<u>CMPE 150/L : Introduction to</u> <u>Computer Networks</u>

> Chen Qian Computer Engineering UCSC Baskin Engineering Lecture 1 Slides source: Kurose and Ross, Simon Lam, Katia Obraczka

# WelcometoCE 150/L!

**Class information:** 

- □ When: T Th 01:30PM-03:05PM.
- □ Where: Thim 001
- Class Web page:

https://cmpe150-winter18-01.courses.soe.ucsc.edu/home

You are responsible to check the information on the web page. At least once every week.

## Course Focus

#### From the catalog:

"Addresses issues arising in organizing communications among autonomous computers. Network models and conceptual layers; internetworking; switching techniques (packet switching, circuit switching); medium access control (MAC) protocols and local area networks; error-control strategies and link-level protocols; routing algorithms; congestion control mechanisms; transport protocols; application of concepts to practical wireless and wireline networks and standard protocol architectures."

## About the Instructor

Chen Qian.

- ✤ Office: E2 231.
- E-mail: cqian12 "at" ucsc.edu
- Office hours: Thu, 10am-11am
- Research lab: E2 211

## Pre-Requisites

- **CE** 16.
- CE 12 and CE 12L, or CS 12B and CS 12M.
- Basic programming skills ideal (project).

## <u>Logistics</u>

 $\Box$  CE 150/L: there is a lab companion to the class.

- Students must register for lecture AND one lab session.
- Lab session is not the only time you will need to use the lab!

#### Do it right now!

# Lab

- Lab location: Soc Sci I Mac Lab (Room 135)
- Lab Session Schedule:
- **Monday 11:00-1:00pm**
- Tuesday 4:00-6:00pm
- UWednesday 3:00-5:00pm
- Thursday 10:00-noon
- Fridays noon-2:00pm

You may go to other sessions, but....

## Lab

Weekly exercises (pre-labs and labs).

- Labs must be done individually unless noted otherwise.
- Can be done with your laptop computer.
   So you do not have to rely on the computer in the physical lab. And your lab sessions are mainly for Q&A purposes.

## Teaching Assistants

Minmei Wang mwang107@ucsc.edu Shouqian Shi sshi27@ucsc.edu



🖵 Lecture:

Computer Networking: A Top Down Approach, by Kurose and Ross

5<sup>th</sup>, 6<sup>th</sup> and 7<sup>th</sup> ed are all good

You are required to read the book BEFORE every class. However the exam questions are ALL related to the material in the slides.

Highly recommend to buy it! It is good based on my experience.

Grading

55% lecture
 Midterm 25%
 Final 30%

45% lab
 Lab exercises 30%
 Project 15%

Sample questions are not graded. It is important to work on it and ask/discuss if you don't understand. Exam questions will be very similar

Only a single grade will be issued for both CE 150 and CE 150L.



https://cmpe150-winter18-01.courses.soe.ucsc.edu/

#### Students must check the Web page frequently!

- Lecture notes.
- Labs.
- Forum.
- News.
- Project information.
- Announcements.

<u>Student Responsibilities:</u> <u>Academic Integrity</u>

□ All submitted work must be individual.

- OK to have discussions on ideas but turn in your own work.
  - Lab and pre-lab reports are done individually!
  - Project is individual!
- Ask instructor and TAs if there are any questions.
- For more info, go to:

www.ucsc.edu/academics/academic\_integrity/

<u>Student Responsibilities:</u> <u>Academic Integrity</u>

Academic integrity violations will not be tolerated.

## Student Responsibilities

Attendance.

- Lectures.
- Lab sessions.
- Keep up with material covered in lecture
  - Readings (chapters in the book).
  - Sample questions.
- Keep up with lab assignments and project.

## <u>Resources</u>

- Instructor.
- 🗆 TAs.
- Class Web page.
  - Lecture notes will be posted before class.
- Lab- and review sessions.
- 🖵 Forum.
  - We will use the forum link on class website
- We use Canvas for lab submission and grade posting. (<u>https://canvas.ucsc.edu/courses/9148</u>)
- Note we have both CMPE150 and CMPE150L pages on Canvas, <u>we ONLY use the CMPE150 page for</u> <u>everything.</u>

## Student Feedback

Feedback is always welcome!

Chance to do it at the end of the quarter.

But you can also do it during the quarter...

## <u>Lectures</u>

□ The more interactivity, the better!

- Ask questions!
- Or answer my questions.
- Lecture notes:
  - Will be posted on-line before class.
  - ✤ But...
- Lectures and lab.

## More Lab Logistics

- Register for ONE lab session.
- Welcome to attend more sessions.
- Students are expected to work on the lab assignments
  - \* during their session and MORE!

## Lab Sessions

- □ Monday: 11am 1pm (Soc Sci).
- □ Tuesday: 4 6pm (Soc Sci).
- □ Wednesday: 3 5pm (Soc Sci).
- Thursday: 10 noon (Soc Sci).
- □ Friday: 12-2pm (Soc Sci)

#### Lab starts next week!

Usually 2 hour per week in the lab is not enough for you to work well for your assignments. So I SUGGEST you work on the assignments in your free time and use the lab session to interact with the TAs.

## More Lab Logistics

- Pay attention to the lab schedule!
  - Pre-labs.
  - Labs.
- Submission due dates and guidelines will be strictly enforced!
  - Late submissions will be penalized.
- Lab usage guidelines must be followed!

## More Lab Logistics

- Lab exercises are posted on the Web page ahead of time.
- Students start getting familiar with the lab exercise and use lab sessions to ask questions.



Basic network programming project.
 Project deliverables:
 Project demo.
 Source code.
 README file.

## Assignment Submission

- We use Canvas this semester rather than eCommons
  - Linked to the main class Web page under "Assignments".
- □ TAs will go over it in lab next week.

# <u>Assignment late submission</u> policy

□ 10% deduction for each day late.

# Administrative Info

- **Communication**:
  - E-mail preferred.
  - Send e-mail to instructor AND TAS.

## <u>Course Outline</u> "Top-down Approach"

# What's "Top-Down"?



Top-down" means that we will start at the "Application" layer and make our way to the "bottom" of the "stack". <u>Course Outline (tentative)</u> <u>"Top-down Approach"</u>

- Introduction
- Application layer
  - Fundamentals
  - Application layer protocols.
- Transport layer
  - Fundamentals
  - Internet transport protocols:
    - UDP and TCP

- Network layer
  - Fundamentals
  - Internetworking
  - IP v4 and v6
  - \* Routing
- Data link layer
  - \* MAC
  - \* Ethernet, 802.11
- Wireless networking

## <u>Course Objectives</u>

Upon successful completion of the course, you will have a good understanding of the layered network architecture, the fundamental design issues in each layer, and the solution approaches towards addressing these issues. You will also get well prepared for investigating advanced topics in the networking field. It's a knowledge-based course, rather than a practice-intensive one.

So, expect much knowledge, not much hands-on experience.

# Why networking is important for you?

#### □ 1. Basics of other advanced areas:

- Cyber security
- Distributed systems
- Cyber physical systems
- Mobile computing
- Cloud computing
- ✤ Etc.
- 2. Tons of job opportunities
  - Cisco, HP, Google, Facebook, Amazon, Microsoft, Nokia, Huawei, LBNL, etc.

# My background

#### PhD in Computer Science (2013), University of Texas at Austin

#### Advisor: Simon Lam – researcher of the chapter for "The Link Layer" pp 511

#### Simon S. Lam

Simon S. Lam is Professor and Regents Chair in Computer Sciences at the University of Texas at Austin. From 1971 to 1974, he was with the ARPA Network Measurement Center at UCLA, where he worked on satellite and radio packet switching. He led a research group that invented secure sockets and prototyped, in 1993, the first secure sockets layer named Secure Network Programming, which won the 2004 ACM Software System Award. His research interests are in design and analysis of network protocols and security services. He received his BSEE from Washington State University and his MS and PhD from UCLA. He was elected to the National Academy of Engineering in 2007.



<u>BTW....</u>

#### Simon Lam's PhD advisor was Leonard Kleinrock, Professor at UCLA

□ researcher of the chapter for "Chapter 1"

#### Leonard Kleinrock

Leonard Kleinrock is a professor of computer science at the University of California, Los Angeles. In 1969, his computer at UCLA became the first node of the Internet. His creation of packet-switching principles in 1961 became the technology behind the Internet. He received his B.E.E. from the City College of New York (CCNY) and his masters and PhD in electrical engineering from MIT.



#### What made you decide to specialize in networking/Internet technology?

As a PhD student at MIT in 1959, I looked around and found that most of my classmates were doing research in the area of information theory and coding theory. At MIT, there was the great researcher, Claude Shannon, who had launched these fields and had solved most of the important problems already. The research problems that were left were hard and of less-

## My Research

Network algorithms, protocols, and systems

Routing, switching, management, etc.

Current focus: Internet of Things, Software Defined Networking, and Network Security







### > 20 billion connected devices after 2016 New networking designs are required







## Radio Frequency Identification (RFID)



Tags: battery-free

Vital system of IoT: cost- and energy-efficient



Backscatter communication/sensing

## **Applications of RFID**



#### Identification is important for access control



# How to sense an intruder NEVER expect they would carry devices!



#### Extra cost and may lack of coverage

## **Device-free sensing**

Massive tags already deployed in warehouses, stores, etc.









Twins: Unexpected discovery makes big impact

Twins: Device-free Object Tracking using Passive Tags, in *IEEE INFOCOM*'14, extended version in *IEEE/ACM Transactions on Networking*.





#### Physical environment Server Tracking results



Twins: Device-free Object Tracking using Passive Tags, in *IEEE INFOCOM*'14, extended version in *IEEE/ACM Transactions on Networking*.

## Prototype and experiments

- COTS devices
- Surveillance in a warehouse 30m x 20m
- 72 Twins pairs
- Distance



## Error: Less than 1 m Smaller than those using battery sensors

Twins: Device-free Object Tracking using Passive Tags, in *IEEE INFOCOM*'14, extended version in *IEEE/ACM Transactions on Networking*.

#### Smart Packaging: verify internal status



# RFID signal analysis may identify different materials

Verifiable Smart Packaging, in ACM MSCC 2015 (Best Paper Award) and ACM UBICOMP'16

### Smart control environment



VADS: Visual Attention Detection with a Smartphone, in IEEE INFOCOM, 2016.

## Secure mobile communication





## Key agreement

### Most fundamental secure problem for communication

- 2002: Rivest, Shamir, and Adleman (1977)
- 2015: Diffie and Hellman (1976)



## Key agreement



Common physical layer features: CSI

## The Dancing Signals

Using CSI and common secret to generate a key
2 secs for a 512-bit key
Prior work:

- Can only use TV signals
- 2 mins for a 512-bit key



#### Instant and Robust Authentication and Key Agreement among Mobile Devices, in ACM CCS'16



## **Research opening**

## Students are welcome to apply for researcher positions in my lab for research or senior project, after this quarter.

- If you feel good about computer networking
- If I feel you did well in my class

### The positions could be paid

Much lower than your internship position in the bay area

## Next class

### Please read Chapter 1.1-1.3 of your textbook BEFORE Class