CSE 222A: GRADUATE NETWORKING

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WELCOME TO 222A!

We’re glad you’re here!

(If not too many logged in, brief introductions)
- Your name
- 1 sentence background
- Why are you interested in networking?
WHY DO WE STUDY NETWORKING IN 2021?

• “The Internet works pretty well”. Why improve it?
• **Computer networking requirements change often**
  • New devices: Billions of low power IoT doodads
  • New usage: Users are increasingly mobile (5G)
  • New apps: Drone control and VR require ultra low latency
  • New threats: State-level adversaries, bombing a CO
  • New policy: Anonymity and Accountability
WHAT ASPECTS OF NETWORKING DO I STUDY?

- **Wireless communication**
  - Efficiently capturing and analyzing the entire RF spectrum

- **Internet Reliability**
  - Figuring out how the Internet lacks redundancy

- **Hardware acceleration**
  - Networking SW at 200G on Reprogrammable FPGAs

- **Security and Privacy**
  - Finding opportunities to observe malicious behavior
  - Mitigating threats from short-range wireless (e.g., Bluetooth)
BUT WAIT? IS THAT STUFF EVEN NETWORKING?

• Yes! Networking is an incredibly broad field.
• In one conference session (SIGCOMM 2019):
  • A protocol for Quantum networks
  • Millimeter wave networks for IoT
  • Underwater communication with backscatter
• Many systems researchers started in networking, and used that knowledge to branch to other areas
  
  (Dina Katabi @ MIT started in Congestion Control and is now working on wireless comms for healthcare)
SO ARE WE GONNA READ ALL OF THE LATEST PAPERS?

• No. We are going to read the foundational work.
• Networking is a relatively old field
  • SIGCOMM had it’s 50th anniversary in 2019
• Ideas go in and out of style, sometimes they click.
• There are lasting features and problems
  • It helps to know what the thinking was
• You can learn from their mistakes and successes
Outline

1. Course overview and structure
2. How to read a paper
3. Internet fundamentals
LOGISTICS

• Canvas
  • https://canvas.ucsd.edu
  • Course homepage has full schedule
  • Online Q&A
  • Quizes, gradebook, some materials
• Each other!
PRE-REQUISITES

- Undergraduate networking
  - E.g., CSE 123
  - You will need a strong foundation in undergrad networking
  - We’re going to be reading research papers built on top of that work

- To brush up:
    - (Free online!)
  - Readings linked in schedule
GOAL OF CSE 222A

- Bring you **up to the state of the art** in contemporary networking research
  - [Mon] review of concept then [Wed]/[Fri] Papers
- Give you the skills needed to **stay at the state of the art** for your entire career
- Project: Work on a (small) research project of your own, culminating in a ~6 page research paper. I love when students submit these!
- Deadlines on schedule, seed ideas posted soon
PRIMARY ACTIVITY: READING NETWORKING PAPERS

• Why? This is where the action is happening!

Session 1: COVID-19 at IMC

10:00-10:45

Session Chair: Fabian E. Bustamante

Slack Channel here

• The Lockdown Effect: Implications of the COVID-19 Pandemic on Internet Traffic
  Anja Feldmann, Oliver Gasser, and Franziska Lichtblau (Max Planck Institute for Informatics); Enric Pujol and Ingmar Poese (DE-CIX); Daniel Wagner and Matthias Wichtlhuber (DE-CIX); Juan Tapiador (Universidad Carlos III de Madrid); Narseo Vallina-Rodriguez (Brandenburg University of Technology); Georgios Smaragdakis (TU Berlin)

• A Characterization of the COVID-19 Pandemic Impact on a Mobile Network Operator Traffic
  Andra Lutu and Diego Perino (Telefonica Research); Marcelo Bagnulo (University Carlos III of Madrid); Enrique Frias-Martinez; Khangosstar (Telefonica O2 UK)

• How the Internet reacted to Covid-19
  Timm Boettger, Ghida Ibrahim, and Ben Vallis (Facebook)
WAYS OF READING

• There are many ways to read something
  • To get a broad overview of the main idea
  • To determine the main “takeaway points”
  • To find something specific (e.g. what is the repair protocol for the Pastry protocol again?)
  • “Close” readings
• We’re going to be doing close readings of 1 paper per class discussion
WHAT IS “CLOSE READING”?

- Not just “what”, but WHY
  - Why did the author focus on this particular problem?
  - Why were alternatives to the presented design ruled out?
  - Why does the system behave the way it does?
- What can you learn from their experimental design? From the workloads used in the evaluation?
- If you apply the idea to a new context, does it work?
KESHEV’S APPROACH

• 1\textsuperscript{st} time: Get a sense of what the problem is, the general approach, terms, and experimental results

• 2\textsuperscript{nd} time: Details of the algorithms, experimental design, experimental result details

• 3\textsuperscript{rd} time: Proof or implementation details, subtleties of experiments
GRADING

• Class project: 50%
• In-class participation: 10%
• After-class Quizzes: 40%
• Total: 100%
222A TEACHING ASSISTANT

• Max Gao

• Master’s student who works in computer systems
READING FOR WEDNESDAY

“A Protocol for Packet Network Intercommunication”

(and corresponding Turing award lecture video)
THE INTERNET IS A NETWORK OF NETWORKS

- Examples of networks that make up the Internet:
  - Companies that provide access (ISPs)
  - Companies that provide services (Cloud)
  - Universities
  - Hospitals
  - Government
  - Homes
- All connected together and can communicate freely
THE INTERNET HAS A “HOURGLASS ARCHITECTURE”
THE INTERNET IS PACKETIZED

Discrete messages to/from users, apps, locations

Packets are interleaved onto shared links

   Trunks at the core can be 400G or more!
   (They carry traffic for an entire datacenter or city)

Internet traffic is best effort

   No guarantees of when or if data will arrive