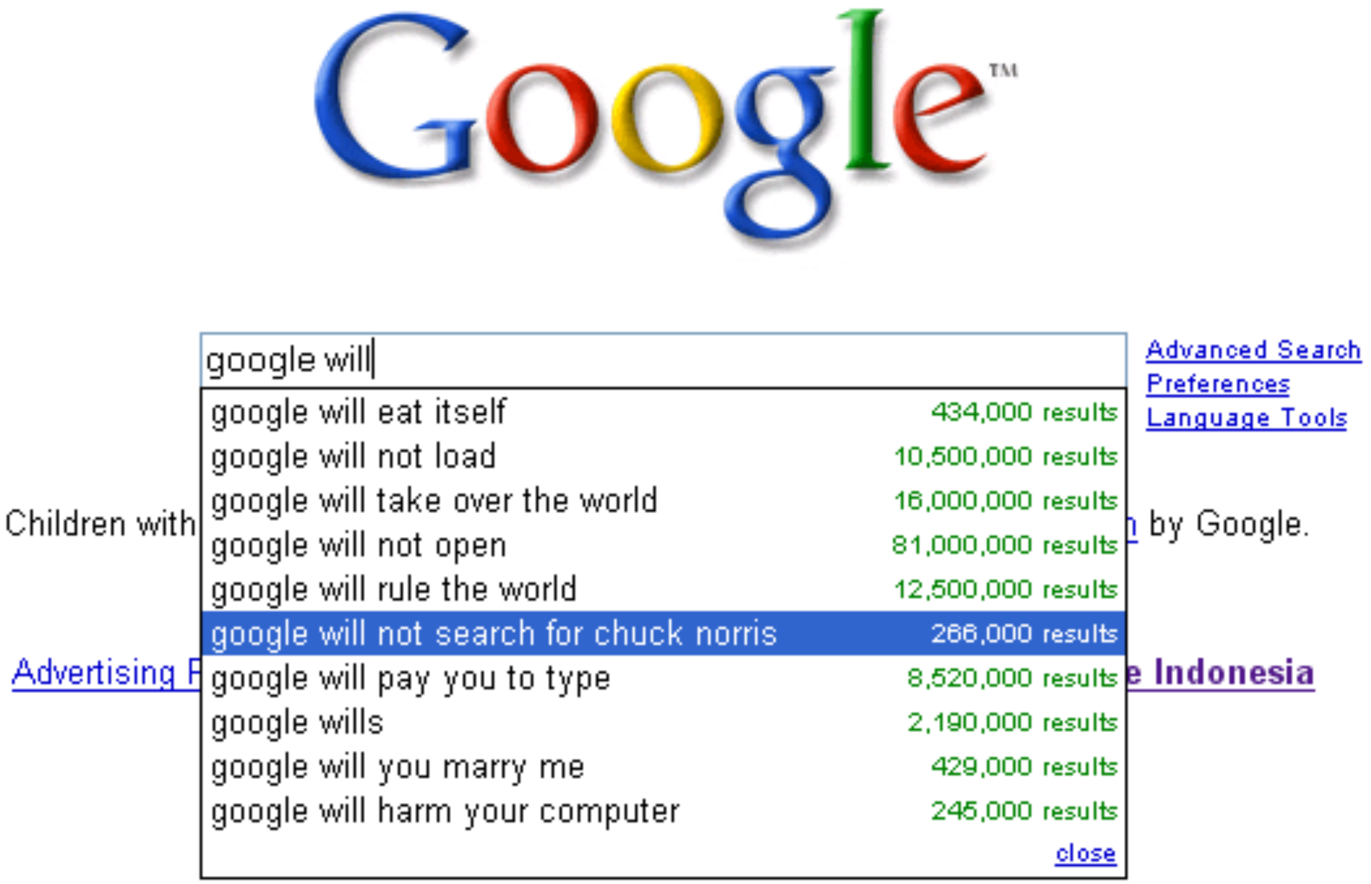
Asynchronous web apps using Ajax



google will

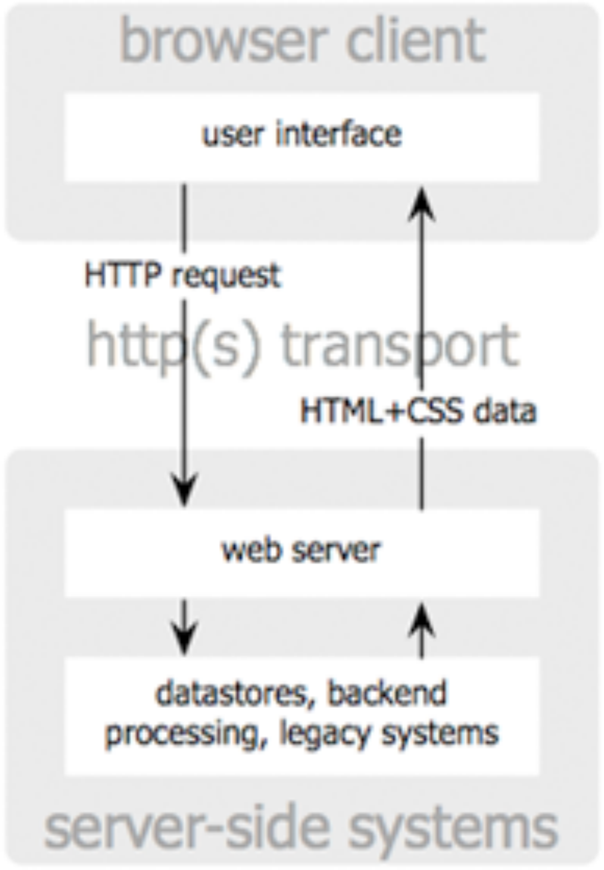
google will eat itself	434,000 results
google will not load	10,500,000 results
google will take over the world	16,000,000 results
google will not open	81,000,000 results
google will rule the world	12,500,000 results
google will not search for chuck norris	266,000 results
google will pay you to type	8,520,000 results
google wills	2,190,000 results
google will you marry me	429,000 results
google will harm your computer	245,000 results

Overview

- Ajax: Asynchronous JavaScript and XML
  - History
  - Basic idea
  - Examples of what it can do
- How it works
  - XMLHttpRequest object
    - Methods and properties
  - Example application

History of Ajax

- In the age before Ajax:
  - Client requests a page
  - Server delivers page
  - Client-side JavaScript can add some interactivity
    - e.g. Validate form fields, pop up alert messages, falling Tetris blocks
    - Whatever the page needs has to be contained in the served page
  - To obtain new information, user must take some action
    - e.g. Hit button to submit form and refresh email



classic
web application model

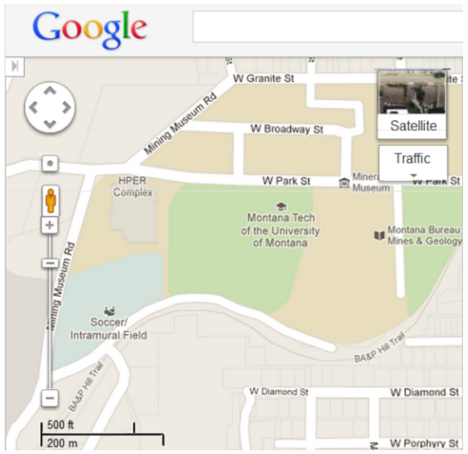
Jesse James Garrett / adaptivepath.com

A small change…

- 1999
  - Microsoft introduces XMLHTTP ActiveX control in IE5
  - Mozilla, Safari and other browser follow suit
    - XMLHttpRequest JavaScript object
    - Microsoft eventually adopts XMLHttpRequest model in IE7
  - Key idea: allows page to do go back for more data
    - Separate from user actions on the page
    - Enables a new wave of responsive and user-friendly apps
- 2000
  - Microsoft uses in Outlook Web Access
- 2002
  - Oddpost uses for web email, bought by Yahoo!

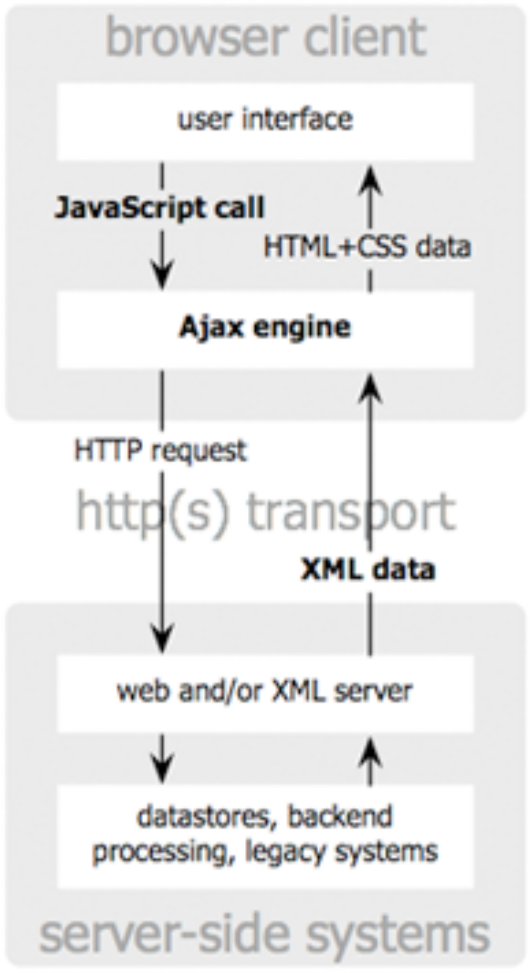
And then…

- 2004, 2005
  - Google uses in Gmail and Maps
  - The world takes notice
- 2005
  - Jesse James Garrett, coins term Ajax
  - Needed something to call combination of:
    - XHTML and CSS
    - Dynamic display and interaction using the DOM
    - Data interchange using XML
    - Asynchronous data retrieval using XMLHttpRequest
    - JavaScript binds things together
- 2006
  - W3C publishes a working draft



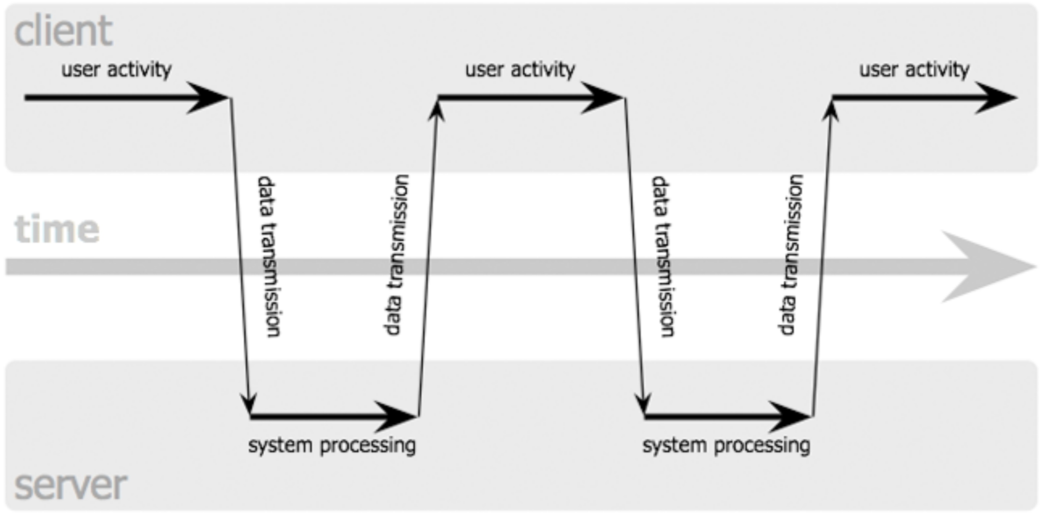
Ajax model

- Eliminates start-stop-start-stop
  - Ajax engine communicates with server periodically
    - Based on user events, e.g. key up
    - Based on a timer
  - Meanwhile user can continue interacting with the page
  - HTTP requests by Ajax engine happen asynchronously
  - Repopulate only a portion of the page instead of re-rendering from scratch

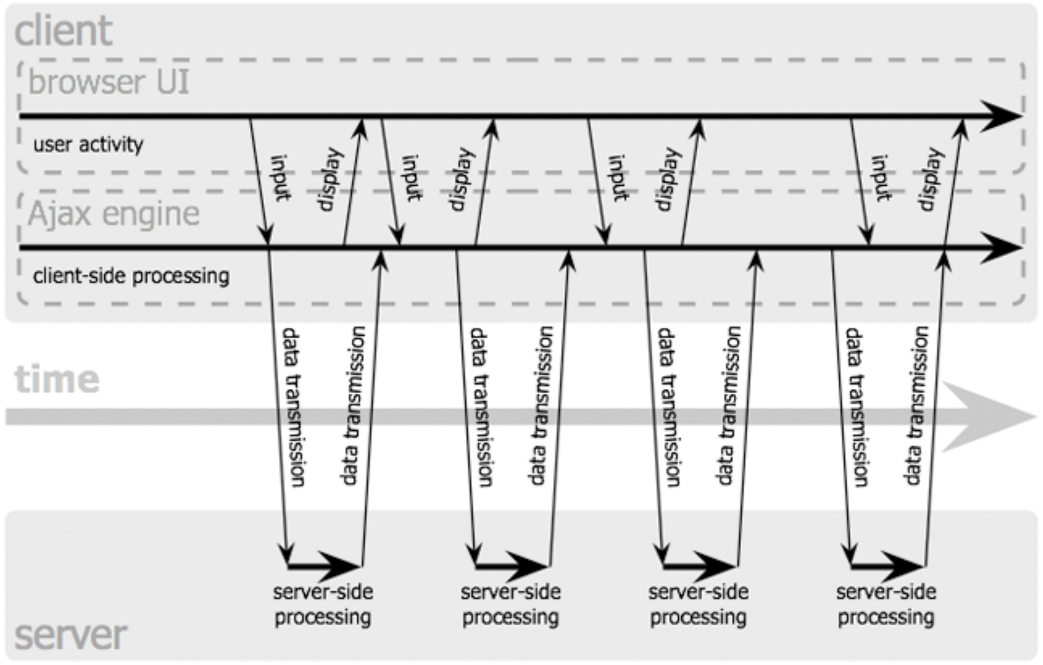


Ajax
web application model

classic web application model (synchronous)



Ajax web application model (asynchronous)



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Examples of Ajax apps

- Google maps: http://maps.google.com
- Google suggest: http://www.google.com/
- Amazon suggest: http://www.amazon.com/
- Lyrics/band search: http://lyricsfly.com/
- Regular expression editor: http://www.rexv.org/
- Wikipedia browser: http://gollum.easycp.de
- Network tools: http://www.ajaxutils.com/
- Multi-player game: http://www.travians.com/
- Our language tutor: http://localhost/tutor.html

How it works

- XMLHttpRequest object
  - Allows JavaScript to retrieve data from the web server
  - Same origin policy
    - Only can request data from domain that served page
    - There are ways around this (stay tuned)

```
var hr = new ActiveXObject("Microsoft.XMLHTTP");
```

Before IE7, creating object using ActiveX.

```
var hr = new XMLHttpRequest();
```

Creating object in Mozilla, Firefox, Safari, Chrome, Opera.

```
var hr;
if (window.XMLHttpRequest)
      hr = new XMLHttpRequest();
else
      hr = new ActiveXObject("Microsoft.XMLHTTP");
```

Cross-browser code for creating the object.

XMLHttpRequest methods

open(method, url, async user, password) - Initializes the XMLHttpRequest object	
method	"GET", "POST", …
url	URL of page to obtain, relative or absolute. Must be on same domain as page called open().
async	Is request asynchronous, optional, default = true
user	Username for authentication, optional
password	Password for authentication, optional

setRequestHeader(name, value) - Set HTTP headers that are sent with request	
name	Text string name of the header field.
value	Text string value of the header field.

send(data) - Actually fire off the HTTP request	
data	Any payload in the HTTP request (e.g. POST data), optional

XMLHttpRequest methods

abort() - Cancels the current request

getResponseHeader(name) - Retrieve value of a specified HTTP header	
name	Text string name of the header field.

getAllResponseHeaders() - Retrieve all the response name/value pairs

overrideMimeType(mime) - Overrides the MIME type of HTTP response	
mime	Text string of new MIME type (e.g. "text/xml")

XMLHttpRequest attributes

- onreadystatechange
  - Method to call on every state change of object
  - Usually the event handler for your application
- readyState
  - Status of the object, changes from 0 to 4:
    - 0: request not initialized
    - 1: server connection established
    - 2: request received
    - 3: processing request
    - 4: request finished and response ready
- status
  - HTTP response code, 200 = OK, 404 = not found, ….
- statusText
  - The string representation of the HTTP response, e.g. "Not Found"

XMLHttpRequest attributes

- responseText
  - Response from the server as a string
  - If server isn't returning XML that you want to parse with DOM
- responseXML
  - Response from the server as XML
  - DOM object that you can call methods on

Putting it all together

- Goal: Provide suggestions based on typed letters
  - Two components, keyword.html and keyword.php
  - HTML page with JavaScript
    - Provide <input> element
    - Call JavaScript function every time key is pressed
    - Make HTTP request with GET param based on current text
    - When result arrives, display in <div> element
  - PHP page
    - Using GET parameter, match against a list of data
    - Return result as HTML text

Cross-domain Ajax

- Same origin policy
  - Prevents security problems
    - Page at www.example.com sharing your data with www.evil.com
  - But often we want to do this for good
    - e.g. Retrieving translation results from Bing web API
  - Allowing cross-domain Ajax
    - Run a proxy on your server:
      - e.g. http://www.example.com/cgi-bin/proxy?req=bing_query_details
    - Cross-origin resource sharing
    - Use a <script> tag with a source URL that returns a JavaScript callback function
      - e.g. The approach taken in the Bing web API samples

Cross-domain with JSON callback

```
function Search()
{
         var requestStr = "http://api.bing.net/json.aspx?"
             + "AppId=" + AppId
             + "&Query=rabbit%20site:wikipedia.org"
             + "&Sources=Web"
             + "&Version=2.0"
             + "&Web.Count=1"
             + "&Web.Offset=0"
             + "&JsonType=callback"
             + "&JsonCallback=SearchCompleted";

        var commScript     = document.createElement("script");
        commScript.src     = requestStr;
        commScript.type    = "text/javascript";
        commScript.charset = "UTF-8";

        if(document.head)
                head = document.head;
        else if(document.getElementsByTagName)
                head = document.getElementsByTagName('head')[0];
        else
                document.write("An error occured");
        head.appendChild(commScript);
}
```

Result from Bing request

```
if(typeof SearchCompleted == 'function')

SearchCompleted(

{"SearchResponse":
   {"Version":"2.0",
    "Query":
      {"SearchTerms":"rabbit site:wikipedia.org"},
       "Web":
         {"Total":5280000,
          "Offset":0,
          "Results":
          [
             {"Title":"Rabbit - Wikipedia, the free encyclopedia",
              "Description":"Rabbits are small mammals in the family
Leporidae of the order Lagomorpha, found in several parts of the world. There
are eight different genera in the family ...",
              "Url":"http:\/\/en.wikipedia.org\/wiki\/Rabbit",
              "DisplayUrl":"en.wikipedia.org\/wiki\/Rabbit",
              "DateTime":"2012-02-05T17:40:00Z"
             }
          ]
       }
    }
} /* pageview_candidate */);
```

Other Ajax problems

- Requires JavaScript and XMLHttpRequest support
  - Trouble on mobile devices?
- Breaks browser back button, bookmarking
  - Solutions involve using # tag, HTML 5 API
- Web crawlers don't use JavaScript
  - If Ajax is used to expose site content, it won't be indexed
- Lots of HTTP requests to server
  - Increases load on your server and network
  - Especially if you proxy for cross-domain requests
- Tricky asynchronous interface
  - Multiple threads of execution, harder to get right

Summary

- Ajax – Asynchronous JavaScript and XML
  - Not really a new technology
  - A style combining existing technologies:
    - HTML + JavaScript
    - XMLHTTPRequest object, asynchronously makes HTTP requests
    - Use DOM to update client's page
  - XML is actually not required
    - Results could be plain text, comma separated, JSON, …
  - Provides many of the useful features you see on the web
    - e.g. Google/Amazon/… auto-complete in search field