

# JQuery, and AJAX

CITS3403 Agile Web Development

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# jQuery



- jQuery is the most popular javascript library in the world.
- It was built by John Resig in 2006, and is available on the MIT license.
- The jQuery library has features for
  - HTML/DOM manipulation
  - CSS manipulation
  - HTML event handling
  - Effects and animations
  - AJAX message handling
  - Some utilities
- jQuery, like Bootstrap, is most commonly accessed through a CDN:

```
<script>
$(document).ready(function(){
  $("#btn1").click(function(){
    $("#test1").text("Hello world!");
  });
  $("#btn2").click(function(){
    $("#test2").html("<b>Hello world!</b>");
  });
  $("#btn3").click(function(){
    $("#test3").val("Dolly Duck");
  });
});
```

```
<head>
<script src="https://ajax.googleapis.com/ajax/libs/jquery/3.3.1/jquery.min.js"></script>
</head>
```

# jQuery Syntax

- Basic jQuery syntax is  $\$(selector).action()$ , where:
  - $\$$  is an abbreviation for jQuery. It can be changed using  $\$.noConflict()$
  - *selector* is a query to find HTML elements, much like in CSS
  - *action* is a jQuery function to be applied to the selected elements.

```
<script>
$(document).ready(function(){
  $("button").click(function(){
    $(".test").hide();
  });
});
</script>
</head>
<body>

<h2 class="test">This is a heading</h2>

<p class="test">This is a paragraph.</p>
<p>This is another paragraph.</p>

<button>Click me</button>
```

## This is a heading

This is a paragraph.

This is another paragraph.

Click me

Syntax	Description
$\$("*)$	Selects all elements
$\$(this)$	Selects the current HTML element
$\$("p.intro")$	Selects all <code>&lt;p&gt;</code> elements with class="intro"
$\$("p:first")$	Selects the first <code>&lt;p&gt;</code> element
$\$("ul li:first")$	Selects the first <code>&lt;li&gt;</code> element of the first <code>&lt;ul&gt;</code>
$\$("ul li:first-child")$	Selects the first <code>&lt;li&gt;</code> element of every <code>&lt;ul&gt;</code>
$\$("a[href]")$	Selects all elements with an href attribute
$\$("a[target='_blank']")$	Selects all <code>&lt;a&gt;</code> elements with a target attribute value equal to <code>"_blank"</code>
$\$("a[target!='_blank']")$	Selects all <code>&lt;a&gt;</code> elements with a target attribute value NOT equal to <code>"_blank"</code>
$\$("button")$	Selects all <code>&lt;button&gt;</code> elements and <code>&lt;input&gt;</code> elements of type="button"
$\$("tr:even")$	Selects all even <code>&lt;tr&gt;</code> elements
$\$("tr:odd")$	Selects all odd <code>&lt;tr&gt;</code> elements

# jQuery Events

- jQuery event notation assigns a javascript function to DOM events.
- For example to assign a click event to all paragraphs, we would use:
- `$( "p" ).click( function () { //code } );`
- jQuery events also include `$( document ).ready ()` to force jQuery to wait until the document is fully loaded.
- The `on()` method allows multiple events to be assigned to a given selector.

```
$( "p" ).on({  
  mouseenter: function () {  
    $( this ).css ( "background-color", "lightgray" );  
  },  
  mouseleave: function () {  
    $( this ).css ( "background-color", "lightblue" );  
  },  
  click: function () {  
    $( this ).css ( "background-color", "yellow" );  
  }  
});
```

Mouse Events	Keyboard Events	Form Events	Document/Window Events
click	keypress	submit	load
dblclick	keydown	change	resize
mouseenter	keyup	focus	scroll
mouseleave		blur	unload

# jQuery Effects

- jQuery implements some useful effects, including hide, show, fade, slide and animate.

```
<script>
$(document).ready(function(){
  $("#flip").click(function(){
    $("#panel").slideDown("slow");
  });
});
</script>
```

```
<style>
#panel, #flip {
  padding: 5px;
  text-align: center;
  background-color: #e5eccc;
  border: solid 1px #c3c3c3;
}
#panel {
  padding: 50px;
  display: none;
}
</style>
</head>
<body>
```

```
<div id="flip">Click to slide down panel</div>
<div id="panel">Hello world!</div>
```

Click to slide down panel

Click to slide down panel

Hello world!

These methods work by changing the display attribute of an element.

# jQuery DOM

- jQuery can select elements and classes in the DOM, traverse the DOM, get and set elements and attributes of the DOM, and add or remove elements.
- You can get the text, raw html, or value of a field with the methods `text()`, `html()` and `val()`.
- You can access the attributes of an element with the method `attr(label)`
- You can modify elements with `text(newText)`, `html(newHTML)` and `val(newVal)`
- You can modify the attributes of an element with the method `attr(label, new value)`
- You can append, prepend, insert before and after with the functions `append`, `prepend` before and `after`.

```
function afterText() {  
    var txt1 = "<b>I </b>";           // Create element with HTML  
    var txt2 = $("<i></i>").text("love "); // Create with jQuery  
    var txt3 = document.createElement("b"); // Create with DOM  
    txt3.innerHTML = "jQuery!";  
    $("img").after(txt1, txt2, txt3); // Insert new elements after <img>  
}
```

# jQuery Filters

- Using selectors, ids, names, and the DOM structure you can selector a number of elements.

```
<script src="https://ajax.googleapis.com/ajax/libs/jquery/3.3.1/jquery.min.js"></script>
<script>
$(document).ready(function(){
  $("#first").parent().find("span").css({"color": "red",
"border": "2px solid red"});
});
</script>
</head>
<body>

<div class="descendants" style="width:500px;">div (current
element)
  <p id="first">p (child)
    <span>span (grandchild)</span>
  </p>
  <p>p (child)
    <span>span (grandchild)</span>
  </p>
</div>
```



- jQuery can also filter results, tables, lists and paragraphs:

```
<script>
$(document).ready(function(){
  $("#myInput").on("keyup", function() {
    var value = $(this).val().toLowerCase();
    $("#myList li").filter(function() {
      $(this).toggle($(this).text().toLowerCase().indexOf(value) > -1)
    });
  });
});
</script>
</head>
<body>

<h2>Filterable List</h2>
<p>Type something in the input field to search the list for specific
items:</p>
<input id="myInput" type="text" placeholder="Search..">
<br>
```

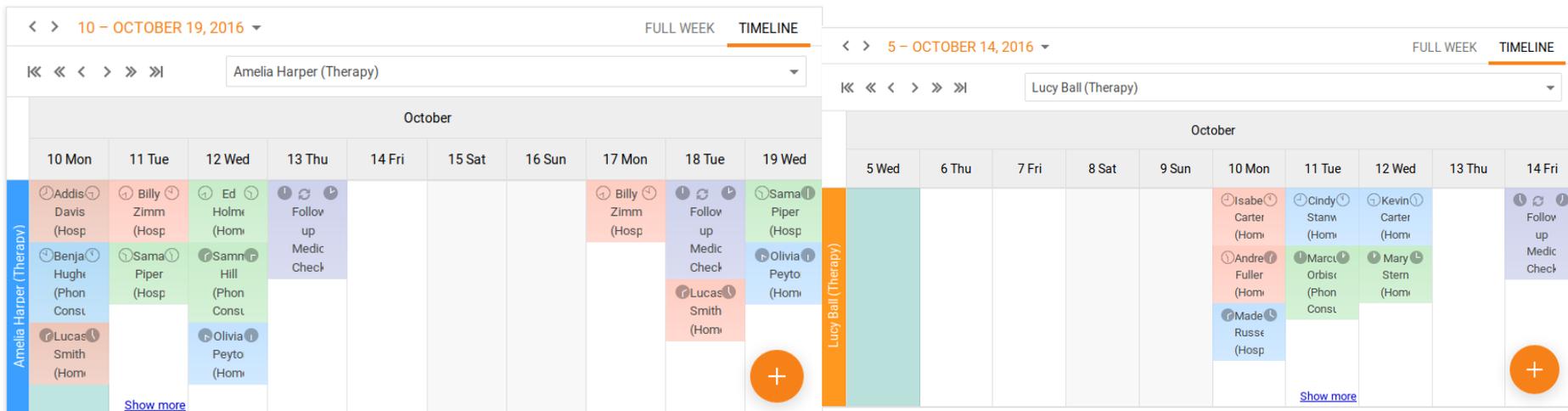
## Filterable List

Type something in the input field to search the list for specific items:

- First item
- Second item
- Third item
- Fourth

# Message Passing in Javascript

- So far the javascript we have seen responds to local events in the browser, such as users clicking buttons, pages loading, mouse movements etc.
- However, we often want to respond to remote events, such as someone sending you a message, liking a post etc.
- We also may want to dynamically respond to a local event using global information: if a user enters the 1<sup>st</sup> of April as a preferred appointment date, then we would like to immediately show them the available appointments.
- We could send the date to the server, have the server rebuild the page and send the entire page back, but we only required a few bytes of data.



The image displays two screenshots of a medical appointment calendar interface. The left screenshot shows a calendar for Amelia Harper (Therapy) for the week of October 10-19, 2016. The right screenshot shows a calendar for Lucy Ball (Therapy) for the week of October 5-14, 2016. Both calendars show various appointments with names and roles, and a 'Show more' link at the bottom of each calendar view.

Calendar	Date	Appointment	Role
Amelia Harper (Therapy)	10 Mon	Addis Davis	(Hosp)
	10 Mon	Benja Hugh	(Phon Cons)
	10 Mon	Lucas Smith	(Homi)
	11 Tue	Billy Zimm	(Hosp)
	11 Tue	Sama Piper	(Hosp)
	12 Wed	Ed Holm	(Homi)
	12 Wed	Samm Hill	(Phon Cons)
	12 Wed	Olivia Peyto	(Homi)
	13 Thu	Follow up Medic Check	
Lucy Ball (Therapy)	17 Mon	Billy Zimm	(Hosp)
	18 Tue	Follow up Medic Check	
	18 Tue	Lucas Smith	(Homi)
	19 Wed	Sama Piper	(Hosp)
	19 Wed	Olivia Peyto	(Homi)
	5 Wed		
	6 Thu		
	7 Fri		
	8 Sat		
9 Sun			
10 Mon	Isabe Carter	(Homi)	
10 Mon	Andre Fuller	(Homi)	
10 Mon	Made Russ	(Hosp)	
11 Tue	Cindy Stan	(Homi)	
11 Tue	Marcu Orbis	(Phon Cons)	
12 Wed	Kevin Carter	(Homi)	
12 Wed	Mary Stern	(Homi)	
13 Thu			
14 Fri	Follow up Medic Check		

# AJAX vs WebSockets

- There are several technologies to solve these problems
- AJAX stands for Asynchronous Javascript And XML (eXtensible Markup Language), and is really an approach rather than a technology.
- AJAX was coined in 2005 by Jesse James Garrett, using *asynchronous http requests* to a remote server and receiving *XML data* which could be parsed using javascript and dynamically update a webpage, using the DOM.
- Each AJAX request is a single http protocol exchange, and is done asynchronously, so that waiting for a response does not freeze the environment.
- The server will send the response as a data object (XML or JSON), which can then be factored into the current page.
- Websockets (2011) maintain an open two way connection between a program running on a browser, and a server, allowing the continual exchange of data.
- We will focus on AJAX for now, as it is the more fundamental technology.

# Asynchrony

- When we make a request to a service in javascript, we do not know when, if ever the server will respond.
- Javascript is single threaded, so it must execute each statement in order.
- The environment Javascript runs in is *not* single threaded, so we can write a function, with a function as a parameter, which will be executed when and if the server responds.
- `Object.asyncFn(parameters, callbackFunction)`
- The callback function takes parameters, for errors or the response generated, and executes them.

```
1 function big_Request(data, callback){
2   var req = request_to_server(data);
3   //register_event_listener(req,callback);
4   //when sever responds:
5     callback(req.error,req.response);
6 }
7
8 big_Request(myData, function(error,data){
9   if(error) alert(error);
10  else render(data);
11 }
```



# XML vs JSON

- For a javascript function to communicate directly with a server, we require a universal format to transmit data. The two most common forms are XML and JSON.
- XML is *eXtensible Markup Language* and is similar in form to HTML. All data is contained in a tree of named tags. It is designed to be as general as possible, it only contains data and does not execute, and is favoured by academics.
- JSON is *JavaScript Object Notation* and stores data in the syntax of javascript: specifically the structural object declaration required to create the object instance representing the data
- JSON is more succinct and can contain arrays, but should not include functions. Both XML and JSON are interpreted by parsers (*JSON.parse*)

```
<employees>
  <employee>
    <firstName>John</firstName> <lastName>Doe</lastName>
  </employee>
  <employee>
    <firstName>Anna</firstName> <lastName>Smith</lastName>
  </employee>
  <employee>
    <firstName>Peter</firstName> <lastName>Jones</lastName>
  </employee>
</employees>
```

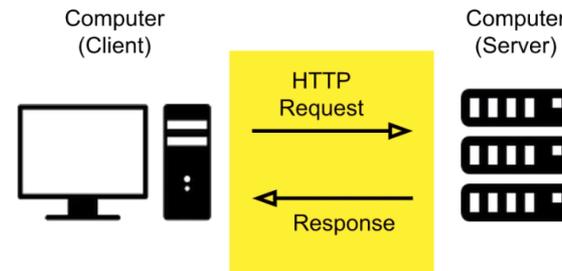
```
{"employees": [
  { "firstName": "John", "lastName": "Doe" },
  { "firstName": "Anna", "lastName": "Smith" },
  { "firstName": "Peter", "lastName": "Jones" }
]}
```

# Client Server Architecture

- When Javascript running in the browser requires a service running on a server, we are using a client-server-architecture.
- 
- The client sends a request to the server, the server receives the request, formulates and sends a response, and then forgets every thing about the exchange (stateless).
- In the HTTP protocol, requests have a specific form , specifying the method (GET, POST, UPDATE, DELETE) and URL, come with a header and a message body.
- A response reports the status (200 OK, 404 file not found), has a header and a message body.

```
GET /doc/test.html HTTP/1.1
Host: www.test101.com
Accept: image/gif, image/jpeg, */*
Accept-Language: en-us
Accept-Encoding: gzip, deflate
User-Agent: Mozilla/4.0
Content-Length: 35
bookId=12345&author=Tan+Ah+Teck
```

Request Line  
Request Headers  
Request Message Header  
A blank line separates header & body  
Request Message Body



```
HTTP/1.1 200 OK
Date: Sun, 08 Feb xxxx 01:11:12 GMT
Server: Apache/1.3.29 (Win32)
Last-Modified: Sat, 07 Feb xxxx
ETag: "0-23-4024c3a5"
Accept-Ranges: bytes
Content-Length: 35
Connection: close
Content-Type: text/html
<h1>My Home page</h1>
```

Status Line  
Response Headers  
Response Message Header  
A blank line separates header & body  
Response Message Body

# XMLHTTP requests

- Modern browsers have an XMLHttpRequest object to handle requests to, and responses from a remote server.
- The object is initialised, and then *opens* a connection to a server. The *send* method sends the request to the server, and when the server responds, the *status* and *response* can be accessed as properties.
- Browsers only handle GET and POST requests.

Property	Description	Method	Description
onreadystatechange	Defines a function to be called when the readyState property changes	new XMLHttpRequest()	Creates a new XMLHttpRequest object
readyState	Holds the status of the XMLHttpRequest. 0: request not initialized 1: server connection established 2: request received 3: processing request 4: request finished and response is ready	abort()	Cancels the current request
responseText	Returns the response data as a string	getAllResponseHeaders()	Returns header information
responseXML	Returns the response data as XML data	getResponseHeader()	Returns specific header information
status	Returns the status-number of a request 200: "OK" 403: "Forbidden" 404: "Not Found" For a complete list go to the <a href="#">Http Messages Reference</a>	open( <i>method,url,async,user,psw</i> )	Specifies the request  <i>method</i> : the request type GET or POST <i>url</i> : the file location <i>async</i> : true (asynchronous) or false (synchronous) <i>user</i> : optional user name <i>psw</i> : optional password
statusText	Returns the status-text (e.g. "OK" or "Not Found")	send()	Sends the request to the server Used for GET requests
		send( <i>string</i> )	Sends the request to the server. Used for POST requests
		setRequestHeader()	Adds a label/value pair to the header to be sent

# HTTP requests continued

- Requests may be either GET or POST. Http allows other request methods (DELETE, PUT) but these are not implemented by most browsers.
- A GET request is used to retrieve data from a server, such as loading a webpage, and a POST request is used to send data to a server, such as submitting a form.
- All requests should be done asynchronously so they do not block other scripts running.
- An asynchronous request has a *readystate* property describing the progress of the request, and an *onreadystatechange* callback function, that is executed when the *readystate* changes.

```
xhttp.open("GET", "demo_get2.asp?fname=Henry&lname=Ford", true);  
xhttp.send();
```

```
xhttp.open("POST", "ajax_test.asp", true);  
xhttp.setRequestHeader("Content-type", "application/x-www-form-  
urlencoded");  
xhttp.send("fname=Henry&lname=Ford");
```

# HTTP responses

- The request changes state when the server responds, and the response is accessible as a property of the request (*responseText* or *responseXML*)
- As with the request, the response has a status, the status text, and a header, which is a set of value key pairs.
- The header can be used to set parameters and cookies etc.
- It is accessible via the *getResponseHeader* function

```
function loadDoc() {  
    var xhttp = new XMLHttpRequest();  
    xhttp.onreadystatechange = function() {  
        if (this.readyState == 4 && this.status == 200) {  
            document.getElementById("demo").innerHTML =  
                this.responseText;  
        }  
    };  
    xhttp.open("GET", "ajax_info.txt", true);  
    xhttp.send();  
}
```

Property	Description
onreadystatechange	Defines a function to be called when the readyState property changes
readyState	Holds the status of the XMLHttpRequest. 0: request not initialized 1: server connection established 2: request received 3: processing request 4: request finished and response is ready
status	200: "OK" 403: "Forbidden" 404: "Page not found" For a complete list go to the <a href="#">Http Messages Reference</a>
statusText	Returns the status-text (e.g. "OK" or "Not Found")

# HTTP response codes

## 1xx Informational

100 Continue

101 Switching Protocols

102 Processing (WebDAV)

## 2xx Success

★ 200 OK

203 Non-Authoritative Information

206 Partial Content

226 IM Used

★ 201 Created

★ 204 No Content

207 Multi-Status (WebDAV)

202 Accepted

205 Reset Content

208 Already Reported (WebDAV)

## 3xx Redirection

300 Multiple Choices

303 See Other

306 (Unused)

301 Moved Permanently

★ 304 Not Modified

307 Temporary Redirect

302 Found

305 Use Proxy

308 Permanent Redirect (experimental)

## 4xx Client Error

★ 400 Bad Request

★ 403 Forbidden

406 Not Acceptable

★ 409 Conflict

412 Precondition Failed

415 Unsupported Media Type

418 I'm a teapot (RFC 2324)

423 Locked (WebDAV)

426 Upgrade Required

431 Request Header Fields Too Large

450 Blocked by Windows Parental Controls (Microsoft)

★ 401 Unauthorized

★ 404 Not Found

407 Proxy Authentication Required

410 Gone

413 Request Entity Too Large

416 Requested Range Not Satisfiable

420 Enhance Your Calm (Twitter)

424 Failed Dependency (WebDAV)

428 Precondition Required

444 No Response (Nginx)

451 Unavailable For Legal Reasons

402 Payment Required

405 Method Not Allowed

408 Request Timeout

411 Length Required

414 Request-URI Too Long

417 Expectation Failed

422 Unprocessable Entity (WebDAV)

425 Reserved for WebDAV

429 Too Many Requests

449 Retry With (Microsoft)

499 Client Closed Request (Nginx)

## 5xx Server Error

★ 500 Internal Server Error

503 Service Unavailable

506 Variant Also Negotiates (Experimental)

509 Bandwidth Limit Exceeded (Apache)

598 Network read timeout error

501 Not Implemented

504 Gateway Timeout

507 Insufficient Storage (WebDAV)

510 Not Extended

599 Network connect timeout error

502 Bad Gateway

505 HTTP Version Not Supported

508 Loop Detected (WebDAV)

511 Network Authentication Required

# jQuery and AJAX

- We can build XMLHttpRequest objects directly, but jQuery provides some basic functionality for us, and pairs it directly with the DOM.
- The *load* function will send a GET request to a url, and load the data directly into an HTML element
- The *get* function will send a GET request to a url, and passes the data to a callback function.
- The *post* function will send a POST request, with data to a url and passes the response to a callback function.

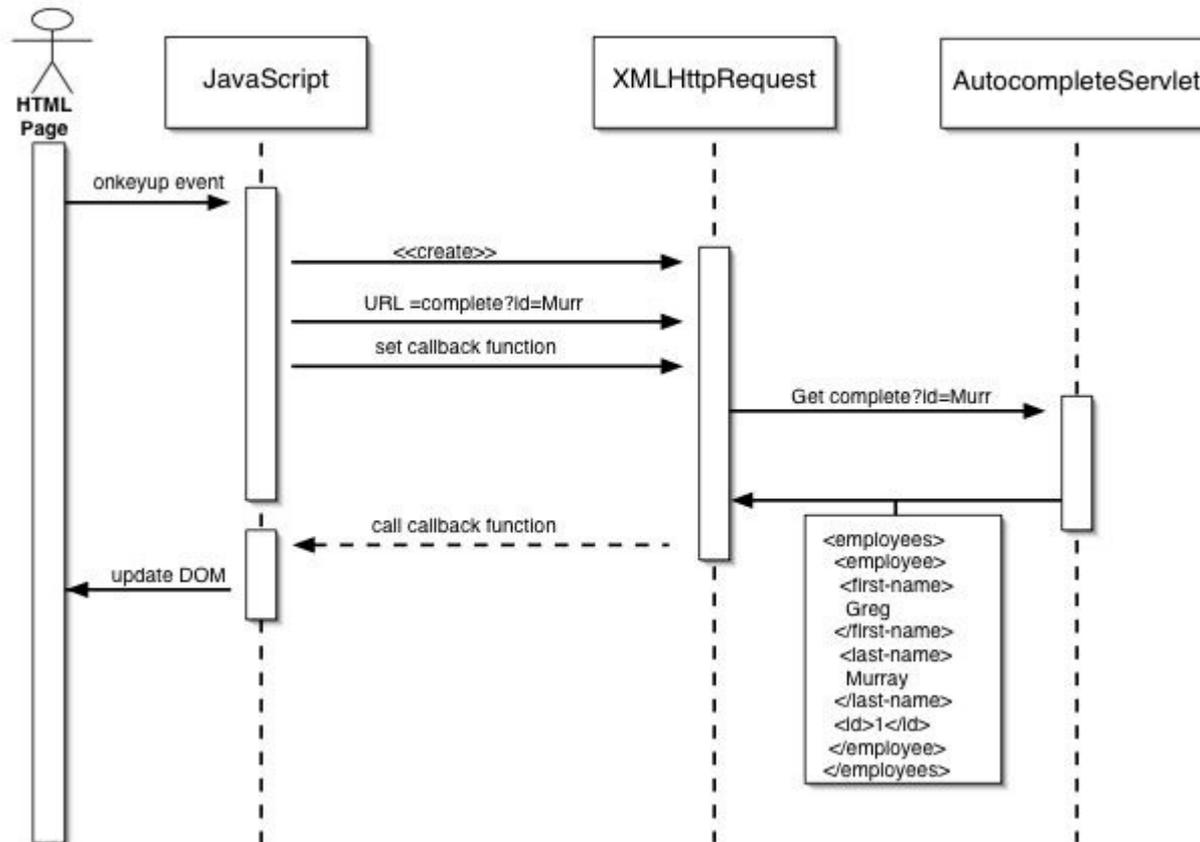
```
$("#button").click(function(){
    $.get("demo_test.asp", function(data, status){
        alert("Data: " + data + "\nStatus: " + status);
    });
});
```

```
$("#button").click(function(){
    $.post("demo_test_post.asp",
    {
        name: "Donald Duck",
        city: "Duckburg"
    },
    function(data, status){
        alert("Data: " + data + "\nStatus: " + status);
    });
});
```

```
$("#button").click(function(){
    $("#div1").load("demo_test.txt", function(responseTxt,
statusTxt, xhr){
        if(statusTxt == "success")
            alert("External content loaded successfully!");
        if(statusTxt == "error")
            alert("Error: " + xhr.status + ": " +
xhr.statusText);
    });
});
```

# AJAX Callbacks

- The following is a sequence diagram for an AJAX request



# Example

```
<!DOCTYPE html>
<html>
<head>
<script src="https://ajax.googleapis.com/ajax/libs/jquery/3.3.1
/jquery.min.js"></script>
<script>
$(document).ready(function(){
  $("button").click(function(){
    $("#div1").load("demo_test.txt", function(responseTxt,
statusTxt, xhr){
      if(statusTxt == "success")
        alert("External content loaded successfully!");
      if(statusTxt == "error")
        alert("Error: " + xhr.status + ": " + xhr.statusText);
    });
  });
});
</script>
</head>
<body>

<div id="div1"><h2>Let jQuery AJAX Change This Text</h2></div>

<button>Get External Content</button>
```

## Let jQuery AJAX Change This Text

Get External Content

External content loaded successfully!

OK

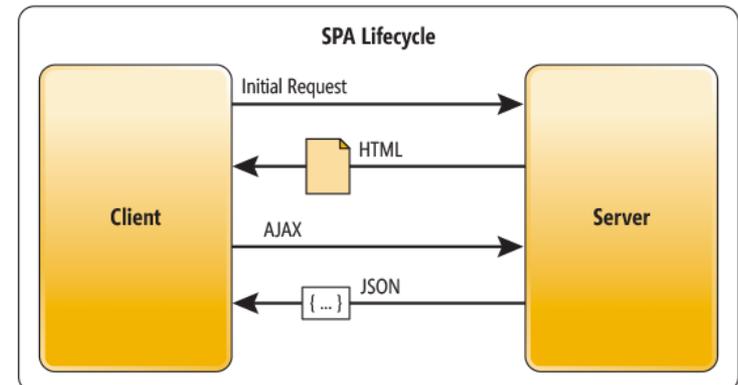
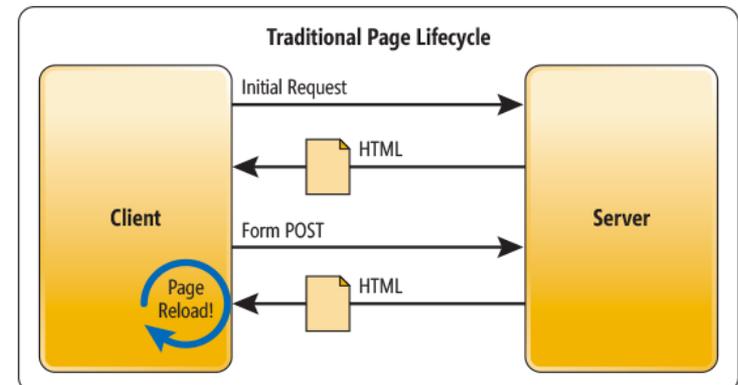
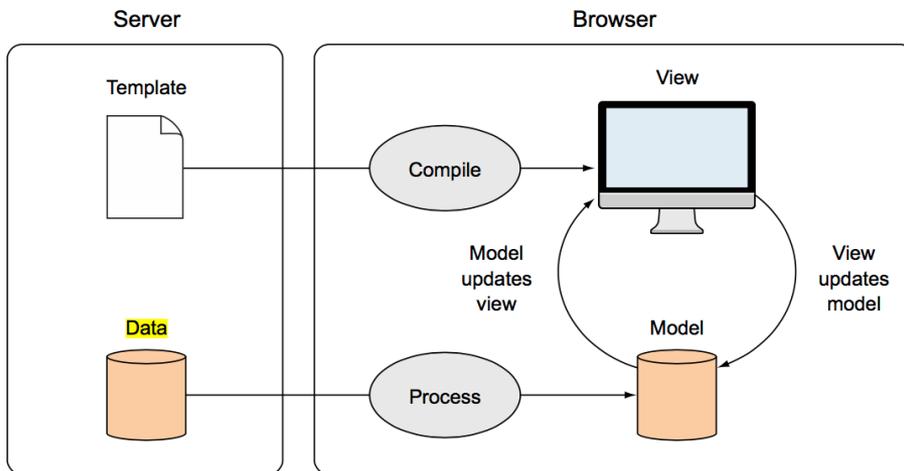
jQuery and AJAX is FUN!

This is some text in a paragraph.

Get External Content

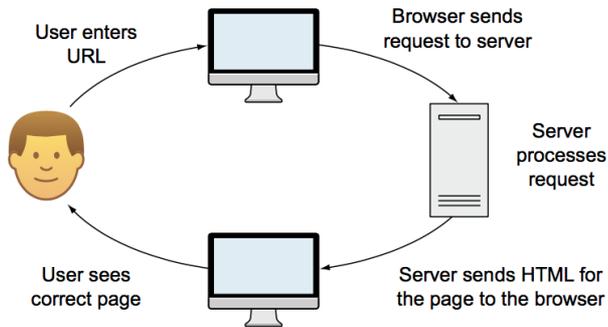
# Single Page Applications

- Single Page Applications have the browser/client do the heavy lifting in a web application: The server just provides the data while the client does the logic and rendering

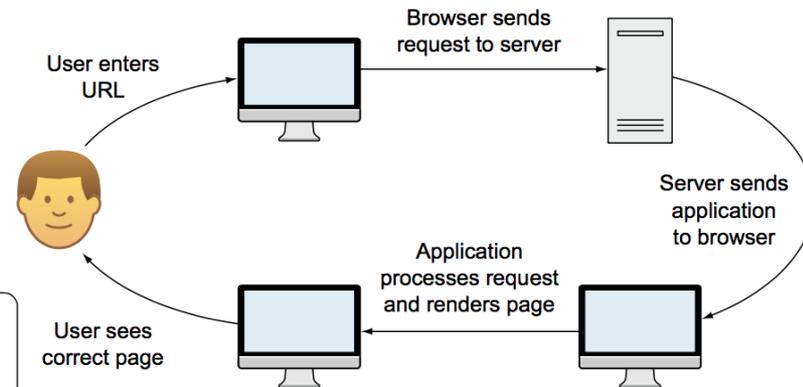


# Application Architectures

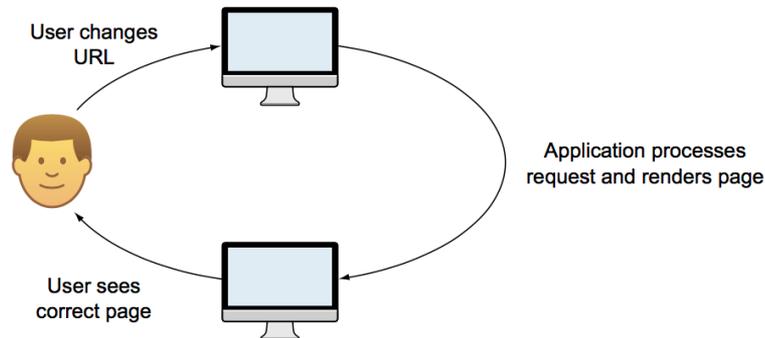
## 1. Server application request loop



## 2. SPA initial request loop



## 3. SPA subsequent request loop



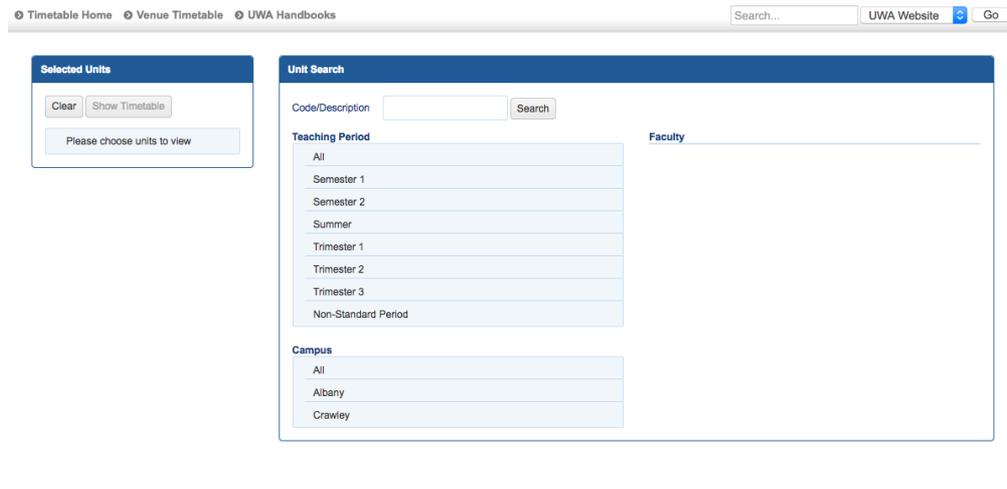
# Pros and Cons

## Pros

- Less load on the server, able to respond to more clients.
- A more responsive client. No need to wait for server responses.
- Genuine separation between content and presentation.

## Cons

- Longer load time, first up. A lot of JS has to be transferred.
- SEO can be a problem. Robots won't crawl js.
- Navigation can be an issue.



The screenshot shows a web browser window with the following elements:

- Navigation links: Timetable Home, Venue Timetable, UWA Handbooks
- Search bar: Search... UWA Website Go
- Selected Units panel: Clear, Show Timetable, Please choose units to view
- Unit Search panel: Code/Description (input), Search button, Teaching Period (dropdown menu with options: All, Semester 1, Semester 2, Summer, Trimester 1, Trimester 2, Trimester 3, Non-Standard Period), Campus (dropdown menu with options: All, Albany, Crawley), Faculty (input)

To use AJAX or build single page applications, we need to be able to configure the server to handle different requests. So next lecture we'll move on to looking at the back end.