Web technologies

- **DOM (document object model)**
  - what's on the page and how it can be manipulated
- **forms / CGI (common gateway interface)**
  - extract info from a form, create a page, send it back
  - server side code in Perl, PHP, ASP, JSP, ...
  - client side uses HTML/CSS, Javascript, XML, ...
- **client-side interpreters**
  - Javascript, Flash, Silverlight, HTML5 (animation, audio/video)
- **Ajax (asynchronous Javascript and XML)**
  - update page content asynchronously **(e.g., Google Maps)**
- **libraries, APIs, GUI tools**
  - client-side code for interfaces, effects, ...
    Prototype, Scriptaculous, YUI, JQuery, Dojo, XUL, ...
- **frameworks**
  - integrated systems for creating web applications
    Rails (Ruby), Django (Python), Google Web Toolkit (Java->Javascript), ...
- **mashups**
  - combining data from multiple web sources into single application
- **databases**
  - MySQL, SQLite, ...

Web

- **basic components**
  - URL (uniform resource locator)
  - HTTP (hypertext transfer protocol)
  - HTML (hypertext markup language)
  - browser

- **embellishments in browser**
  - helpers or plug-ins to display non-text content
    pictures (e.g., GIF, JPEG), sound, movies, ...
  - forms filled in by user
    client encodes form information in URL or on stdout
    server retrieves it from environment or stdin
    usually with cgi-bin program
    can be written in anything: Perl, PHP, shell, C, Java, ...
  - active content: download code to run on client
    Javascript
    Java applets
    plug-ins (Flash, Quicktime, RealPlayer, Firefox extensions, ...)
    ActiveX

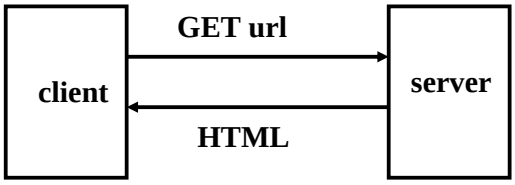
HTTP: Hypertext transfer protocol

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

  `GET` *`url`* `HTTP/1.0`

  `[other header info]`

  `(blank line)`



- **server returns**

  `header info`

  `(blank line)`

  `HTML`

  - server returns text that can be created as needed
  - can contain encoded material of many different types

    uses MIME (Multipurpose Internet Mail Extensions)

- **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)

Forms and CGI-bin programs

- **"common gateway interface"**
  - standard way for client to ask the server to run a program
  - using information provided by the client
  - usually via a form
- **if target file on server is executable program,**
  - e.g., in /cgi-bin directory
- **and if it has right permissions, etc.,**
- **server runs it to produce HTML to send to client**
  - using the contents of the form as input
- **CGI programs can be written in any language**
  - typically Perl, PHP, ASP, JSP, …
- **local CGI facility: campuscgi.princeton.edu**
  - anyone can run CGI scripts
  - restrictions on what scripts can access and what they can do

HTML form hello.html

```
<FORM ACTION="http://campuscgi.princeton.edu/~bwk/hello1.cgi"
      METHOD=GET>
<INPUT TYPE="submit" value="hello1: shell script, plain text">
</FORM>


<FORM ACTION="http://campuscgi.princeton.edu/~bwk/hello2.cgi"
      METHOD=POST>
<INPUT TYPE="submit" value="hello2: shell script, html">
</FORM>
```

[and a bunch of others]

Simple echo scripts hello[12].cgi

- plain text… (hello1.cgi)

```
#!/bin/sh
echo "Content-type: Text/plain"
echo
echo Hello, world.
```

- HTML … (hello2.cgi)

```
#!/bin/sh
echo 'Content-Type: text/html

<html>
<title> Hello2 </title>
<body bgcolor=cyan>
<h1> Hello, world </h1>'

echo "<h2> It's `date` </h2>"
```

- no user input or parameters but content can change (as in hello2)

HTML forms: data from users (surv0.html)

```
<html>
<title> COS 333 Survey </title>
<body>
<h2> COS 333 Survey </h2>
<form METHOD=GET
      ACTION="http://campuscgi.princeton.edu/~bwk/surv2.py">
Name: <input type=text name=Name size=40>
<p> Password: <input type=password name=Pwd
<p> Class: <input type=radio name=Class value=10> '10
           <input type=radio name=Class value=11> '11
<p> CS courses:
    <input type=checkbox name=c126> 126
    <input type=checkbox name=c217> 217
<p> Experience?
    <textarea name=Exp rows=3 cols=40 wrap></textarea>
<p>
    <input type=submit> <input type=reset>
</form>
</body></html>
```

URL encoding of form data

- **how form data gets from client to server**
  - http://hostname/restofpotentially/very/very/longline
  - everything after hostname is interpreted by server
  - usually /program?encoded_arguments
- **if form uses GET, encoded in URL format in QUERY_STRING environment variable**
  - limited length
  - visible in browser, logs, ...; can be bookmarked
  - usually used if no change of state at server
- **if form uses POST, encoded in URL format on stdin (CONTENT_LENGTH bytes)**
  - sent as part of message, not in URL itself
  - read from stdin by server, no limit on length
  - usually used if causes change of state on server
- **URL format:**
  - keywords in keyword lists separated by +
  - parameters sent as **name=value&name=value**
  - funny characters encoded as %NN (hex)
  - someone has to parse the string
    most scripting languages have URL decoders in libraries

Retrieving info from forms (surv2.py)

- **HTTP server passes info to cgi program in environment variables**
- **form data available in environment variable QUERY_STRING (GET) or on stdin (POST)**

```
#!/usr/princeton/bin/python

import os
import cgi
form = cgi.FieldStorage()

print "Content-Type: text/html"
print ""
print "<html>"
print "<title> COS 333 Survey </title>"
print "<body>"
print "<h1> COS 333 Survey </h1>"
for i in form.keys():
   print "%s = %s <br>" % (i, form[i].value)
for i in os.environ.keys():
   print "%s = %s <br>" % (i, os.environ[i])
```

Cookies

- **HTTP is stateless: doesn't remember from one request to next**
- **cookies intended to deal with stateless nature of HTTP**
  - remember preferences, manage "shopping cart", etc.
- **cookie: one line of text sent by server to be stored on client**
  - stored in browser while it is running (transient)
  - stored in client file system when browser terminates (persistent)
- **when client reconnects to same domain,**
  browser sends the cookie back to the server
  - sent back verbatim; nothing added
  - sent back only to the same domain that sent it originally
  - contains no information that didn't originate with the server
- **in principle, pretty benign**
- **but heavily used to monitor browsing habits, for commercial purposes**

PHP (www.php.com)

- **an alternative to Perl for Web pages**
  - Rasmus Lerdorf (1997), Andi Gutmans, Zeev Suraski
  - originally Personal Home Pages, then PHP Hypertext Processor
- **sort of like Perl turned inside-out**
  - text sent by server after PHP code within it has been executed

```
<html>
<title> PHP hello </title>
<body>
<h2> Hello from PHP </h2>
<?php
echo $_SERVER["SCRIPT_FILENAME"] . "<br>";
echo $_SERVER["HTTP_USER_AGENT"] . "<br>";
echo $_SERVER["REMOTE_ADDR"] . "<br>";
echo $_SERVER["REMOTE_HOST"] . "<br>";
phpinfo();
?>
</body>
</html>
```

PHP version of survey (survey.php)

```
<html>
<title>COS 333 Survey</title>
<h4> COS 333 Survey</h4>
<?php
echo "ENV====\n";
foreach ($_ENV as $key => $value) {
        echo "<br> $key = $value\n";
}
echo "POST=====\n";
$s = "";
foreach ($_POST as $key => $value) {
        echo "<br> $key = $value\n";
        $s .= "$key = $value\n";
}
echo "SERVER======\n";
foreach ($_SERVER as $key => $value) {
        echo "<br> $key = $value\n";
}
?>
<P>
<?php $b = mail("bwk", "survey reply", $s);
echo "mail status = $b\n";
echo "mail message = [$s]\n";
?>
</body>
</html>
```

Formatter in PHP

```
<?
$line = ''; $space = '';
$rh = STDIN;
while (!feof($rh)) {
   $d = rtrim(fgets($rh));
   if (strlen($d) == 0) {
      printline();
      print "\n";
   } else {
      #$words = split("/[\s]+/", $d); #doesn't work
      $words = explode(" ", $d);
      $c = count($words);
      for ($i = 0; $i < $c; $i++)
         if (strlen($words[$i]) > 0)
            addword($words[$i]);
   }
}
fclose($rh);
printline();

function addword($w) {
   global $line, $space;
   if (strlen($line) + strlen($w) > 60)
      printline();
   $line .= $space . $w;
   $space = ' ';
}
function printline() {
   global $line, $space;
   if (strlen($line) > 0)
      print "$line\n";
   $line = ''; $space = '';
}
# the \n after the next line shows up in the output!!  even if it's removed!!
?>
```

Formatter in Ruby

```
$space = ''
$line = ''

def addword(wd)
   printline() if $line.length()+wd.length()>60
   $line = "#{$line}#{$space}#{wd}"
   $space = ' '
end

def printline()
   print "#{$line}\n" if ($line.length() > 0)
   $line = $space = ''
end

while line = gets()
   line.chop       # get rid of newline
   if (line =~ /^$/)
      printline()
      print "\n"
   else
      line.split().each {|wd| addword(wd) }
   end
end
printline()
```

Why scripting languages?

- **very expressive**
- **efficient enough (usually)**
- **extensible (usually)**
- **portable**

- **good for glue, prototyping**
- **often good enough for production**

- **see John Ousterhout on scripting languages:**
  http://home.pacbell.net/ouster/scripting.html

- **downsides:**
  - creeping featurism
  - inconsistencies among similar languages