ECE 435 – Network Engineering
Lecture 4

Vince Weaver

https://web.eece.maine.edu/~vweaver

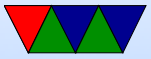
vincent.weaver@maine.edu

10:00am, Barrows 123

30 January 2026

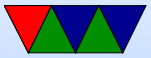
Announcements

- Homework #1 due today
- Homework #2 will be delayed a bit, will send an e-mail when posted
- Sorry if slow responding to e-mails, ECE177 is keeping me busy

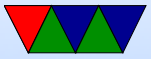


The World Wide Web – precursors

- Before the WWW how did you use the internet?
- telnet: to connect to other machines, including for things like chatting/gaming (talkers/MUDs)
- e-mail: to communicate with other people
- usenet: sort of like a big distributed discussion forum
- file-transfer: ftp
  - random places would host files
  - only some allowed uploads
  - anonymous ftp let anyone download

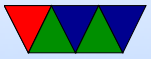


- there were some attempts at search, like archie (archive w/o the V)
- for people w/o reliable network some places would slowly e-mail you a file you wanted piece by piece
- things were really slow, sometimes better off getting CD-rom mailed to you



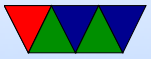
Gopher

- The most similar predecessor
- university of Minnesota, 1991.
- Text based way to share info, could follow links
- search with jughead/veronica (pun on archie)
- Why fail? UMN tried to charge license fee, much more restricted file format than html.
- Some retro people still have support (though firefox dropped support a while ago)



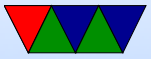
The World Wide Web – history

- World-Wide-Web: Tim Berners-Lee, CERN, (NeXT machine) Initial Proposal 1989, first text-based prototype 1991
- Marc Andersen UIUC worked on graphical browser, Mosaic, 1993
- Andersen went on to form Netscape Communications 1994. Webserver software, made Navigator ("mozilla") relatively cheap/free to drive uptake of web servers.
- Microsoft Internet Explorer. Licensed version of Mosaic.

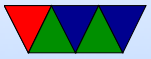


1995 (as add-on to Win95). MS paid percentage royalties to Spyglass Mosaic, so what happened when they gave it away for free?

- Browser wars.
- Netscape bought by AOL in 1998
- By 2000, IE had over 80% due to bundling with windows, famous lawsuit
- Gap between IE6 and IE7 of 5 years (2001 to 2006)
- Netscape released firefox as open source in 2004
- Safari/Webkit browsers based off of KDE browser
- Google Chrome took over the lead around 2012 or so



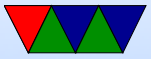
- Standards fight. ACID test.
- IE cancelled, with Edge Microsoft joins everyone besides firefox by using webkit-based engine



Top Browsers

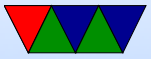
1996	Mosaic 1.2%	Netscape 77.3%	IE 19%				
2003	IE 94%	Firefox 2%	Safari —	Opera 1%	Navigator 1%		
2010	IE 42%	Firefox 29%	Chrome 11%	Safari 6%			
2017	Chrome 46.5%	Safari 21.5%	IE 10.1%	Firefox 6.3%	Edge 1.9%	Opera 1.3%	Android 1.2%
2021	Chrome 52.5%	Safari 23.9%	Edge 3.0%	Firefox 4.4%	Samsung 2.2%	Opera 1.0%	

Stats can vary for desktop vs mobile. Stats from Wikipedia. EWS for 1996. TheCounter.com for 2003, wikimedia 2010,2017,2021



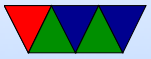
Modern Situation

- webkit-based browsers most of market
  - Chrome, Safari, Edge
  - All trace lineage to KDE Konquerer engine
- Firefox tries, but management not helping, and they get a lot of their money from google anyway
- Some alternatives
- Still some test based: lynx, links, w3m. Sadly google dropped support for them recently



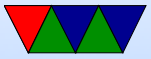
HTML

- HTML – hyper text markup language
- Based on SGML (Standard Generalized Markup Language)
- Hypertext (documents that can link to each other) actually proposed by Vannevar Bush in 1945
- Simplest form, just a text file with some extra commands specified in angle brackets, and usually a closing tag with a / in it. Case insensitive (though supposed to use lowercase these days).

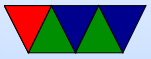


HTML Standards

- Internet Engineering Task Force (IETF) HTML 2.0 in 1994
  RFC 1866, 1867, 1942, 1980, 2070
- Since 1996 by the World Wide Web Consortium (W3C)
- 2000 HTML (ISO/IEC 15445:2000)
- HTML 4.01 in 1999
- HTML5 by Web Hypertext Application Technology Working Group in 2014 (in response to FLASH)
- Javascript (ECMAscript) ECMA-262 and ISO/IEC 16262

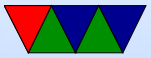


- HTML4 vs HTML5 vs XHTML
- XML (trendy for a bit) eXtensible markup language, can do things like add new tags on fly

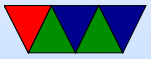


Sample ancient HTML

```
<!DOCTYPE html>
<html>
<head><title>ECE435 Test</title></head>
<body>
<center><h1>ECE435 Test</h1></center>

<hr>

This is a test.
<img src="image.png" alt="alternate text">
```

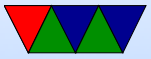


```
<br>Line Break
<!-- Comment -->
<p> Paragraph
<b>Bold</b> <i>Italic</i>

<a href="other.html">A link to another page</a>

</body>
</html>
```



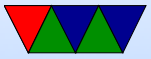
Other HTML tags

- Bulleted list
- Tables relatively easy (also abused for formatting)
- Input / Submitting back to the website (HTML forms)
- Early on vendors went crazy with custom tags: Marquee tag, Blink Tag. Frames.
- “view source”

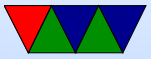


Postel's Law / Robustness Principle

- "Be conservative with what you send, liberal with what you accept"
- Turns out to be trouble. What if a major browser auto-closes a forgotten tag?
- People developing with it won't notice bug in their HTML because "it works for me"
- Users of other browsers don't complain to the author, but to their browser makers "the site is broken with your browser"

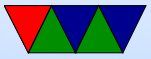


- They can become bug-compatible, but in the end have to maintain that code forever



HTML Formatting

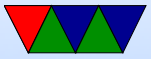
- Originally idea was no formatting, web browser should automatically display simple text in a way to best be displayed on your local machine (sort of like markdown)
- Publishers/graphics designers got a hold of it and that's where all the pixel perfect positioning stuff came in
- CSS (cascading style sheets), Javascript



Dynamic Content – Server Side

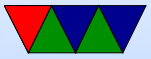
- cgi-bin: Write a program that takes input as environment vars, output as standard out sent to the requesting browser.

  Can write in any program. Typically was things like perl, I often did this in C or even Fortran
- Dynamic content – SSI (server side includes)
- Server extensions (such as PHP, modperl, ASP, .NET) more commonly used (with security issues)



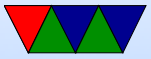
Dynamic Content – Client Side

- Mostly Javascript
- Huge blobs of code that run on your computer, rather than the server (fan spins up viewing website)
- Lots of security implications



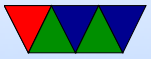
Plugins

- Ways to extend browser with external plugins
- Flash player
- JAVA applets
- Ad blockers
- On the way out for security issues but also companies not wild about ad blockers



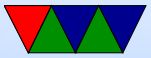
Other Modern Web Content

- Web Assembly?
- WebGL?
- Infinite scrolling websites?



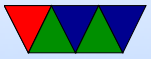
WWW client – brief overview

- A URL (uniform resource locator) specifies the document you want (sometimes partly hidden these days)
  `http://web.eece.maine.edu/~vweaver/`
- Browser parses URL
- It looks up the address of web.eece.maine.edu via DNS
- DNS reports 192.168.8.99
- Browser makes TCP connection to port 80 (default) of 192.168.8.99
  how do you specify other port? web.eece.maine.edu:8080



why would you want to?
security

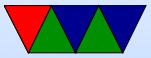
- The client requests the file vweaver/index.html (index.html is the default). Often there's a server root, and special handling for user dirs (with the tilde) that are often in user home dirs, as in this case
- The server returns this file
- The TCP connection is closed
- The browser displays the text
- The browser might have to fetch any images linked to by the document



URLs

- URI (uniform resource identifier)
- URL (uniform resource locator) subset of URI, includes info on how to find the resource (protocol and server)

- URN (uniform resource name) asks for a document but from anywhere. I.e. give it something like an ISBN and returns the book
-
```
scheme:[//[user:password@]host[:port]][/]path[?query][#fragment]
: / ? # [ ] @ reserved, must encode if use %3f
query key1=value1&key2=value2 or key1=value1;key2=value2
```
- protocol: http, ftp, file, news, gopher, mailto, telnet



Serving Non-HTML Files

- You can serve up any kind of binary file. Often have associated MIME-type like with e-mail
- Browser also often has built in support
- GIF (trouble due to patents), PNG, JPG, SVG, WEBP
- MP3 music? Movies?
- Plugins. Flash? Java? PDF?
  deprecated. PDF viewer built into browser now