# IN4MATX 133: User Interface Software

## Lecture 6:
## DOM Manipulation

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## Wrapping up A1

- A lot of GitHub accounts aren’t linked to UCI emails on GitHub Classroom
  - Please go to GitHub Classroom and find your UCI email
  - You’re probably not on the list if you added the class late—email us and we’ll add you
- Make sure your code is committed to the *master* branch
  - `git merge [branchname]`
  - If this doesn’t mean anything to you, then your code is committed to master already :-)
- A2 will be posted later this week

## Today’s goals

### By the end of today, you should be able to…

- Debug scoping and hoisting issues in your JavaScript code
- Describe the different roles JavaScript has in client-side and server-side development
- Explain the role of the Document Object Model (DOM)
- Write code which edits the DOM using built-in JavaScript functions
- Write jQuery code to edit the DOM

## Some useful JavaScript methods and important notes

## null, undefined, and NaN

- `null`: a nonexistent object
  - Therefore it is an object, just unitialized

```
var nullObj = null;

console.log(typeof nullObj); //object
if(!nullObj) {
 console.log("It's falsy");
}
//but it's not equal to false
console.log(nullObj == false); //false
```

https://codeburst.io/understanding-null-undefined-and-nan-b603cb74b44c

# null, undefined, and NaN

- `undefined`: an undefined primitive value
    - Therefore it's a primitive value, like a number or a string

```
var undefinedObj;

console.log(undefinedObj); //undefined
console.log(typeof undefinedObj); //undefined
if(!undefinedObj) {
 console.log("It's falsy");
}
//but it's not equal to false
console.log(undefinedObj == false); //false
```

https://codeburst.io/understanding-null-undefined-and-nan-b603cb74b44c

## null, undefined, and NaN

- `NaN`: Not a Number
  - Will be the result of any computation on an `undefined` value
  - Or any other impossible computation
  - But it’s type is a number (despite the name)

```
console.log('12' - 5); // 7
console.log('word' - 5);// NaN
console.log(undefined * 3);// NaN
console.log(typeof NaN);// number
if(NaN) {
 console.log("It's not falsy!");
}
```

https://codeburst.io/understanding-null-undefined-and-nan-b603cb74b44c

# Useful array methods

- JavaScript arrays have stack functions
  - `.push()` and `.pop()` to add and remove the last item, respectively
- Arrays can be combined with `.concat()`
- `.sort()` will sort alphabetically/numerically by default
  - But can take in a comparator
  - For example, sort by the count attribute of an object:

```
array.sort(function(a, b) {
  return a.count - b.count;
});
```

https://medium.com/@DaphneWatson/10-useful-javascript-array-methods-8ffe22e7a959

# Useful object methods

- `Object.keys(`object/dictionary/associative-array`)`
    - returns an array containing the keys
    - order is not guaranteed
    - Or `Object.values(`object`)` to get an array of the values
    - Or `Object.entries(`object`)` to get an array containing an array of key, value pairs

```
obj = { pet1: 'Dog', pet2: 'Cat' };

console.log(Object.entries(obj));
// [ ["pet1", "Dog"], ["pet2", "Cat"] ]
```

https://codeburst.io/useful-javascript-array-and-object-methods-6c7971d93230

## Scoping

- Variables are scoped to wherever they are defined
    - So if they are within a function, they will only be visible within that function

```
var globalScopedVar = "I'm global!";

function func() {
 var funcScopedVar = "I'm only visible in this
function!";
 return funcScopedVar;
}

console.log(funcScopedVar); //undefined
```

## Hoisting

- Functions can be either *declared* or *expressed*, and the two are treated differently in scoping
  - Declaration: `function name() {}`
  - Expression: `var name = function() {}`
- Both are called the same way: `name()`

https://stackoverflow.com/questions/7609276/javascript-function-order-why-does-it-matter

# Hoisting

- Variable and function declarations get *hoisted* to execute before the rest of the code
  - Assignment occurs later, where you specify it

```
bar();
var foo = 42;
function bar() {}
//=> is interpreted as
var foo;
function bar() {}
bar();
foo = 42;
```

https://stackoverflow.com/questions/7609276/javascript-function-order-why-does-it-matter

## Hoisting

- Function expressions get initialized at the top of the code, but not assigned

```
bar();
function bar() {
    foo();
}
var foo = function() {}
//=> turns into
var foo;
function bar() {
    foo(); //error! not yet defined
}
bar();
foo = function() {}
```

https://stackoverflow.com/questions/7609276/javascript-function-order-why-does-it-matter

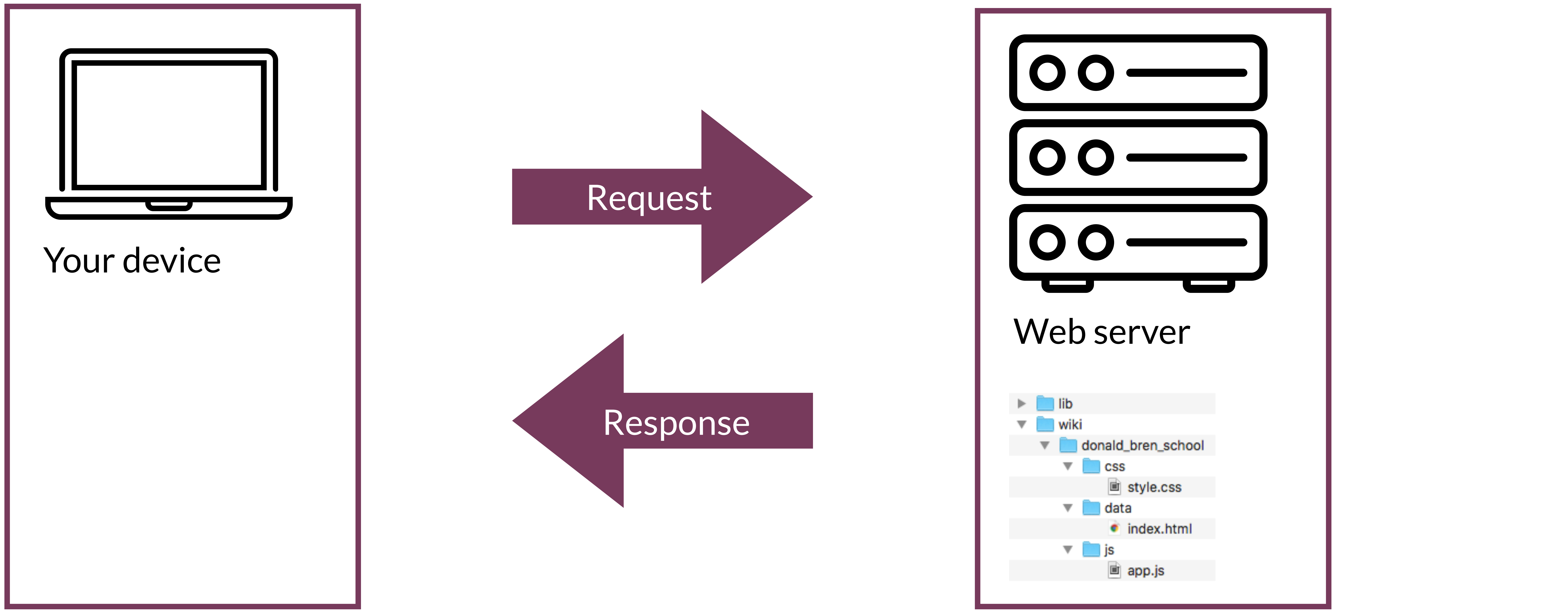
## Thus far, JavaScript looks just like any other language

## What about JavaScript makes it used so widely on the web?

## JavaScript has many functions for editing webpages

## Today, JavaScript is used both client-side and server-side

# Client-side and server-side JavaScript



Edit what's being rendered
Trigger or react to events

Navigate file system programmatically
Dynamically generate pages or views
Transport, store, or interact with data

## Client-side

- Can be seen by the user
- Changes happen in real-time in the browser
- Examples: AJAX, Angular, React, Vue.js

## Server-side

- Cannot be seen by the user
- Changes happen on the server in response to HTTP requests
- Examples: Node, ASP.NET

**It can be confusing to follow your code if JavaScript is on both sides**

# Client-side object: Window

- The window object refers to the browser itself.
  You can access properties and execute functions on it

```
/* example properties */
var width = window.innerWidth;    //viewport width
var height = window.innerHeight; //viewport height

/* example functions */
window.alert("Boo!");

var confirmed = window.confirm("Are you sure?");
var quest = window.prompt("What is your quest?”);
```

↑ Bad form, put it on your page instead

## Client-side object: Window

- It's possible to use window to control the browser, but behavior varies drastically by browser

```
var xPos = window.screenX; //offset from screen edge
var yPos = window.screenY; //offset from screen edge
var scroll = window.scrollY; //pixels scrolled down
var url = window.location.href; //url for this page

window.scrollTo(0,1000); //scroll to position
window.open(url); //open a new window loading the URL
window.close(); //close window
```

Again, better to keep your program inside the window

# Client-side object: Timer

- `window` has functionality for running code on a delay or on an interval

```
function doAfterDelay() { console.log("Surprise!"); }

//run after 1 second
window.setTimeout(doAfterDelay, 1000);

function doRepeatedly() { console.log("Are we there
yet?"); }

//run every 1 second
var timerId = window.setInterval(doRepeatedly, 1000);

window.clearInterval(timerId); //to stop
```

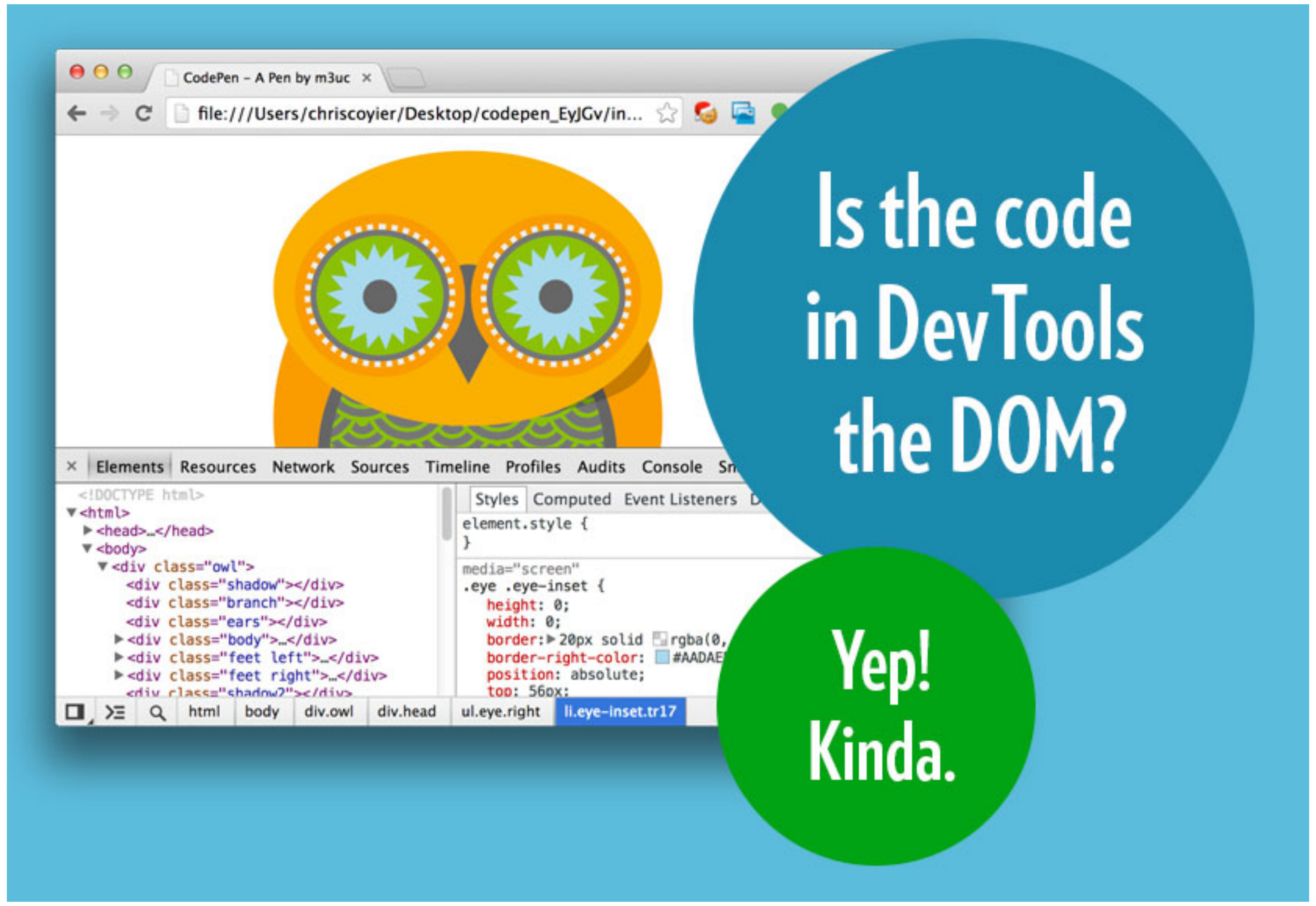
## Server-side object: Timer

- Server-side JavaScript usually implements the same functionality without the window object

```
setTimeout(doAfterDelay, 1000);

setInterval(doRepeatedly, 1000);

clearInterval(timerId); //to stop
```

# HTML Document Object Model (DOM)

- “A standard for how to get, change, add, or delete HTML elements”
- “the HTML you write is parsed by the browser and turned into the DOM”
- Client-side JavaScript can then edit the DOM



```
<!DOCTYPE html>
▼<html>
  ►<head>…</head>
  ▼<body>
    ▼<div class="owl">
       <div class="shadow"></div>
       <div class="branch"></div>
       <div class="ears"></div>
      ►<div class="body">…</div>
      ►<div class="feet left">…</div>
      ►<div class="feet right">…</div>
       <div class="shadow2"></div>
```

```
element.style {
}
media="screen"
.eye .eye-inset {
   height: 0;
   width: 0;
   border:►20px solid rgba(0,
   border-right-color: #AADAE
   position: absolute;
   top: 56px;
```

https://css-tricks.com/dom/

## JavaScript in HTML

- Can insert inline using the `<script>` tag

```
<head>
  <script>
    alert("Hello, world!");
  </script>
</head>
<body>

</body>
```

# JavaScript in HTML

- Your script should wait until after the page has loaded
  - Otherwise elements you're trying to access might not exist

```
<head>
 <script>
  function pageLoaded() {
   alert("Page Loaded!");
  }
 </script>
</head>
<body onload="pageLoaded();">

</body>
```

## JavaScript in HTML

- Functions can respond to events

```
<head>
  <script>
    function buttonClicked() {
      alert("Button Clicked!");
    }
  </script>
</head>
<body>
  <!--Bad style! Don't do this-->
  <button onclick="buttonClicked()">Click me!</button>
</body>
```

## JavaScript in HTML

- Like CSS, better to load an external script

```
<head>
 <script src="js/script.js"></script>
</head>
```

# Editing the DOM

- document object model
- Write into the DOM with `document.write`

```
<script>
  document.write("<h1>Hello, World!</h1>");

  var myCourse = "IN4MATX 133";
  document.write("<h1>Hello, " + myCourse + "!");
</script>
```

## Selecting elements

- We can reference individual HTML elements by calling selector functions

```
//element with id="foo"
var fooElem = document.getElementById('foo');

//elements with class="row"
var rowElems = document.getElementsByClassName('row');

//<li> elements
var liElems = document.getElementsByTagName('li');
```

## Selecting elements

- We can reference individual HTML elements by calling selector functions

```
/*easiest to select by reusing CSS selectors! */
var cssSelector = 'header p, .title > p';

//selects FIRST element that matches css selector
var elem = document.querySelector(cssSelector);

//matches ALL elements that match css selector
var elems = document.querySelectorAll(cssSelector);
```

## Editing elements

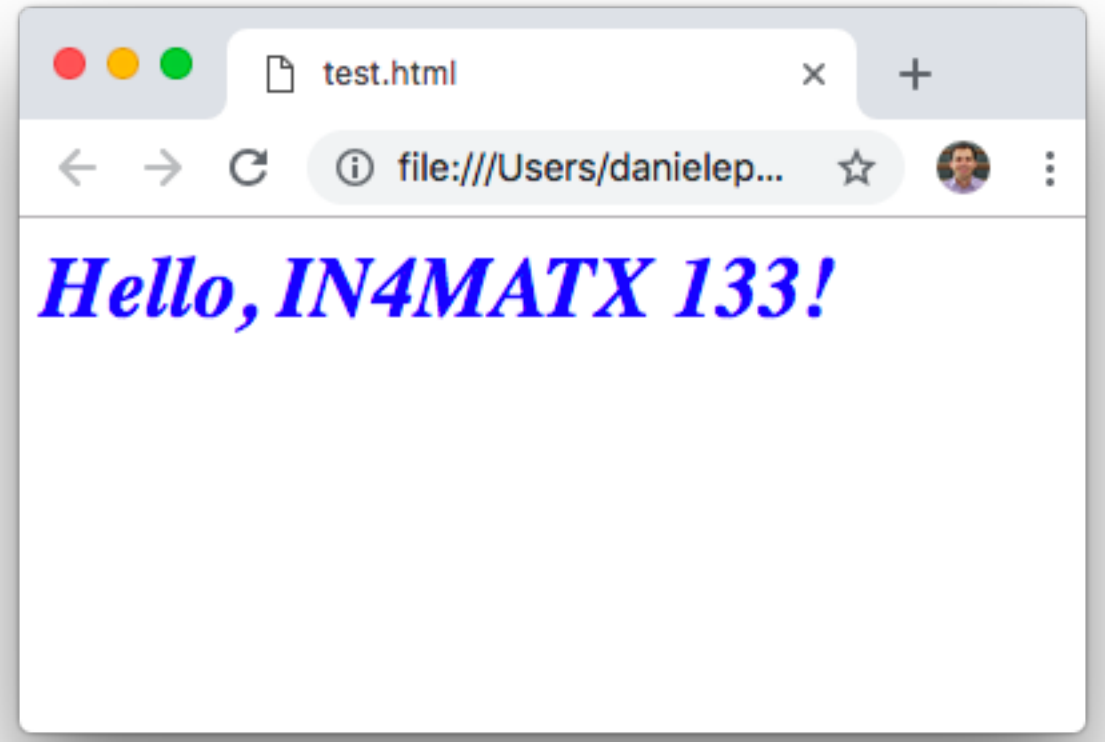
- Properties and functions of elements can manipulate them

```
/* properties to access the CONTENT of the element */

var elem = document.querySelector('p');

var text = elem.textContent; //the text content of the elem
elem.textContent = "I'm different!"; //change the content


var html = elem.innerHTML; //content including tags
elem.innerHTML = "I'm <strong>different</strong>";

var parent = elem.parentNode; //get the parent node
```

## Editing elements

- Can add/remove classes, IDs, and inline style

```
<style>/*Bad form! Just for demo*/
  .title {
    font-style: italic;
  }
</style>
<h1>Hello, IN4MATX 133!</h1>
<script>
  var elements = document.getElementsByTagName("h1");
  for(var i = 0; i < elements.length; i++) {
    elements[i].classList.add("title");
    elements[i].style.color="blue";
  }
</script>
```



Hello, IN4MATX 133!

## Changing the DOM

```
//create a new <p> (not yet in the tree)
var newP = document.createElement('p');
newP.textContent = "I'm new!";

//create Node of textContent only
var newText = document.createTextNode("I'm blank");

var div = document.querySelector('div#container');
div.appendChild(newP); //add element INSIDE (at end)
div.appendChild(newText);

//add node BEFORE element (new, old)
div.insertBefore(document.createTextNode("First!"), newP);

//replace node (new, old)
div.replaceChild(document.createTextNode('boo'), newText);

//remove node
div.removeChild(div.querySelector('p'));
```

# Question

## Which snippet would edit the p to display “1, 2, 3, 4, 5”?

```
<p class="para" id="intro">1, 2, 3</p>
```

- A `document.getElementById("intro").append(", 4, 5");`
- B `document.getElementsByClassName("para").innerHTML("1, 2, 3, 4, 5");`
- C `document.getElementsByTagName("p")[0].innerHTML("1, 2, 3, 4, 5");`
- D Two of the above
- E All of the above

## Validating data

- Check form fields before sending to a server
    - Provide instant feedback, reduce server back-and-forth

```
<script>
  function validateForm() {
    var x = document.forms["myForm"]["fname"].value;
    if(x==null || x=="") {
      alert("Name must be filled out");
      return false;
    }
  }
</script>
<form name="myForm" onsubmit="return validateForm()" method="post">
  <label>Name: </label>
  <input type="text" name="fname">
  <input type="submit" value="Submit">
</form>
```

## Gather and use information

- Remember: this is client-side!
  - Storage would require sending to a server, which people can block in their browsers

```
<script>
  var x = document.getElementById("demo");
  function getLocation() {
      if (navigator.geolocation) {
          navigator.geolocation.getCurrentPosition(showPosition);
      } else {
          x.innerHTML = "Geolocation is not supported by this browser.";
      }
  }
  function showPosition(position) {
      x.innerHTML = "Latitude: " + position.coords.latitude +
      "<br>Longitude: " + position.coords.longitude;
  }
</script>
```

## How do we make interactive pages?

## Listeners

- Can attach a listener to that method, specifying that we want to do something when that element causes an event

```
//respond to "click" events
elem.addEventListener('click', callback);

//often use an anonymous callback function
elem.addEventListener('click', function(){
  console.log('clicky clicky!');
});
```

# Listeners

- Listener callback function will be passed an **event** parameter
  - Sometimes useful, but can often be ignored

```
elem.addEventListener('click', function(event) {
   console.log('You clicked me!');

   //get what was clicked;
   var clickedElem = event.target;
});
```

Remember, parameters are optional

The “target” (source) of the event

## Event types

```
'click'     //mouse or button clicked

'dblclick'  //double-clicked

'hover'     //mouse hover

'focus'     //element gains focus (important!)

'mouseenter' //mouse is moved over an element

'mouseleave'  //mouse leaves the element

'mousedown' //mouse button is pressed

'keydown'   //key is pressed

//... and more!
```

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

## Manipulation in pure JavaScript is verbose

- If you're editing a lot of tags, your code can get very long and difficult to read

```
var elem = document.querySelector('div.header');

var newP = document.createElement('p');
newP.textContent = "I'm new!";

div.appendChild(newP);

elem.addEventListener('click', function(event) {
   console.log('You clicked me!');

   //get what was clicked;
   var clickedElem = event.target;
});
```

# jQuery

- Predefines methods for manipulating the DOM
  - Include before your own script
- Remember:
  - Integrity: hashes to ensure the downloaded file matches what's expected
  - Crossorigin: some imports require credentials, anonymous requires none

```
<script
  src="https://code.jquery.com/jquery-3.3.1.min.js"
  integrity="sha256-FgpCb/KJQlLNfOu91ta32o/NMZxltwRo8QtmkMRdAu8="
  crossorigin="anonymous"></script>
```

## jQuery selector

- Use the `jQuery()` function to select DOM elements.
  The parameter is a CSS selector String (like `querySelector`)
  - More common to use the `$()` shortcut

```
//selects element with id="foo" (e.g., <p id="foo">)
var fooElem = jQuery('#foo');

//selects all <a> elements (returns an array)
var allLinksArray = jQuery('a');

//selects element with id="foo" (e.g., <p id="foo">)
var fooElem = $('#foo');

//selects all <a> elements (returns an array)
var allLinksArray = $('a');
```

## jQuery selector

- jQuery handles all CSS selectors, as well as some additional pseudoclasses

```
$('#my-div') // by id
$('div') // by type
$('.my-class') // by class
$('header, footer') // group selector
$('nav a') // descendant selector
$('p.red') // scoped selector

$('section:first') // first <section> element
                   // not a css selector!
```

# jQuery and elements

- Similar to pure JavaScript, jQuery provides methods to access and modify attributes and CSS

```
//Pure JavaScript
var txt = document.querySelector('#my-div').textContent;
document.querySelector('#my-div').textContent = 'new info!';
document.querySelector('#my-div').innerHTML = '<em>new html!
</em>';

//jQuery
var txt = $('#my-div').text();       //get the textContent
$('#my-div').text('new info!');      //change the textContent
$('#my-div').html('<em>new html!</em>'); //change the HTML
```

Changes apply to all selected elements

# jQuery and the DOM tree

```
//create an element (not in DOM)
var newP = $('<p class="new">This is a new element</p>');

//add content to DOM
$('main').append(newP); //add INSIDE, at end
$('main').append('<em>new</em>'); //can create element on the fly

$('main').prepend('<em>new</em>'); //add INSIDE, at beginning
```

Works without closing tag

```
$('main').before('<header>'); //insert BEFORE

$('footer').insertAfter('main'); //insert target AFTER param
```

Selects existing element, so will move!

```
$('main').wrap('<div class="container"></div>'); //surround

$('footer').remove(); //remove element
$('main').empty(); //remove all child elements
```

# jQuery event handling

- jQuery also provides convenience methods for registering event listeners

Like `addEventListener('click')`

```
$('#button').click(function(event) {
   console.log('clicky clicky!');

   //what was clicked
   var element = $(event.target);
});
```

`event.target` is equivalent to `this`

Get as jQuery-style element to call jQuery methods on it ("wrap it")

## Document ready: JavaScript

- Remember earlier: your script should wait until after the page has loaded
    - Otherwise elements you're trying to access might not exist

```
<head>
  <script>
   function pageLoaded() {
     alert("Page Loaded!");
   }
  </script>
</head>
<body onload="pageLoaded();">

</body>
```

# Document ready: jQuery

```
$(document).ready(function() {
  //your program goes here
  //this need not be an anonymous function

});
```

# Document ready: jQuery

```
//shortcut: just pass the function to the jQuery method
$(function() {
  //your program goes here
  //this need not be an anonymous function

});

//shortest cut: use the abbreviated syntax
$(() => {
  //your program goes here
  //this need not be an anonymous function

});
```

## Importing JavaScript

- When your script uses document ready, convention is to load it in the `<head>` tag
  - Important to think about ordering, particularly for libraries
  - e.g., import JQuery before you use it in a script

```
<head>
  <script src="https://code.jquery.com/
jquery-3.3.1.min.js"></script>
  <script src="index.js"></script>
</head>
```

## jQuery effects

- jQuery supports adding transitions to modify the appearance of effects

```
$('#id').fadeIn(1000);    //fade in over 1 second
$('#id').fadeOut(500);    //fade out over 1/2 sec
$('#id').slideDown(200); //slide down over 200ms
$('#id').slideUp(500);    //slide up over 500ms
$('#id').toggle();        //toggle whether displayed
```

# jQuery utility functions

- jQuery includes many utility functions to simplify syntax

```
//check if an item is in an array
$.inArray(4, [3,4,3] );

//this is like .filter, but works on old browsers
$.grep( [3,4,3], function(item) {
   return item > 3;
});

//iterate over arrays or objects -- works for either!
$.each( [1,3,3], function(key, value) {
   console.log('Give me a '+value);
});

$.each( {dept:'IN4MATX',num:'133'}, function(key, value) {
   console.log(key+' name: '+value);
});
```

http://api.jquery.com/category/utilities/

## Even more utilities: Lodash

- A handy library for working with basic data structures

```
_.flatten([1, [2, [3, [4]], 5]]);
// => [1, 2, [3, [4]], 5]

var zipped = _.zip(['a', 'b'], [1, 2], [true, false]);
// => [['a', 1, true], ['b', 2, false]]

_.unzip(zipped);
// => [['a', 'b'], [1, 2], [true, false]]
```

https://lodash.com/

## Today’s goals

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- Describe the different roles JavaScript has in client-side and server-side development
- Explain the role of the Document Object Model (DOM)
- Write code which edits the DOM using built-in JavaScript functions
- Write jQuery code to edit the DOM

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Lecture 6:
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