Web Application Development

COMP4347
COMP5347

Client-side Development with jQuery and AJAX

Week 8
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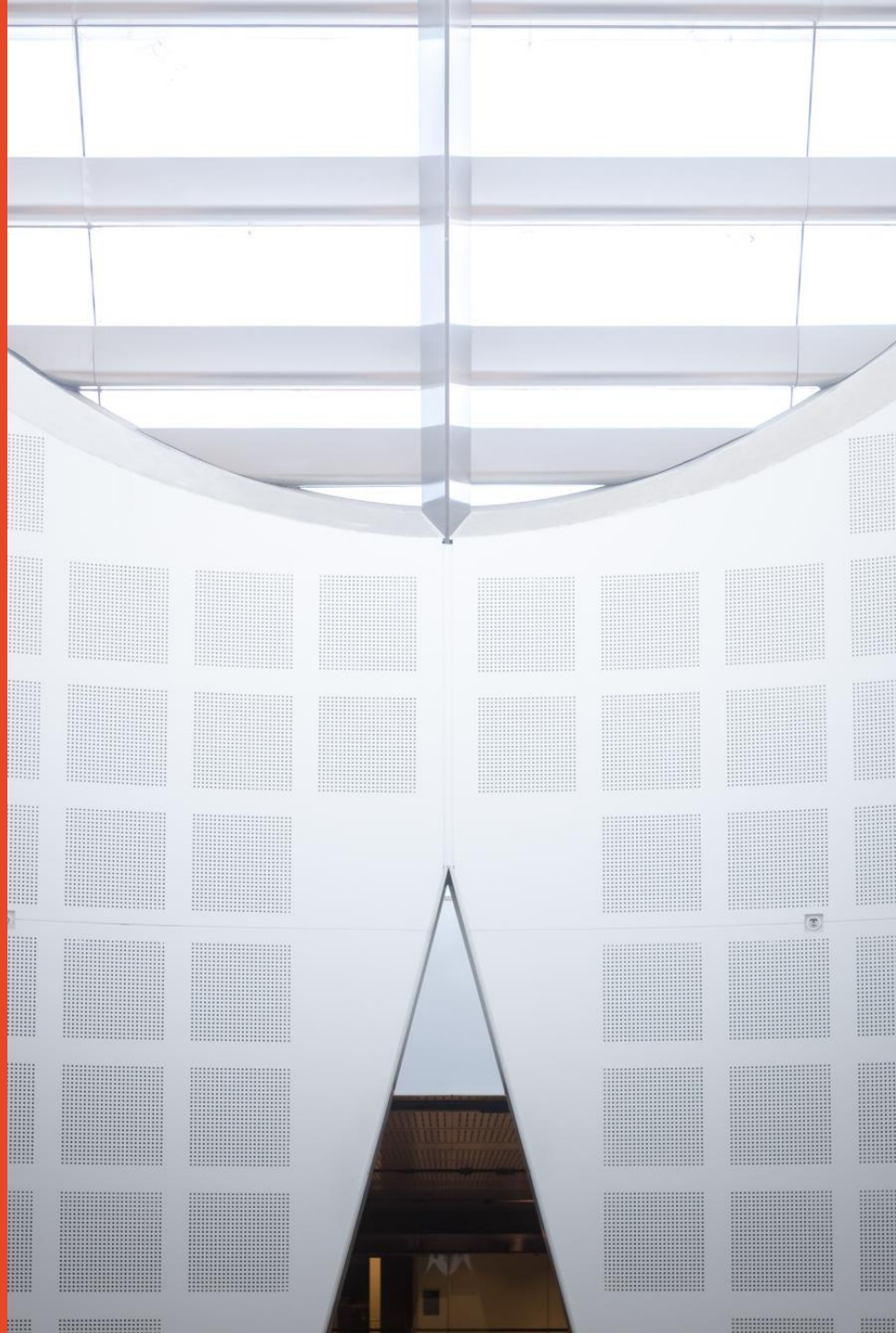
Dr. Mehdi Nobakht
School of Computer Science
THE UNIVERSITY OF SYDNEY



Outline

- JavaScript Front-End Frameworks
- Intro to jQuery
  - Selectors
  - Event handler and DOM Manipulation
  - Ajax requests
- Integrate jQuery with Express.js Application

Client-Side Development

- Web client is not a pure passive receiver of data sent from the server
- Modern client has lots of interactive features to make it like desktop GUI
  - HTML5
  - CSS3
  - JavaScript
- A library or framework is software that you can utilize in your own software, which provides some common implementations of standard ideas.

Front-End Frameworks

- A web framework can be expected to have features related to the web including
  - HTTP headers
  - AJAX
  - Authentication
  - DOM manipulation
  - Cross-browser implementation
- Many client-side JavaScript frameworks
  - jQuery
  - Specialized libraries, e.g. D3.js, various google libraries
- Client side "scripting" becomes real application development with its own model, view and controller
  - AngularJS framework
  - Backbone MVC framework

Popular Front-End Frameworks

- jQuery
  - Started in Aug 2005
  - To better combine CSS selectors
  - AJAX and animation added in a year
  - Provides many useful shortcuts compared to pure JavaScript
- Angular
  - Created by Google
  - Use TypeScript
- React
  - From Facebook
  - Use JavaScript and JSX
- Vue.js
  - Open-source
  - Focuses on views

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jQuery

- jQuery is a lightweight JavaScript library
  - Provides methods to wrap common JavaScript tasks
    - HTML/DOM and CSS manipulation (e.g., selecting elements)
    - HTML event methods (e.g., register element's event handler)
    - AJAX (managing asynchronized request)
    - Effects and animation

- jQuery will run consistently across all major browsers
  - Cross-browser knowledge and issues are considered

- Adopted by major companies including Google, Microsoft and IBM

Using jQuery

- The library is released as a single JavaScript file
  - Can be downloaded then installed locally
  - Include it from a CDN like Google, Microsoft or jQuery itself
    - Reference it in the HTML <script> tag
- Using a Content Delivery Network (CDN):

```
<script src="http://code.jquery.com/jquery-3.1.0.min.js"> </script>
```

- Use a failsafe in case the CDN is down

Using jQuery – Failsafe Loading

```
<script src="http://code.jquery.com/jquery-1.9.1.min.js"></script>
<script type="text/javascript">
window.jQuery ||
document.write('<script src="/jquery-1.9.1.min.js"><\/script>');
</script>
```

- Pros of CDN host:
  - The bandwidth is offloaded to reduce the demand on your servers
  - The user may already have cached the third-party file; reducing the total loading time
- Cons of CDN host:
  - jQuery will fail if the third-party host fails (unlikely but possible)

jQuery Function

- The jQuery syntax is customized for **selecting** HTML elements and performing some **action** on the element(s)
  - Remember getElementById() …

- The **jQuery()** or **$()** function
- **$(selector).action()**
  - **$** sign to define/access jQuery
  - **(selector)** to "query (or find)" HTML elements
  - jQuery **action()** to be performed on the element(s)

- The **$()** function always returns a set of results

jQuery – Selectors

- Selecting using regular JavaScript

```
var node = document.getElementById("here");
var link = document.querySelectorAll("ul li");
```

- equivalent selection using jQuery

```
var node = $("#here");
var link = $("ul li");
```

- Example with action
  - Hide all elements with class="test“
  - $(".test").hide()

jQuery – Main Selectors

- The selectors are very similar to CSS selectors

- The four basic selectors are:
  - **$("*") Universal selector** matches all elements (slow)
  - **$("tag") Element selector** matches all elements with the given element name
  - **$(".class") Class selector** matches all elements with the given CSS class
  - **$("#id") Id selector** matches all elements with a given HTML id attribute.

- Other selectors defined in CSS can be used

jQuery – Basic Selector Examples

- Select the single element with id="grab"
  - **var singleElement = $("#grab");**
- Get a set of all the <a> elements the selector
  - **var allAs = $("a");**
- Select all odd <tr> elements
  - $("tr:odd")
- These selectors replace the use of **`getElementById()`** and similar functions entirely

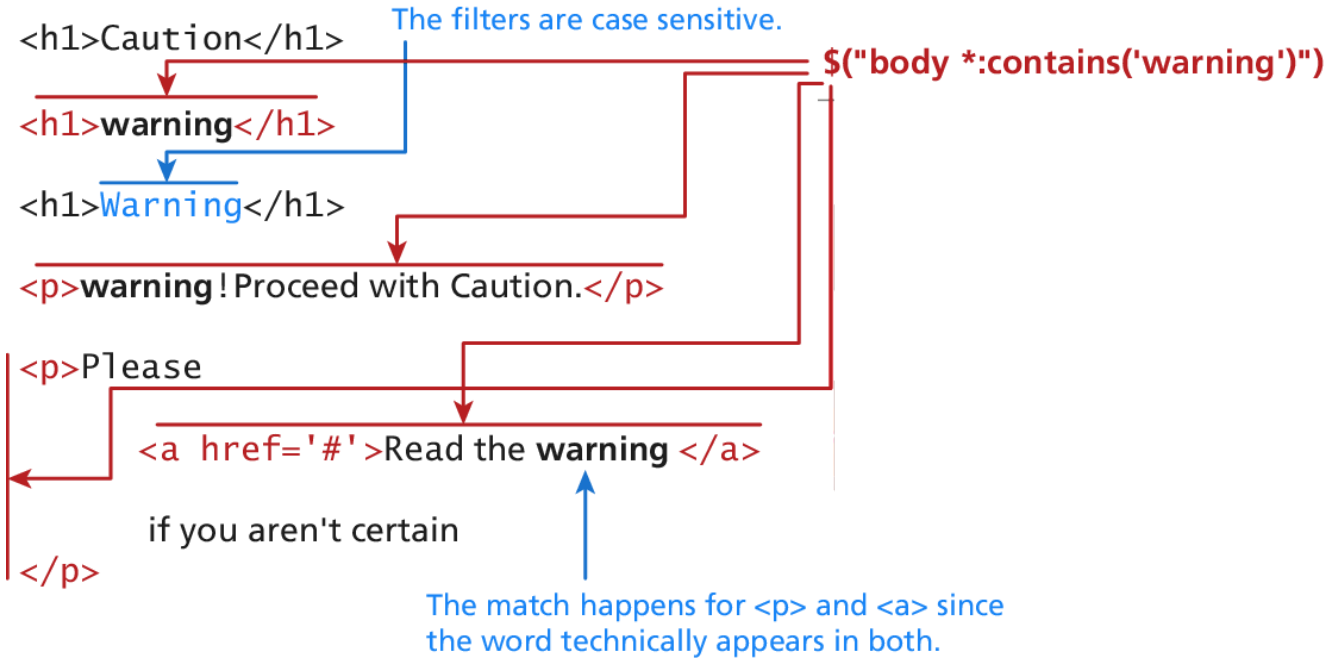
jQuery – Advanced Selectors

- Pseudo class selector
  - E.g. Selecting all links that have been visited
  - **var visitedLinks = $("a:visited");**

- Beyond CSS selectors
  - Content Filters
    - Select elements based on criteria
  - Form Selectors
    - Shorthand version to select form elements

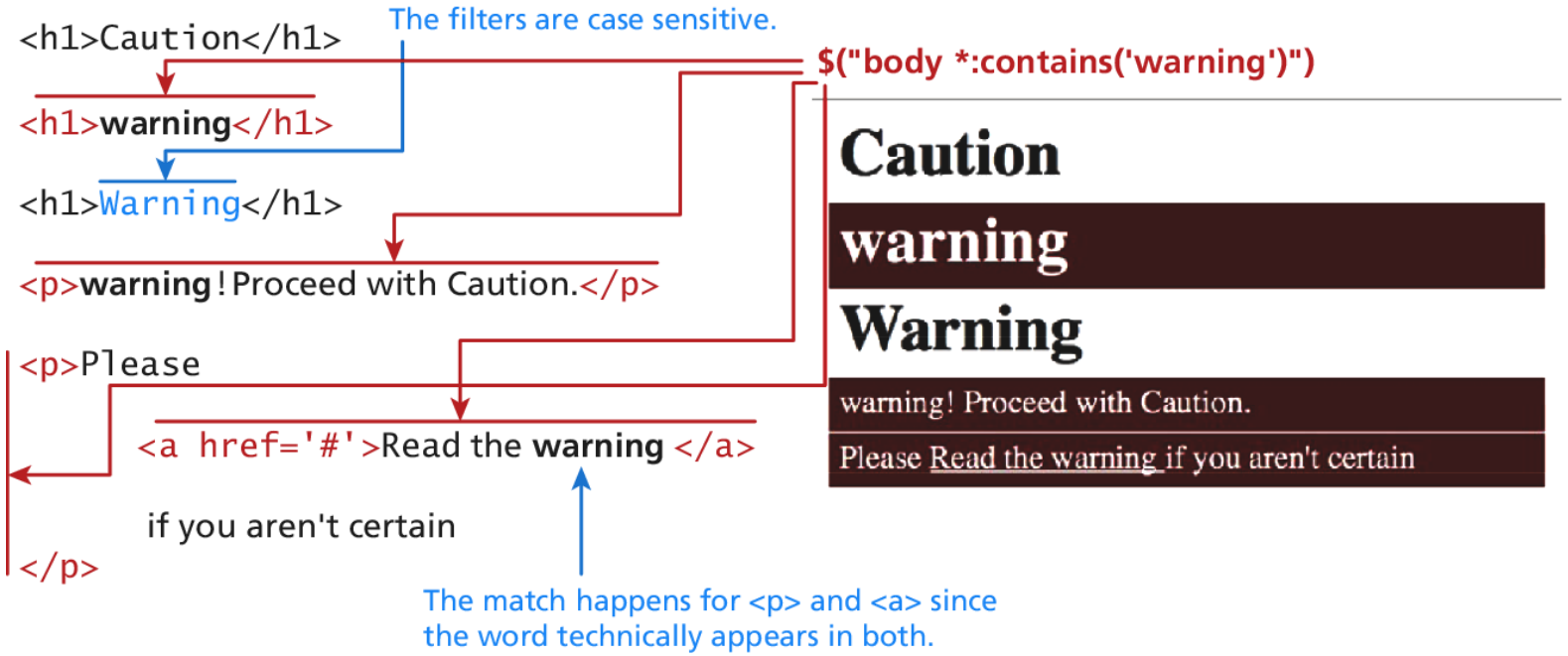
jQuery – Content Filters Selector

- $("body *:contains('warning')")



jQuery – Content Filters Selector

- $("body *:contains('warning')")



jQuery – HTML Attributes and Properties

- We can both set and get an attribute value by using the **attr()** method

```
var link = $("a").attr("href");
$("a").attr("href","http://funwebdev.com");
$("img").attr("class","fancy");
```

jQuery – HTML Attributes and Properties

- The **prop()** method is the preferred way to retrieve and set the value of a property.

```
<input class="meh" type="checkbox" checked="checked">
```

```
var theBox = $(".meh");

theBox.prop("checked"); // evaluates to TRUE
```

Form Selectors

Selector	CSS Equivalent	Description
$(:button)	$("button, input[type='button']")	Selects all buttons
$(:checkbox)	$('[type=checkbox]‘)	Selects all checkboxes
$(:checked)	No Equivalent	Selects elements that are checked. This includes radio buttons and checkboxes.
$(:disabled)	No Equivalent	Selects form elements that are disabled.
$(:enabled)	No Equivalent	Opposite of :disabled
$(:file)	$('[type=file]')	Selects all elements of type file
$(:focus)	$(document.activeElement)	The element with focus
$(:image)	$('[type=image]')	Selects all elements of type image
$(:input)	No Equivalent	Selects all <input>, <textarea>, <select>, and <button>
$(:password)	$('[type=password]')	Selects all password fields
$(:radio)	$('[type=radio]')	Selects all radio elements
$(:reset)	$('[type=reset]')	Selects all the reset buttons
$(:selected)	No Equivalent	Selects all the elements that are currently selected of type <option>. It does not include checkboxes or radio buttons.
$(:submit)	$('[type=submit]')	Selects all submit input elements
$(:text)	No Equivalent	Selects all input elements of type text. $('[type=text]') is almost the same, except that $(:text) includes <input> fields with no type specified.

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jQuery – Event Handling

- jQuery supports creation and management of handlers for JavaScript events
- jQuery has **on()** and **off()** methods and shortcut methods to attach events
  - Pure JavaScript uses the **addEventListener()** method

jQuery – Registering Event Handler

- Standard event handling syntax
  - ```
    $("p").click(function(){
      // action goes here!!
    });
    ```

- Common DOM events are
  - `click, dbclick, mouseenter, mouseleave`
    ```

jQuery – Registering Event Handler

- The `Document Ready` Event
  - Best practice to put jQuery code inside a document ready event
  - The ready event is defined by jQuery, fired after the DOM is completed

```
$(document).ready(function(){
 //set up listeners on the change event for the file items.
 $("input[type=file]").change(function(){
     console.log("The file to upload is "+ this.value);
  });
});
```

JQuery – DOM Manipulation

- Create DOM element/node (JavaScript)

```
// pure JavaScript way
var jsLink = document.createElement("a");
jsLink.href = "http://www.funwebdev.com";
jsLink.innerHTML = "Visit Us";
jsLink.title = "JS";
```

- Create DOM element/node (jQuery)

```
// jQuery way
var jQueryLink = $("<a href='http://funwebdev.com'
title = 'jQuery'>Visit Us</a>");

// jQuery long-form way
var jQueryVerboseLink = $("<a></a>");
jQueryVerboseLink.attr("href",'http://funwebdev.com');
jQueryVerboseLink.attr("title","jQuery verbose");
jQueryVerboseLink.html("Visit Us");
```

DOM Manipulation – Appending Elements

- Appending DOM Elements
  - The **append() method** takes as a parameter an HTML string, a DOM object, or a jQuery object. That object is then added as the last child to the element(s) being selected

```
var jQueryLink = $("<a href='http://funwebdev.com'
title = 'jQuery'>Visit Us</a>");
```

DOM Manipulation – Appending Elements

- Appending DOM Elements

```
var jQueryLink = $("<a href='http://funwebdev.com'
title = 'jQuery'>Visit Us</a>");
```

HTML Before

```
<div class="external-links">
     <div class="linkOut">
        funwebdev.com
    </div>
     <div class="linkIn">
         /localpage.html
    </div>
     <div class="linkOut">
        pearson.com
    </div>
<div>
```

jQuery append

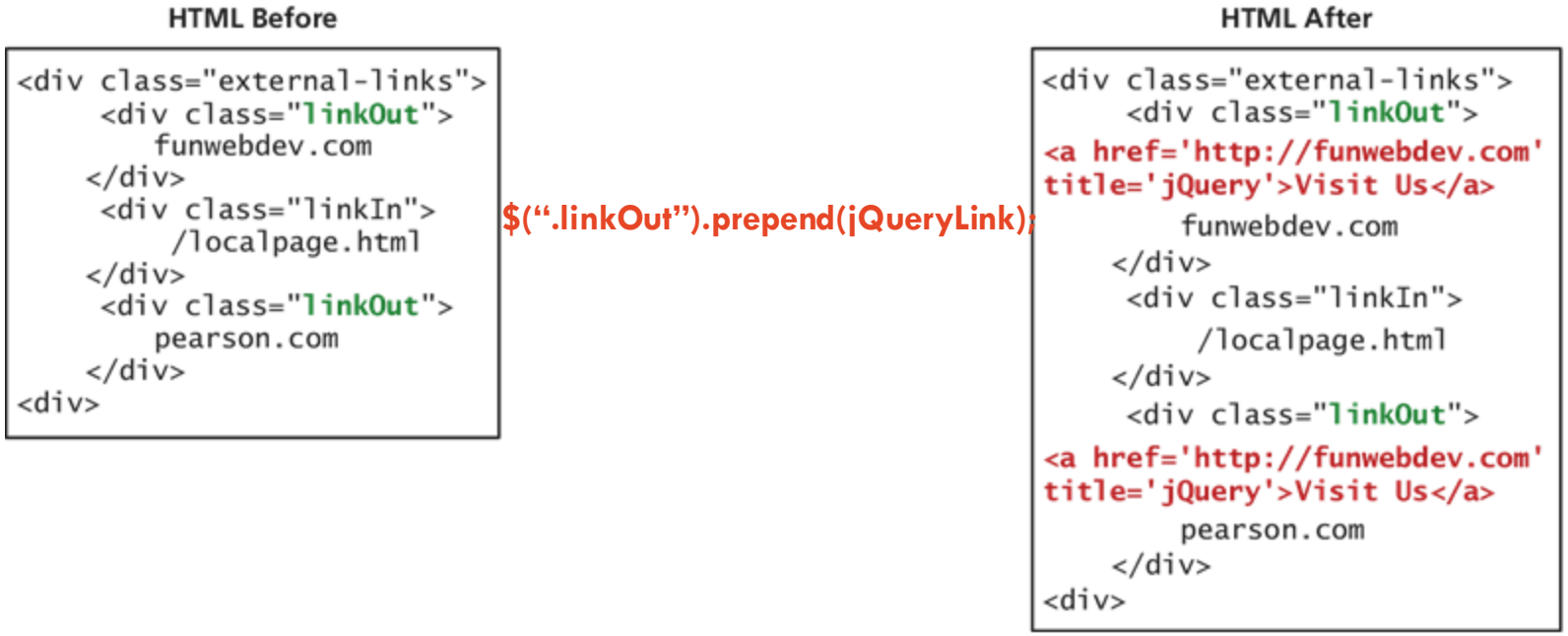
```
$(".linkOut").append(jQueryLink);
```

HTML After

```
<div class="external-links">
     <div class="linkOut">
        funwebdev.com
<a href='http://funwebdev.com'
title='jQuery'>Visit Us</a>
    </div>
     <div class="linkIn">
         /localpage.html
    </div>
     <div class="linkOut">
        pearson.com
<a href='http://funwebdev.com'
title='jQuery'>Visit Us</a>
    </div>
<div>
```

Normal DOM manipulation

- Prepending DOM Elements
  - The **prepend() method** adds the new element as the first child rather than the last



jQuery – DOM Manipulation

```
<div class="dest">
existing content
</div>
```

```
var link = $('<a href="http://funwebdev.com">Fun</a>');
```

```
$(".dest").append(link);
```

```
<div class="dest">
existing content
<a href="http://funwebdev.com">Fun</a>
</div>
```

```
$(".dest").prepend(link);
```

```
<div class="dest">
<a href="http://funwebdev.com">Fun</a>
existing content
</div>
```

```
link.appendTo($(".dest"));
```

```
<div class="dest">
existing content
<a href="http://funwebdev.com">Fun</a>
</div>
```

```
link.prependTo($(".dest"));
```

```
<div class="dest">
<a href="http://funwebdev.com">Fun</a>
existing content
</div>
```

```
$(".dest").before(link);
```

```
<a href="http://funwebdev.com">Fun</a>
<div class="dest">
existing content
</div>
```

```
$(".dest").after(link);
```

```
<div class="dest">
existing content
</div>
<a href="http://funwebdev.com">Fun</a>
```

```
link.insertBefore($(".dest"));
```

```
<a href="http://funwebdev.com">Fun</a>
<div class="dest">
existing content
</div>
```

```
link.insertAfter($(".dest"));
```

```
<div class="dest">
existing content
</div>
<a href="http://funwebdev.com">Fun</a>
```

jQuery – Useful Methods

- **attr()** – set/get attribute value on any element from a selector
  - var link = $("a").attr("href");
  - $("img").attr("class","fancy");

- **css()** - to set/get CSS properties on any element from a selector
  - var color = $("#element").**css**("background-color");
  - $("#colourBox").**css**("**background-color**", "**#FF0000**")

JQuery – Useful Methods

- The **html()** - get the HTML contents of an element. If passed with a parameter, it updates the HTML of that element

- The **val()** returns the value of the element. It is mainly used to get the value of form element.

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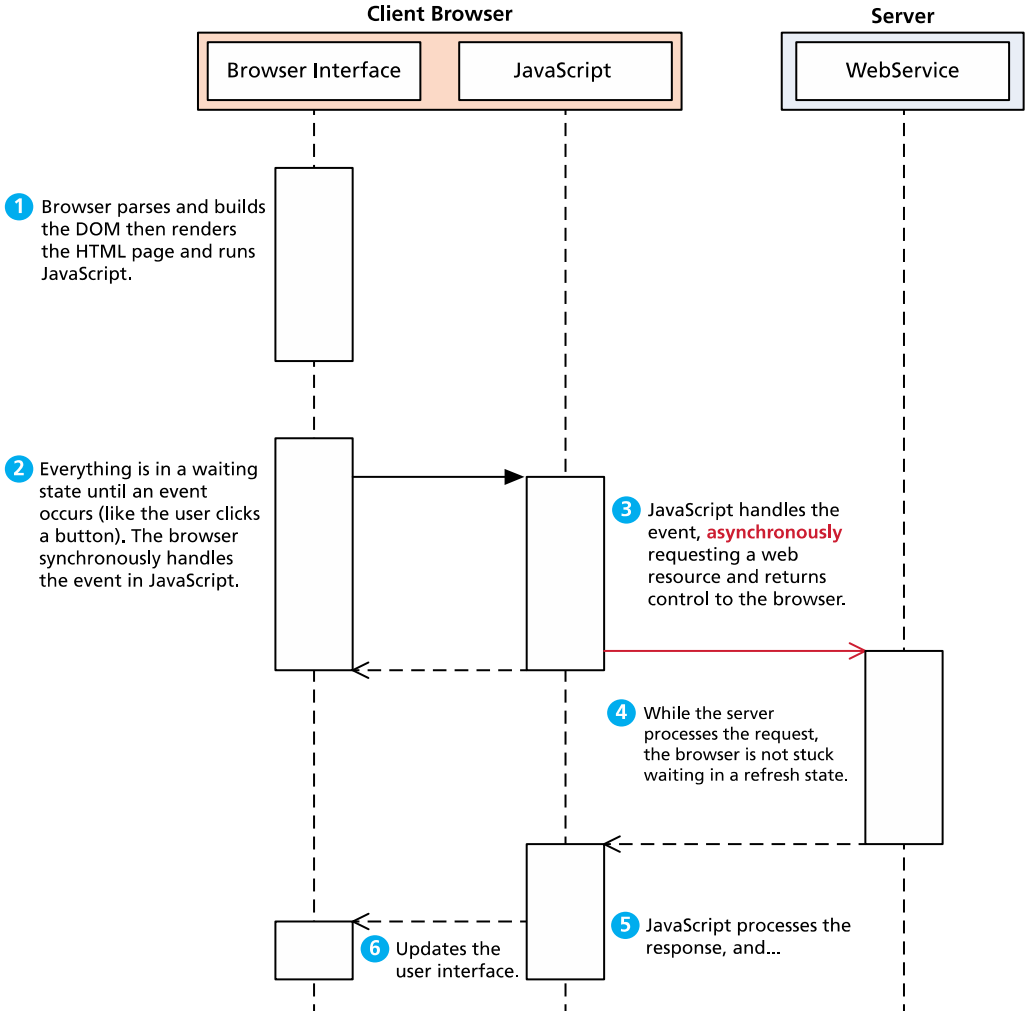
Synchronous and Asynchronous Requests

- **Synchronous** request
  - Browser sends a request then **WAIT** for the response and then render
  - Non-responsive: the user cannot interact with the client while the server is processing the request
  - Originally designed for a web of hypertext documents

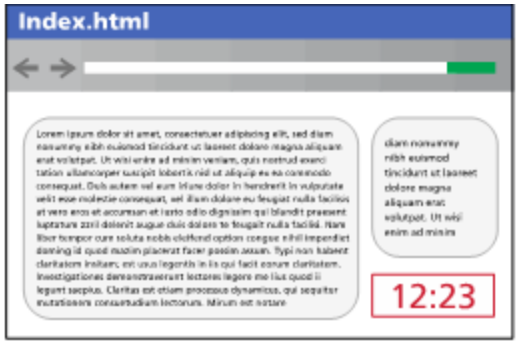
- **Asynchronous** request
  - user can interact with the application while the server processes the request concurrently
  - Client-side script creating an ***XMLHttpRequest object*** to manage a request and implicit/explicit callback function to handle the response

Asynchronous JavaScript with XML (AJAX)

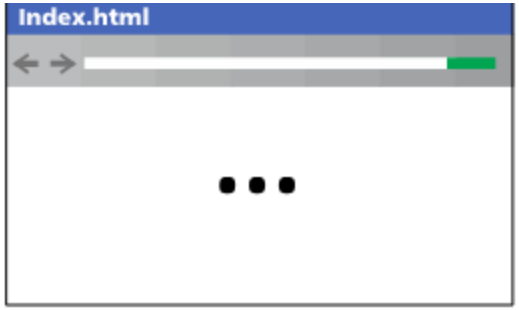
- AJAX is a paradigm that allows a browser to send messages to the server without interrupting the flow of what's shown in the browser



AJAX – Synchronous Request

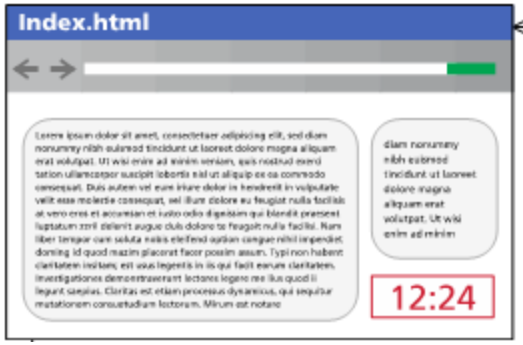


1 The page loads and shows the current server time as a small part of a larger page.



2 A **synchronous** JavaScript call makes an HTTP request for the "freshest" version of the page.

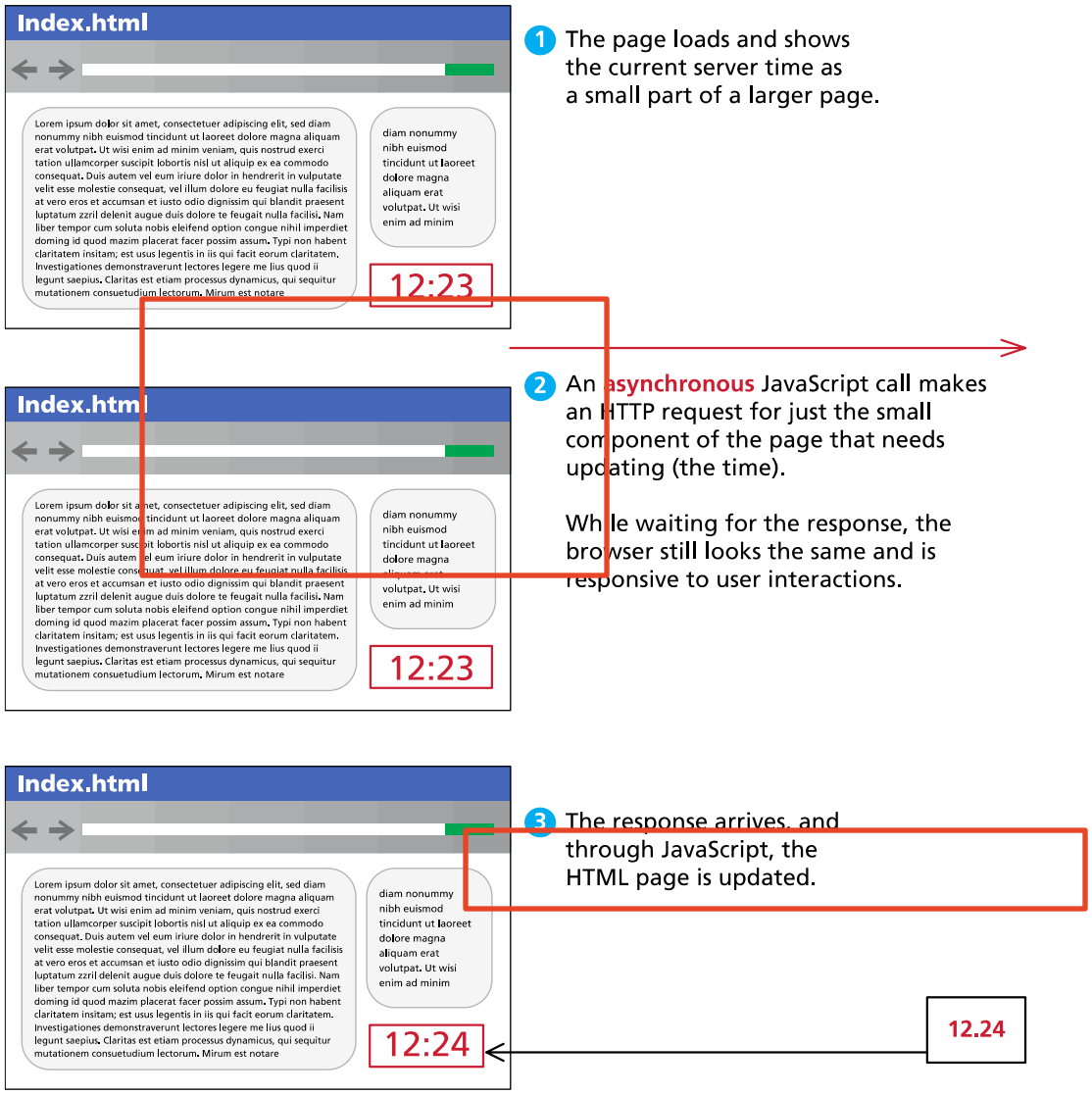
While waiting for the response, the browser goes into its waiting state.



3 The response arrives, so the browser can render the new version of the page, and the functionality in the browser is restored.

```
<html>
        <head>
        ...
        </head>
        <body>
        ...
        <div id='serverTime'>
                12.24
        </div>
        ...
        </body>
</html>
```

AJAX – Asynchronous Request



jQuery – AJAX Support

- `load()`
  - `$(selector).load(URL,data,callback);`
  - Load URL's response into the selected element, optional `data` can be sent along with the request; optional callback can be executed after load() finishes
  - A GET request is sent if no data is present, otherwise a POST request is sent

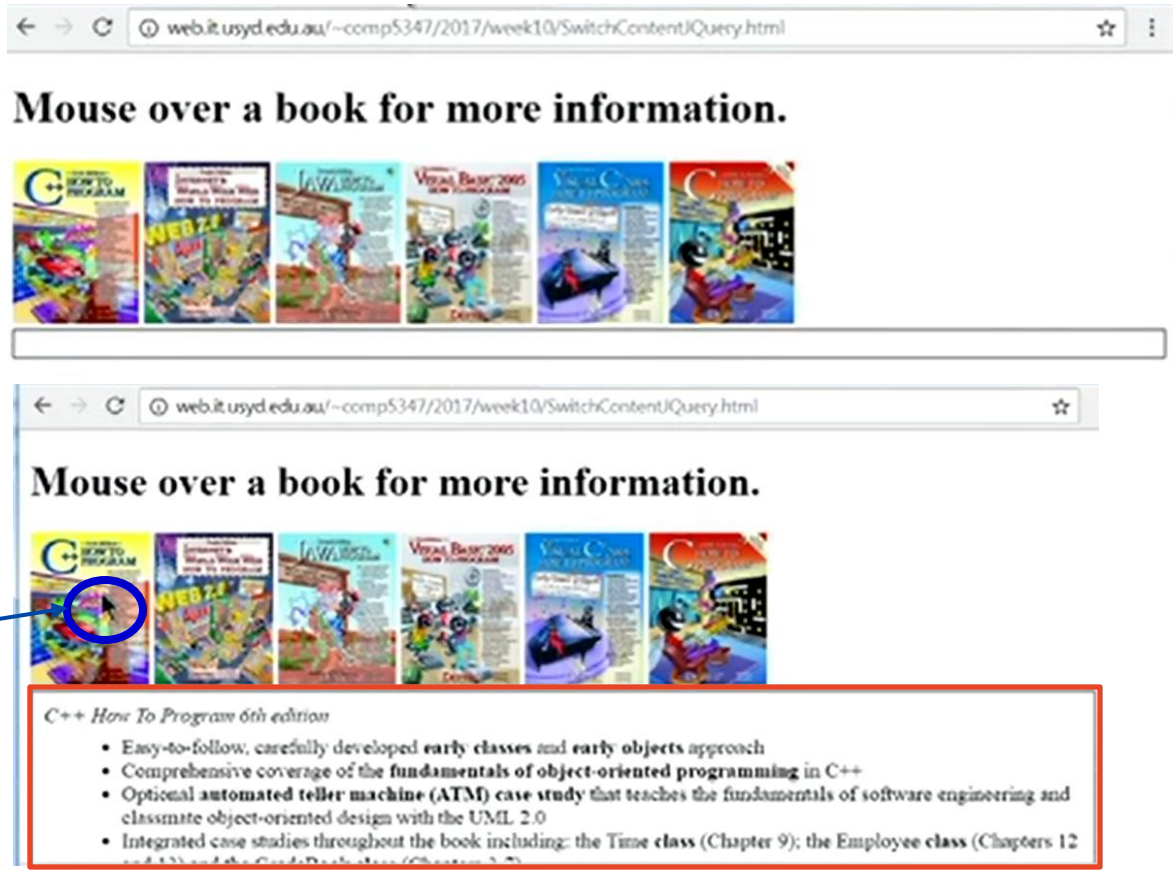
- `get()`
  - `$.get(URL, data, callback);`
  - Request data using HTTP GET method; the optional callback parameter is the name of a function to be executed after the response arrives

- `post()`
  - `$.post(URL, data, callback);`
  - Request data using HTTP POST methods; optional `data` can be sent along with the request; optional callback can be executed after response arrives

More about jQuery APIs - http://api.jquery.com/

Asynchronous Request – Source Code Example

- The *XMLHttpRequest* object will fetch a static file from the server, the JavaScript running on the client browser dynamically insert the content into the current DOM tree.



When the mouse is moved on any of the picture, a description of the corresponding book is shown

How this Works – Source Code

```
1  <!DOCTYPE html>
2  <html>
3  <head><meta http-equiv="Content-Type" content="text/html; charset=UTF-8">
4     <style type="text/css">
5        .box { border: 1px solid black;
6               padding: 10px }
7     </style>
8     <title>Switch Content Asynchronously</title>
9     <script src="https://code.jquery.com/jquery-3.2.1.js"></script>
10    <script type="text/javascript">
11    $(document).ready(function(){
12     $("img").mouseenter(function(){
13         var url = $(this).attr("id") + ".html";
14         $("#contentArea").load(url);
15     });
16     $("img").click(function(){
17         var url = "http://www.smh.com.au";
18         $("#contentArea").load(url);
19     });
20     $("img").mouseleave(function(){
21         $("#contentArea").html("");
22      });
23    })
24 </script>
25
26 </head>
27 <body>
28    <h1>Mouse over a book for more information.</h1>
29    <img src="./thumbs/cpphtp6.jpg" id="cpphtp6">
30    <img src="./thumbs/iw3htp4.jpg" id="iw3htp4">
31    <img src="./thumbs/jhtp7.jpg" id ="jhtp7">
32    <img src="./thumbs/vbhtp3.jpg" id="vbhtp3">
33    <img src="./thumbs/vcsharphtp2.jpg" id="vcsharphtp2">
34    <img src="./thumbs/chtp5.jpg" id="chtp5">
35    <div class="box" id="contentArea"></div>
36 </body></html>
```

Load JQuery JavaScript library

When the DOM is fully loaded, execute this function;

It registers three event handler functions to the <img> tag ;

When the mouse enters an imageThe url is constructed based on image tag's id value

When the mouse leaves an image, clear the tag with id "contentArea";

When the mouse enters this image, load the content form this url "cpphtp6.html" to the division with id "contentArea"

Selectors in the Example code


```
<body>
  <h1>Mouse over a book for more information.</h1>
  <img src="./thumbs/cpphtp6.jpg" id="cpphtp6">
  <img src="./thumbs/iw3htp4.jpg" id="iw3htp4">
  <img src="./thumbs/jhtp7.jpg" id ="jhtp7">
  <img src="./thumbs/vbhtp3.jpg" id="vbhtp3">
  <img src="./thumbs/vcsharphtp2.jpg" id="vcsharphtp2">
  <img src="./thumbs/chtp5.jpg" id="chtp5">
  <div class="box" id="contentArea"></div>
</body></html>
```

```
<script type="text/javascript">
$(document).ready(function(){
    $("img").mouseenter(function(){
            var url = $(this).attr("id") + ".html";
            $("#contentArea").load(url);
    });

    $("img").mouseleave(function(){
    $("#contentArea").html("");
  });
})
</script>
```

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The Client-side Script

```
$(document).ready(function(){
  $('#button').on('click', function(e){
      var parameters = {title: $('#title').val() };
     $.get( 'revisionajax/getLatest',parameters, function(result) {
      $('#results').html(result);
    });
  });
});
```

```
$(document).ready(function(){
  $('#button').on('click', function(e){
    var data=$('#title').val();
    $('#results').load('revisionajax/getLatest?title='+data)
  });
});
```

The jqXHR Object

- All jQuery Ajax requests return a **jqXHR object** to encapsulate the response from the server
  - jqXHR is a superset of the original **XMLHttpRequest** object

- jqXHR can be used handle various server responses:
  - **jqXHR.done()** for success
  - **jqXHR.fail()** for error
  - **jqXHR.always()** is like the regular **try-catch-finally** block

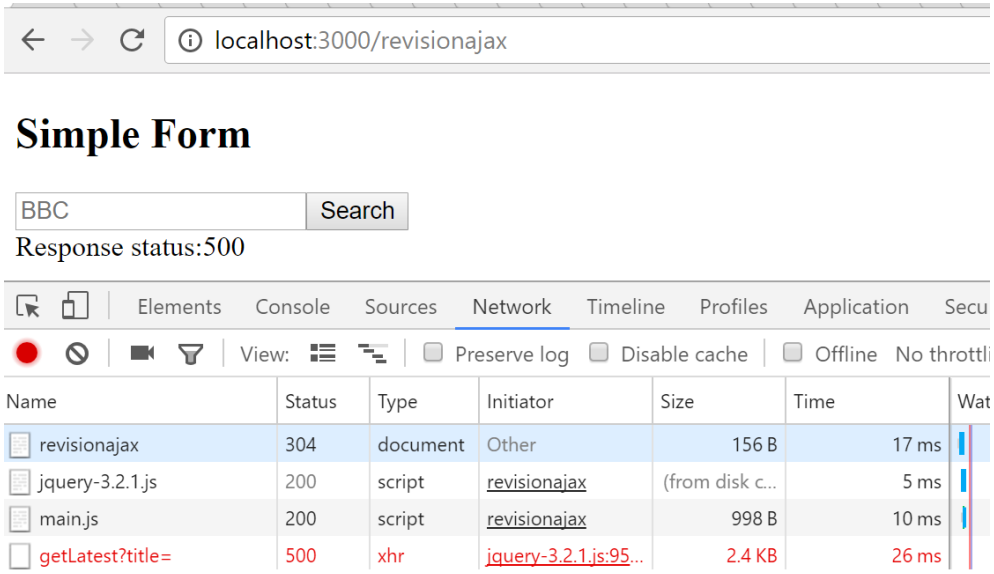
The jqXHR Object Example

```
$(document).ready(function(){
  $('#button').click(function(e){
var parameters = {title: $('#title').val() };
      var jqxhr = $.get( 'revisionajax/getLatest',parameters)
      jqxhr.done(function(result) {
         $('#results').html(result);
      });
      jqxhr.fail(function(jqXHR){
         $('#results').html("Response status:" + jqXHR.status)
      //console.log("Response status:" + jqXHR.status)
      })
  });
});
```

http://api.jquery.com/jQuery.ajax/#jqXHR

The jqXHR Object Example

```
$(document).ready(function(){
  $('#button').click(function(e){
var parameters = {title: $('#title').val() };
      var jqxhr = $.get( 'revisionajax/getLatest',parameters)
      jqxhr.done(function(result) {
          $('#results').html(result);
      });
      jqxhr.fail(function(jqXHR){
          $('#results').html("Response status:" + jqXHR.status)
      //console.log("Response status:" + jqXHR.status)
      })
  });
});
```



http://api.jquery.com/jQuery.ajax/#jqXHR

Same Origin Policy (SOP)

- Cross-origin scripting
  - malicious script (hosted on another domain) try to access the content of other pages on the user's browser
- Important security concept in modern browsers
  - Mostly, restrict what resources JavaScript (and other scripting language) can access inside a browser
    - DOM, Cookie, XMLHttpRequest, and so on
- An origin is defined by protocol, host name and port number
- If two pages are from same origin, the web browser permits scripts from one page to access data in a second page

AJAX – Same Origin Policy

- `XMLHttpRequest` object does not allow a web application to request resources from servers other than the one that served the web application (SOP on XHR)

- Sharing content lawfully between two domains become a challenge
  - E.g., www.funwebdev.com and images.funwebdev.com

AJAX – dealing with SOP

- Implement a server-side proxy— an application on the web application's web server—that can make requests to other servers on the web application's behalf

- **Cross-origin Resource Sharing (CORS)** uses new headers in the HTML5 standard to let site specify other domains that can share its content through JavaScript
  - E.g., Access-Control-Allow-Origin: www.funwebdev.com

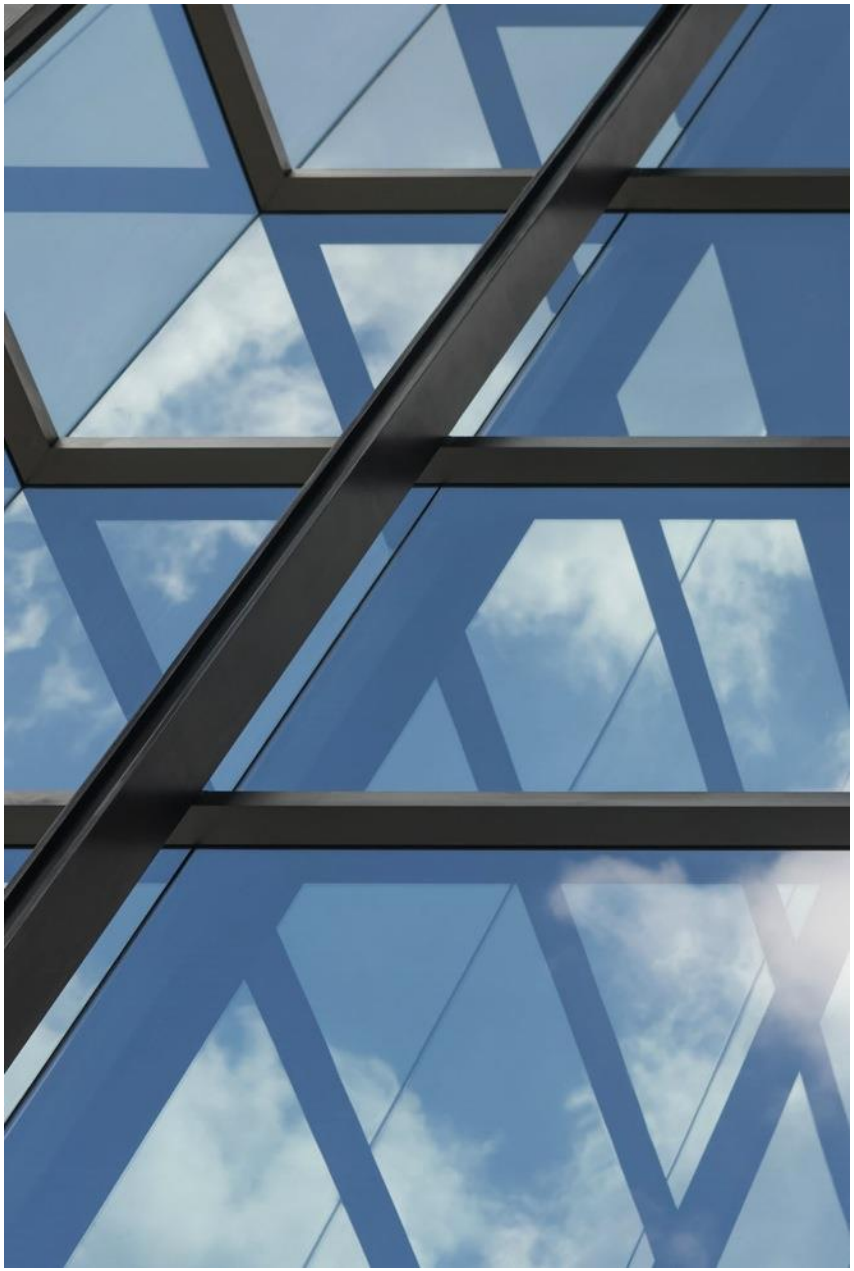
Resources

- Randy Connolly, Ricardo Hoar, Fundamentals of Web Development, Global Edition, Pearson
- W3C school jQuery Tutorial
  - http://www.w3schools.com/jquery/default.asp
- jQuery API Documentation
  - http://api.jquery.com/

W8 Tutorial: Mongoose

W9 Lecture: Introduction to React/Angular

W9 Tutorial: jQuery/AJAX



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