DATA ANALYTICS REFERENCE DOCUMENT	
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REVISION HISTORY

Revision	Details of Modification(s)	Reason for modification	Date	By
0	Draft release	Document description here	2019/09/22 10:26	Gerhard van der Linde

52957 - Data Representation

Week 1 - Introduction

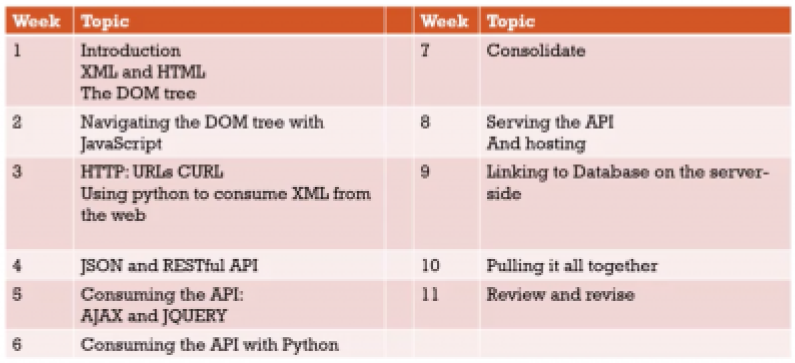
The syllabus has 4 learning outcomes

1. Compare data models and architecture used in applications
2. Write software applications that adhere to common standards and protocols.
3. Explain the basic mechanisms by which application data is transmitted across the internet.
4. Design and Utilise application programming interfaces for interacting with data sources.

Which in practices means:

- XLM and JSON
- How the data is transferred ie HTTP and Restful APIs
- Being able to create a web-application

Indicative Schedule



Week	Topic	Week	Topic
1	Introduction XML and HTML The DOM tree	7	Consolidate
2	Navigating the DOM tree with JavaScript	8	Serving the API And hosting
3	HTTP: URLs CURL Using python to consume XML from the web	9	Linking to Database on the server-side
4	JSON and RESTful API	10	Pulling it all together
5	Consuming the API: AJAX and JQUERY	11	Review and revise
6	Consuming the API with Python		

- 40% - ongoing assessments

- 60% - Project

Week 2 - XML and DOM

xml → eXtensible Markup Language

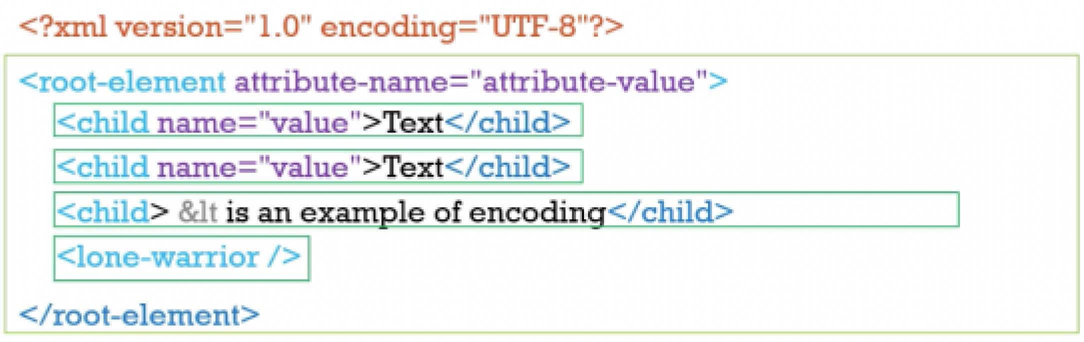
- **Extensible** - Designed to accommodate change
- **Markup** - Annotates text
- **Language** - Set of rules for communication

```xml
<?xml version="1.0" encoding="UTF-8"?>
<book isbn-13="978-0131774292" isbn-10="0131774298">
  <title>Python Programming</title
  <publisher>Prentice Hall</publisher>
  <author>Peter van der Linden</author>
</book>
```

- XML looks like HTML, but it is different.
  - XML was designed to carry/represent data - with focus on what data is
  - XML tags are not predefined like HTML tags are
  - HTML was designed for browser to use to display - It has predefined tags

- XML's purpose is to represent information in text form
- XML does not do anything (either does HTML)
- There are no pre-defined tag names - you make them up yourself
- XML has a tree-like syntax.
- The document Object Model (DOM) can be applied to XML.

```xml
<?xml version="1.0" encoding="UTF-8"?>
<root-element attribute-name="attribute-value">
  <child name="value">Text</child>
  <child name="value">Text</child>
  <child>&lt is an example of encoding</child>
<lone-warrior/>
</root-element>
```


```xml
<?xml version="1.0" encoding="UTF-8"?>
<root-element attribute-name="attribute-value">
  <child name="value">Text</child>
  <child name="value">Text</child>
  <child> &lt is an example of encoding</child>
  <lone-warrior />
</root-element>
```

Declaration	XML documents should have a single line at the start stating that it's xml, the versionof xml it is and an encoding
Root Element	XML must have a single root element that wraps all others
Elements	XML is structured as elements, which are enclosed in angle brackets. Elements must have a closing tag.
Tag	<Tags> indicate the start and the end of each element(end tag indicated with </tagname>)
Attributes	Elements can have attributes, which are name-value pairs within the angle brackets. A given attribute name can only be specified once per element.

Entity References	Certain characters must be escaped with entity references, e.g &lt; for<.
case sensitive	Everything in XML is case sensitive. (HTML is not)
Plain text	Or Data, can be inside the tags

Exercise

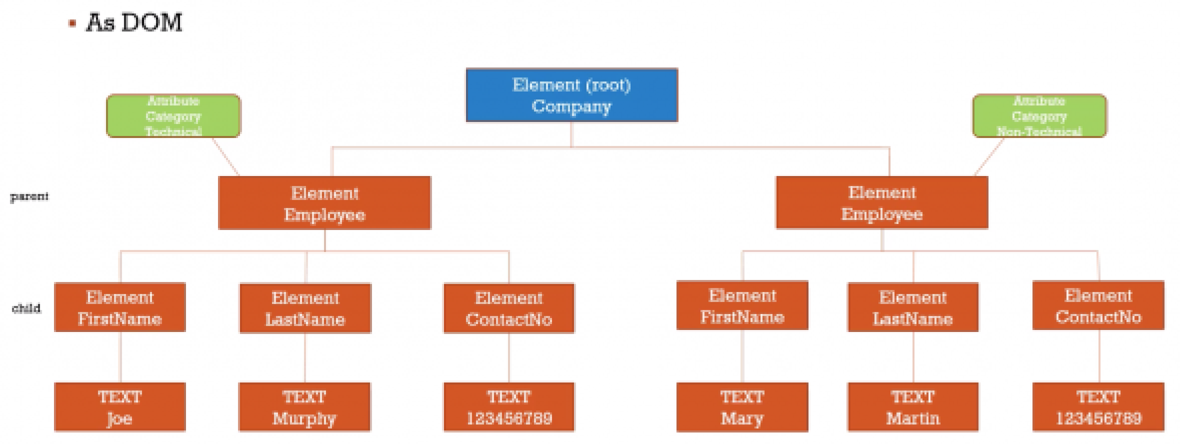
- Create an xml file that stores information for a breakfast menu.
- It should contain food items, and the price, description and calories for each item.

```xml
<?xml version="1.0" encoding="UTF-8"?>
<breakfast_menu>
  <food>
     <name>Belgian waffles</name>
     <price>$5.95</price>
     <description>Two of our famous Belgian Waffles with syrup</description>
     <calories>650</calories>
  </food>
    <food>
     <name>Strawberry Belgian waffles</name>
     <price>$7.95</price>
     <description>Light Belgian waffles covered with strawberries and whipped
cream</description>
     <calories>900</calories>
  </food>
</breakfast_menu>
```

DOM

- The Document Object Model (DOM) is how programs store xml internally
- It provides a model of the XML as a structured group of nodes that have three properties
  1. Type (element, tree, comment, atrribute)
  2. Name(tag name or attribute name)
  3. Value (value of the text node, comment or attribute value)

- Programs can use the DOM to manipulate the XML(or HTML)
- E.g in JavaScript we can use commands like:
  - document.createElement
  - document.createTextNode and
  - document.element.appendChild to add to the DOM
  - document.getElementByID to access elements to the DOM



HTML

- Using W3Schools to learn html
- The page tags `<html>, <head>,<body>`
- The attribute id and class (for later)
- The `<div>` tag
- The table tags `<table>, <tr>, <th>, <td>`
- The form tags `<form>, <input>, <button>, <select>, <option>`

I am not going through how to make pages look nice, that is a whole course in itself. Know that CSS exists and is used to format webpages. The script tag I will go through next week.

Week 3 - JavaScript

Overview

- There is a lot to learN
- You can let some of this spill into next week(there is not so much in next weeks topic)
- The purpose of this week is so that you create a simple client side web-application that can perform CRUD operations on some data
- We will link it later in the course to a server

Files on this topic

- This video
- Lecture on JavaScript in two parts
- The powerpoint file used in the lectures
- A word document with the exercises from the lectures
- The lab as a pdf
- A lab as a pdf
- A link to githup
    - The code I wrote for exercises
    - The code for the lab

JavaScript 1

Overview

- What you will be able to do: Lab
- CSS
    - Hidden, block and inline display
    - Disabled
- JavaScript(W3School)
    - Overview of the language
    - DOM Manipulation
    - Attributes
    - Setting values and innerHTML
        - Theory
        - Exercise
        - Demonstration(Rinse and Repeat)

CSS (Cascading Style Sheets)

- Too much for this course
- Style can de defined:
    1. In another file(with selectors)
    2. In the head(with selectors)
    3. In the element itself
- Make an element visible/hidden

```
<div style="display:block">
text
</div>
```

- Put the keyword disabled in an element to make it disabled

```
<input type="text" value="blah" disable/>
```

Exercise 2.1

Write some html that has a hidden element

```
<html>
  <head>
    <title>2.1</title>
  </head>
  <body>
    <div style="display:none">Hi Mom</div>
    <div style="display:block">div1</div>
    <div style="display:block">div2</div>
    <div style="display:inline">div3</div>
  </body>

</html>
```

JavaScript

- Inside `<script></script>` tags

```
<script>
console.log("hello world")
</script>
```

- bLOCKS HAVE {} (not indents like in python)

```
<script>
function sayHelloAgain(){
  console.log("helloagain")
  }
  sayHelloAgain()

</script>
```

Exercise: Print out Hello World

```
<html>
  <head>
    <title>e2.2</title>
  </head>
  <body>
    hello
    <script>
    console.log("Hello world")

    function sayhelloagain(message){
       console.log("Hello" + message);
    }
    sayhelloagain("Andrew")
    </script>
  </body>

</html>
```

JavaScript To/FROM HTML

- Onclick attribute

```
<button onclick="myFunction('hello')">click me</button>
```

- Document getElementById

```
<div id="messageOut"></div>
```

```
document.getElementById("messageOut").innerText = message
```

Exercise 2.3

Make a webpage with an input and a button, when the user clicks the button then the contents of the input will display in another div.

```
<html>
  <head>
    <title>e2.2</title>
  </head>
  <body>
    <input id="name" type="text" />
    <br/>
    <button onclick="buttonClicked()">Click me</button>
    <br/>
    <div id="output">output will go here</div>
    <script>
    function buttonClicked(){
        var output =document.getElementById('name').value
        document.getElementById('output').innerText = output
    }

    </script>
  </body>

</html>
```

JavaScript 2

Variables

- Define a variable with the var keyword, eg var age =21
- Variable types are defined by the value, they can be
    - Integre
    - Float

  - String
  - Boolean
  - Null
  - Undefined
  - Object
  - Array
  - function

```
var i = 12
var fl = 3.3
var firstName = "andrew"
var lastName = "O'Neill" //or 'O\'Neill'
var admin = true
var foo = null
var dunno //= undefined
var car = {}
var books = []
var fun = function(){console.log('in fun')}
```

Objects

- Properties can be added to objects

```
car.reg = '12 mo 1234'
car.make = "ford"
```

- Or defined using JSON

```
var employee = { name:'joe', role:"Manager"}
```

- Use JSON.stringfy() to output

```
console.log("car" +JSON.stringify(car))
```

Exercise 2.4

Create a book object as a variable with Title, author and ISBN and display it in the console

```
<html>
  <head>
    <title>2.4</title>
  </head>
  <body>

    <script>
var book = {}
book.title= "Harry Potter"
book.author = "JK"
book.isbn="1234"
console.log("book is "+ JSON.stringify(book))


    </script>
  </body>

</html>
```

Manipulate Display

- We can make am element visible and hidden

```
document.getElementById("div1").style.display = "block"
document.getElementById("div2").style.display = "none"
```

- or we can disable a button

```
document.getElementById("button1").disabled = true
```

Exercise 2.5:

Make a webpage that has two div, only one should be visible at a time, each <div> will have a button that will make the other <div> visible (and hide itself)

```
<html>
  <head>
    <title>2.4</title>
  </head>
  <body>
<div id="div1" style="background-color:royalblue">
<br/>
some text
<br/>
<button onclick="showDiv2()">Show Div2</button>
</div>
<div id="div2" style="background-color:red;display:none">
<br/>
some text
<br/>
<button onclick="showDiv1()">Show Div2</button>
</div>

    <script>
function showDiv2(){
    document.getElementById("div1").style.display = "none";
    document.getElementById("div2").style.display = "block";
}

function showDiv1(){
    document.getElementById("div2").style.display = "none";
    document.getElementById("div1").style.display = "block";
}

    </script>
  </body>

</html>
```

Control

if statement

```
    if(condition){
         do stuff
      }else {
      do other stuff
      }
```

```
if(value < 10){
   outputElement.innerText = "too low"
   }else if(value >20){
   }else{
     outputElement.innerText ="goo enough"
   }
```

Exercise 2.6:

Make a web page that has a text box, when the content of the text area changes the page will display whether the value entered is greater or less than 10 or equal to 10

```
<body>
        <input type="number" onchange="checkNumber(this)"/>
        <br/>
        <div id="output">
            output here
        </div>
        <script>
            function checkNumber(inputElement){
                var value = inputElement.value
                if( value <10){
                    document.getElementById("output").innerText = "too low"
                }else if (value > 10){
                    document.getElementById("output").innerText = "too high"
                }else{
                    document.getElementById("output").innerText = "just right"
                }
▯            }
        </script>
    </body>
```

For loop

- Simple count

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

- Iterate an array

```
var names=['Joe', 'Mary', 'Fred']
```

- Iterate an object

```
var book ={title:'harry Potter and something',author:'JKR', isbn:"12345"}

for(propName in book){
   bookoutput += propName+'='+book[propName]+'<br/>'
}
```

Exercise 2.7:

- Make a webpage that outputs 1 to 10(or N)

```
<!DOCTYPE HTML>
<html>
  <head>
    <title>e2.7</title>
  </head>
<body>

<script>
    for(var i=0;i<10;i++){
        console.log(i)
    }
</script>
</body>
</html>
```

- Make a webpage that outputs all the values of an array

```
<!DOCTYPE HTML>
<html>
  <head>
    <title>e2.8</title>
  </head>
<body>
    <div id="output">
        output  here
    </div>

<script>
    for(var i=0;i<10;i++){
        console.log(i)
    }
    var names=['Joe', 'Mary', 'Fred']
var output = ""
    for(name of names){
        output += name + '<br//>'
    }
document.getElementById("output").innerHTML = output
</script>
</body>
</html>
```

DOM

- Get Element By id, we have seen this already
- QuerySelector: The querySelector function searches all the child nodes of a particular element for nodes that match the query, and returns the first one (it is like CSS selectors and JQuery selectors, see later).
  - Name name of tag
  - #id a node with id="id"
  - .classname A node with class="classname"
  - [atName="atVal"] A node with the attribute atName="atValue"
- More data at https://www.w3schools.com/cssref/css_selectors.asp

Exercise 2.8:

Create a webpage with multiple inputs and a button, when the user hits the button read all the inputs, store the values into a class and output the class to the console

```
<body>
        <div id="myForm">
            First name: <input type="text" name='firstName'/><br/>
            Last name: <input type="text" name='lastName'/><br/>
            age: <input type="text" name='age'/><br/>
            <button onclick="doForm()">go</button>
        </div>
         <script>
         function doForm(){
             var employee ={}
             var form = document.getElementById("myForm")
             employee.firstName = form.querySelector('input[name="firstName"').value
             employee.lastName = form.querySelector('input[name="lastName"').value
             employee.age = form.querySelector('input[name="age"').value
            console.log("form data "+JSON.stringify(employee))
        }

      </script>
  </body>
```

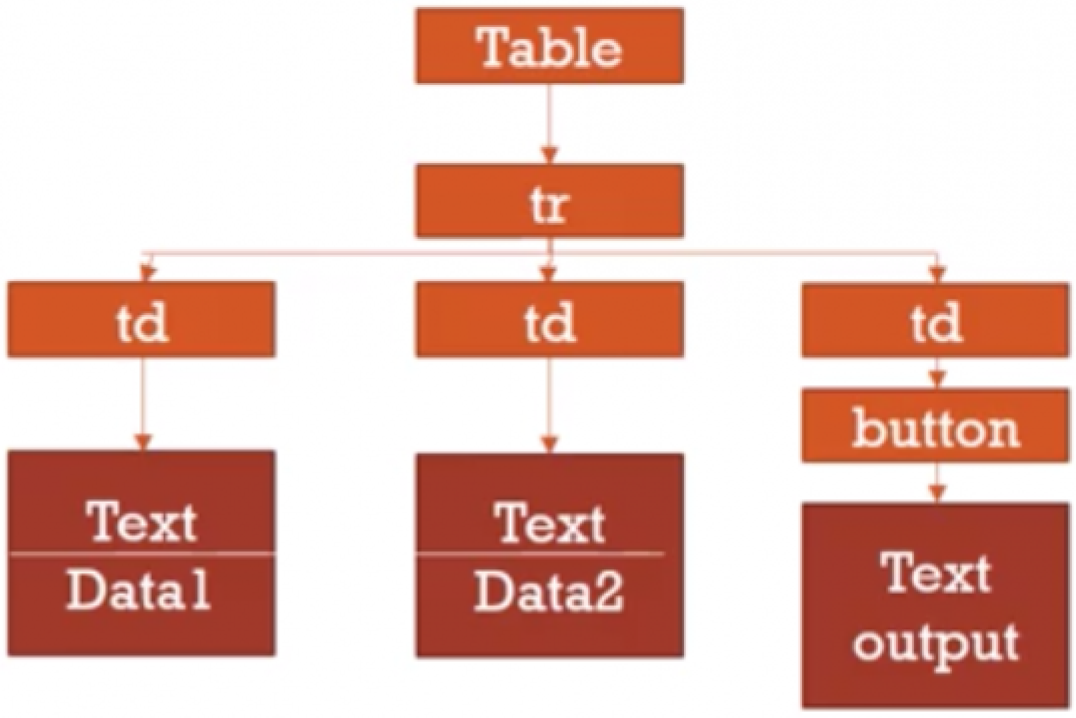
Child Nodes

- Consider

```
<table>
  <tr>
    <td>data1</td>
    <td>data2</td>
    <td><button onclick="doRow(this)">output</button></td>
  </tr>
</table>
```

To get the content of the first cell, you need to get the child of that cell and its text value

```
  rowElement.cells[0].firstChild.textContent
```

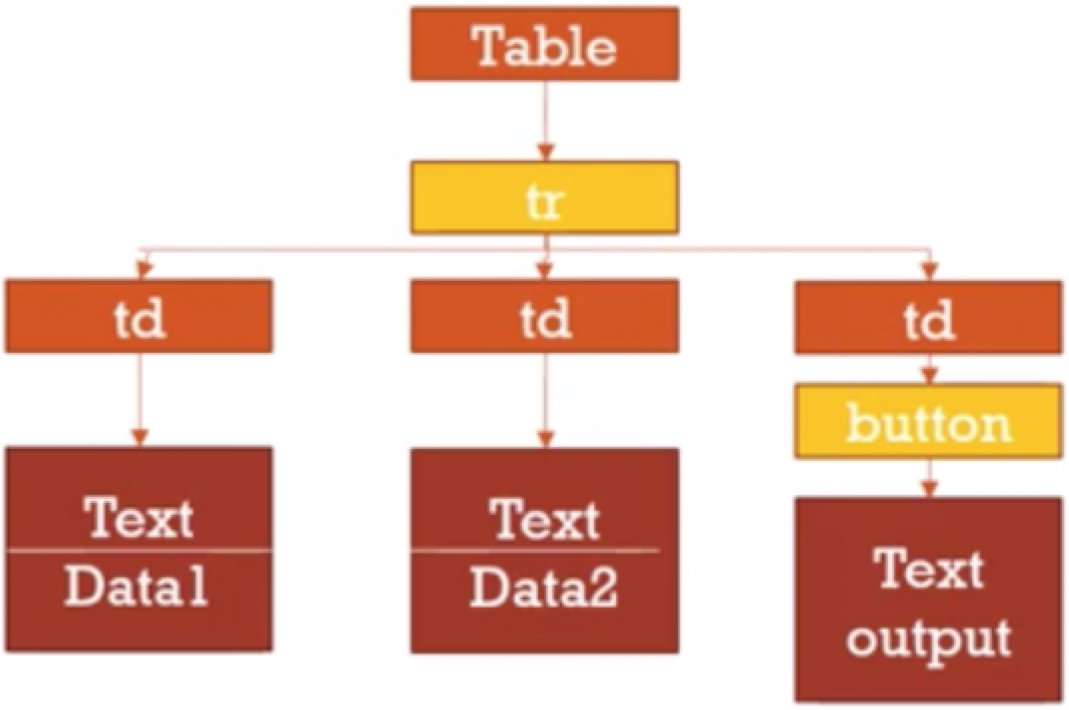


Parent Nodes

- Similarly we can look up the DOM Tree
- Consider the html in the previous slide
- What is the relationship between the row element and the button?
- `<td>` is the parent and `<tr>` is the `<td>`

so we can access the `<tr>` by:

```
var rowElement = buttonElement.parentNode.parentNode
//or
Var rowElement = buttonElement.closest('tr')
```



Exercise 2.9

Write the code so that when the user clicks on the button in a row, the contents of the cells in that row are stored in an object and outputted to the console.

```
<body>
        <table>
            <tr>
                <td>how now</td>
                <td>brown cow</td>
                <td><button onclick="doRow(this)">output</button></td>
            </tr>
        </table>

        <script>
            function doRow(buttonElement){
                var rowElement = buttonElement.parentNode.parentNode
                var data={}
                data.cell1 = rowElement.cells[0].firstChild.textContent;
                data.cell2 = rowElement.cells[1].firstChild.textContent;
                 console.log(JSON.stringify(data))

            }

        </script>
    </body>
```

Add to DOM Tree

- Add element

```
var para = document.createElement("p");
var node = document.createTextNode("This is new");
para.appendChild(node);
```

- Add row

```
var rowElement =table.Element.insertRow(-1)
```

- Add cell

```
var cell = rowElement.insertCell(0);
```

- Add attribute

```
rowElement.setAttribute("id", car.reg)
```

Exercise 2.9.2

Create a button that when it is clicked adds a row to the table(above) with data

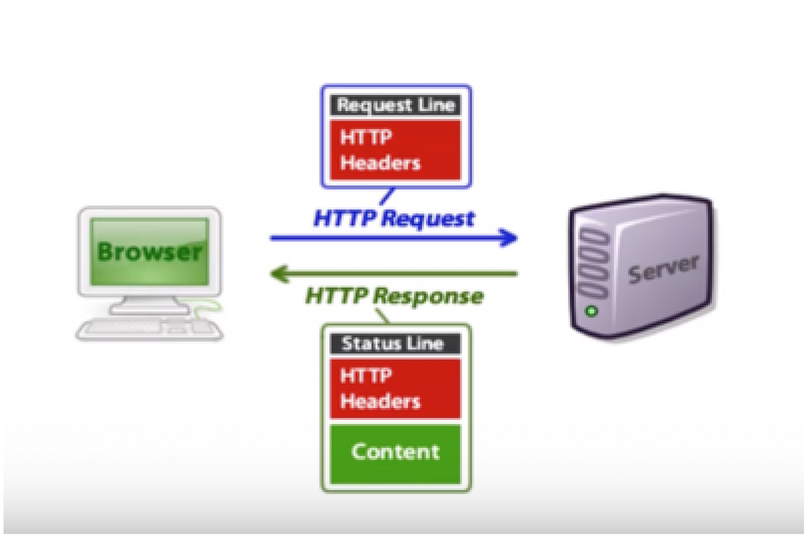
```
function createRow(){
            var tableElement = document.getElementById('mainTable')
            var data = {cell1:'hi',cell2:'bye',cell3:'thanks for the fish'}
            var rowElement = tableElement.insertRow(-1)
            var cellElement = rowElement.insertCell(0)
            cellElement.innerHTML = data.cell1;
            cellElement = rowElement.insertCell(1)
            cellElement.innerHTML = data.cell2;
            cellElement = rowElement.insertCell(2)
            cellElement.innerHTML = data.cell3;

        }
```

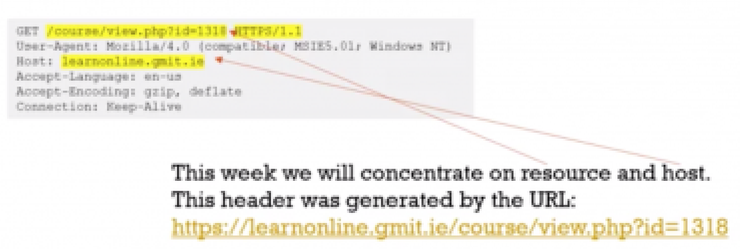
Week 4 - HTTP and Web Scraping

What is HTTP?

- HTTP: HyperText Transfer Protocol
  - HyperText Text with Links
  - Transfer communication of data
  - Protocol set of rules for communication
- HTTP Versions
  - HTTP/1.0 first version -
  - HTTP/1.1 -
  - HTTP/2.0 use is growing (current version)
- Browsers use HTTP

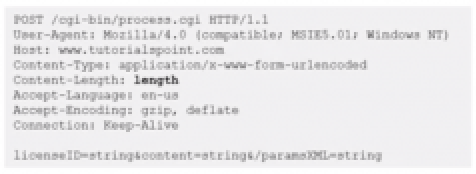


HTTP Request



```
GET /course/view.php?id=1318 HTTPS/1.1
User-Agent: Mozilla/4.0 (compatible; MSIE5.01; Windows NT)
Host: learnonline.gmit.ie
Accept-Language: en-us
Accept-Encoding: gzip, deflate
Connection: Keep-Alive
```

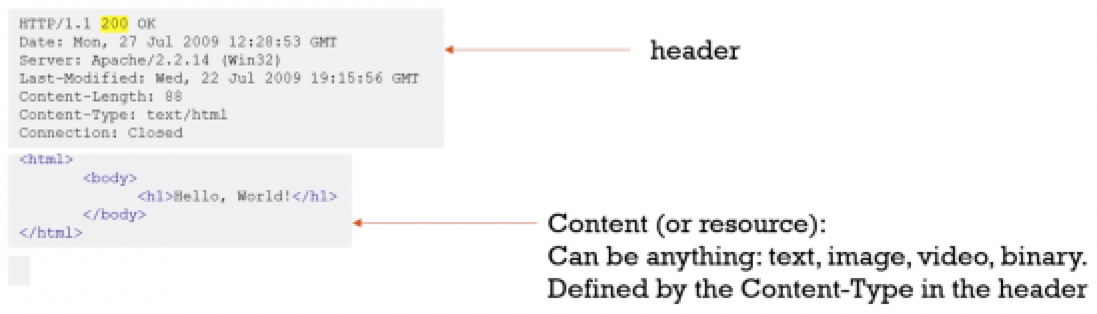
This week we will concentrate on resource and host.
This header was generated by the URL:
https://learnonline.gmit.ie/course/view.php?id=1318



```
POST /cgi-bin/process.cgi HTTP/1.1
User-Agent: Mozilla/4.0 (compatible; MSIE5.01; Windows NT)
Host: www.tutorialspoint.com
Content-Type: application/x-www-form-urlencoded
Content-Length: length
Accept-Language: en-us
Accept-Encoding: gzip, deflate
Connection: Keep-Alive

licenseID=string&content=string&/paramsXML=string
```

HTTP Response



```
HTTP/1.1 200 OK
Date: Mon, 27 Jul 2009 12:28:53 GMT
Server: Apache/2.2.14 (Win32)
Last-Modified: Wed, 22 Jul 2009 19:15:56 GMT
Content-Length: 88
Content-Type: text/html
Connection: Closed
```

header

```
<html>
        <body>
            <h1>Hello, World!</h1>
        </body>
</html>
```

Content (or resource):
Can be anything: text, image, video, binary.
Defined by the Content-Type in the header

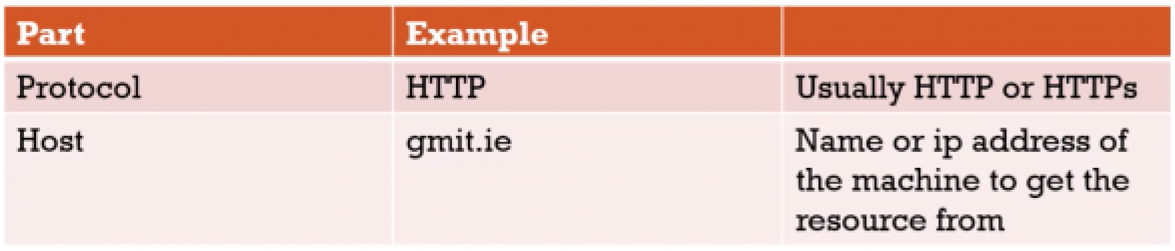
URL: Universal Resource Locator

- Resources can be anything: text, images, pages, files or videos.

- You see URLs at the top of browsers
- E,g http://gmit.ie
- ftp://ftp.domain.com

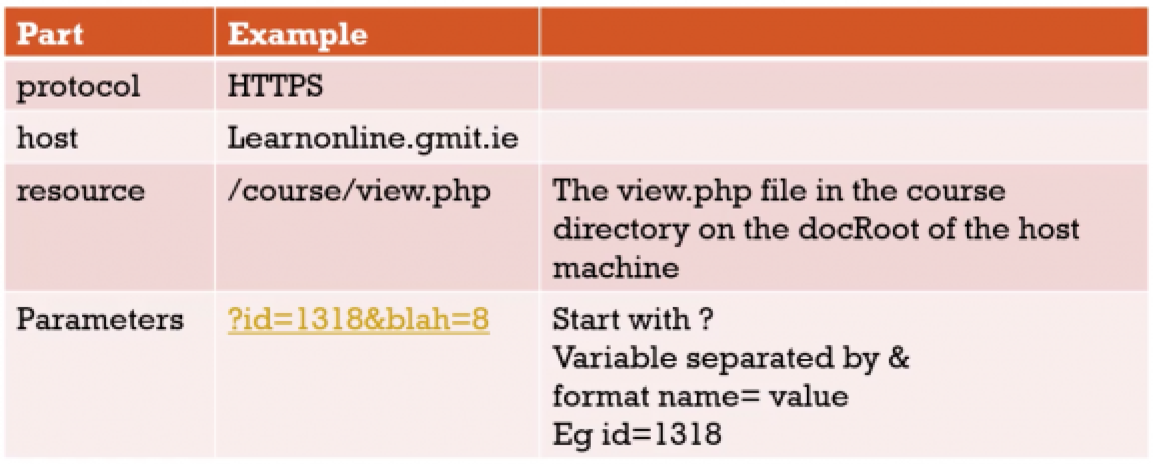
Parts of URL

http://gmit.ie



Part	Example	
Protocol	HTTP	Usually HTTP or HTTPs
Host	gmit.ie	Name or ip address of the machine to get the resource from

http://learnonline.gmit.ie/course/view.php?id=1318&blah=8



Part	Example	
protocol	HTTPS	
host	Learnonline.gmit.ie	
resource	/course/view.php	The view.php file in the course directory on the docRoot of the host machine
Parameters	?id=1318&blah=8	Start with ? Variable separated by & format name= value Eg id=1318

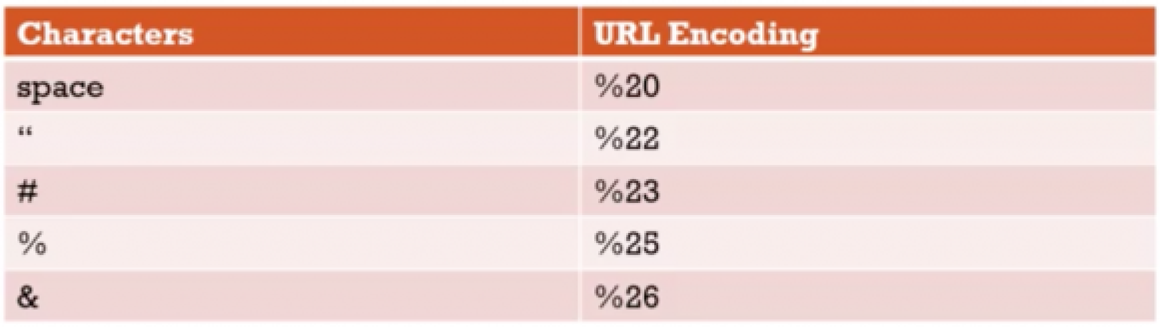
Encoding

- Special Characters need to be encoded (eg space ?:/& etc)
- Incorrect

http://ps.com/martin Kenirons

- Correct

http://ps.com/martin%20Kenirons



Characters	URL Encoding
space	%20
“	%22
#	%23
%	%25
&	%26

Further Reading

- A more detailed look at http

http://www.jmarshall.com/easy/http/

- Interview with Tim Berners Less (inventor of the Web)

http://www.youtube.com/watch?v=TkOpzbTsDJE

Web Scraping Part 1

This lecture

1. Reading web pages with Request
2. Reading last weeks html file
3. Using BeautifulSoup4 to go through the html
4. Searching down (and up) the DOM file
5. Saving Content in a csv file
6. The dark art of web scraping

Request Module

Request module

```
import requests
page = requests.get("http://dataquestio.github.io/web-scraping-pages/simple.html")
print(page)
print("------------")
print(page.content)
```

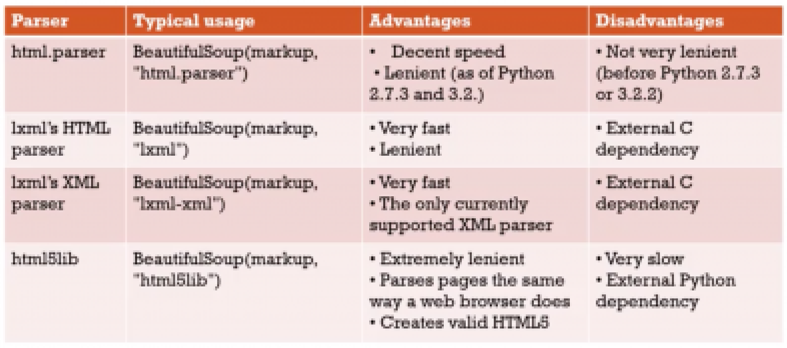
Use BeautifulSoup to prettify

```
import requests
from bs4 import BeautifulSoup

page = requests.get("http://dataquestio.github.io/web-scraping-pages/simple.html")
```

```
print(page)
print("------------")
print(page.content)
soup1 = BeautifulSoup(page.content, 'html.parser')
print(soup1.prettify())
```

Parsers



Parser	Typical usage	Advantages	Disadvantages
html.parser	BeautifulSoup(markup, "html.parser")	• Decent speed • Lenient (as of Python 2.7.3 and 3.2.)	• Not very lenient (before Python 2.7.3 or 3.2.2)
lxml's HTML parser	BeautifulSoup(markup, "lxml")	• Very fast • Lenient	• External C dependency
lxml's XML parser	BeautifulSoup(markup, "lxml-xml")	• Very fast • The only currently supported XML parser	• External C dependency
html5lib	BeautifulSoup(markup, "html5lib")	• Extremely lenient • Parses pages the same way a web browser does • Creates valid HTML5	• Very slow • External Python dependency

Read in from a file

- I assume that you have covered reading from files before.
- This just opens a file and sends its contents to BeautifulSoup
- BeautifulSoup parses the file and stores a DOM tree in memory

```
from bs4 import BeautifulSoup

with open("../week02/carview2.html") as fp:
    soup = BeautifulSoup(fp, 'html.parser')

print(soup.prettify())
```

To search the DOM Tree

- For any element .tagname will find the first occurance of it
- You can use find() this will allow you to find the first element by id and/or class

```
aElement = someElement.find(id="someID")
```

```
aElement = someElement.find(class="aClass")
```

```
aElement = someElement.find(div, class="aClass")
```

- You can use findAll to return a list of elements that match the search criteria

```
listOfElement = someElement.findAll(tr, class="aClass")
```

Navigate the DOM tree

- .children

- .parent
- .parents(a list of parents)

```
from bs4 import BeautifulSoup

with open("lab02-JS/carviewer2.html") as fp:
   soup = BeautifulSoup(fp, 'html.parser')


print(soup.tr)
```

```
from bs4 import BeautifulSoup

with open("lab02-JS/carviewer2.html") as fp:
   soup = BeautifulSoup(fp, 'html.parser')

rows = soup.findAll("tr")
for row in rows:
    print(row)
```

```
from bs4 import BeautifulSoup

with open("lab02-JS/carviewer2.html") as fp:
   soup = BeautifulSoup(fp, 'html.parser')

#print(soup.prettify())
#print(soup.tr)
rows = soup.findAll("tr")
for row in rows:
    #print(row)
    datalist = []
    cols = row.findAll("td")
    for col in cols:
        datalist.append(col.text)
    print(datalist)
```

Using CSV Package

- Write to a csv(comma delimiter file)
- You can read a csv with Excel
- We could create an excel file in python, maybe later

```
import csv

employee_file = open('employee_file.csv', mode='w')
employee_writer = csv.writer(employee_file, delimiter=',', quotechar='"',
quoting=csv.QUOTE_MINIMAL)

employee_writer.writerow(['John Smith', 'Accounting', 'November'])
employee_writer.writerow(['Erica Meyers, what', 'IT', 'March'])

employee_file.close()
```

Web Sraping part 2

Finding what you want from a web page

- This is a dark art
- Web pages are not designed to be read like this
- If a webapplication wants you to be able to extract data they use JSON (they used to use XML in RSS feeds).
- Case Study: Get the price and address from myhome.ie
    1. We will need the URL
    2. Don't use inspect because a lot of webpages use javascript to modify themselves, we need to use viewsource or curl
    3. This is a dark art (yep I am saying it again)
    4. ID and class are what you are looking for, possibly tag

HTTP and URL's

https://learnonline.gmit.ie/course/view.php?id=1318&blah=8

https://andrewbeattycourseware:pass@github.com/andrewbeattycourseware/dataRepresentation.git

You can also have a username:password pair before a @ if you need to log into the host There are other authentication methods (EG Oauth)

web_scraping.py

```python
import requests
import csv
from bs4 import BeautifulSoup
url = "https://www.myhome.ie/residential/mayo/property-for-sale?page=1"
# load the page from the above url in the object page.
page = requests.get(url)
#parse only the html from page.content
soup = BeautifulSoup(page.content, 'html.parser')
#open a file and csv writer objects
home_file = open('week03MyHome.csv', mode='w', newline='\n', encoding='UTF-8')
home_writer = csv.writer(home_file, delimiter=',', quotechar='"',
quoting=csv.QUOTE_MINIMAL)
#parse the listings from soup using the class label
listings = soup.findAll("div", class_="PropertyListingCard" )
#loop trhough the listings
for listing in listings:
    #create an empty list for writing out to csv
    entryList = []
    #parse and append price to listing
    price = listing.find(class_="PropertyListingCard__Price").text.strip()
    entryList.append(price)
    #parse and append address to listing
    address = listing.find(class_="PropertyListingCard__Address").text.strip()
    entryList.append(address)
    #write parsed data to the csv file
    home_writer.writerow(entryList)
#close the file
home_file.close()
```

Note: Note the specification for 'UTF-8' encoding and `strip()` commands to clean the parsed data and specify the newline characters

```
"€625,000","Curraghmore, Belcarra, Castlebar, Co Mayo"
"Reserve Not To Exceed €80,000","April Cottage (Folio MY51001F), Balloughadalla, Killala, Co.
Mayo"
"AMV €30,000","C. 4.09 Acres of Land, Dooagh, Achill, Mayo"
"€140,000","15 Riverside Drive, Ballina, Mayo"
"Reserve Not To Exceed €110,000","Riverbank House, Bachelors Walk, Abbeyhalfquarter, Ballina,
Co. Mayo"
"€115,000","Croghan, Killala, Mayo"
"€195,000","Carrowbaun, Westport, Co Mayo, F28K298"
"€235,000","3 Rosmore, Newport, Co Mayo, F28 VF38"
"AMV €245,000  -€30,000 on 5th Oct 19","ONLINE AUCTION Camcloon More, Newport, Mayo"
"€250,000","Roonith, Louisburgh, Mayo"
"€125,000","8 Rathkelly , Ballinrobe, Mayo"
"€179,500","5 Ballyhaunis Road, Knock, Co. Mayo"
"€175,000","1 Cinnamon Wharf, The Quay, Westport, Co Mayo, F28 K6W8"
"Reserve Not To Exceed €15,000","Ballymunnelly (Folio MY14396F), Bellacorick, Co. Mayo"
"Reserve Not To Exceed €130,000","Loughrusheen, Castlebar, Co. Mayo"
"€198,000","13 Church Manor, Ballina, Mayo"
"€110,000","Cappaghduff East, Tourmakeady, Mayo"
"€215,000","12 Rushbrook, Claremorris, Mayo"
"€120,000","Knockfin, Westport, Mayo"
"Reserve Not To Exceed €40,000","5A and 5B, Main Street, Ballyhaunis, Co. Mayo"
"€45,000","Main Street, Ballycastle, Mayo"
```

References

- A very good tutorial, takes it from html and builds to making a python program to read it. Be warned he is using python2 and we are using python3, the main difference is with the print statements.

https://www.dataquest.io/blog/web-scraping-tutorial-python/

- Documentation on BeautifulSoup4

https://buildmedia.readthedocs.org/media/pdf/beautiful-soup-4/latest/beautiful-soup-4.pdf

Week5 - JSON, AJAX and REST

HTTP 2: methods and Response Codes

Request Methods

Method	Description	In RESTful API
GET	Retrieves a Resource(s)	Read
POST	Updates/creates/changes a Resource	Create
PUT	Used more to update a Resourse	Update
DELETE	Remove a resourse	Delete
HEAD	Retrieves header info	
TRACE	Used for Debugging	
OPTIONS	Retrieve allowable options	

Method	Description	In RESTful API
PATCH	Partial resource modification	
CONNECT	Set up a tunnel for other traffic to pass through HTTP	

HTTP Methods GET vs POST

	GET	POST
Security	Parameters are visible to the user and browser History.	POST is a little safer than GET because the parameters are not stored in browser history or in web server logs
	Never use GET when sending passwords or other sensitive information!	
Back Button	harmless	Data will be resubmitted
Bookmarked	Can be bookmarked	Parameters are not bookmarked
Cached	Can be cached	Not cached
Encoding type	application/x-www-form-urlencoded	application/x-www-form-urlencoded or multipart/form-data. Use multipart encoding for binary data
History	Parameters remain in browser history	Parameters are not saved in browser history
Visibility	Data is visible to everyone in the URL	Data is not displayed in the URL
Restrictions on data length	data length	No Restrictions
	Yes, when sending data, the GET method adds the data to the URL; and the length of a URL is limited (maximum URL length is 2048 characters)	
Restrictions on data type	Only ASCII characters allowed	No restrictions. Binary data is also allowed

HTTP Response

Requests and responses both have this format: • Intial line.

- Zero or more header lines.
- A blank line.
- Optional message body (e.g. a HTML file)

```
HTTP/1.1 200 OK
Date: Mon, 27 Jul 2009 12:28:53 GMT
Server: Apache/2.2.14 (Win32)
Last-Modified: Wed, 22 Jul 2009 19:15:56 GMT
Content-Length: 88
Content-Type: text/html
Connection: Closed
```

```
<html>
 <body>
 <h1>Hello, World!</h1>
 </body>
</html>
```

Status codes

Code Range	Status
100 – 199	Informational
200 – 299	Successful
300 – 399	Redirection
400 – 499	Client Error
500 – 599	Server Error

Code	text	description
200	OK	Successful
201	Created	Resource created
204	No Content	The requested resource is empty
400	Bad Request	Bad Syntax
401	Unauthorised	Client might need to be authenticated
403	Forbidden	Operation not allowed
404	Not Found	Resource does not exists
500	Internal Server Error	Something went wrong during processing

More at https://www.restapitutorial.com/httpstatuscodes.html

Summary

- HTTP request have methods
- HTTP responses have status codes
  (These are used in restful APIs)

JSON

- Javascript Object Notation
  - JavaScript - A scripting/programming language.
  - Object - Groups of name-value pairs.
  - Notation - Set of rules for representing objects.
- Human readable.
- Is just text.
- Open standard.
- Data interchange format.

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

```
// Turning text into a JavaScript object.
var obj = JSON.parse(text);
// obj is an object.
// Turning a JavaScript object into text.
var text = JSON.stringify(obj);
// text is a string.
```

Syntax

- Name/Value pairs separated by a colon. “name”: “Martin”
- Objects identified by curly braces. { }
- Lists identified by square brackets. [ ]
- All strings (names if space in it) use double quotes (not single). “Martin”

Examples

```
Numbers   - 123.456
Boolean   - true
Objects   - {"name": "Ian"\}
Functions - function(){//commands}
Strings   - "Hello, world!"
Arrays    - [1,2,3]
null      - null
```

Consider

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

Exercise (not an assignment!):

1. Add two New employees to the above JSON?
2. Extend the JSON to include address?
3. Extend the JSON object to include age?

JSON in the wild

```
{
    "time": {
        "updated": "Oct 16, 2019 15:03:00 UTC",
     },
    "disclaimer": "This data was produced from the CoinDesk Bitcoin Price Index (USD). ",
    "chartName": "Bitcoin",
    "bpi": {
        "USD": {
            "code": "USD",
            "symbol": "&#36;",
            "rate": "7,968.2517",
            "description": "United States Dollar",
            "rate_float": 7968.2517
        },
             "EUR": {
            "code": "EUR",
            "symbol": "&euro;",
            "rate": "7,209.3474",
            "description": "Euro",
            "rate_float": 7209.3474
        }
    }
}
```

Look at: https://api.coindesk.com/v1/bpi/currentprice.json

AJAX (with Jquery)

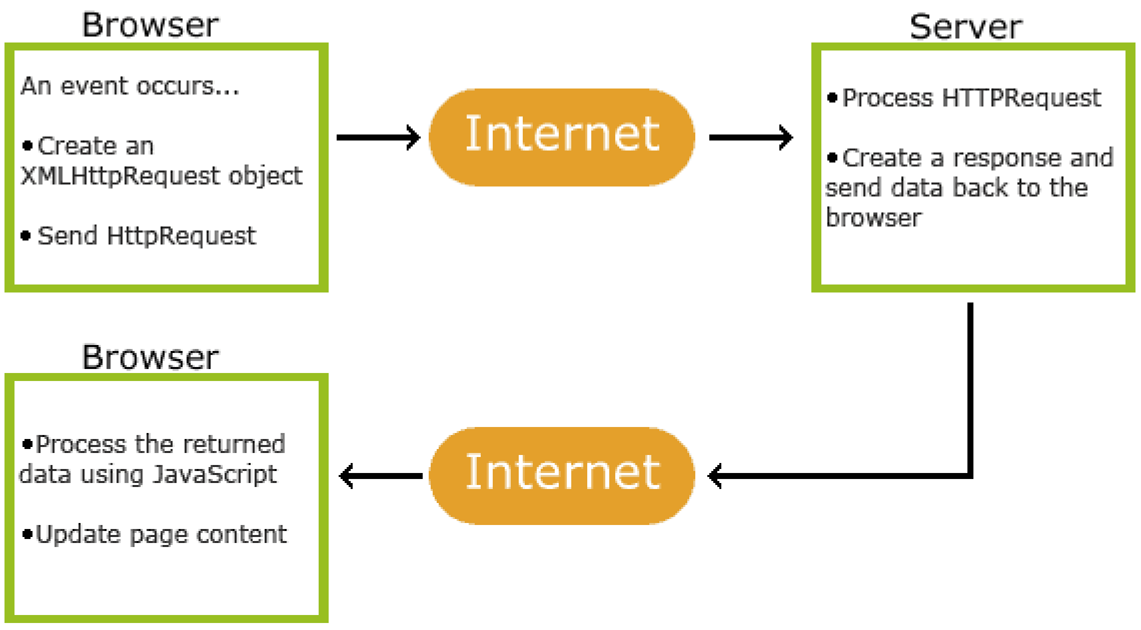
Asynchronous:	Does not block code, the return function gets called when complete
Javascript:	The language
And XML:	Well not much anymore, usually JSON or html is used

More info at https://www.w3schools.com/xml/ajax_intro.asp

We will use AJAX with Jquery not the plain JavaScript version: https://www.w3schools.com/jquery/jquery_ajax_intro.asp

What does AJAX do?

- Allows us to call up a resource with HTTP from inside a web page


Browser
An event occurs...
•Create an XMLHttpRequest object
•Send HttpRequest
Internet
Server
•Process HTTPRequest
•Create a response and send data back to the browser
Browser
•Process the returned data using JavaScript
•Update page content
Internet

JQuery

- We will be using JQuery for AJAX,
- JQuery is a javascript library that make finding and manipulating elements in the HTML DOM tree easier.
- I am not going into detail about JQuery now
- You will need this magic line of code in the header of any page that uses Jquery

```
<head>
  <script src="https://ajax.googleapis.com/ajax/libs/jquery/3.4.1/jquery.min.js"></script>
```

```
</head>
```

$.AJAX function

- We will use the $.AJAX function, ittakesonparameter, aJSONObjectthatdescribeseverything.*''$.ajax({the object that describes everything}); <code js> $.ajax({ "url": "https://api.coindesk.com/v1/bpi/currentprice.json ", "method":"GET", "data":"", "dataType": "JSON", "success":function(result){ console.log(result); }, "error":function(xhr,status,error){ console.log("error: "+status+" msg:"+error); } }) </code> ^ url: |the url to call| ^ method: |the HTTP method| ^ data: |parameters (none in this case)| ^ datatype: |that is returned JSON or HTML or XML| ^ success: |the function to call if this is a success (with the result from server)| ^ error: |The function to call if we don't get a status code in the 200s| ===== Putting the code together ===== <code js> <html> <head> <script src="https://ajax.googleapis.com/ajax/libs/jquery/3.4.1/jquery.min.js"></script> <title> read a simple json </title> </head> <body> <button onclick="readJSON()">go</button> </body> <script> function readJSON(){ $.ajax({ "url": "https://api.coindesk.com/v1/bpi/currentprice.json ", "method":"GET", "data":"", "dataType": "JSON", "success":function(result){ console.log(result); }, "error":function(xhr,status,error){ console.log("error: "+status+" msg:"+error); } }); } </script> </html> </code> ===== Read the euro price from the JSON ===== Looking at the JSON you can see the value we are looking for is in the object: bpi.EUR.rate''

```
{
    "time": {
        "updated": "Oct 16, 2019 15:43:00 UTC",
        "updatedISO": "2019-10-16T15:43:00+00:00",
        "updateduk": "Oct 16, 2019 at 16:43 BST"
    },
    "disclaimer": "This data was produced from the CoinDesk Bitcoin Price Index (USD). Non-
USD currency data converted using hourly conversion rate from openexchangerates.org",
    "chartName": "Bitcoin",
    "bpi": {
        "USD": {
            "code": "USD",
            "symbol": "&#36;",
            "rate": "7,979.8633",
            "description": "United States Dollar",
            "rate_float": 7979.8633
        },
        "EUR": {
            "code": "EUR",
            "symbol": "&euro;",
            "rate": "7,220.6990",
            "description": "Euro",
            "rate_float": 7220.699
        }
    }
}
```

So the code to extract it is:

```
var rate = result.bpi.EUR.rate
```

```
console.log(rate);

//document.getElementById("output").innerText = rate;
```

RESTful API

API

- Application
- Programming
- Interface

I.e. An interface that a program that you write can use to transfer data to another program

SOAP

```
<?xml version="1.0"?>
<soap:Envelope
xmlns:soap="http://www.w3.org/2003/05/soap-envelope/"
soap:encodingStyle="http://www.w3.org/2003/05/soap-encoding">

<soap:Body>
  <m:GetPrice xmlns:m="https://www.w3schools.com/prices">
    <m:Item>Apples</m:Item>
  </m:GetPrice>
</soap:Body>

</soap:Envelope>
```

RESTful

- **REST** stands for **Re**presentational **S**tate **T**ransfer.
- REST is an architecture describing how we might use HTTP.
- RESTful APIs make use of more HTTP methods than just GET and POST.
- Most HTTP APIs are not RESTful.
- RESTful APIs adhere to a few loosely defined constraints.
- Two of those constraints are that the API is stateless and cacheable.
- Idempotency
- More at https://www.restapitutorial.com/

REST Example

Method	URL	Description	Sample return
GET	/emails	Get all the Emails	[{id:32,from:"joe@joe.ie",message:"hi"}, {id:33,from:"me@gmail.ie",message:"i"}, {id:35,from:"a@b.com",message:"blah"}]
POST	/emails	Create an Email	{created:true}
GET	/emails/32	Retrieve the Email with id 32	{id:32,from:"joe@joe.ie",message:"hi"}
PUT	/emails/32	Update the Email with id 32	{id:32,from:"joe@joe.ie",message:"bye"}

Method	URL	Description	Sample return
DELETE	/emails/32	Delete the Email with id 32	{deleted:true}

Stateless

- Statelessness is a REST constraint.
- HTTP uses the client-server model.
- The server should treat each request as a single, independent transaction.
- No client state should be stored on the server.
- Each request must contain all of the information to perform the request.

Cachable

- REST APIs should provide responses that are cacheable.
- Intermediaries between the client and server should be able to cache responses.
- This should be transparent to the client.
- Cacheability increases response time.
- Browsers usually cache resources, in case they are requested again.
- There is usually a time limit on cached resources.

Site that use RESTful APIs

- Facebook, google, stripe, CSO etc
- More at https://any-api.com/
- Python has a lot of packages that handle these APIs (more on week06)

Summary

- REST is a loose set of constraints/guidelines used for making an API
  - Stateless
  - Cacheable
  - Use HTTP methods
- I will be going through this in more detail next week
  - We will create a web page that consumes a RESTful API I have created already for a database (CRUD)

Labs

Lab01-simpleJSON.html

```
<html>
    <head>
        <title>simple json</title>
    </head>
    <script>
        var obj = JSON.parse('{ "isbn": 1234567, "Author": "Gerhard van der Linde","Title" :
"the rain in spane falls mailey on the plane"}')

        console.log(obj.Title)

    </script>
</html>
```

Lab02-json-array.html

```
<html>
    <head>
        <title>lab02</title>
    </head>
    <body>
        <button onclick="displayJSON()">go</button>
    </body>
    <script>
        function displayJSON(){
            var obj = JSON.parse('{"employees": [{"firstName": "John", "lastName": "Doe"},{
"firstName": "Anna","lastName": "Smith"},{"firstName": "Peter","lastName": "Jones"}]}');
            //for (employee of obj.employees){
            //    console.log(employee.firstName)
            //}
            //var employees=obj.employees;
            obj.employees.forEach(employee => {
                console.log(employee.lastName);
            });
        }
    </script>
</html>
```

Lab03-ajax-readsimple.html

```
<html>
    <head>
        <script
src="https://ajax.googleapis.com/ajax/libs/jquery/3.4.1/jquery.min.js"></script>
        <title>
            read a simple json
        </title>
    </head>
    <body>
        <button onclick="readJSON()">go</button>
        <div id="output"></div>
    </body>
    <script>
        function readJSON(){
            $.ajax({
                "url": "https://api.coindesk.com/v1/bpi/currentprice.json ",
                "method":"GET",
                "data":"",
                "dataType": "JSON",
                "success":function(result){
                    console.log(result);
                    var rate = result.bpi.EUR.rate
                    //console.log(rate);
                    document.getElementById("output").innerText = rate;
                },
                "error":function(xhr,status,error){
                    console.log("error: "+status+" msg:"+error);
                }
            });

        }
    </script>
</html>
```

LAB04-extra.html

```
<html>

<head>
    <script src="https://ajax.googleapis.com/ajax/libs/jquery/3.4.1/jquery.min.js"></script>
    <title>
        read etherium
    </title>
</head>

<body>
    <button onclick="readJSON()">go</button>
    <div id="output"></div>
</body>
<script>
    function readJSON() {
        $.ajax({
            "url": "https://min-api.cryptocompare.com/data/price?fsym=ETH&tsyms=BTC,USD,EUR",
            "method": "GET",
            "data": "",
            "dataType": "JSON",
            "success": function (result) {
                console.log(result);
                var rate = result.USD
                //console.log(rate);
                document.getElementById("output").innerText = rate;
            },
            "error": function (xhr, status, error) {
                console.log("error: " + status + " msg:" + error);
            }
        });

    }
</script>

</html>
```

Last update: **2019/10/18 20:26**