# CMPE 150: Introduction to Computer Networks

**Dr. Chane L. Fullmer**

**chane@cse.ucsc.edu**

# Class information

- Text

  Computer Networking, 2nd Ed. – Kurose & Ross

  Chapters 1, 5, 4, 3, 2 (in that order)

  We're going from the bottom up…

# Class information

- Homework..
  - Based on Lecture AND text reading
    - One set for each chapter
- Midterm

  April 29 – requires Scantron
- Final

  June 11 – 8:00 to 11:00 ☺

  (Bring Scantron)

# (Optional) Class Project

- Network programming project
  - In lieu of taking final examination
- Goal:
  - Build an FTP client/server from scratch
  - Using 'C' language
- Details on web page.. Soon…

# Grading Information

- Weights
  - Homework – 40%
  - Midterm – 30%
  - Final – 30%

# Grading Information

| Grade | Score |
|---|---|
| A | 90% → 100% |
| B | 75% → 90% |
| C | 60% → 75% |
| Fail | < 60% |

# Homework Assignments

Homework assignment #1

Problems from text at end of chapter

See web page for problem numbers

Due by April 8 (next Tuesday)

# CMPE 150: Introduction to Computer Networks
# LECTURE 1:

## *Introduction and Background*

# Outline

- What is a computer network?
- Brief history and outlook of the Internet.
- What are communication protocols and how do we go about studying them?
- Architectural structure of the Internet.
- Issues of interest with transmission media as a black box.
- Next lecture: More about networks and links.

# What Is a Computer Network?

- A *communication network* is a set of nodes connected by links and able to communicate with one another.
- **A *computer network* is a communication network in which nodes are computers.**
- The purpose of the network is to serve users, which can be humans or processes.
- Network links can be point-to-point or multipoint and implemented with several *transmission media*.
- Information exchanged can be represented in multiple media (audio, text, video, images, etc.)
- Services provided to users can vary widely.

# Why Learn about Computer Networks?

- **Before .com went bust:**
  - **THE MONEY!**
  - **THE JOBS!**
    - Microsoft, Cisco, HP, Sun, Nokia, Lucent, AT&T, Sprint, MCI, …..
  - **THE IPOS AND ACQUISITIONS!**
    - Akamai, Fastforward (Inktomi), Granite (Cisco), Rooftop (Nokia)

# Why Learn about Computer Networks?

- **After .com collapse:**
  - **NETWORKING  RESEARCH IS GREAT!**
    - Yeah, sure :-)
  - **THE ONLY CLASS MEETNG YOUR SCHEDULE!**

# But Really: Why Learn about Computer Networks?

- **Computer networks started as a means for**
  - Distributed processing
  - Communicating among people (electronic mail, conferencing)
  - Increasing system reliability
- **The "web" and affordable hardware have changed this!**
  - We are evolving into Internet-based enterprises, Internet-based home services, and an Internet society
- **The network will be everywhere…**
  - Computers will be used in almost everything we build (including sensors, appliances, books, newspapers)
  - These computers need to be interconnected

**NETWORKING = COMPUTING**

# Why Learn about Computer Networks?

- **Industry and research are wide open to innovation!**
  - As we will discuss over the next few weeks, today's protocols are oriented to support "host-to-host" communication and assume a client-server model for services and an "open door" policy for the Internet community.
  - The continuing success of the Internet requires:
    - Person-to-person communication (voice and other media over the Internet)
    - Client-to-content services.
    - Security in the services, the infrastructure, and the clients of the Internet
- **Innovation required includes:**
  - Mechanisms to "look-up" content, rather than addresses.
  - Protocols aimed at the new types of communication and services
  - Protocols that adhere to new principles of design.

# Evolution of Computer Networks

1876: Telephone by A. Graham Bell
1890s: Electromagnetic telephone switches
1897: Cathode Ray Tube by K.F. Braun
1940s: Computers, error detection and retransmission
1960: RS-232 physical layer interface (the "serial port") and modems
1960s: T-1 carrier system for telephone transmission (1.5Mbps)
1961: The Compatible Time Sharing System
1962: Paul Baran at RAND proposes packet switching
1965: Automatic equalization by Bob Lucky and others
1968: Carterfone FCC decision that led to AT&T divestiture in 1984.
1969: DARPA funds project on packet switching
1970s: Computerized switches; work on ISDN starts

# Evolution of Computer Networks

1970s: ARPANET starts (UCLA, Utah, SRI, UCSB); its technology evolved into today's Internet

1970s: ALOHA system at U. of Hawaii; first protocol for multiple access channels; leads to Ethernet

1970s: GUI, mouse, hypertext by Doug Engelbart at SRI

1974: "A Protocol for Packet Network Interconnection," V. Cerf and R. Kahn, IEEE Trans. Comm (May).

1980s: OSI (open system interconnection) reference model

1982: TCP/IP is deployed in ARPANET/MILNET

1984: Host table evolves into DNS in ARPANET

1984: AT&T breaks up

1986: NSFNET is created; becomes Internet backbone

1992: WWW by Tim Berners-Lee (CERN) is released; gives a GUI to the Internet

1990s: Caches and proxies helping clients access content

# Evolution of Computer Networks

1970s: CCITT publishes standards for public data networks (X.25 standards)

1980s: Token ring LANs, FDDI emerge; do not replace Ethernet

1990s: ATM evolves; does not replace IP

1990s: Internet: From 4 to 30M+ wired, published nodes in two decades

1990s: SONET (synchronous optical network) and SDH (synchronous digital hierarchy) evolve

1990s: Cellular phones, laptops, palmtops become popular

1999: Gigabit Ethernet starts, simplicity wins again.

# Evolution of Computer Networks

***What will happen in the 2000s?:***

- Ad-hoc wireless networks; self-configuring nets
- Networked sensors and appliances
- System-area networks ("the network is [in] the computer")
- Network-based computing: grid computing

  ("the computer--processing and storage--is in the network")
- Internet-to-go; deeply networked systems
- IP voice, IP devices
- Content routing: ISPs start to be CDNs, allow clients to obtain content based on its name from the best location

***…. Networking = Computing***

# What Do We Study?

- We will take the Internet as our running example.
- The Internet has computer hardware, software, operating systems, transmission technology, services defined over it... ***What is its glue?***
- ***Communication protocols*** implemented in software or hardware transform otherwise isolated machines into a society of computers.
- Protocols specify how processes in different machines can interact to provide a given service.
- Distributed algorithms are the essence of what we study.

# Communication Protocols

- **A set of rules governing the interaction of concurrent processes in a system.**
- **A protocol has five parts:**
  - The service it provides.
  - The assumptions about the environment where it executes, including the services it enjoys.
  - The vocabulary of messages used to implement it
  - The format of each message in the vocabulary.
  - The procedure rules (algorithms) guarding the consistency of message exchanges and the integrity of the service provided.

# What Do We Study Regarding Protocols?

- What is a good protocol design?
  - Judging by their survival, Ethernet and IP are good; token ring protocols are not very good
- What are good and bad aspects in a protocol?
  - TCP adapts to congestion, but it inherently assumes that the Internet sends packets in order.
- Use representative protocols to go over these issues.
- Discuss new directions in computer communication.

# What Do We Study Regarding Protocols?

- We will take a first look at the ***principles of computer communication***.
- Our principles are:
  - The description of a protocol has no ambiguity.
  - A protocol does what it is supposed to do, all the time.
  - A protocol does not leave any communicating party waiting forever for something to happen.
  - A protocol makes efficient use of available resources.
  - A protocol enables the use of resources fairly or according to a predefined contract.
  - As with most engineering topics, simplicity is important.