Asynchronous Javascript + XML (Ajax)

CSE 190 M (Web Programming), Spring 2007
University of Washington

References: w3schools, Wikipedia

Web data

- most interesting web pages revolve around data
  - examples: Google, IMDB, Digg, Facebook, YouTube, Rotten Tomatoes
  - can take many formats: text, HTML, XML, multimedia
- today we'll learn ways to connect to web applications that serve data
- we'll also learn the Ajax technique for retrieving and displaying data on our web pages

URLs and web servers

```
http://server/path/file
```

- usually when you type a URL in your browser:
  - your computer looks up the server's IP address using DNS
  - your browser connects to that IP address and requests the given file
  - the web server software (e.g. Apache) grabs that file from the server's local file system, and sends back its contents to you

- some URLs actually specify *programs* that the web server should run, and then send their output back to you as the result:

  ```
  http://science.slashdot.org/article.pl?sid=07/04/20/1651219
  ```

  - the above URL tells the server `science.slashdot.org` to run the program `article.pl` with certain parameters

Query strings

```
http://www.google.com/search?q=colbert&ie=utf-8
```

- query string: a way of encoding parameters into a URL

  ```
  http://server/path/program?query_string
  ```

- a query string has the following format:

  ```
  field1=value1&field2=value2&field3=value3...
  ```

  - preceded by a `?`
  - `name=value` pairs separated by `&`
- the above URL runs the program `search`, with parameter `q` set to `colbert` and the parameter `ie` set to `utf-8`
  - the program outputs the HTML search results

Web data example

- we have set up a program to retrieve student ASCIImations:
  - the program is called `get_ascii.php`
  - on server `faculty.washington.edu` in folder `/stepp/190m/`
  - accepts required parameter `name` specifying the student's UW NetID
  - accepts optional parameter `file` specifying the student's ASCIImation file name (if no value is passed, uses `asciimation.txt`).
- what URL will request `essigw`'s animation with default file?
- what URL will request `amylocke`'s animation with file name `asciianimation.txt`?

What is Ajax?

- Ajax: Asynchronous Javascript + XML
- not a programming language; a way of using JS
- a way to download data from a server without reloading your page
- allows dynamically displaying data or updating the page without disturbing the user experience
- aids in the creation of rich, user-friendly web sites
  - the most excellent CSE 14x Diff Tool
  - other examples: Google Suggest, Facebook, Flickr, A9

Web applications

- web application: a web site that mimics the look, feel, and overall user experience of a desktop application
  - web app presents a continuous user experience rather than disjoint pages
  - as much as possible, "feels" like a normal program to the user
- some of Google's web apps
  - Gmail, Google Maps, Google Docs and Spreadsheets
- many web apps use Ajax to battle these problems of web pages:
  - slowness / lack of UI responsiveness
  - lack of user-friendliness
  - jarring nature of "click-wait-refresh" pattern

Quick Ajax example

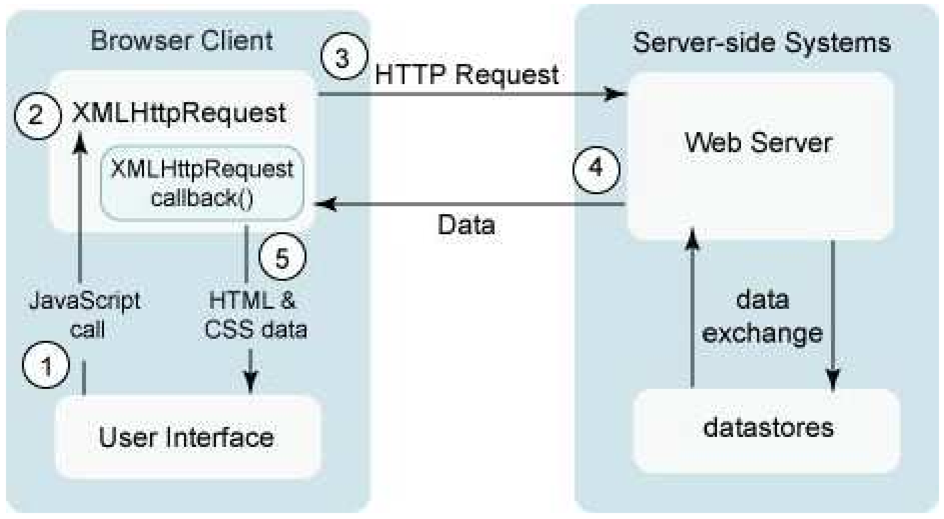
http://www.cs.washingt Fetch

Core Ajax concepts

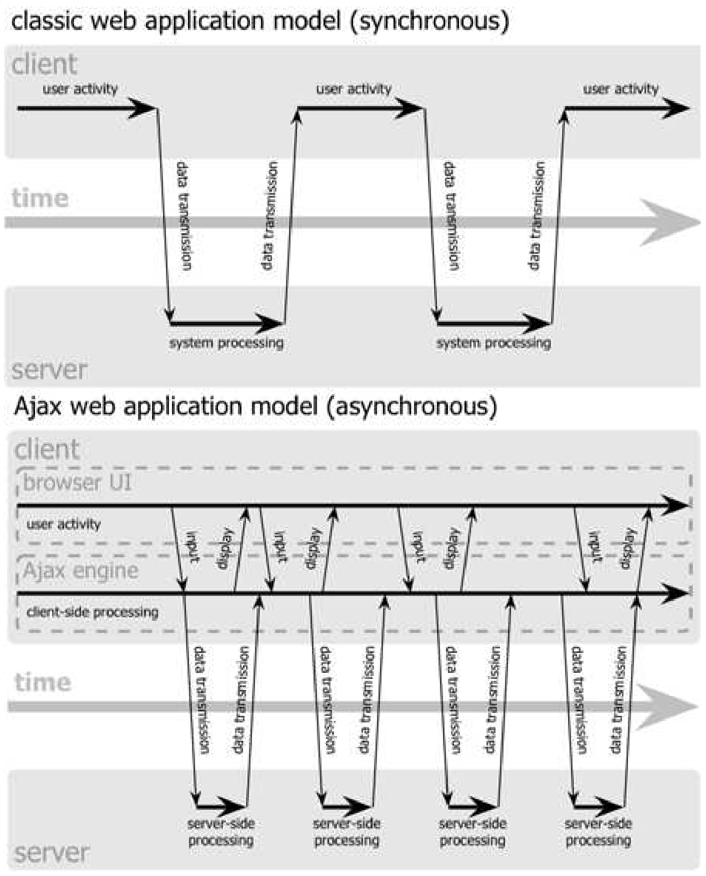
- Javascript's `XMLHttpRequest` object can fetch files from a web server
  - supported in IE5+, Safari, Firefox, Opera (with minor compatibilities)
- it can do this asynchronously (in the background, transparent to user)
- contents of fetched file can be put into current web page using DOM
- result: user's web page updates dynamically without a page reload

A typical Ajax request

- user clicks, invoking event handler
- that handler's JS code creates an `XMLHttpRequest` object
- `XMLHttpRequest` object requests a document from a web server
- server retrieves appropriate data, sends it back
- `XMLHttpRequest` fires event to say that the data has arrived
  - this is often called a callback
  - you can attach a handler to be notified when the data has arrived
- your callback event handler processes the data and displays it



Asynchronous communication



- synchronous: user must wait while new pages load
- asynchronous: user can keep interacting with page while data loads

Ajax communication flow

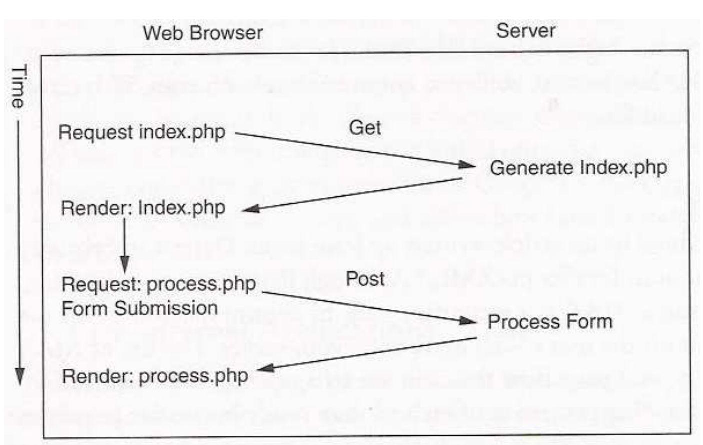


FIGURE 1-1
Web application request flow

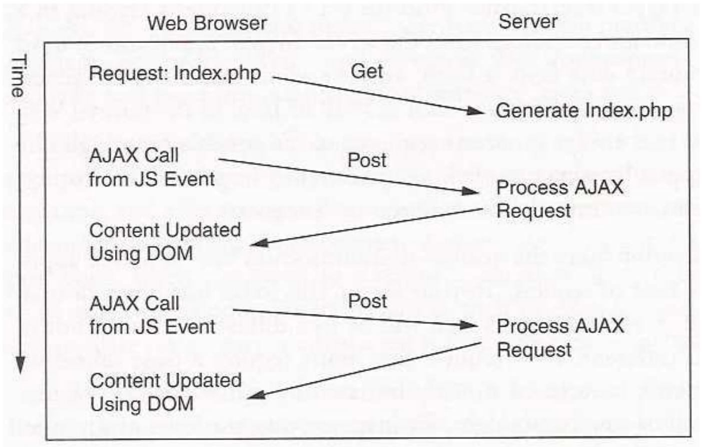


FIGURE 1-2
AJAX application request flow

- Ajax leads to more frequent, smaller communications between browser and server

The `XMLHttpRequest` object

- methods:
  - `abort`, `getAllResponseHeaders`, `getResponseHeader`, **`open`**, **`send`**, `setRequestHeader`
- properties:
  - **`onreadystatechange`**, `readyState`, **`responseText`**, `responseXML`, `status`, `statusText`

Usage of `XMLHttpRequest`

```
// this code is in some onscreen control's event handler
var ajax = new XMLHttpRequest();
ajax.onreadystatechange = function;
ajax.open("GET", url, true);
ajax.send(null);
```

- attach an event handler to the `onreadystatechange` event
- handler will be called when request state changes, e.g. finishes
- function contains code to run when request is complete
- replace url with the file you want to download
- IE6 sucks and requires special `ActiveXObject` code instead

The `readyState` property

- holds the status of the `XMLHttpRequest`
- possible values for the `readyState` property:

State	Description
0	not initialized
1	set up
2	sent
3	in progress
4	complete

- `readyState` changes → `onreadystatechange` handler runs
- usually we are only interested in `readyState` of 4 (complete)

Ajax `XMLHttpRequest` template

```
var ajax = new XMLHttpRequest();
ajax.onreadystatechange = function() {
    if (ajax.readyState == 4) {
        do something with ajax.responseText;
    }
};
ajax.open("GET", url, true);
ajax.send(null);
```

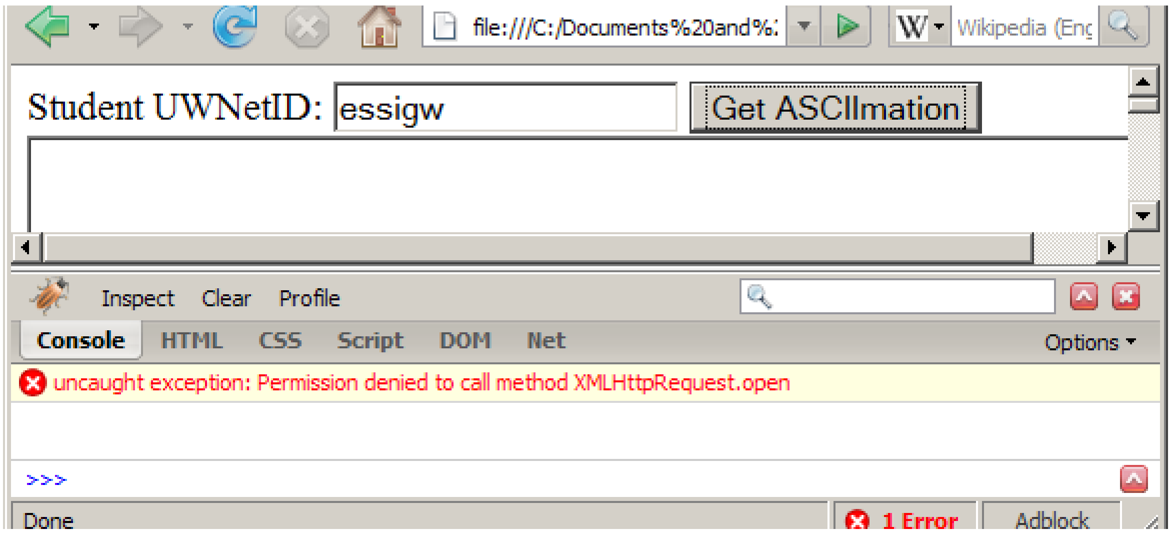
- most Ajax code uses an anonymous function as the event handler
  - a function declared inside another, and not given a name
  - useful because it can access the surrounding local variables (e.g. `ajax`)

What if the request fails?

```
var ajax = new XMLHttpRequest();
ajax.onreadystatechange = function() {
    if (ajax.readyState == 4) {
        if (ajax.status == 200) {
            do something with ajax.responseText;
        } else {
            code to handle the error;
        }
    }
};
ajax.open("GET", url, true);
ajax.send(null);
```

- web servers return status codes for requests (200 means Success)
- you may wish to display a message or take action on a failed request

`XMLHttpRequest` security restrictions



```
uncaught exception: Permission denied to call method XMLHttpRequest.open
```

- cannot be run from a web page stored on your hard drive
- can only be run on a web page stored on a web server
- can only fetch files from the same site that the page is on
  - `www.foo.com/a/b/c.html` can only fetch from `www.foo.com`

Practice problem: ASCIImation viewer

- Edit the provided get_ascii files (HTML, JS) to fetch the student's ASCIImation program from the server-side `get_ascii.php` program using Ajax.
- Add code to allow a custom file name.
- Add code so that the page gives a good error message if the URL is broken or the file is not found.