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?

<p>| | | |</p>
<table>
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<tr>
<th></th>
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</tr>
<tr>
<td>10</td>
<td>2</td>
<td>$1 \times 2^1 + 0 \times 2^0$</td>
</tr>
<tr>
<td>11</td>
<td>3</td>
<td>$1 \times 2^1 + 1 \times 2^0$</td>
</tr>
<tr>
<td>100</td>
<td>4</td>
<td>$1 \times 2^2 + 0 \times 2^1 + 0 \times 2^0$</td>
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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? $2^{128} = 3.4028237 \times 10^{38}$
- 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: qtbz 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 http://nyti.ms/boxZJx
Ed Felten

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

Compsci 92, Spring 2014
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