Announcements

- **Handouts**
  - class syllabus (on web page)
  - programming assignment #1 (also on web page)
  - info about jobs at Transarc outside my office

- **Enrollment**
  - at least the first 5 on the waiting list who have taken 311/330 will be able to enroll for the class
Design Issues In Layers

- Rules for data transmission (Protocol)
  - full vs. half duplex
  - error control (detection, correction, etc.)
  - flow control (rate matching, overuse of shared resources)
  - message order (do things arrive in the same order as sent?)

- Abstractions for communications
  - end points for communication
    - switches, nodes, processes, threads in a process
    - how are these end points named (addresses)?
  - service providers and service users

- Service Primitives
  - operations performed by a layer
    - events and their actions
  - request, indication, response, confirm
Protocols are divided into layers

- **ISO - seven layer reference model**
  - Application
  - Presentation
  - Session
  - Transport
  - Network
  - Link
  - Physical

- **TCP/IP - four layer model**
  - link
  - network
  - transport/session/presentation
  - application

- **Old Saying**: If you know what you are doing, four layers is enough; if you don’t seven won’t help.
Physical Layer

● **Goal:** Raw bits over a communication channel

● **Sample Issues:**
  – how to encode a 0 vs. 1?
  – what voltage should be used?
  – how long does a bit need to be signaled?
  – what does the cable, plug, antenna, etc. look like?

● **Examples:**
  – modems
  – “knock once for yes, twice for no”
Data Link Layer

- **Goal:** transmit error free frames over the physical link
- **Sample Issues:**
  - how big is a frame?
  - can I detect an error in sending the frame?
  - what demarks the end of the frame?
  - how to control access to a shared channel?
- **Examples:**
  - Ethernet framing
The Network Layer

- **Goal:** controlling operations of the subset
- **Sample Issues:**
  - how route packets that have to travel several hops?
  - control congestion - too many messages at once
  - accounting - charge for use of the network
  - fragment or combine packets depending on rules of link layer
- **Examples:**
  - IP
The Transport Layer

- **Goal:** accurately transport session data in order
  - end points are the sending and receiving machines
- **Sample Issues:**
  - how to order messages and detect duplicates
  - error detection (corrupt packets) and retransmission
- **Examples:**
  - TCP
The Session & Presentation Layers

- **Goal:** common services shared by several applications
- **Sample Issues:**
  - network representation of bytes, ints, floats, etc.
  - encryption?? (this point is subject to lots of debate)
  - synchronization
- **Examples:**
  - eXternal Data Representation (XDR)
Application

- **Goal:** common types of exchanges standardized
- **Sample Issues:**
  - when sending email, what demarks the subject field
  - how to represent cursor movement in a terminal
- **Examples:**
  - Simple Mail Transport Protocol (SMTP)
  - File Transfer Protocol (FTP)
  - Hyper-Text Transport Protocol (HTTP)
  - Simple Network Management Protocol (SNMP)
  - Network File System (NFS)
  - Network Time Protocol (NTP)
  - Net News Transport Protocol (NNTP)
  - X (X Window Protocol)