Class Structure
Grading

• **Assignments: 10%**
  - Reading from the books
  - Canvas homework (try as many times as you want)
Grading

• Assignments: 10%

• **Surprise Quizzes: 5%**
  • Short unannounced timed quizzes during the quarter
  • Drop lowest
Grading

• Assignments: 10%
• Surprise Quizzes: 5%
• 3 Projects: (15 + 17 + 18)%
  • Use canvas groups (feel free to start making groups now)
  • 3 coding exercises:
    • Socket programming
    • Link and Network layer behavior
    • TCP Bufferbloat
Grading

- Assignments: 10%
- Surprise Quizzes: 5%
- 3 Projects: (15 + 17 + 18)
- **Midterm: 15%**
- Final: 20%
Grading

• Assignments: 10%
• Surprise Quizzes: 5%
• 3 Projects: (15 + 17 + 18)%
• Midterm: 15%
• Final: 20%

Late Policy: Each person gets 13 late days.
Administrivia

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

• Tools
  • Mailing list: Primary class announcements
  • Canvas Announcements: Secondary communication idiom
  • Canvas Assignments: Homework and projects
  • Ed Discussion: Back and forth discussions on class content
  • Canvas Gradebook: Grades will be posted here
Administrivia (2)

• Slides
  • Adapted from David Wetherall and Kurtis Heimerl
  • I will be posting class slides right before lecture as well
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
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
  • 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
Fundamentals – Reinvention (3)

- Examples of upheavals in the past 1-2 decades

<table>
<thead>
<tr>
<th>Change</th>
<th>Enabling Technology</th>
</tr>
</thead>
<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>
</tr>
</tbody>
</table>

*mostly actually spare capacity
## Fundamentals – Reinvention (4)

### Upcoming/Ongoing upheavals?

<table>
<thead>
<tr>
<th>Change</th>
<th>Enabling Technology</th>
</tr>
</thead>
<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>
</tr>
</tbody>
</table>
The Main Point

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   - SDN, Load Balancers, Architectures
Who cares about the internet?

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

ARPANET LOGICAL MAP, MARCH 1977

To this...
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 – 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
The Main Point

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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!