CS5229
Advanced Computer Networks

aka
Foundation of Computer Networks

Ooi Wei Tsang

ooiwt@comp.nus.edu.sg

AS6, 05-14

Fundamental principles/techniques of computer networking

Research methodologies in computer networking

Through reading classic/influential papers

CS5229 Semester 1, 2009/10

Continuous Assessment

35% Final exam (open book)

45% Three assignments

20% Midterm (open book)

Assignment 1

Survey something.
Write a report.

Assignment 2

Measure something.
Analyze data collected.

Assignment 3

Simulate something.
Analyze results.

Assignment

To be done in a group of 2 (3?)

Other Related Courses

CS4222: Wireless Computing and Sensor Networks

CS4274: Mobile and Multimedia Networking

CS4344: Networked and Mobile Gaming

CS5321: Network Security and Management

CS5428: Systems Support for Continuous Media

CS6204: Advanced Topics in Networking
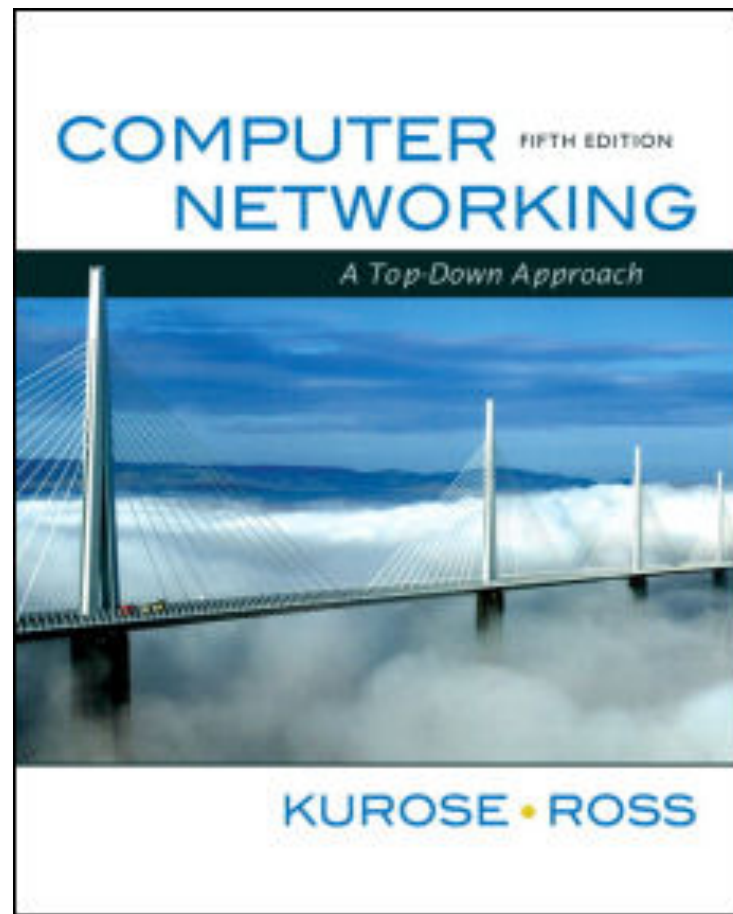
EE5913, 6302, 6401, 6902 etc.

You won't see much..

wireless networks
sensor networks
mobile networks
network security

Reading Materials

No textbook for this class. Materials comes from research papers online.

Need a refresher?

COMPUTER NETWORKING
FIFTH EDITION
A Top-Down Approach
KUROSE • ROSS

Every Lecture

I introduce 2-3 papers.

You are expected read the papers
for the details after the lectures.

CS5229

Advanced Computer Networks, Semester 1, 2009/10

About CS5229

- **Who**: Ooi Wei Tsang (ooiwt)
- **Where**: Building COM1, Room 204 (#02-04, aka Seminar Room 2)
- **When**: Fri 1830-2030
- **Workload**: Lecture (2hr) Preparation (6hr) Homework (2hr) per week
- **CA**: Open Book Exam (35%) Assignments (40%) Quizzes/Midterm (25%)
- **Objective**: This course covers advanced fundamental principles of computer networks and techniques for networking. The goal of this course is to teach these fundamentals/techniques that will remain important and relevant regardless of the hot topics in networks and networking. Briefly, the topics include advanced network architecture and design principles, protocol mechanisms, implementation principles and software engineering practices, network algorithmic, network simulation techniques and tools, performance analysis and measurement, and protocol specification/verification techniques.

Tentative Schedule

- Week 1: Design principles of Internet
- Week 2: Measuring the Internet
- Week 3: TCP
- Week 4: Modeling TCP Throughput
- Week 5: TFRC and DCCP
- Week 6: Midterm
- Week 7: Semester Break
- Week 8: End-to-end Congestion Control and RED
- Week 9: Introduction to Tcl/OTcl/ns-2
- Week 10: Simulation and Modeling of the Internet
- Week 11: Routing
- Week 12: Self Similarity in Ethernet
- Week 13: Reviews

Sample Readings

In this class, we will examine some classic papers in the networking literatures. Here are some sample papers. If you enjoy reading the papers, then likely you will enjoy this class.

- D. D. Clark. "The design philosophy of the DARPA Internet protocols," SIGCOMM 1988, CiteSeerX | ACM DL
- J. Padhye, V. Firoiu, D. Towesley, and J. Kurose "Modeling TCP Throughput: A Simple Model and its Empirical Validation," SIGCOMM 1998. CiteSeerX
- M. Faloutsos, P. Faloutsos, C. Faloutsos, "On Power-Law Relationships of the Internet Topology", SIGCOMM 1999, CiteSeerX

Assignments

1. Measurement and Analysis of Network Traffic (3 weeks)
2. Simulation of TCP/AQM (3 weeks)

Assumed Background

Undergraduate-level Networking

(CS2105/CS3103 or equivalent)

Internet Architecture

You know what the following terms mean: router, switches, ISP, AS.

You know how Internet is different from a Telephony network.

Naming/Addressing

You know what is a domain name, what is an IP address, and how to map between the two.

You know how DHCP assigns a dynamic IP address to you host.

Protocol Layers

You know the functionalities of 5 layers of the Internet protocol stack.

Application Protocol

You roughly know how HTTP and FTP works.

Transport Protocol

You know what is a port and socket

You can tell the differences between TCP and UDP. You know in what situation you should use which.

TCP

You know why congestion control and flow control are needed. You roughly know how TCP's congestion control works.

Network Layer

You know that almost everything runs on IP. You know how packets are routed on the Internet, at least within an AS.

Network Layer

You know what's a private IP address and why NAT makes P2P file sharing difficult.

Ethernet

You know why Ethernet is a random access protocol. You know what collision and backoff mean in this context.

Ethernet

You know why MAC address is needed despite having an IP address.

You know how mapping between MAC and IP addresses is done.

Tools

You have used ping or traceroute. Or at least heard about them and know what they are for.

Basic Probability

You know what is expected value, variance, random variable, and cumulative distribution function.

You know how to compute conditional probability and probability of two events.

Programming

You know how to program in C or C++, and is comfortable in picking up new languages.

Philosophy

Students are expected to be: Mature, Independent, Resourceful

What you learned is more important than your grade.

Please don't ask..

"Should I memory this equation?"

"Do I have to memorize this header format?"

"Post model answer to X"

Academic Honesty

No copying among students

No copying from published work

ZERO tolerance to plagiarism.

Please do ask ..

"What is the effect of changing *k* in the equation?"

"Why did the designer added this bit in the header?"

Discussion?

Strongly encouraged (when permitted)

But ..

must acknowledge all contributions
write up solution independently

Slides != Notes

Is CS5229 for me?

interesting but difficult

like:

"a deep understanding into how protocol works"

like:

"mathematical insights into TCP mechanism"

like:

"exposed to a variety of research methods in networking"

like:

"get to read classic networking papers"

hate:

"too many papers. no time to read"

hate:

"exam questions cannot be found in the notes!"

hate:

"slides has too few words!"

hate:

"the math!"