Last Class!

Today:
- what have we learned?
- where is the networking world going?
- question and answers
- evaluation

Course Summary

What have we learned: a huge amount!

- Comprehensive view of field of Computer Networks
  - principles
  - practice

... using Internet to motivate examples
What did we do?

**Introduction**
- What is the Internet, protocol?
- network edge, core, access nets
- physical media
- delay, loss
- layers, service models
- Internet backbones, NAPs, ISPs
- history

**Application Layer**
- application-layer protocols
- the WWW: HTTP
- FTP
- email: SMTP, POP3, IMAP
- DNS
- Socket programming

**Transport Layer**
- services, principles
- multiplexing, demultiplexing
- UDP
- Principles of reliable of data transfer
- TCP
- Principles of congestion control
- TCP congestion control

**Network Layer**
- service model(s)
- routing principles
- hierarchical Routing
- IP protocol
- routing in the Internet
- what’s inside a router?
What did we do?

Link Layer, LANs
- introduction, services
- error detection, correction
- multiple access protocols
- LAN addresses, ARP
- Ethernet
- hubs, bridges and switches
- wireless: IEEE 802.11

What is the Internet?

local ISP
company network
regional ISP
router
workstation
mobile
server
Q: Where is Networking headed?

A: nobody really knows!

General trends:

- ubiquity of communications
  - IP dialtone, IP will be like electricity: it’s everywhere!
  - network-capable appliances (e.g., IP thermostat)
  - issues of scale important: 100’s of millions of network-connected devices
  - sensor networks

- mobility important:
  - people move, need to communicate

Q: Where is Networking headed?

- multimedia important:
  - it is how people communicate
  - QoS not a solved problem end-end

- high bandwidth to home (ADSL, cable modems) a major driver for future
  - games, VR, education, information, entertainment
  - merger of networking and telephony
  - broadcast entertainment (TV) and WWW

- security, and network management: critical concerns

- application-layer services: a network over the network: P2P, CDNs, etc.
The Future: a broader CS view

1980 - 1995
communications
computing

1995-2005
communications
computing

2005 - ?
communications
information
processing

Remember Course Goals

- networking: will play a central role in computing, information processing
- this course:
  - specific architectures, protocols
  - fundamental issues: APIs, reliable data transfer, flow/congestion control, routing, multiple access, addressing, security, management
- remember: you learned it HERE!
Evaluation

- on-line
- need CCNY email (R1/505)
- instructions sent to your email
- follow instruction
- please do it

Final

- Short answers
- Routing algorithms
- Routing table
- Ethernet collisions and back-off
- Routing and addressing
The End!