ECE 356/COMPSI 356
Computer Network Architecture

Lecture 1: Introduction and Course Overview

Monday August 26th, 2019

About the Instructor (1/2)

- Started at Duke last year
- Previously: Associate Research Scholar, Princeton University, Electrical Engineering
- Ph.D. Columbia University, Electrical Engineering
- M.Sc., B.Sc. University of Ottawa, Canada

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About the Instructor (2/2)

- Worked in industry before, during, and after all degrees

IBM

Disney Research SCIENCE & PLAY

D E Shaw Research

Canadian Intellectual Property Office

Telcordia Technologies

DEFENCE R&D DÉFENSE

SiriusXM SATELLITE RADIO

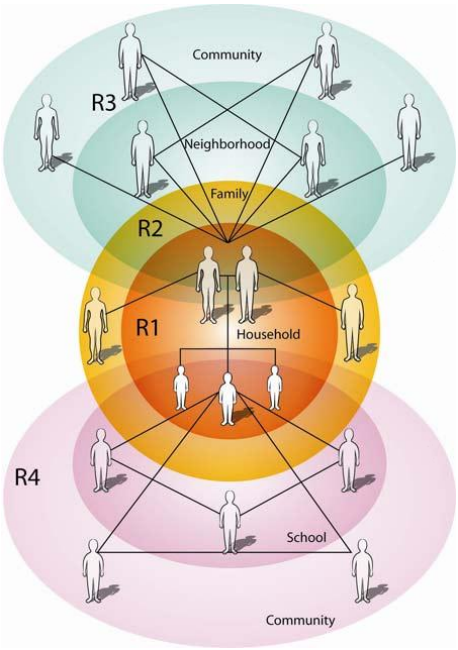
Duke UNIVERSITY

Lecture Outline

- Introduction to networking
- Why study networking
- Course logistics

What is a Network?

- Wikipedia: A wide variety of systems of *interconnected components* are called **networks**
- Arise in many contexts
  - *Network science* studies complex networks
  - *Graph theory* studies networks represented as a graph



Social Networks

- Offline and online

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Water Distribution Networks

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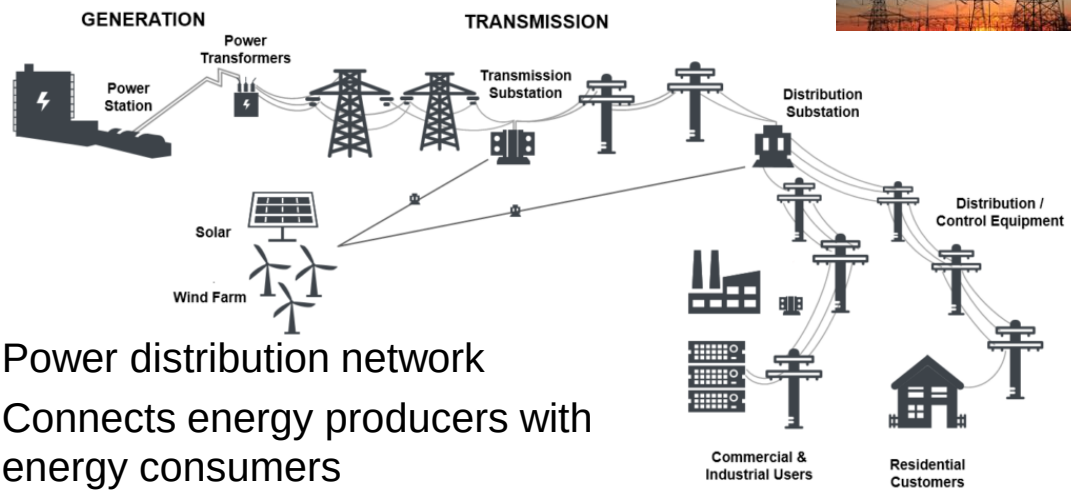
Power Grid



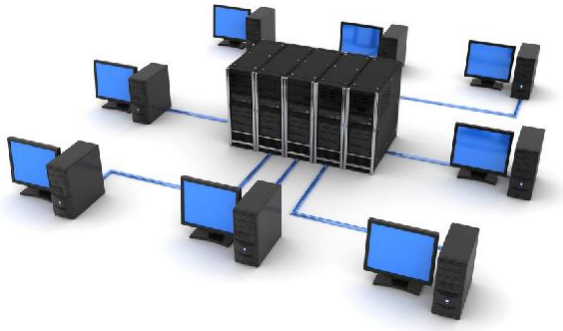
- Power distribution network
- Connects energy producers with energy consumers

Networks in Communications

- Why do we build networks?
  - ➢ To distribute/transfer something
- Broadcast networks: radio, TV
- Telephone networks

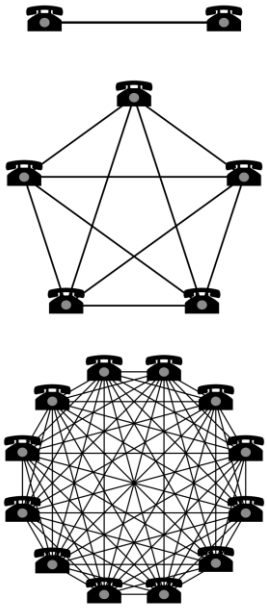
Computer Networks

- Exchange data between computing devices



The Internet

- The Internet transfers information between computing devices
- It is a **large-scale general-purpose** computer network
  - Run more than one application
- The Internet is a **network of networks**



Metcalfe's Law

- The effect (value) of a telecommunications network is **proportional to the square of the number of connected users** of the system (n^2).

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Understand the Technology You Use Every Day

- Who can see the data you transmit?
- Why does Netflix video quality fluctuates?
- What happens when you connect to Duke VPN?

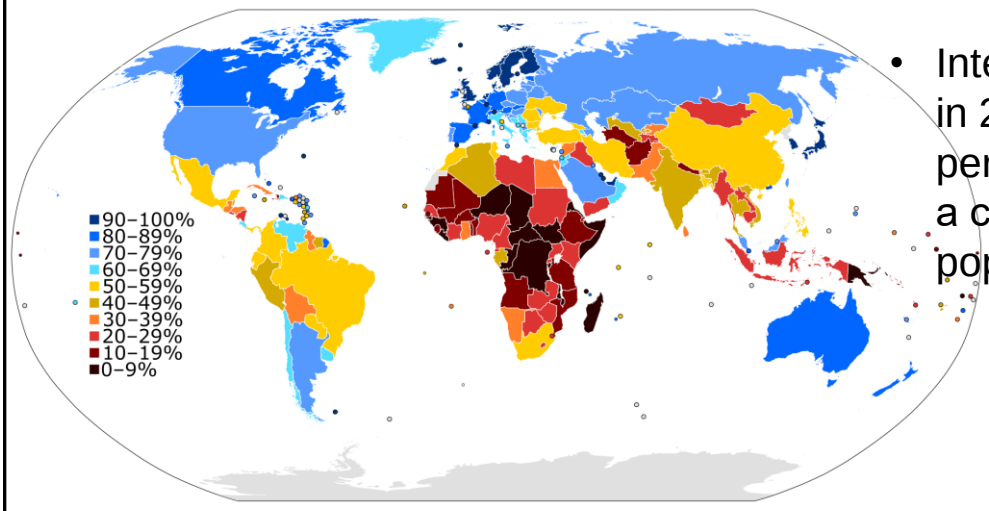
Exciting Field

- Majority of most valuable tech companies in the world made their fortunes on connected products

Almost All Areas of Computing are Network-based

- Cloud-based solutions
- Networking fundamentals are useful regardless of your specialization
  - ➢ Need to know how to write networked applications

Networks Change Lives



- Internet users in 2015 as a percentage of a country's population

https://info.internet.org/en/impact/

Networks Change Lives

- Access to knowledge
- Access to markets
  - ➢ Participation in global commerce
- Staying connected with friends and family

- *Connecting the next billion* is one of the frontiers in communications and networking

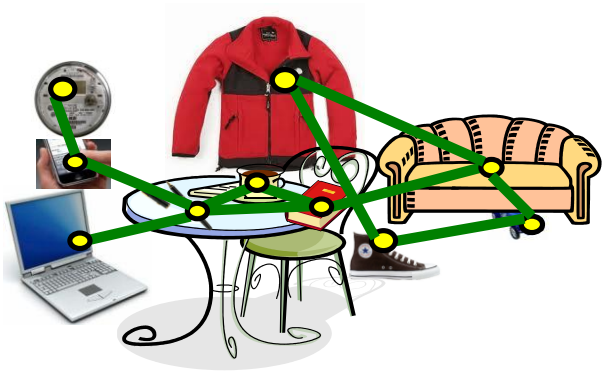
https://info.internet.org/en/impact/

Smart Everything is the Future

- Smart homes, cities, cars.

Why I Study Networks (1/2)

- Main research interests: mobile computing, Internet of Things, edge computing, connected augmented reality
- Pervasive connectivity



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Why I Study Networks (2/2)

- Fun problems
  - Complex heterogeneous and multi-user scenarios
  - Jointly optimizing communications, computing, and energy consumption
- Technology we develop will be in the hands of *billions* of people

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Lecture Outline

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- **Course logistics**
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Instructor and Teaching Assistants

- Instructor: Professor Maria Gorlatova
  - maria.gorlatova.com/bio
- Graduate TA: Xiao Zhang
  - http://users.cs.duke.edu/~xzhang/
- Undergraduate TA: Yunfan Zhang

Course Contents (1/2)

- First course in computer networking
  - What computer networks are and how to make them work
  - Focus on the Internet architecture
- *Bottom-up* approach: from physical layer to higher-layer protocols and applications

Course Contents (2/2)

- Network architectures
- Physical layer
- Logical link layer
- Switching technologies
- Internet protocol
- Routing protocols
- Transport control protocols
- Queue management
- Content distribution
- Application layer protocols
- Advanced topics
  - Overlay networks
  - Network security
  - Invited speaker: enterprise network at Duke

Course Textbook

- Larry L. Peterson, Bruce S. Davie, **Computer Networks: A Systems Approach**, 5th Edition, Morgan Kaufmann
  - 4th is okay
- 6th edition available online at https://book.systemsapproach.org/

Sakai & Piazza

- On Sakai: lectures, book chapters related to lectures
  - Read before class for discussion
- On Sakai: assignments and due dates
- All subject to change. Check for updates regularly.

- Piazza: link on Sakai
  - Please make use of it

We are Here to Help You

- Graduate TA **Xiao Zhang** *xzhang@cs.duke.edu*:
  - Tue 04:30 – 06:30 PM LSRC D344
- Undergraduate TA **Yunfan Zhang** *yunfan.zhang@duke.edu*:
  - Wed 11:25 AM – 01:25 PM LSRC D344
- Prof: **Maria Gorlatova** *maria.gorlatova@duke.edu*:
  - Mon 10:30 – 11:30 AM, Wed 04:00 – 05:00 PM CIEMAS 2471
- E-mail for meetings outside of normal office hours

Grading Policy

- In-class quizzes: **5%**
- Homeworks: **20%**
- Labs: **40%**
  - In a group assignment, all students get the same grade for the assignment
- Midterm: **15%**
- Final: **20%**

Your Work

- Assigned readings
- In-class quizzes (5%)
  - 5-7 short pop quizzes
  - Bring your laptop to every class
- Homeworks (20%)
  - 3 homeworks, each 10 points (individual)
- Labs (40%)

Labs (1/2)

- Lab 1: An echo server. 10 pts
  - Individual
- Lab 2: Simple router. 15 pts
  - Groups of 1 or 2 students
- Lab 3: Dynamic routing protocols. 15 pts
  - Groups of 1 or 2 students

Labs (2/2)

- Some labs contain pre-lab questions that help you understand the basic concepts
- Labs are distributed with skeleton code and most of them have reference implementations for testing
- Turn-ins include answers to pre-lab questions, source code, lab reports if we ask for them

Midterm, Final

- Closed book
- Allowed:
  - A calculator
  - One hand-written double-sided page of notes, standard US letter format

Final Grade Assignment

- No curving
- >= 90% A-/A/A+
- [80, 90) B-/B/B+
- [70, 80) -/C/C+
- [60, 70) D
- < 60% F
- May scale up, but not down

Collaboration Policy

- Discussions are encouraged
- Individual assignments must be completed independently
- Group assignments only need to turn in one copy of the files with group members noted in the submission

Academic Integrity Policy

- Don't know if you are cheating? Please consult the description: http://www.cs.duke.edu/courses/spring19/compsci356/index.html
- If you are caught cheating, you will be reported to the Office of Student Conduct **and you will receive a failing grade in the class**

Late Policy

- Due dates/times will be posted on the course website
- The deadline for an assignment can be extended with a 10% penalty per day for up to two days
  - Assignments *will NOT be accepted 48 hours after the due date*
    - Tight schedule
    - Extension will delay next assignment
  - If you are ill: contact the instructor and provide a medical note
- **Questions?**

Lecture Summary

- Introduction to networking
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Course Contents: Next Lectures

- **Network architectures**
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