PFTD: What is Computer Science?

- Understanding *scale*, what does it mean?
  - Using numbers to estimate size, performance, time
  - What makes a password hard to break?
  - How hard to break encrypted message?

- Part of understanding computer science, not because numbers intrinsically interesting

Review: Background on Bits

- Bit is a *Binary digit*
  - What's binary? What's a digit?
  - It's all zeros and ones in computers on Internet? mp3?

Scale and Bits: Binary Digits

- Number of IPv4, 32-bit addresses?
  - How many 33-bit addresses?
  - $2^{32}$ and $2^{33}$, how do these compare?

- If you use a 32-bit encryption key, and computers can test one billion keys/second
  - # seconds to break with brute force?
  - If we add 1 bit, how many seconds?
  - # seconds for 128-bit encryption key?

- Skype uses 256-bit encryption key!

BIT: Binary Digit

- Why do humans use base-10 numbers?
- Why do computers use base-2 numbers?

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What matters, what doesn't

- Adding 01 to 11 to get 100?
  - Adding 1 to 3 to get 4

- Using 64 bit or 128 bit or 256 bit encryption
  - What does browser use? why?

- How can we scale a computational solution
  - From Thimble to Facebook

Reasoning about scale and IPv6

- One bit: 0,1
- Two bits: 00, 01, 10, 11
- Three bits: 000, 001, 010, 011, 100, 101, 110, 111
- n bits: how many values? $2^n$

- 128 bits? $2^{128} = 3.4028237e+38 = 3.4 \times 10^{38}$
- Divide by a billion
  - Which is ... (what's a billion?)
  - Use the Google (or the Bing)

Simple combinatorics

- X.Y where X is two colors, Y is 3 foods
  - green banana, yellow bagel, green cheese
    - How many total combinations?

- X.Y where X is 5 names, Y is 26 letters
  - How many total combinations?

- Four letter strings, all lower case 'a'-'z'
  - How many (not real: qitzb counts)

- Dotted quad IPv4 address? x.y.z.w
  - 32 bits, or four 8 bit parts, ...

How do you answer questions?

- It depends on ...
  - For this course and getting credit

- What's rhythm?
  - (if you gotta ask, you ain't got it)
  - Fats Waller

- What's jazz?
  - (if you have to ask, you'll never know)
  - Louis Armstrong
Question Interlude


Work with a partner or two

YouTube terabytes video/day

- What kind of search queries help?
  - What does response depend on?
  - How do you explain/justify your response

- Record steps, play back
  - Convince others

Memphis, FedEx packages/day

- Why is Memphis important?
  - Determining if you don't know already

- Spend time searching
  - Spend time reasoning
  - Spend time calculating

World Wide Web, simplified
Web Server (client server)

- What does a web server do?
  - netcraft.com (server share)
  - Serves content via HTTP
  - Handles requests from many clients
  - Uses the Internet to communicate
  - Hardware and software

Web Browser (client server)

- What does a browser do?
  - http://www.w3schools.com/browsers/browsers_stats.asp
  - Connects to servers
  - Authenticates with certificate authorities
  - Renders content
  - Interacts with File and Operating systems

Anatomy of a web [page | site]

- What is a web page? What is a web site?
  - How is it accessed? Who accesses it?
  - How is it built? What are the issues?

- What the standards?
  - How does HTML work?

HTML: from theory to practice

- HyperText Markup Language
  - What is HTTP? What is the difference?
- Information sent from server to client, rendered in a browser
  - Browser uses mark-up, displays to user
  - <xyz> ... </xyz> what does this mean?
  - <img src="URL"> what does this mean?
  - <a href="URL">click me</a> ...
HTML revisited

- Platform differences
  - OS, phone/laptop, character set, ...
- Accessibility, vision, reading, ...
  - Combined with platform

- Aesthetics matter, content matters, revisiting history: wayback machine, internet archive
  - URL here

HTML, another layer

- Interactive webpages, client and server
  - Benefits of interacting client-side (you)
  - Drawbacks of NOT going to server
  - Validating form data

- UI and UX, interactions with app/pages
  - User Interface, User Experience
  - Architect, builder, carpenter, mason, plumber, ...

What is Net Neutrality?

The secret of the Internet's success has been its openness to new services. Google and Facebook were started by students; eBay was started by a guy in his apartment. These innovators didn't need to beg or buy permission from anyone. Once they bought a connection to the Internet, their traffic got the same treatment as everyone else's.

Ed Felten

- Chief Technologist
  - FTC, 2011-2012
- Princeton professor
- @EdFelten

Ed Felten http://nyti.ms/boxZJx
Three Flavors of Net Neutrality

- **End-to-End Design**
  - Engineering Principle
- **Nonexclusionary Business Practices**
  - Economic Principle
- **Content Nondiscrimination**
  - Free speech principle

This is from 2008, it's always current

What is Net Neutrality?

Network neutrality is best defined as a network design principle. The idea is that a maximally useful public information network aspires to treat all content, sites, and platforms equally.

http://timwu.org/network_neutrality.html
http://wapo.st/1eGXfJu

Abstraction
Computers: Bits and Atoms
- What flows through wires? Memory? Drives?
  - Electricity? Light? …
  - What is a computer?

- Some videos are easier to copy
  - Visit the stacks, visit ereserves/JSTOR

Bits and Atoms: Negroponte
  - Are there differences?

- Negroponte's Being Digital
  - http://bit.ly/12xV0f
Bits and Atoms again

- Amazon, Kindle, 1984
  - July, 2009

Comparing Bits and Atoms

- Number of atoms in the observable universe
  - Where do you find an answer to this?
  - What about atoms on Earth? Different?

- Number of IPv6 addresses
  - Where do you find this out?
  - How does compare to IPv4?
  - What is the v in IPv?

What is IPv6?

  - When will the Internet stop growing?
  - What did Chicken Little say?

- Difference between 32 bits and 128 bits?
  - $2^{32} = 4,294,967,296$
  - $2^{128} = 340,282,366,920,938,463,463,374,607,431,768,211,456$

Popularity index

- What about Internet Traffic?

- What about browsers and servers?
  - Browsers: [w3schools](http://w3schools.com)
  - Servers: it depends: sites versus traffic