CSE 461: Computer Networks

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Who we are
ICTD

• Information and Communication Technology for Development
  • Development -> Poverty Alleviation (not software development)
  • Broad field covering health, justice, and access

• Why?
  • Lots of natural intuition from Alaska, I know rural.
  • Able to use networking skill -> Many opportunities (NSRC)

• My subfield: Cellular access
• My Answer: Community Cellular
BE THE PHONE COMPANY.

No more waiting for coverage: now you can build cellular networks yourself.

Learn More
TAs Now!
Matt J.

- From Houston, TX, USA
- Grad Student at UW CSE - researching rural networking
- Love reading, photography, and bikes
- Office hours Mondays before class M(11:30-12:30) in CSE2-131
Name: Chenyang Fang (Michael)

Year: Senior

What I like: Music Music and Music

Favorite Band: The Stone Roses

Favorite Guitarist: John Squire

Favorite Professor: Kurtis Heimerl

Favorite Town: KurtisTown

I don’t really have many photos 😊
I’m a senior CSE undergrad
I also minor in Japanese
I love watching movies
This is my first time TA-ing
Class Structure
Book

• Previous years used *Computer Networks (5E 12), Peterson*
  • Normal book for normal classes.

• We're moving to *Computer Networks (6E 19), Peterson*
  • Open source book still in development by same authors
  • Lots of repeated content
  • ++ -> It's free and covers new exciting things
  • -- -> It's buggy and there are no questions
Grading

• **Reading and Quizzes: 15%**
  • Reading from online book and quizzes per chapter held in section
  • Covers reading and in-class material
  • Expect around 6-7 of these
Grading

• Reading and Quizzes: 15%
• 3 Projects: (15 + 15 + 15)%
  • Socket programming (basic networking)
  • Link and Network layer behavior (link layer)
  • HTTP Proxy (application layer)
Grading

• Reading and Quizzes: 15%
• 3 Projects: (15 + 15 + 15)%
• **Midterm: 15%**
  • Somewhere in the middle of the quarter (was late October last year)
Grading

• Reading and Quizzes: 15%
• 3 Projects: (15 + 15 + 15)%
• Midterm: 15%
• Final: 25%
  • Comprehensive of all content from the class
Grading

• Reading and Quizzes: 15%
• 3 Projects: (15 + 15 + 15)%
• Midterm: 15%
• Final: 25%

Late Policy: Each person gets three late days. Late days will be decided at end of quarter and selected as to have the most positive impact.
Administrivia

• Office hours
  • Opportunity to have more personal interactions with both me and the TAs.

• Tools
  • Mailing list: primary class communications
  • Canvas Assignments: Homework and projects
  • Canvas Discussion: Back and forth discussions on class content
  • Canvas Gradebook: Grades will be posted here

• Slides
  • Adapted from David Wetherall, his talks are online
  • I will be posting my own slides right before lecture as well
Laptop Policy

• Laptops are fine
  • If you are going to be on Facebook do it in the back of class
    • This is distracting to other students
  • TAs will be enforcing this policy
Questions?
CSE 461: Computer Networks
Focus of the course
Focus of the course (in today’s terms)
Focus of the course (2)

• Three “networking” topics:

<table>
<thead>
<tr>
<th>Distributed systems</th>
<th>CSE 452</th>
</tr>
</thead>
<tbody>
<tr>
<td>Networking</td>
<td>CSE 461</td>
</tr>
<tr>
<td>Communications</td>
<td>EE 417</td>
</tr>
</tbody>
</table>
The Main Point

1. **To learn the fundamentals of computer networks**

2. Learn how the Internet works
   - What really happens when you “browse the web”? 
   - TCP/IP, DNS, HTTP, NAT, VPNs, 802.11 etc.

3. Understand why the internet is designed how it is designed
   - SDN, Load Balancers, Architectures
Why learn the Fundamentals?

1. Apply to all computer networks
2. Intellectual interest
3. Change / reinvention
Fundamentals – Intellectual Interest

• Example key problem: Reliability!
  • Any part of the Internet might fail
  • Messages might be corrupted
  • So how do we provide reliability?

• Reliability solutions
  • Codes to detect/correct errors
  • Routing around failures ...
## Fundamentals – Intellectual Interest (2)

<table>
<thead>
<tr>
<th>Key problem</th>
<th>Example solutions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reliability despite failures</td>
<td>Codes for error detection/correction (§3.2, 3.3)</td>
</tr>
<tr>
<td></td>
<td>Routing around failures (§5.2)</td>
</tr>
<tr>
<td>Network growth and evolution</td>
<td>Addressing (§5.6) and naming (§7.1)</td>
</tr>
<tr>
<td></td>
<td>Protocol layering (§1.3)</td>
</tr>
<tr>
<td>Allocation of resources like bandwidth</td>
<td>Multiple access (§4.2)</td>
</tr>
<tr>
<td></td>
<td>Congestion control (§5.3, 6.3)</td>
</tr>
<tr>
<td>Security against various threats</td>
<td>Confidentiality of messages (§8.2, 8.6)</td>
</tr>
<tr>
<td></td>
<td>Authentication of communicating parties (§8.7)</td>
</tr>
</tbody>
</table>
Fundamentals – Reinvention

• The Internet is constantly being re-invented!
  • Growth over time and technology trends drive upheavals in Internet design and usage

• Today’s Internet is different from yesterday’s
  • Lots of new exciting things (QUIC, SDN, etc)
  • And tomorrow’s will be different again
  • But the fundamentals remain the same
Fundamentals – Reinvention (2)

- Many billions of Internet hosts and growing ...
  - 5B+ on Cell Networks
  - 3B+ on Internet

Source: Internet Systems Consortium (www.isc.org)
Fundamentals – Reinvention (3)

• Examples of upheavals in the past 1-2 decades

<table>
<thead>
<tr>
<th>Change</th>
<th>Enabling Technology</th>
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<tbody>
<tr>
<td>Emergence of the web</td>
<td>Content Distribution Networks</td>
</tr>
<tr>
<td>Piracy</td>
<td>Peer-to-peer file sharing</td>
</tr>
<tr>
<td>Voice over IP (VoIP)</td>
<td>Quality of Service (QoS)*</td>
</tr>
<tr>
<td>Internet of Things</td>
<td>IPv6</td>
</tr>
<tr>
<td>Mobile Devices</td>
<td>Wireless Networking</td>
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</tbody>
</table>

*mostly actually spare capacity
Fundamentals – Reinvention (4)

• Upcoming/Ongoing upheavals?

<table>
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<tr>
<th>Change</th>
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<tbody>
<tr>
<td>Fake News</td>
<td>Social Media</td>
</tr>
<tr>
<td>No-power devices?</td>
<td>Backscatter</td>
</tr>
<tr>
<td>Generic Networks?</td>
<td>SDN</td>
</tr>
<tr>
<td>Ubiquitous Networks?</td>
<td>Satellite/Long-Distance Networks</td>
</tr>
<tr>
<td>Videos as Comms</td>
<td>High-Bandwidth Mobile (4G/5G)</td>
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Who cares about the internet?

1. Curiosity
2. Impact on our world
3. Job prospects!
From this experimental network (~1970)...

(a) Dec. 1969.  
(b) July 1970.  
(c) March 1971.
To this! (2011)
And this (2015)!

- An everyday institution used at work, home, and on-the-go
- Visualization contains millions of servers
  - Red = .com, Yellow = .org
- Network now contains literally 3 billion people!
Internet – Societal Impact

• An enabler of societal change
  • ++ -> Easy access to knowledge
  • ++ -> Electronic commerce
  • ?? -> Personal relationships
  • ?? -> Private communications
  • -- -> Fake News
  • -- -> Arguing politics on Facebook
Internet – Economic impact

• An engine of economic growth
  • Information sources
    • And lots of ethical questions!
  • ++ -> Online marketplaces
  • ?? -> Social media/Crowdsourcing
  • -- -> "Gig economy"
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Architectures

• Lots of ways to build networks with different tradeoffs

• Goals:
  • Open Access (Internet)
    • Safety--, Security--, Flexibility++, Privacy++
  • Identity First (Cellular)
    • Safety++, Security++, Privacy --, Flexibility--
  • Centralized (Comcast)
    • Complexity++, Freedom--
  • Decentralized (Mesh)
    • Complexity--, Freedom++
Why things are how they are

• A bit of a reach – might not make it here
• Modern networking
  • Software defined networks (SDN)
  • Content Delivery Networks (CDN)
  • Cellular Networks
  • Domain Name Service (DNS)
  • Debugging tools: Dig/traceroute/whois
Not a Course Goal

To learn IT job skills

• How to configure specific equipment or technologies
  • e.g., Cisco certifications,
  • Technical whack-a-mole

• But course material is relevant, and we use hands-on tools
  • Hopefully you’ll be able to use these tools to build stuff at the end of class