Csci 4131

JSON revisited
AJAX
Node.js

Lecture 8, March 24th

Spring 2020

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Logistics

- HW 5 is now due Friday, April 3rd at 3:00pm. After that time, assignments will be accepted with penalty, until Saturday evening (6:00pm), April 4th
- After 6:00pm 4/3 – HW 4 submissions will not be accepted.
- Exam 1 Grades posted on Canvas, I'm trying to figure out a way to get it back to you.

Reading and Tutorials: JSON, Ajax, Node.js

- JSON
  - Sebesta – Chapters 10, Section 3.3
  - https://www.w3schools.com/js/js_json_intro.asp
  - https://www.json.org/
- AJAX
  - Sebesta – Chapter 10
  - https://www.w3schools.com/xml/ajax_intro.asp
- Node.js
  - https://www.w3schools.com/nodejs/default.asp
  - https://www.tutorialspoint.com/nodejs/
  - https://nodejs.org/en/docs/guides

Node.js training videos on Linked-in Learning

- To log in for the first time, go to:

  - https://it.umn.edu/technology/linkedin-learning

  - Look for the Mauve Text region toward the top left of the page with the link named: Sign in to LinkedIn Learning

  - Click on the Link

  - ***Use your x.500 id and password to sign in.***

The following videos are most helpful:

- 1. Node.js Essential Training (6h 22m - Detailed Node.js video)
- 2. Building a Website with Node.js and Express.js (3h 16m - Focusses on Express.js and Node.js)
- 3. Learning Node.js (1h 57m)

Last Time

- Exam 1
- HW 4 Revisited

Today -

- Exam Stats / Comments
- Node.js
- HW 5 Overview, Demo
- JavaScript Object Notation (JSON)
- AJAX

Questions ?

Exam Statistics

	Question 1	Question 2	Question 3	Question 4	Question 5	Question 6	Total
	Internet and World Wide Web Basics	HTML and CSS	JavaScript and Closures	JavaScript and the DOM	JavaScript and the DOM	HTTP Response Codes and HTTP Messages	
Possible Points	20	20	26	10	10	14	100
Mean	15.32394366	15.71126761	18.16549296	9.366197183	7.64084507	10.3028169	76.51056338
Median	15	16	19	10	10	10	77
Standard Deviation	3.664182193	2.332566194	5.071377697	1.470653221	3.700376729	2.336844683	11.91168273

Technologies needed in HW 5

- All the stuff from the first ½ of the course plus:
- Node.js
- JSON
- AJAX

Node.js:

(info obtained from:
https://www.w3schools.com/nodejs/nodejs_intro.asp
https://www.w3schools.com/nodejs/nodejs_get_started.asp
https://www.w3schools.com/nodejs/nodejs_modules.asp

- Node.js is an open source **server** framework
- Node.js is free
- Node.js runs on various platforms (Windows, Linux, Unix, Mac OS X, etc.)
- Node.js uses JavaScript to implement and augment **server** functionality

Node.js can:

- generate dynamic page content
- create, open, read, write, delete, and close files on the server
- can collect form data
- can add, delete, modify data in your database

A Node.js file contains:

- tasks that will be executed when triggered by certain events
  - A typical event is someone trying to access a port on the server
  - Node.js files must be initiated on the server before having any effect
- Node.js files have extension ".js"

Node.js handles a file request as follows

1. Sends the task to the computer's file system.
2. Ready to handle the next request.
3. When the file system has opened and read the file, the server returns the content to the client.

- Thus node.js is single threaded, non-blocking, and asynchronous
- Here is how Php handles a file request:
  1. Sends the task to the computer's file system.
  2. Waits while the file system opens and reads the file.
  3. Returns the content to the client.
  4. Ready to handle the next request.
- So, for this task, PHP (and ASP) operate synchronously (and block).

Like Python, Node.js has lots of libraries (called modules) that you will want to include in your application

- For example:
  - http module, used to create a server

Example of a node.js file

```
var http = require('http');
http.createServer(function (req, res) {
   res.writeHead(200, {'Content-Type': 'text/html'});
   res.end('Hello World!');
}).listen(8080);
```

Assuming it is in the file: myfirst.js

You run it from the command line by typing:
node myfirst.js

Then fire up your browser, and in the address bar type:
http:/localhost:8080

And, you will get the response: **Hello World – rendered in your browser**

HW 5

- Demo and Overview

A Tip

- For redirect, use:

  res.writeHead(302, {‘Location’: ‘contact.html’});

Exercise 1 – Submit via the Exercise 1, March 24 item on the Class canvas site by 10pm

JavaScript Object Notation

- JavaScript Object Notation (JSON)
- References – Chapter 10.3.3 Sebesta
  - https://www.w3schools.com/js/js_json_intro.asp
  - https://www.w3schools.com/js/js_json.asp
  - www.json.org

JSON

- Lightweight data interchange format
- Self-describing – human readable and writeable
- It is based on a subset of the JavaScript Programming Language, Standard ECMA-262 3rd Edition - December 1999.
- JSON is a text format that is completely language independent **BUT**
- It uses conventions that are familiar to programmers of the C-family of languages, including C, C++, C#, Java, JavaScript, Perl, Python, and many others.

- JSON is built on two structures:
  - A collection of name/value pairs. In various languages, this is realized as an *object*, record, struct, dictionary, hash table, keyed list, or associative array.
  - An ordered list of values. In most languages, this is realized as an *array*, vector, list, or sequence

JSON Values Can Be:

- A number (integer or floating point)
- A string (in double quotes)
- A Boolean (true or false)
- An array (in square brackets)
- An object (in curly braces)
- null

JSON Objects / JSON Arrays

- JSON objects are written inside curly braces.
- Just like in JavaScript, objects can contain multiple name/values pairs:
  - e.g., {"firstName":"John", "lastName":"Doe"}

- JSON arrays are written inside square brackets.

- As in JavaScript, an array can contain multiple objects:

- {"employees":[
  {"firstName":"John", "lastName":"Doe"},
  {"firstName":"Anna", "lastName":"Smith"},
  {"firstName":"Peter", "lastName":"Jones"}
  ]}
- The object "employees" is an JavaScript object with a value that is an array containing three objects. Each object in the array is a record of a person (with a first name and a last name).

Have you used JSON in this Course Before?

Where?

Answers in Chat!!!!

JSON Uses JavaScript Syntax

Example:

```
var employees = [
   {"firstName":"John", "lastName":"Doe"},
   {"firstName":"Anna", "lastName":"Smith"},
   {"firstName":"Peter", "lastName": "Jones"}
];
```

The first entry in the JavaScript object array can be accessed as follows:

```
employees[0].firstName + " " + employees[0].lastName;
```

The content returned will be:
John Doe

Data in the array can be modified as follows:

```
employees[0].firstName = "Gilbert";
```

Creating JSON Objects from a string

The following creates a JavaScript string containing JSON syntax:

```
var text = '{ "employees" : [' +
'{ "firstName":"John" , "lastName":"Doe" },' +
'{ "firstName":"Anna" , "lastName":"Smith" },' +
'{ "firstName":"Peter" , "lastName":"Jones" } ]}';
```

The JavaScript function **JSON.parse(*text*)** can be used to convert text in a JSON format into a JavaScript object:

```
var obj = JSON.parse(text); // creates a json object from the string text and
                            //  associates the object with the identifier obj
```

Question – Answer in chat:

```
alert(obj.employees[1].lastName) // what is shown in the alert box?
```

Creating a string from a JSON object

```
var text = '{ "employees" : [' +
'{ "firstName":"John" , "lastName":"Doe" },' +
'{ "firstName":"Anna" , "lastName":"Smith" },' +
'{ "firstName":"Peter" , "lastName":"Jones" } ]}';
var obj = JSON.parse(text);

// Answer the question in chat!!!
alert(obj.stringify); // What is shown in the alert box???
```

Example – JSON to JavaScript Objects

jsonex1.html

An HTML and JAVASCRIPT example that starts with text stored in JSON notation

Converts the text to a JavaScript Object

Displays the contents of the Object

Example – JSON to JavaScript Objects

```
<!DOCTYPE html>
<html>
<body>

<h2>JSON Object Creation in JavaScript</h2>

<p id="demo"></p>

<script>
var text = '{"name":"President Trump","streetaddress":"1600 Pennsylvania Ave.","phone":"202 4561414"}'

var obj = JSON.parse(text);


document.getElementById("demo").innerHTML =
obj.name + "<br>" +
obj.streetaddress + "<br>" +
obj.phone;
</script>

</body>
</html>
```

jsonex1.html

Example 2: JSON to JavaScript Arrays

jsonex2.html

An HTML and JAVASCRIPT example that starts with text stored in JavaScript Array notation

Converts the text to a JavaScript Array

Displays the contents of the Array

Example 2: JSON to JavaScript Arrays

```
<!DOCTYPE html>
<html>
<body>

<h2>JSON Array Creation in JavaScript</h2>
        <p id="result"></p>

        <script>
        var nums = '["200","400","600","800"]';
        var anarray = JSON.parse(nums);

        var sum = 0;
        for (i = 0; i < anarray.length; i++) {
                sum += parseInt(anarray[i]);
        }
        document.getElementById("result").innerHTML = sum;
        </script>
</body>
</html>
```

jsonex2.html

Exercise 2: JSON – Submit via Canvas Ex 2 Submission Item in the Week 9 Module by 10 PM tonight

AJAX

- Not a cleaning product that is stronger than dirt
- AJAX = Asynchronous JavaScript and XML
- Enables the implementation of more efficient web pages

AJAX

- Enables web pages to be updated asynchronously by exchanging small amounts of data with the server behind the scenes. This means that it is possible to update parts of a web page, without reloading the whole page.
- Web pages that do not use AJAX reload the entire page if any content on the page changes

AJAX – Based on Internet Standards

- Uses a combination of:
  - XMLHttpRequest object (to exchange data asynchronously with a server)
  - JavaScript/DOM (to display/interact with the information)
  - CSS (to style the data)
  - XML (often used as the format for transferring data) – but can be JSON or just plain text

Who uses AJAX?

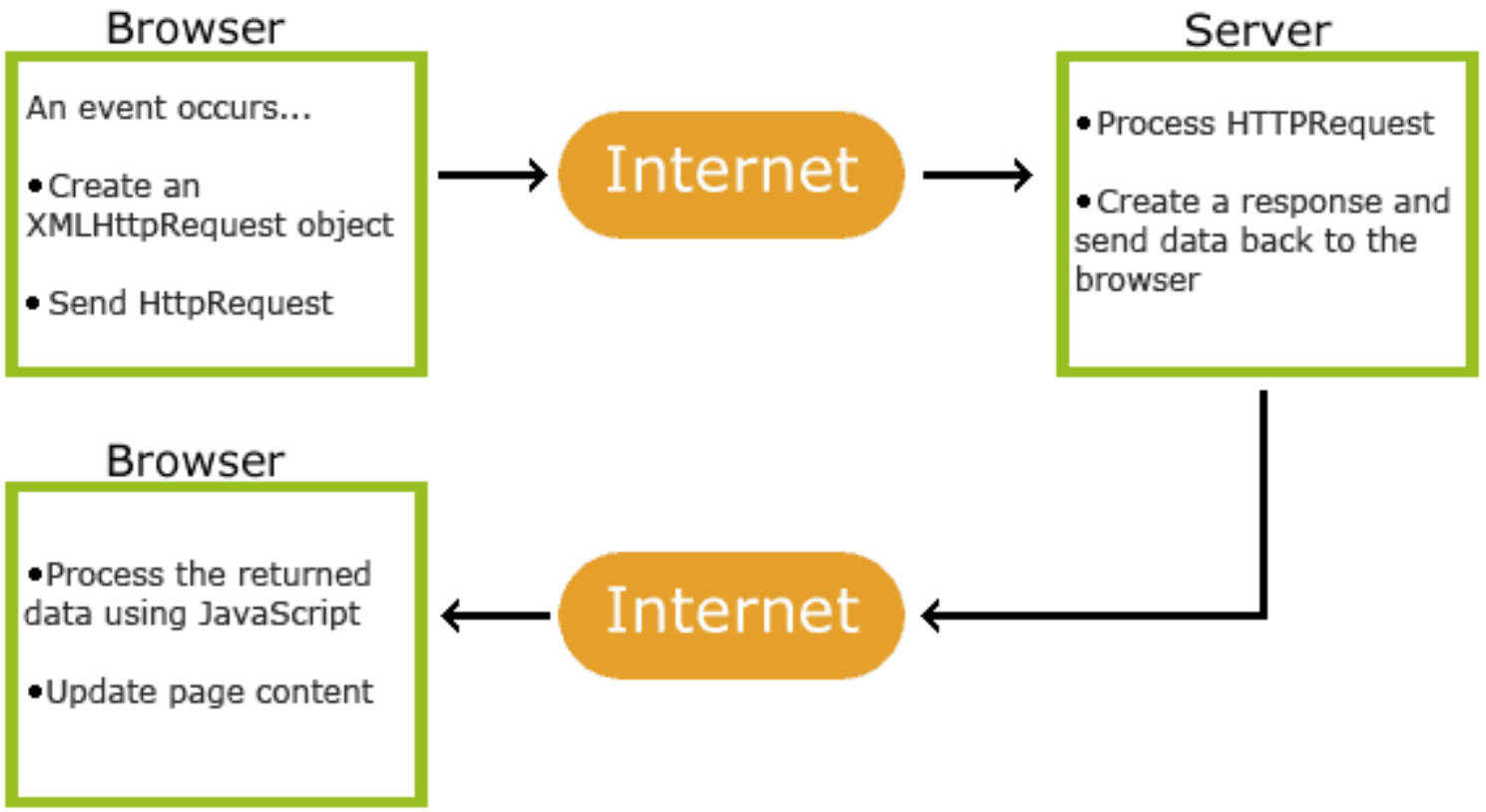
- Google (Gmail, Maps and Suggest)
- Facebook (tabs)
- Youtube

- Source: http://www.w3schools.com/php/php_ajax_intro.asp

The name AJAX (or AJAJ) is a bit of a misnomer

- Asynchronous JavaScript can be used to retrieve data stored in various formats including:
  - Text
  - Images
  - JSON (in string form)
  - XML
  - ???

How Does AJAX Work (Getting HTML, CSS, JAVASCRIPT, JSON, XML FILES FROM SERVER)?



Source: http://www.w3schools.com/php/php_ajax_intro.asp

The XMLHttpRequest Object

- This is the backbone of AJAX
- The XMLHttpRequest object is used to exchange data with a server behind the scenes. This means that it is possible to update parts of a web page, without reloading the whole page.

Creating an XMLHttpRequest Object

- Syntax for creating an XMLHttpRequest object:

  variable=new XMLHttpRequest();

Key Event for : The **onreadystatechange** Event

- **When a request to a server is sent,**
  we want to perform some actions based on the response.
- **The onreadystatechange event is triggered every time the readyState changes.**
- **The readyState property holds the status of the XMLHttpRequest.**
- **In the onreadystatechange event,**
  we specify what will happen when the server response is ready to be processed.

Source:http://www.w3schools.com/ajax/ajax_xmlhttprequest_onreadystatechange.asp

Three Important Properties of the onreadystatechange event:

When status == 200, and state =4, we have obtained the respose from our initial request

Property	Description
onreadystate change	Stores a function (or the name of a function) to be called automatically each time the readyState property changes
readyState	Holds the status of the XMLHttpRequest. Changes from 0 to 4: 0: request not initialized 1: server connection established 2: request received 3: processing request 4: request finished and response is ready
status	200: "OK" 404: Page not found

Source:http://www.w3schools.com/ajax/ajax_xmlhttprequest_onreadystatechange.asp

Example of AJAX in Action – reading a text file

http://www-users.cs.umn.edu/~challou/simpleAJAXex.html

Note, the example returns a string

- And strings can contain JSON objects / arrays (or an object with an array or …)

Here is another example (returns JSON string)

- http://www-users.cs.umn.edu/~chal0006/JSON/JSONreqex.html

AJAX Adheres to A “Same Origin” Policy

- https://en.wikipedia.org/wiki/Same-origin_policy

You'll use AJAX to get your schedule in HW 5

- Let's revisit what we gave to you for HW 5

- Then, step 1, put in the code to load all the pages we gave you – starting with contacts.html

Next Time

- More on AJAX, Node.js

- Readings – at the beginning of this bunch-o-lecture slides
- I'll update schedule and notify you of the update
- But, lets continue…