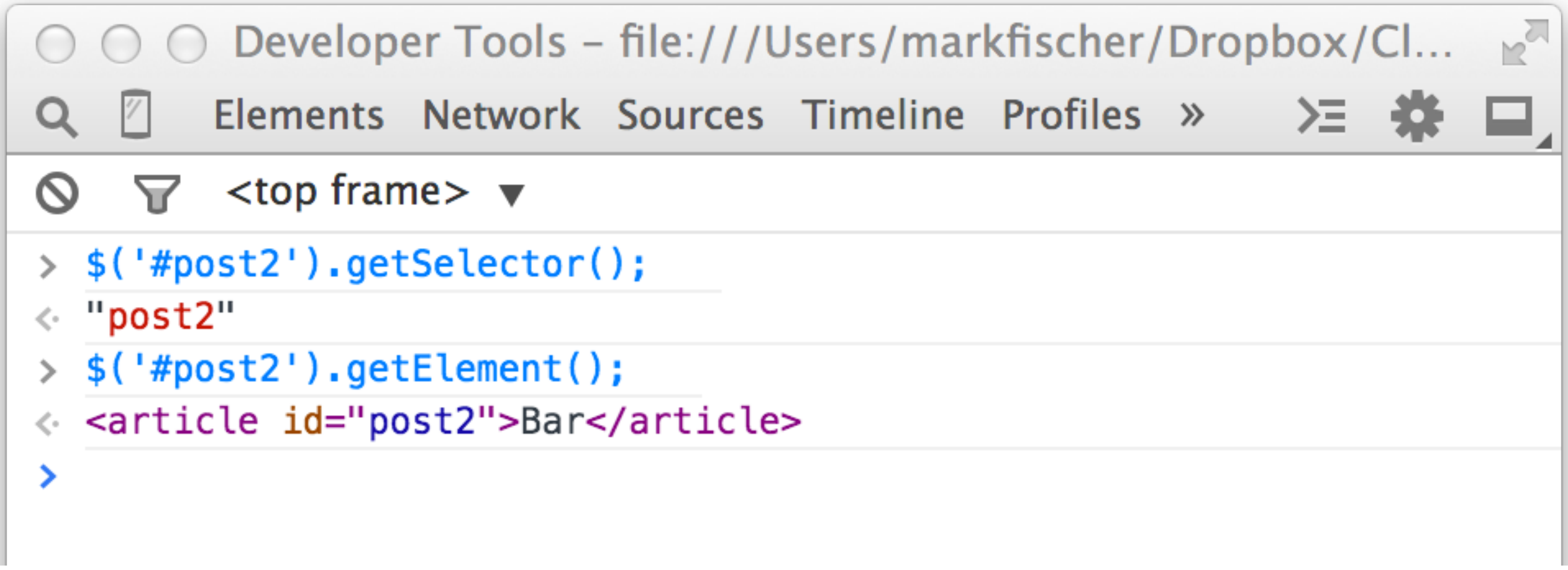
```
> e = $('#main');
<· ▶ myQuery {element: section#main, selector: "main", getElement:
   function, getSelector: function}
> e.getElement();
<· ▶ <section id="main">…</section>
>
```

Function Chaining

- Supports function chaining.
- The return value from the function call is an object, which has methods we can call.
- Don’t need intermediate variables.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```
> $('#post2').getSelector();
<· "post2"
> $('#post2').getElement();
<· <article id="post2">Bar</article>
>
```

jQuery

- This is basically what jQuery does.
- More methods and selector types.
- There’s a lot more edge cases handled, and checks made.
- jQuery ‘plugins’ just add their own function calls to the jQuery `prototype` property.

[`http://code.jquery.com/jquery-2.2.1.js`](http://code.jquery.com/jquery-2.2.1.js)

And now for something moderately different