Web interfaces

- **Javascript**

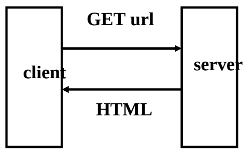
- **HTML**
- **DOM**
- **CSS**

- **XMLHttpRequest**
- **Ajax**

Reprise of HTTP

- **What happens when you click on a URL?**
- **client sends request:**

```
    GET  url  HTTP/1.0
       (blank line)
```



- **server returns**

```
    header info
       (blank line)
    HTML
```

  - since server returns the text, it can be created as needed
  - can contain encoded material of many different types (MIME)

- **URL format**

  service://hostname/filename?other_stuff

filename?other_stuff **part can encode**
  - data values from client (forms)
  - request to run a program on server (cgi-bin)

HTML form

```
<html>
<body>

<FORM METHOD=GET
  ACTION="http://campuscgi.princeton.edu/
      ~bwk/hello1.cgi" >
<INPUT TYPE="submit" value="hello" >
</FORM>

</body>
</html>
```

- **form data is URL-encoded in query string (GET) or to server's stdin (POST)**
- **limited interaction on client side**
- **requires synchronous exchance with server**
  - potentially slow, client blocks waiting for response
- **requires recreating entire page with whatever comes back**
  - even if it's identical to current content

- **how can we make web interfaces more interactive and responsive?**

Javascript

- **very widely used programming language**
- **all browsers support it (though not identically)**
- **usually enabled (though not always)**

- **simple scripting language**
  - C/Java-like syntax
  - about the level of Awk
  - very weakly typed
    - basic data types: double, bool, string, array, object
  - object-oriented

- **runs inside browser**

  `<script>` ***javascript program*** `</script>`
  `<script src="`***url***`"></script>`
  `<sometag on`***SomeEvent***`='`***javascript code***`'>`

- **can catch events from mouse, keyboard, ...**
- **can access browser's object interface**
  - window object
  - document object (DOM == document object model)
- **can create original page and alter it later**

Javascript on a page or two

- **case sensitive**
- **semicolons or newline as statement terminators**
- **// or /*...*/ comments**
- **var x to declare variable**
  - scope is either global or current function
- **double, bool, 'string' or "string" with \ escapes**
  - null for undefined value
- **operators, expressions, and control flow are like C or Java, sort of**
  - for (v in obj) ...
  - try {...} catch( ) {...} finally {...}
- **user-defined functions**

```
 function sum(x, y) { return x + y; }
```

- **arrays are sort of quasi objects**

```
   var a = [zero, 1, "2", 'three', 4.5]
   var b = new Array()
   for (i = 0; i < a.length; i++)
       b[i] = a[i]
```

- **other array methods**
  - sort, shift, join, reverse, ...

Find the largest number

```
<html>
<body>
<script>

 var max = 0
 var num
 num = prompt("Enter new value")
 while (num != null && num != "") {
    if (parseFloat(num) > max)
       max = num
    num = prompt("Enter new value")
 }
 alert("Max = " + max)

</script>
</body>
</html>
```

- **needs parseInt or parseFloat to coerce string value to a number**

Sorting (the hard way)

```
var name, i = 0, j, temp
var names = new Array()

name = prompt("Enter new name")
while (name != "") {
   names[names.length] = name
   name = prompt("Enter new name")
}

for (i = 0; i < names.length-1; i++) {
   for (j = i+1; j < names.length; j++) {
      if (names[i] > names[j]) {
         temp = names[i]
         names[i] = names[j]
         names[j] = temp
      }
   }
}

s = names[0]
for (i = 1; i < names.length; i++)
    s += "\n" + names[i]
alert(s)
```

- **the easy way:**

```
names.sort()
alert(names.join("\n"))
```

Javascript library

- **math**
  - sqrt, max, min, random, ...
- **string**
  - searching, substring, case conversion,
  - convert to HTML, ...
- **regular expressions**
  - about the same as Perl
- **date/time**
  - current time, elapsed time, conversions
- ...

Javascript objects

- **objects are associative arrays**
  - associate names with properties
  - name of property is the subscript
- **can define your own objects**
  - including inheritance
- **can create anonymous objects**

  ```
  var o = { x:1, y:2, z:hello" };
  ```
- **browser environment includes objects like window and document**

DOC: Document Object Model

- **a web page in HTML (or XHTML) is structured data**
  - XHTML is a tag set for HTML
- **the document object model (DOM) is a representation of this hierarchy**
- **DOM methods, properties and events are accessible from Javascript**
  - usually in <form> tag for buttons, text, etc.
  - can also appear in other tags, images, ...
  - event handling code can be attached to tags as attributes
- **window methods and properties**
  - alert(msg), prompt(msg), ...
  - open(url)
  - size, position, scrolling, ...
  - history, status bar, ...
  - document

Embedding Javascript

- **in a form:**

```
<form>
<input type=button value="Hit me"
    onClick='alert("Ouch! That hurt.")'>
<input type=text name=url size=30>
<input type=button value="GO"
    onCLick='window.open(url.value)'>
<input type=button value="color it "
    onClick='document.bgColor=color.value'>
<input type=text name=color
    value='type a color here'>
<input type=button value='make it white'
    onClick='document.bgColor="white"'>
</form>
```

- **in a tag**

```
<body onUnload='alert("bugging out")'>
```

- **on an image**

```
<img src="smiley.gif"
    onMouseover='src="new.gif"'
    onMouseout='src="smiley.gif"'>
```

- **etc.**

CSS: Cascading Style Sheets

- **a language describing how to display (X)HTML documents**
- **separates structure (HTML) from presentation (CSS)**

```
p { font-family: "Garamond", serif; }
h2 { font-size: 110%; color: red;
    background: white; }
a:hover { text-decoration: none;
    color: #f0f; font-weight: bold }
```

- **style property of most document entities can be set by Javascript**

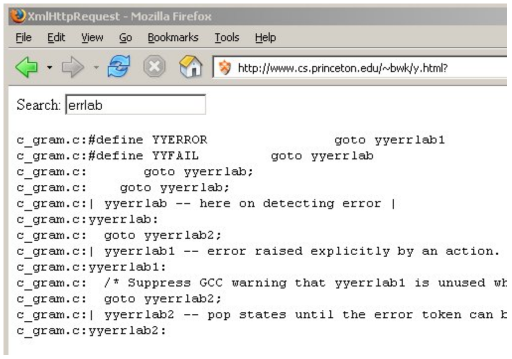
```
<body id="body">
<script>
var b = document.getElementById("body")
b.style.backgroundColor='lightyellow'
b.style.fontFamily='Verdana'
b.style.fontSize='72px'
b.style.color='blue'
</script>
hello
```

XMLHttpRequest

- **interactions between client and server are usually synchronous**
  - so there can be significant delay
  - and page has to be redrawn
- **XMLHttpRequest provides <u>asynchronous</u> communication with server**
- **used in Google Suggest and Google Maps**
  - also Orkut, Gmail, Flickr, A9 (it is said)
- **"The real importance of Google's map and satellite program, however, is not its impressive exterior but the novel technology, known as Ajax, that lies beneath."**
  - James Fallows, *NY Times*, 4/17/05
- **Ajax: Asynchronous Javascript + XML**
  (shorthand/marketing/buzzword term for an oldish idea)
  - XHTML + CSS for presentation
  - DOM for changing display
  - Javascript to implement client actions
  - XML for data exchange with server
    (but it doesn't have to use XML)

Google Suggest in microcosm

```
<body>
<form>
Search:
<input type="text"  id="pat"
  onkeyup='geturl(pat.value); return true;' >
</form>

<pre>

</body>
</html>
```


XmlHttpRequest - Mozilla Firefox
File Edit View Go Bookmarks Tools Help
http://www.cs.princeton.edu/~bwk/y.html?

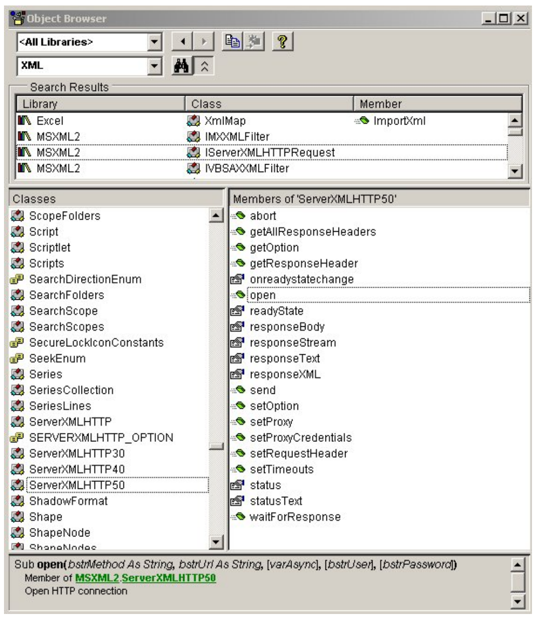
Search: errlab

```
c_gram.c:#define YYERROR                goto yyerrlab1
c_gram.c:#define YYFAIL         goto yyerrlab
c_gram.c:       goto yyerrlab;
c_gram.c:    goto yyerrlab;
c_gram.c:| yyerrlab -- here on detecting error |
c_gram.c:yyerrlab:
c_gram.c:  goto yyerrlab2;
c_gram.c:| yyerrlab1 -- error raised explicitly by an action.
c_gram.c:yyerrlab1:
c_gram.c:  /* Suppress GCC warning that yyerrlab1 is unused wh
c_gram.c:  goto yyerrlab2;
c_gram.c:| yyerrlab2 -- pop states until the error token can b
c_gram.c:yyerrlab2:
```

Basic structure

```
var req;

function loadXMLDoc(url) {
   if (window.XMLHttpRequest) { // native
      req = new XMLHttpRequest();
      req.onreadystatechange = processReqChange;
      req.open("GET", url, true);
      req.send(null);
   } else if (window.ActiveXObject) { // IE ActiveX
      req = new ActiveXObject("Microsoft.XMLHTTP");
      if (req) {
         req.onreadystatechange = processReqChange;
         req.open("GET", url, true);
         req.send();
      }
   }
}

function processReqChange() {
   if (req.readyState == 4) {  // completed request
      if (req.status == 200)   // status OK
         show(req.responseText)
   }
}

function geturl() {
   url = 'http://www.cs.princeton.edu/~bwk/echo.cgi';
   loadXMLDoc(url); // loading is asynchronous
}

function show(s) {  // show whatever came back
   var e = document.getElementsByTagName("P")[0]
   e.firstChild.nodeValue = s
}
```

XMLHTTP methods/properties



Library	Class	Member
Excel	XmlMap	ImportXml
MSXML2	IMXXMLFilter	
MSXML2	IServerXMLHTTPRequest	
MSXML2	IVBSAXXMLFilter	

Classes	Members of 'ServerXMLHTTP50'
ScopeFolders	abort
Script	getAllResponseHeaders
Scriptlet	getOption
Scripts	getResponseHeader
SearchDirectionEnum	onreadystatechange
SearchFolders	open
SearchScope	readyState
SearchScopes	responseBody
SecureLockIconConstants	responseStream
SeekEnum	responseText
Series	responseXML
SeriesCollection	send
SeriesLines	setOption
ServerXMLHTTP	setProxy
SERVERXMLHTTP_OPTION	setProxyCredentials
ServerXMLHTTP30	setRequestHeader
ServerXMLHTTP40	setTimeouts
ServerXMLHTTP50	status
ShadowFormat	statusText
Shape	waitForResponse
ShapeNode	
ShapeNodes	

Sub **open(***bstrMethod As String, bstrUrl As String,* [*varAsync*], [*bstrUser*], [*bstrPassword*]**)**
Member of **MSXML2.ServerXMLHTTP50**
Open HTTP connection

Assessment

- **potential advantages**
  - can be much more responsive (cf Google maps)
  - can offload work from server to client

- **potential negatives**
  - Javascript has to be enabled
  - Javascript is not a great language
  - asynchronous code can be hard to write
  - DOM is very awkward
  - mechanism not yet fully standardized
  - Javascript code is exposed to client

- **what next?**
  - better libraries for XML, DOM ?
  - better tools and languages for programming ?
  - better standardization ?