CS 43: Computer Networks
Course Introduction

Kevin Webb
Swarthmore College
September 1, 2015

Grab a clicker and please sit towards the front, next to other students!
What This Class Is About

THE INTERNET IS A SERIES OF TUBES

AND THEY'RE FULL OF CATS
What This Class Is About

• How networks (focus on the internet) work
• How applications that use networks work
  – HTTP, DNS, Email, etc.
• How to write programs that communicate over networks
• How different protocols, policies, and mechanisms interact to provide an effective communication medium
Instructor: Kevin Webb

- http://www.cs.swarthmore.edu/~kwebb/

- Hobbies: Making stuff (woodworking, ceramics), plants, PC games

- Research: Controlling network resource allocation

- Please call me Kevin (or Professor Webb)
Office Hours

• Wednesday 11:00 AM – Noon
• Thursday 2:30 – 4:00 PM (After class)
  – Faculty dept. meeting at 4:15 on Thursdays
• By appointment

• 255 Science Center
Resources

• Piazza Q&A Forum, Github Enterprise
  – https://piazza.com/swarthmore/fall2015/cs43/home
  – https://github.swarthmore.edu

• Slides & audio recordings on course website

• Lab sections:
  – Science Center 256
  – Friday 2:15-3:45, Friday 4:00-5:30
Email Policy

• For public questions: use Piazza!
  – Your classmates benefit from your questions
  – Your classmates can answer your questions
  – I will check the forum frequently

• For private questions: use email (kwebb@cs)

• I will attempt to respond to within 24 hours
How does this class work?

• This class is designed a bit differently from what you might normally be used to
  – Class will be centered around you
  – Requires your participation

• Ever considered why we have lectures?
Traditional Lectures:

- Roughly one millennium old
Traditional Lectures:

- Little opportunity for expert feedback
- Might as well skip class and watch video lectures!
  - (I am not actually suggesting this. Please attend your classes!)
Interactive Classes with Peer Instruction

• You do the “easy” part before class.

Textbook, videos, website

First Exposure

In class quiz

Gauge understanding

Instruction

Fill in gaps, Explore details, Add context, Provide feedback

Exam

Show Knowledge Mastery

• Class is reserved for interactive, customized experiences

• Research on how people learn:
  – Everyone constructs their own understanding
  – To learn, YOU must actively work with a problem and construct your own understanding of it
Clickers!

- Lets you vote on questions in real time.
- Like pub trivia, but the subject is always networks.
- Note which one you’re using. (Take a photo, etc.)
Peer Instruction

• Short quiz at the beginning of class
• During class: pose carefully designed questions
  – Solo vote: Think for yourself and select answer
  – Discuss: Analyze problem in teams of 3
    • Practice analyzing, talking about challenging concepts
    • Reach consensus
    • If you have questions, raise your hand and I’ll come over
  – Group vote: Everyone in group votes
    • You must all vote the same to get your point
  – Class wide discussion:
    • Led by YOU (students) – tell us what you talked about in discussion that everyone should know!
Why Peer Instruction?

• You get a chance to think.
• I get feedback as to what you understand.
• It’s less boring!
• Research shows it promotes more learning than traditional lecture.
Giving out Candy

• To people willing to
  – Ask a question
  – Share an explanation
  – Summarize what their group talked about

• Your explanations are CRITICAL for fellow students’ learning
Example Question

• Individual vote

• Group discussion / group vote
  – Room should be LOUD

• Class discussion
The most useful super power for a college student would be:

A. Invisibility
B. Lots of $$$
C. Telepathy
D. Weather

E: Some other power (be prepared to discuss)
Grading

• 5% Reading Quizzes
• 5% Class participation
• 25% Midterm Exam
• 30% Final Exam
• 35% Programming Assignments
Grading

• 5% Reading Quizzes
• 5% Class participation
• 25% Midterm Exam
• 30% Final Exam
• 35% Programming Assignments

• I will drop your three lowest quizzes/no-shows.
Textbook

- You need this book!
Policies

• Collaboration
  – You may discuss approaches, not solutions
  – You must submit your own work
  – Exams may include questions on programming

• Cheating
  – Zero tolerance for cheating, don’t do it!

• Lab Lateness
  – 48 hours of extra time for the semester
  – Let me know when you’ve submitted
Tentative Schedule

• Midterm – October 22, in class

• Final - TBD

• Labs
  – Out on Fridays (lab section)
  – Due on Thursdays
  – First lab: solo, others in pairs
Administrative Questions?

• All of this info (should be) on class website

• Feel free to ask on Piazza discussion board
Clicker Registration

- [https://clickers.cs.swarthmore.edu](https://clickers.cs.swarthmore.edu)

- Can register for course or one-day loaner
What is the goal of a network?

• Allow devices communicate with one another and coordinate their actions to work together.

• Piece of cake, right?
A “Simple” Task

• Send information from one computer to another

  • Endpoints are called hosts
    ◆ Could be computer, iPod, cell phone, etc.
  • The plumbing is called a link
    ◆ We don’t care what the physical technology is: Ethernet, wireless, cellular, etc.
Is Not Really So Simple
Is Not Really So Simple
Is Not Really So Simple

[Diagram showing connections between Google, AT&T, Quest, CENIC, Sprint, and Swarthmore]
Is Not Really So Simple
We only need...

- Manage complexity and scale up
  - Layering abstraction: divide responsibility
  - Protocols: standardize behavior for interoperability
We only need...

- Manage complexity and scale up
- Naming and addressing
  - Agreeing on how to describe/express a host, application, network, etc.
We only need...

- Manage complexity and scale up
- Naming and addressing
- Moving data to the destination
  - Routing: deciding how to get it there
  - Forwarding: copying data across devices/links
We only need...

• Manage complexity and scale up
• Naming and addressing
• Moving data to the destination
• Reliability and fault tolerance
  – (How) can we guarantee that the data arrives?
  – How do we handle link or device failures?
We only need...

• Manage complexity and scale up
• Naming and addressing
• Moving data to the destination
• Reliability and fault tolerance
• Resource allocation
  – How do we share the network’s capacity?
We only need...

• Manage complexity and scale up
• Naming and addressing
• Moving data to the destination
• Reliability and fault tolerance
• Resource allocation

(Lots of others too.)
Pull back the curtain on the Internet
Why should you care?

• To know how the Internet works
  – What may be wrong with your networks
  – When was the last time you went 24 without going online?

• Network programmers get respect
  – In high demand, get paid well
The Internet is Exciting!

• Rapid growth and success.
  – 1977: 111 machines on Internet
  – 1981: 213
  – 1983: 562
  – 1986: 5000
  – 1989: 10,000
  – 1992: 1,000,000
  – 2001: 150 – 175 million
  – 2002: > 200 million
  – 2011: > 2 billion (~1B are phones/tablets)
Global Internet Device Sales

BI INTELLIGENCE

Source: Gartner, IDC, Strategy Analytics, Company Filings, BI Intelligence Estimates
The Internet is Exciting!

• Rapid growth and success.
The Internet is Exciting!

• Rapid growth and success.

• We’re here at the beginning.
  – Most of the growth happened in our lifetime.
  – Still TONS of untapped potential.

Google
Founded 1998

Facebook
Founded 2004
The Internet is Exciting!

- Rapid growth and success.
- We’re here at the beginning.
- Communication is empowering.
The Internet is Exciting!

• Rapid growth and success.
• We’re here at the beginning.
• Communication is empowering.

(Late 60s)
The scheduled office hour times are...

Wednesday 11:00 AM – Noon, Thursday 2:30 – 4:00 PM

A. Great, I don’t have a scheduling conflict with either one.

B. Probably ok, I don’t have a scheduling conflict with at least one of them.

C. Not good, I have a scheduling conflict with both of them!

D. I’m not sure, I haven’t memorized my schedule yet.
Reading

• Protocols
  – Sections 1.1, 1.5

• Sign up on Piazza!

• Please let me know about:
  – Your preferred name, if different than roster name
  – Disability accommodations
  – Discussion group preference, if you have one

• Lab 1: Due Thursday, September 10