

Welcome to CSE 561 (Au 26)

Ratul Mahajan

Course goals

Learn what's up at the frontier of networking today

- Design principles, concrete techniques

Use that knowledge in your work as a researcher or developer

Instructor: Ratul Mahajan

Systems and networking researcher

- Current focus: Network verification, self-defining systems

Worked across industry and academia

- UW → Microsoft Research → UW
- Intentionet → Amazon

Soccer, running, riding motorcycles

TA: Brody Franks

3rd year PhD student, advised by Ratul

- Formal methods, networks, databases

~5 years in industry (AWS) before starting PhD

Running, cycling

Course organization (1): Readings

1-2 deep reads and 1-2 shallow reads

Check out [How to Read a Paper](#)

- Deep read = All three passes
- Shallow read = First two passes

Course organization (2): Discussions

Online (EdStem): Finish posting before noon on class day

In-class: You will lead one class in groups of 1-2

- Sign up information on the course website

Both discussions are on the topic, not limited to the paper

Course organization (3): Guest lectures

You will hear directly from leading practitioners

Unique opportunity to get a behind-the-scenes view

Come prepared with questions

Course organization (4): Project

Your choice of topic

- Extend your own research
- Extend one of the papers
- Implement a new protocol in aRPC and benchmark it

Milestones

- Oct 19: Proposal
- Nov 9: Progress update
- Dec 9, 17: Presentations
- Dec 17: Final report

Course organization (5): Grading

Project: 50%

- Final report is 20%; proposal, update, presentation are 10% each.

Online discussions: 20%

Discussion lead: 20%

In-class discussions: 10%

Schedule

Oct 5

Philosophy

Deep reads

- [End-to-End Arguments in System Design](#)
- [The Design Philosophy of the DARPA Internet Protocols](#)

Schedule

Oct 7	DC topology and network virtualization <i>Deep read</i> • VL2: A Scalable and Flexible Data Center Network <i>Shallow reads</i> • A Scalable, Commodity Data Center Network Architecture • Network Virtualization in Multi-tenant Datacenters	
Oct 12	Guest lecture: Flat network topologies <i>Deep read</i> • RNG: Flat Datacenter Networks at Scale <i>Shallow reads</i> • Jellyfish: Networking Data Centers Randomly • Xpander: Towards Optimal-Performance Datacenters • A Throughput-Centric View of the Performance of Datacenter Topologies	Giacomo Bernardi Sr. Principal Scientist, AWS
Oct 14	Optical switching <i>Deep read</i> • Beyond the Mega-Data Center: Networking Multi-Data Center Regions <i>Shallow reads</i> • Realizing RotorNet: Toward Practical Microsecond-scale Optical Networking	

Schedule

Oct 19	Collective communication <i>Deep read</i> • TACCL: Guiding Collective Algorithm Synthesis using Communication Sketches <i>Shallow reads</i> • Demystifying NCCL: An In-depth Analysis of GPU Communication Protocols and Algorithms Due: Project proposal (2 pages)
Oct 21	ML networks <i>Deep read</i> • RDMA over Ethernet for Distributed AI Training at Meta Scale <i>Shallow reads</i> • An Introduction to the InfiniBand Architecture • InfiniBand Credit-Based Link-Layer Flow-Control • Credit-Based Flow Control for ATM Networks

Schedule

Oct 26	End host stack <i>Deep read</i> • Falcon: A Reliable, Low Latency Hardware Transport <i>Shallow reads</i> • Snap: A Microkernel Approach to Host Networking	
Oct 28	Guest lecture: Multipath Reliable Connection <i>Deep read</i> • Resilient AI Supercomputer Networking using MRC and SRv6	Jitu Padhye Member of Technical Staff, OpenAI

Schedule

Nov 2	Global routing <i>Deep read</i> • BGP Routing Policies in ISP Networks <i>Shallow reads</i> • Understanding BGP Misconfiguration
Nov 4	Traffic engineering <i>Deep read</i> • Engineering Egress with Edge Fabric: Steering Oceans of Content to the World <i>Shallow reads</i> • Achieving High Utilization with Software-Driven WAN • Decentralized Cloud Wide-Area Network Traffic Engineering with BlastShield
Nov 9	Network management <i>Deep read</i> • Evolve or Die: High-Availability Design Principles Drawn from Google's Network Infrastructure <i>Shallow reads</i> • Pingmesh: A Large-Scale System for Data Center Network Latency Measurement and Analysis Due: Project progress update (2 pages)

Schedule

Nov 16	Guest lecture: A whistlestop tour through AWS's networking evolution <i>Deep reads</i> • Jupiter Evolving: Transforming Google's Datacenter Network via Optical Circuit Switches and Software-Defined Networking • Datacenter Networks Are In My Way (James Hamilton, 2010 talk) <i>Shallow reads</i> • AWS networking lab tour: Making networking disappear (The Register) • A lot of datacenter networks are run by absolute clowns. Not Amazon's (The Register)	Stephen Callaghan Sr. Principal Technologist, AWS
Nov 18	Guest lecture: Networking from First Principles with Software at AWS <i>Deep read</i> • Ravel: A Database-Defined Network <i>Shallow reads</i> • Improving Network Availability with Protective ReRoute • Layering as Optimization Decomposition: A Mathematical Theory of Network Architectures	Jorge Vasquez Sr. Principal Engineer, AWS
Nov 23	Guest lecture: AI in Physical Networks <i>Deep read</i> • Intent-Driven Network Management with Multi-Agent LLMs: The Confucius Framework	Jamie Gaudette VP, Azure Global Networking

Schedule

Nov 25	No class (day before Thanksgiving)	
Nov 30	Guest lecture: Network Switches and Interconnects – The Lego blocks of Network <i>Deep read</i> • Data Center Switch Architecture in the Age of Merchant Silicon	Satish Vangala Director, Network Product Development, AWS
Dec 2	Guest lecture: Life as a packet slinger – lessons learned from several decades in the trenches <i>Deep read</i> • Assessing the Aftermath: The Effects of a Global Takedown against DDoS-for-hire Services <i>Shallow reads</i> • Click Trajectories: End-to-End Analysis of the Spam Value Chain • Measuring the Cost of Cybercrime	Tom Scholl VP and Distinguished Engineer, AWS
Dec 7	Guest lecture: Real-world network verification <i>Deep read</i> • Lessons from the Evolution of the Batfish Configuration Analysis Tool <i>Shallow reads</i> • Relational Network Verification	Dan Halperin Principal Scientist, AWS

AI use

YES: Improve understanding, efficiency	NO: Circumvent learning
Explain (parts of) readings	Read yourself end-to-end
Writing code	Design yourself, understand corner cases
Polishing writeups	Do first drafts yourself

Absolutely no AI for online discussion posts

Submit notes on how you used AI (prompts, process)

See the [UW CSE policy](#) for more details

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