# Announcements

- Handouts (reminder from last time)
  - class syllabus (on web page)
  - programming assignment #1 (also on web page)
- Enrollment
  - if you have not taken 311 **and** 330 you will be removed from the class tonight.


copyright 1996 Jeffrey K. Hollingsworth

# 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


copyright 1996 Jeffrey K. Hollingsworth

# 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.


copyright 1996 Jeffrey K. Hollingsworth

# 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”


copyright 1996 Jeffrey K. Hollingsworth

# 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


copyright 1996 Jeffrey K. Hollingsworth

# 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


copyright 1996 Jeffrey K. Hollingsworth

# 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


copyright 1996 Jeffrey K. Hollingsworth

# 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)


copyright 1996 Jeffrey K. Hollingsworth

# Application Layer

- 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)


copyright 1996 Jeffrey K. Hollingsworth