COEN 168/268

Mobile Web Application Development

JavaScript and jQuery

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JS

JavaScript!

Brings life to the web

JavaScript is the most widely deployed programming language

Everyone has it in their browsers (except if you're running Lynx or something)

Some history about JavaScript…

- Created by Brendan Eich at Netscape
- Was originally called Mocha, then LiveScript
- Name changed to JavaScript to jump on the Java marketing bandwagon of the 1990s
- It is not at all related to Java other than in name
- First shipped in September of 1996 in Netscape Navigator 2.0B3

For years JavaScript languished in the hell that is `<form>` validation

That's not longer the case...

JavaScript adds interactivity

Now, the basics

Imperative and structured

- C-style syntax for the most part
- However, scoping not block level, but rather function level
- Semi-colons are not required at the end of newlines

Dynamic

- Dynamically typed
  - `var` keyword is used to declare all types
- Object-based
  - All objects are hashes made up of `key` and `value` pairs
- Runtime evaluation is possible (but not recommend as `eval()` is evil)

Functional

- Functions are first-class citizens
- Functions are objects and can have properties and methods
- Closures are easy and in wide-spread use

Prototypical Inheritance

- JavaScript is not class-based
- You can simulate class-based inheritance if you want
- Functions are methods and the `this` property is bound to the object itself

Prototypical Inheritance Continued

- Functions are object constructors
  - `new` keyword can be used to create a new instance of a prototype that inherits properties and methods
  - `.prototype` property on a object determines what is carried over when `new` is called
  - This means that if you have an object declared on the `prototype`, it can be shared with all instances of the object (it's a bit weird)

JavaScript Syntax

I assume that you all know the basic C-style syntax so I won't go into all that

For most examples, we will be using the Chrome's Web Inspector

We will be using `console.log()` a lot

See:

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

for more JS language examples like the next several slides

JavaScript Values

JavaScript recognizes the five following types of primitive values:

- **Numbers** like 42, 3.14159
- **Logical (Boolean)** like true / false
- **Strings** like "Howdy"
- **null** - a special keyword denoting a null value
- **undefined** - a top-level property whose value is undefined

Data type conversion

JS is dynamically typed so variables can be reused

```
var answer = 42;

// then later:
answer = "Thanks for all the fish...";

x = "The answer is " + 42 // "The answer is 42"
y = 42 + " is the answer" // "42 is the answer"

// but the + operator can cause strange things to happen:
"37" - 7 // 30
"37" + 7 // "377"
```

JavaScript Variables

```
var thisIsAString = "My voice is my passport.";

var thisIsANumber = 2;

var thisIsABoolean = false;

var thisIsAnObject = {
  key1: "value1",
  key2: "value2"
};

var thisIsAnArray = [1, 2, 3];
```

Variable identifier naming conventions

- Must start with letters (a-zA-Z), $, or _
- Subsequent characters can also be digits
- Should be `camelCase`
- Case sensitive!

All of these are valid, but pretty bad

```
var $;
var _;
var $parameter;
var __$myValue;
var this_is_a_long_variable_name;
```

Variables can declared all on one line (preferred)

```
var isVisible = false;
var idString = 'abc';

instead:

var isVisible = false,
    idString  = 'abc';
```

Also note that the alignment of the variable names and assignments.

Variable scope

- When you declare a variable outside of a function, it will be **global**
- This means that you can see it anywhere so be careful
- If it is declared inside of a function, it is in **function scope**

```
if (true) {
  var x = 5;
}
console.log(x); // 5 since there isn't block level scope
```

undefined and null

```
var isVisible;
console.log(isVisible); // undefined

var idString = null;
console.log(idString); // null

if (!isVisible) {
  // Will go in here
}

if (!idString) {
  // Will go in here
}
```

Converting strings to numbers

- Use `parseInt()` and `parseFloat()`
- Important to avoid strange behavior when:

```
"1.1" + "1.1"
// results in: "1.11.1"

parseFloat("1.1",10) + parseFloat("1.1", 10)
// results in 2.2
```

A Note about using == and !=

- Using == and != do work, but can yield strange results
- This is due to JavaScript's **type coercion** that gets around checking type

```
if("0" == 0) {
  // You go in here
}
```

If you care about type...

- Use === and !== to disable type coercion and enforce the type as well

```
if("0" === 0) {
  // You do not enter here
}
```

Strings

- Strings can be concatenated using +
- Can concatenate any type together with strings
- However, the results can get weird when mixing numbers and strings

Let's take a look...

```
var numBlue  = 2,
    numGreen = 5;

var colorString = "There are " + numBlue + numGreen + " objects.";
// Results in: "There are a total of 25 objects."

...

var colorString = "There are " + (numBlue + numGreen) + " objects.";
// Results in: "There are a total of 7 objects."
```

JavaScript Objects

Creating an `Object` is easy.

Let's create a `mustang` object

```
var mustang = {};
```

It has no properties and it is empty. However, there are `prototype` properties attached to it in the `__proto__` property.

Object prototype properties and methods

For example, here are some methods

```
> mustang.toString();
  "[Object object]"

> mustang.constructor()
  Object {}

> mustang.constructor
  function Object() { [native code] }
```

Creating properties on `objects`

- Three ways:
  - dot notation
  - square brackets
  - literal notation

Dot notation

```
var mustang = {};

mustang.make = "Ford";
mustang.model = "Mustang";
mustang.year = 2015;
```

Square brackets

```
var mustang = {};

mustang["make"] = "Ford";
mustang["model"] = "Mustang";
mustang["year"] = 2015;
```

Literal Notation

```
var mustang = {
  make: "Ford",
  model: "Mustang",
  year: 2015
};
```

Myself, I prefer this way for complex objects.

You can also do a combination, if you need to.

```
// Define base properties
var mustang = {
  make: "Ford",
  model: "Mustang",
  year: 2015
};


// Define an additional property
mustang.color = "Red";
```

You can also add methods on objects:

```
// Define base properties
var mustang = {
  make: "Ford",
  model: "Mustang",
  year: 2015,

  description: function() {
    return this.year + " " + this.make + " " + this.model;
  }

};

> mustang.description();
  "2015 Ford Mustang"
```

Custom objects

- The previous example was just adding properties to a base `Object`
- However, most of the time, you will want to create custom `Objects` to represent your data
- This will help you scale up the complexity of your app

This won't scale well...

```
var mustang = {
  make: "Ford",
  model: "Mustang",
  year: 2015,

  description: function() {
    return this.year + " " + this.make + " " + this.model;
  }
};

var camaro = {
  make: "Chevrolet",
  model: "Camaro",
  year: 2015,

  description: function() {
    return this.year + " " + this.make + " " + this.model;
  }
};
```

Instead, create a `car` `Object` as the base

```
var car = {

  description: function() {
    return this.year + " " + this.make + " " + this.model;
  }

};
```

Then use the `Object.create()` method

```
var mustang = Object.create(car);
mustang.make = "Ford";
mustang.model = "Mustang";
mustang.year = 2015;

var camaro = Object.create(car);
camaro.make = "Chevrolet";
camaro.model = "Camaro";
camaro.year = 2015;
```

Why not just pass in the properties as values?

```
// Doesn't work
var mustang = Object.create(car, {
  make: "Ford",
  model: "Mustang",
  year: 2015
});


// Works
var mustang = Object.create(car, {
  make: {
    value: "Ford"
  },
  model: {
    value: "Mustang"
  },
  year: {
    value: 2015
  }
});
```

A side effect of JavaScripts prototypical nature

- If you define other objects on the `prototype` of an `Object`, any created instances will have that object referenced
- This means, that if you modify that object in one instance, it will be modified in all instances
- To fix this, create objects on initialization, not when the object is defined initially
- Primitives are OK

The side effect in action

```
var car = {
  colors: ['red', 'blue', 'yellow', 'green'],
  name: 'default car'
};

var ford = Object.create(car);
var bmw  = Object.create(car);

ford.colors.push('black');

> ford.colors
  "['red', 'blue', 'yellow', 'green', 'black']"

> bmw.colors
    "['red', 'blue', 'yellow', 'green', 'black']"
```

One way to fix this...

```
var car = {
  name: 'default car',
  init: function() {
    this.colors = ['red', 'blue', 'yellow', 'green'];
    return this;
  }
};

var ford = Object.create(car).init();
var bmw  = Object.create(car).init();

ford.colors.push('black');

> ford.colors
  "['red', 'blue', 'yellow', 'green', 'black']"

> bmw.colors
    "['red', 'blue', 'yellow', 'green']"
```

Demo

1 - JavaScript Variables

Code can be found at:

http://coen268.peterbergstrom.com/resources/demos/jslecturedemos.zip

JavaScript `function` declaration

- The name of the `function`.
- A list of arguments to the `function`, enclosed in parentheses and separated by commas.
- The JavaScript statements that define the function, enclosed in curly brackets, `{ }`.

```
function name(param, ...) {
 // Do stuff in here.
}
```

JavaScript `functions` can return values

```
function whoami() {
 return "Peter";
}
```

- Primitive parameters (such as a number) are passed to/from functions by value
- Non-primitive parameters (such as a object) are passed to/from functions by reference

Ways to declare `functions`

There are several ways to declare functions

- constructor
- declaration
- anonymous expression

JavaScript function constructor

```
var add = new Function("x", "y", "return x + y;");
```

JavaScript function declaration

```
function add(x, y) {
    return x + y;
}
```

JavaScript anonymous function expression

```
var add = function(x, y) {
    return x + y;
};
```

Nesting JavaScript functions

- One interesting thing about JavaScript is that you can nest functions
- This does enforce some encapsulation
- This is usually called a `closure`

What is a closure?

A closure is an expression (typically a function) that can have free variables together with an environment that binds those variables (that "closes" the expression).

```
function addSquares(a,b) {
    function square(x) {
        return x * x;
    }
    return square(a) + square(b);
}
a = addSquares(2,3); // returns 13
b = addSquares(3,4); // returns 25
c = addSquares(4,5); // returns 41
```

```
function outside(x) {
    function inside(y) {
        return x + y;
    }
    return inside;
}
// Think of it like: give me a function
// that adds 3 to whatever you give it
fn_inside = outside(3);
result = fn_inside(5); // returns 8

result1 = outside(3)(5); // returns 8
```

Nesting can actually continue forever...

```
function A(x) {
    function B(y) {
        function C(z) {
            alert(x + y + z);
        }
        C(3);
    }
    B(2);
}
A(1); // alerts 6 (1 + 2 + 3)
```

Demo

2 - JavaScript Functions

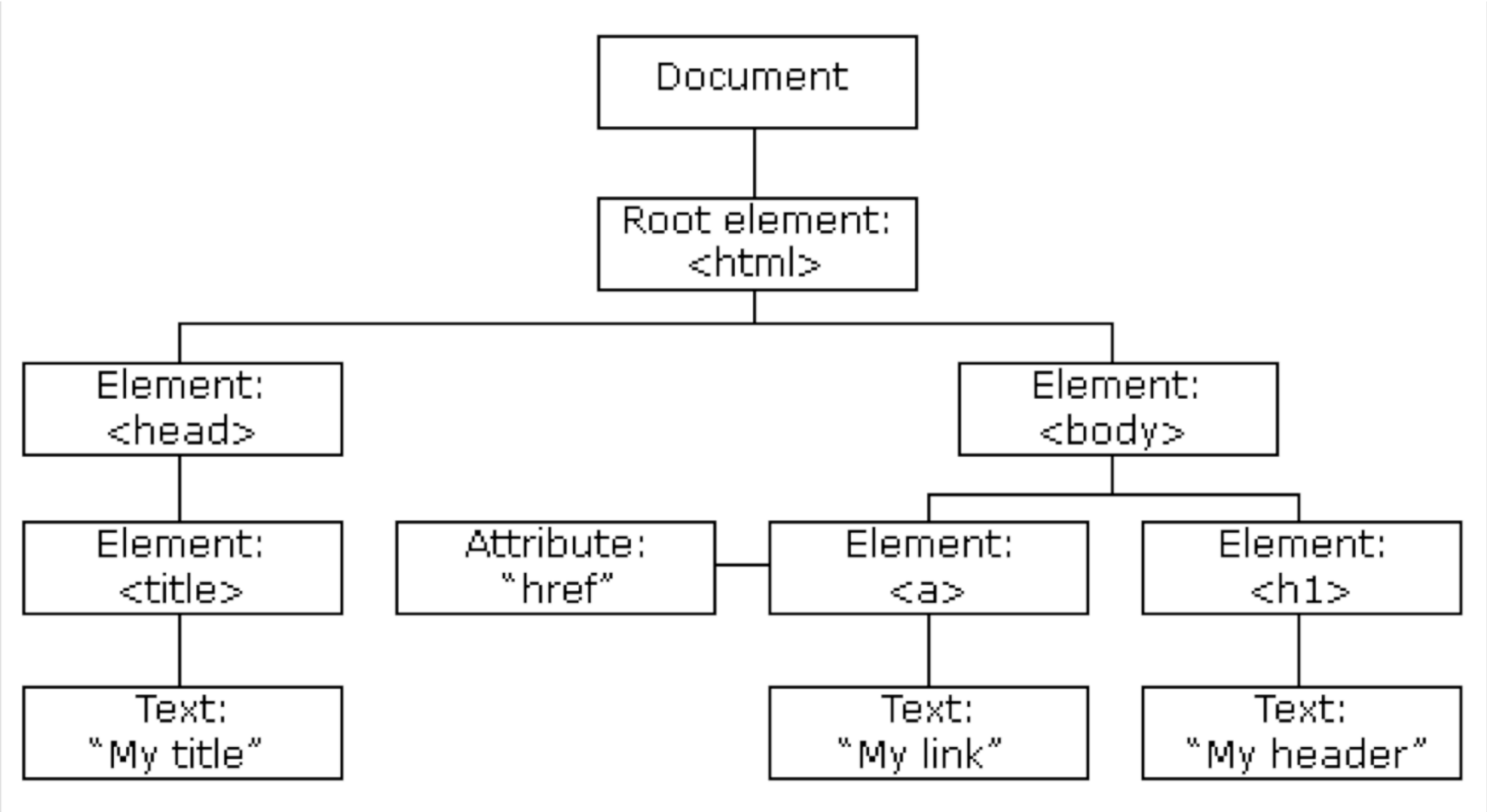
Code can be found at:

http://coen268.peterbergstrom.com/resources/demos/jslecturedemos.zip

Okay, that was a bit boring, let's bring things to life

Working with HTML and the DOM

- When a HTML document is loaded, the browser creates a **D**ocument **O**bject **M**odel representation of the page
- JavaScript's primary function is to interact with the HTML on the page
- It is a tree structure that you can navigate and modify in JavaScript
- In the context of DOM manipulation, HTML tags are called **DOM elements**



From: http://www.w3schools.com/js/js_htmldom.asp

What can you do with the DOM with JavaScript?

- Change all the HTML elements and attributes in the page
- Add or remove existing HTML elements and attributes
- Change all the CSS styles in the page
- React to or create HTML events in the page

Finding DOM elements

```
document.getElementById('my-id');

document.getElementsByTagName('h2');

document.getElementsByClassName('my-classname');
```

Changing DOM elements

```
element.className = 'my-class';
element.id = 'my-id';
element.style.fontSize = '10px';

and more...
```

Adding and Removing DOM elements

```
document.createElement()
document.removeChild()
document.appendChild()
document.replaceChild()
```

Demo

3 - DOM traversal

Code can be found at:

http://coen268.peterbergstrom.com/resources/demos/jslecturedemos.zip

DOM events, bringing a page to life

- There are many mouse and touch events such as `click`, `scroll`, `mousedown`, `ontouchstart`, etc
  - These are the ones that bring your app to life
  - There are so many, so look them up
- There are events such as `load` that trigger when things load
  - A common one is `window.onload` to do things once the page is loaded

Several ways to add events

Inline in element

```
<div class="my-class" onclick="function() {alert(this.className;)}">
  This is my div
</div>
```

Hard to manage!

In JavaScript...

```
<div class="my-class">This is my div</div>

// assuming only 1 div
var myDiv = document.getElementsByTagName('div')[0];

myDiv.onclick = function() {
  alert(this.className);
};
```

Better, but there is one problem. You overwrite any other `click` handler

In JavaScript, using addEventListener():

```
<div class="my-class">This is my div</div>

// assuming only 1 div
var myDiv = document.getElementsByTagName('div')[0];

myDiv.addEventListener('click', function() {
  alert(this.className);
});
```

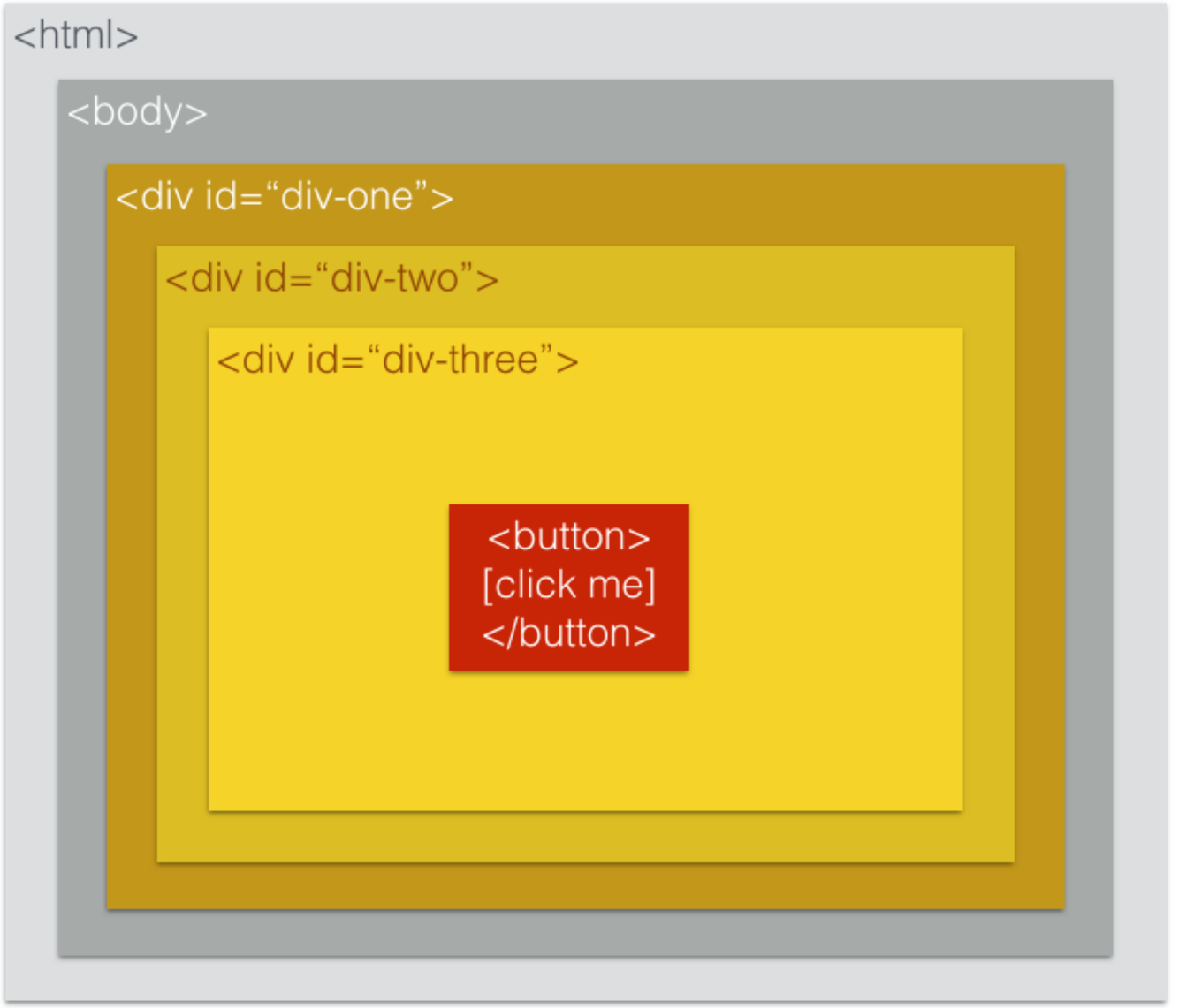
Now you can have multiple handlers going to the same event, if you want

JavaScript Event Capturing & Bubbling

- Events do not happen on their own as they are part of a hierarchy of elements
- As you know, HTML documents are all about nesting elements within each other
- Let's go through an example...

Let's use this HTML

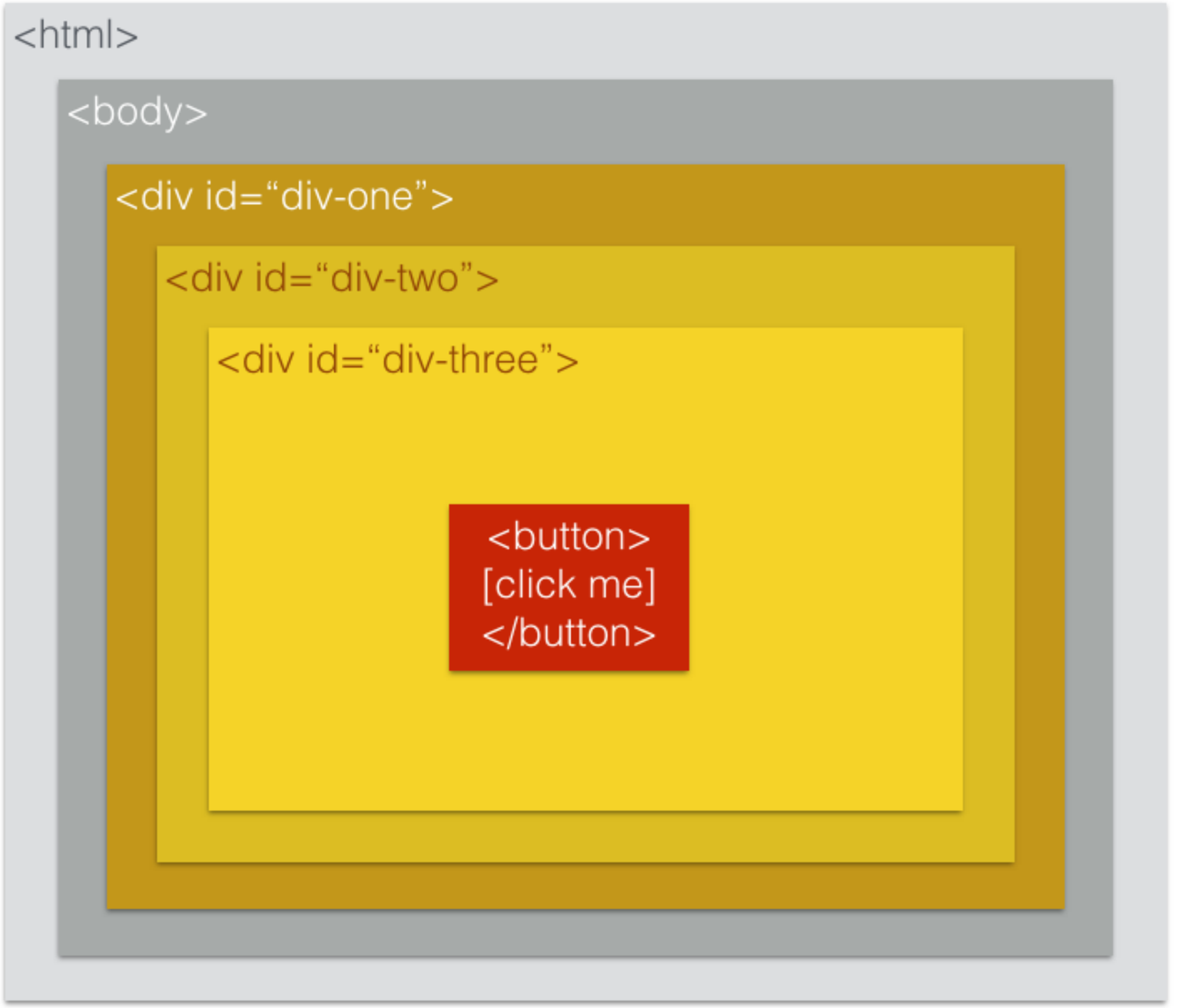
```
<div id="div-one">
    <div id="div-two">
        <div id="div-three">
            <button id="button">[click me]</button>
        </div>
    </div>
</div>
```


<html>
<body>

<button>
[click me]
</button>

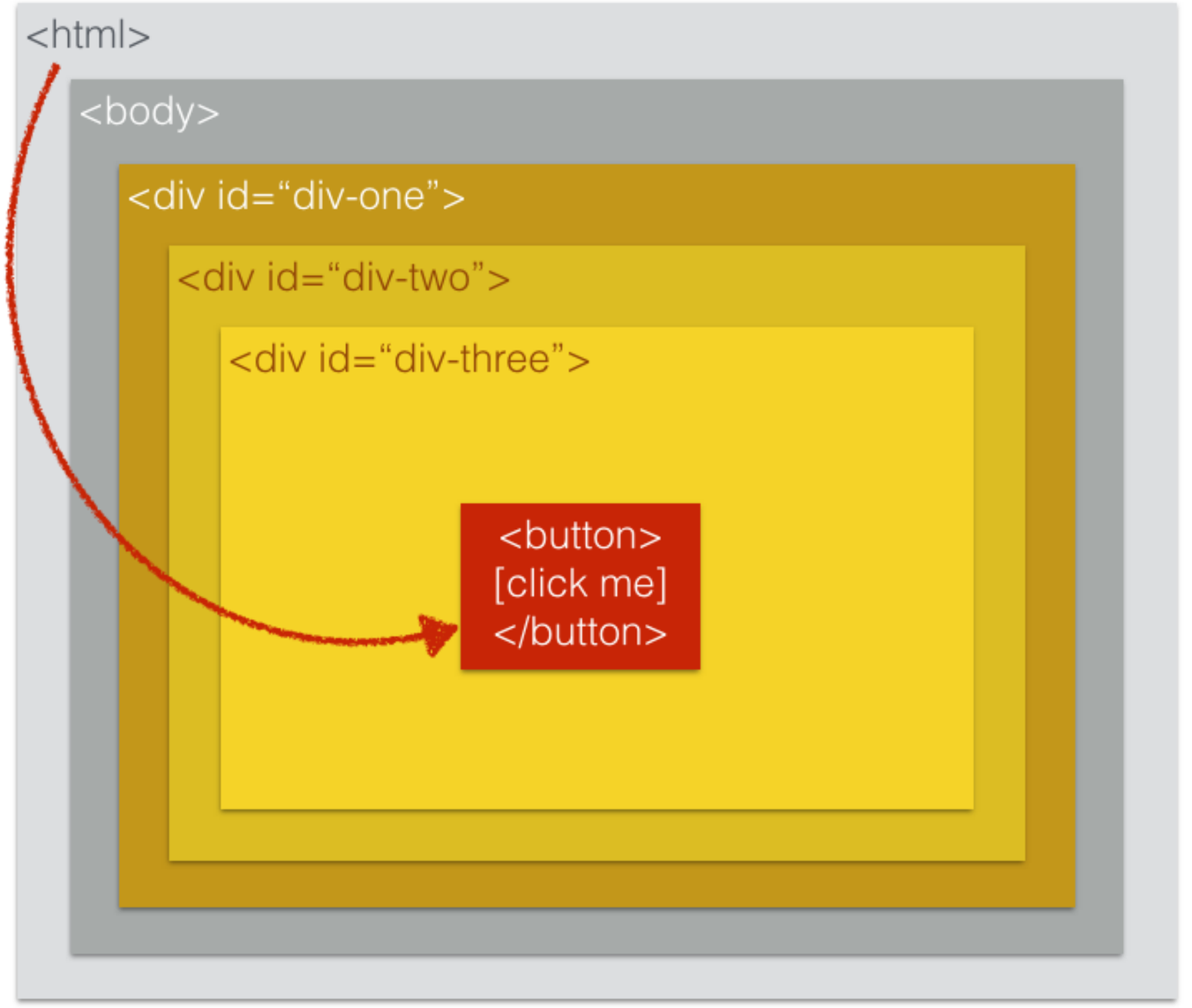
Two Phases: Capturing and Bubbling

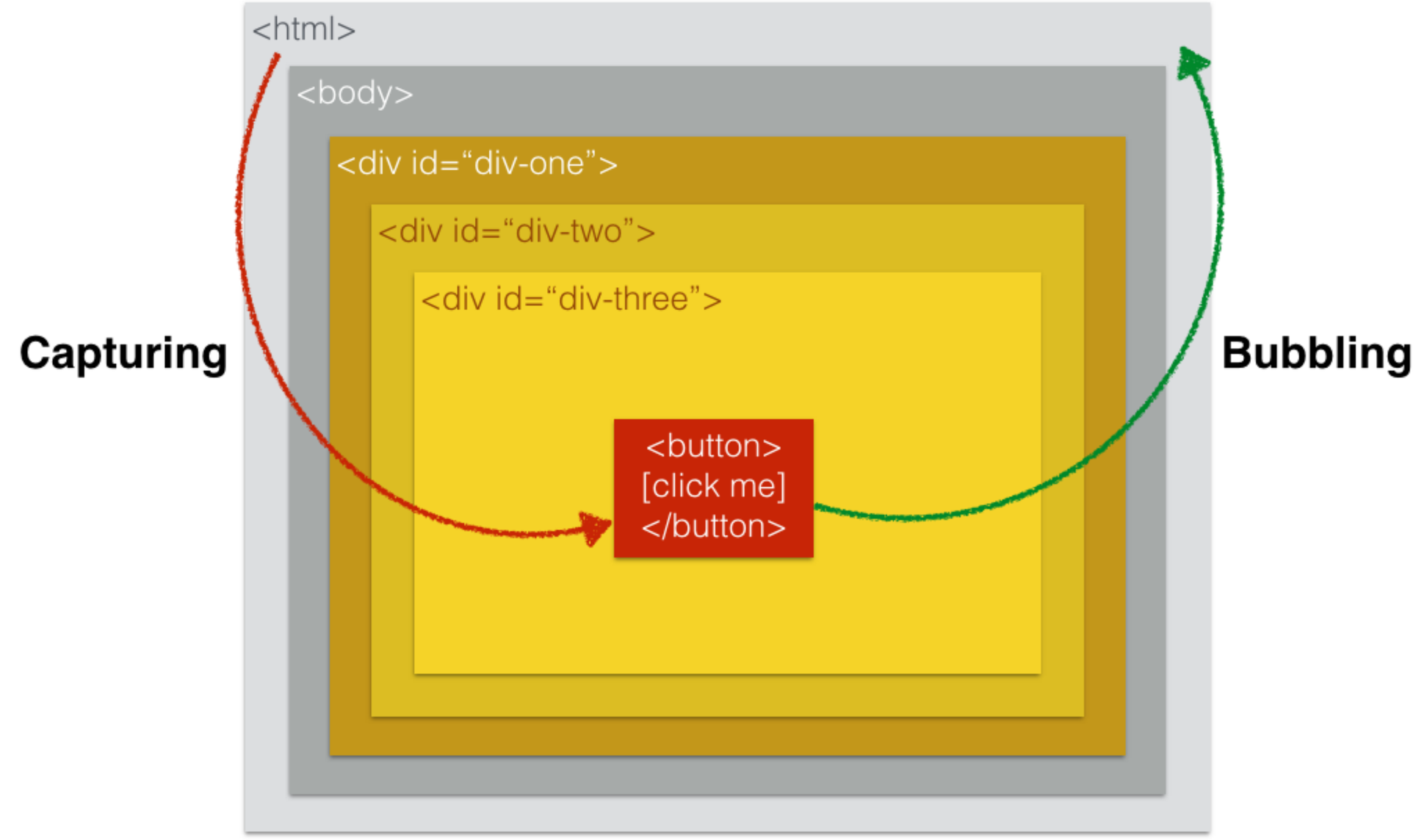
- Capturing goes down from the `root`, the `<html>` element down to the element that triggered the event
- Then, the event bubbles up from the element that triggered the event back up to the `root`


<html>
<body>

<button>
[click me]
</button>

Capturing




Capturing
<html>
<body>

<button>
[click me]
</button>
Bubbling

When to trigger the event, capturing or bubbling?

When calling `addEventListener()`, you can specify if you want to trigger on capture or on bubbling

```
// triggers on capture
addEventListener('click', myFunction, true);

// triggers on bubble
addEventListener('click', myFunction, false);

// default, triggers on capture
addEventListener('click', myFunction);
```

Why does it matter?

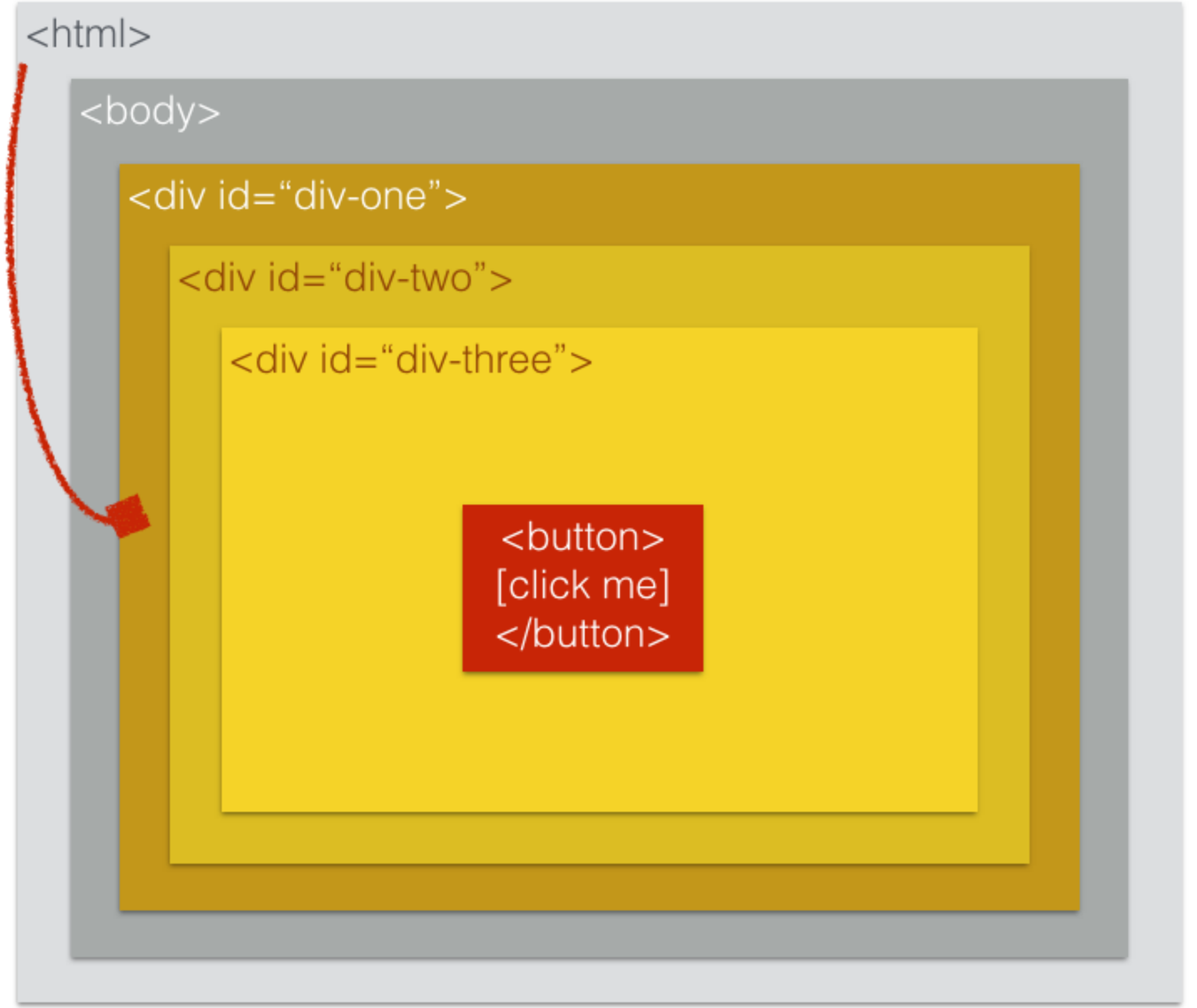
- Usually it doesn't
- However, there can be times when you want to alter behavior
- If you trigger on capture, instead of bubble, you can deal with the order of
  events in one way, and vice versa

Stopping event propagation

- There are times when you want to stop the capturing or bubbling traversal
- If each nested `<div>` had a click handler, it would trigger all of them in order unless you call `e.stopPropagation()` at some point:

```
divOne.addEventListener('click',  // divOne points to id="div-one"
    function myFunction(e) {
      e.stopPropagation(); // stop it cold and do your thing.
    });
```

Capturing



Stopping event default actions

- Another call that you can use is `e.preventDefault()`
- HTML elements have default actions like, clicking an `<input>` element will focus on it.
- With `e.preventDefault()` you can turn off those things and control it completely
- This is used quite often when you get into writing custom controls

CalculatorDemo

Adding JavaScript interactivity

Code can be found at:

https://github.com/pbergstr/calculator-demo/tree/v8-add-javascript

https://github.com/pbergstr/calculator-demo/tree/v9-organize-javascript

jQuery is DOM manipulation framework

- Takes care of browser incompatibilities
- Makes it easier to look up DOM elements
- Makes it easier to add and respond to events
- Contains a lot of nice utility methods

How jQuery works

```
<!doctype html>
<html>
<head>
    <meta charset="utf-8" />
    <title>Demo</title>
</head>
<body>
    <a href="http://jquery.com/">jQuery</a>
    <script src="jquery.js"></script>
    <script>

    // Your code goes here.

    </script>
</body>
</html>
```

Launching code on Document Ready

```
// Many developers do this:
window.onload = function() {
    alert("welcome");
}

// But blocks on image loads so this is better:
$( document ).ready(function() {
    // Your code here.
});
```

Adding Events on Document Ready

Since the DOM is loaded, but images might not be, you can add events:

```
$(document).ready(function() {

    $("a").click(function(event) {

        alert("Thanks for visiting!");

    });

});
```

A complete example

```
<!doctype html>
<html>
<head>
    <meta charset="utf-8" />
    <title>Demo</title>
</head>
<body>
    <a href="http://jquery.com/">jQuery</a>
    <script src="jquery.js"></script>
    <script>

    $(document).ready(function() {
        $("a").click(function(event) {
            alert( "The link will no longer take you to jquery.com" );
            event.preventDefault();
        });
    });

    </script>
</body>
</html>
```

With jQuery it is easy to add and remove class names

```
<style>
a.test {
    font-weight: bold;
}
</style>

$("a").addClass("test"); // Now bold

$("a").removeClass("test"); // Not bold
```

jQuery makes it easy to show and hide elements

```
$("a").hide(); // Now it is set to display: none

$("a").show(); // Now it is no longer display: none
```

You can even animate it

```
$("a").click(function(event) {

    event.preventDefault();

    $(this).hide("slow");

});
```

CalculatorDemo

Converting to jQuery real quick

Code can be found at:

https://github.com/pbergstr/calculator-demo/tree/v10-add-jquery

Demo

4 - jQuery Events

Code can be found at:

http://coen268.peterbergstrom.com/resources/demos/jslecturedemos.zip

HTML 5 and JavaScript

- HTML5 has a lot of features that use JavaScript
- Local Storage, Location, Accelerometer, and more…

Local Storage

- Very simple to use
- Supported in modern browsers
- Typically 5MB per site
- Key value store
- Stores only strings natively

Local Storage example

```
var data = {
  firstName: "Peter",
  lastName: "Bergström"
}

// Convert to JSON so we can store it
localStorage.setItem('name', JSON.stringify(data));

var data = JSON.parse(localStorage.getItem('name'));
```

Location

- Based on browser permission, you can get lat and long
- Works for mobile devices and desktops
- Great for apps

Location example

```
function getLocation() {
  if (navigator.geolocation) {
    var options = {
      enableHighAccuracy: true,
      timeout: 5000,
      maximumAge: 0
    };
    navigator.geolocation.getCurrentPosition(showLocation, showError, options);
  } else {
    showError();
  }
};
```

Demo

5 - Local Storage and Location

Code can be found at:

http://coen268.peterbergstrom.com/resources/demos/jslecturedemos.zip

Accelerometer

- Captures the motion of the device in physical space
- Enables a lot of interactivity
- Can be used in games or apps

Demo: http://www.html5rocks.com/en/tutorials/device/orientation/devicemotionsample.html

COEN 168/268

Mobile Web Application Development

JavaScript and jQuery

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