CSE 461: Computer Networks

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Kyle Yan- kyleyan@cs
Dao Yi - daoyee@cs
Jeff Zhao - zhaox27@cs
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!
Pat Kosakanchit

- BS/MS student
- Currently located in Thailand (15 hours ahead of Seattle)
- Did undergraduate research at ICTD lab on Community LTE Networks
- Love street photography and Thai food
Kyle Yan

- BS/MS student; still here in PST
- Doing research in NLP
- Miss traveling; plan to visit NYC and Japan once quarantine ends
- Miss eating out; favorite Seattle restaurant: Ishoni Yakiniku
- Miss campus; favorite campus spot: the Alberg Terrace (on 6th floor of CSE1)
Dao Yi

• BS/MS student
• Love cooking; except deep fry
• Miss theater; waiting Dune
• Hate corona
• Room in pandemic
Jeff Zhao

- BS/MS student, my last quarter at UW
- Computer Security & Networks
- Big fan of *A Song of Ice and Fire*
- Spring in Vienna, 2017
Rithik Duggempudi

- Senior, last quarter at UW
- 2nd time TAing Computer Networks
- Love anything Sci-fi
- Trying to improve cooking skills due to the pandemic
Class Structure
Grading

• **Assignments: 10%**
  • Reading from the book (Peterson OSS textbook)
  • Canvas homework (try as many times as you want)
Grading

• Assignments: 10%

• **Surprise Quizzes: 5%**
  • Short unannounced timed quizzes during the quarter
  • Conducted on gradescope
  • Drop lowest
  • Alternative times for people off time-zone
Grading

• Assignments: 10%
• Surprise Quizzes: 10%

• **3 Projects: (15 + 15 + 15)%**
  • Use canvas groups (feel free to start making groups now)
  • 3 coding exercises:
    • Socket programming
    • Link and Network layer behavior
    • TCP Bufferbloat
      • New project!
      • May default to HTTP Proxy
Grading

• Assignments: 10%
• Surprise Quizzes: 5%
• 3 Projects: (15 + 15 + 15)%
• Midterm: 15%
• Final: 25%
Grading

• Assignments: 10%
• Surprise Quizzes: 5%
• 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: backup class announcements
  • Canvas Announcements: Primary communication idiom
  • Canvas Assignments: Homework and projects
  • Canvas Discussion: Back and forth discussions on class content
  • Canvas Gradebook: Grades will be posted here
Administrivia (2)

- Slides
  - Adapted from David Wetherall, his talks are online
  - I will be posting my own slides right before lecture as well
- No Section this week.
COVID Effects

• Things are hard now
• Our goal is to be generous but fair
  • Chat with us if there’s a problem in any particular direction
    • We’ll try to help
• Be generous back
  • Staff are people too
  • For instance, daycare gets cancelled
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>
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</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>
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<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>
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</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
  • 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>
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<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 <em>mostly actually spare capacity</em></td>
</tr>
</tbody>
</table>
Fundamentals – Reinvention (4)

• Upcoming/Ongoing upheavals?

<table>
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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)...

To this...
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 – Economic impact

• An engine of economic growth
  • Information sources
    • And lots of ethical questions!
  • Online marketplaces
  • Social media/Crowdsourcing
Internet – Societal Impact

• An enabler of societal change
  • Easy access to knowledge
  • Electronic commerce
  • Personal relationships
  • Private communications
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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
Thanks!

Let’s have a good remote learning quarter together.