computing: nature, power and limits—robotics applications (cis1.0)
fall 2006—lecture # A.2
## wednesday 6-sep-2006

today

- network concepts
- internet specifics
- clients and servers
- IP address and domain name servers

network concepts

- when computers talk to each other, this is called a **network**
- *open system* = "a system whose architecture is not a secret"
- the network can have different kinds of computers and peripherals attached to it
- networks in which computers are physically connected to each other in the close geographical proximity are called **local area networks** (LANs)
- other networks are called **wide area networks** (WANs)
- the **internet** is a wide area network
- the way in which the computers are connected to each other is called the network's **topology**

network topologies

- bus (linear model; inexpensive to run cables, but not robust to node failure)
- ring (example: IBM token ring)
- star (can be expensive to run cables, but robust to node failure)
- hub (efficient; internet model)

linear

ring

star

hub
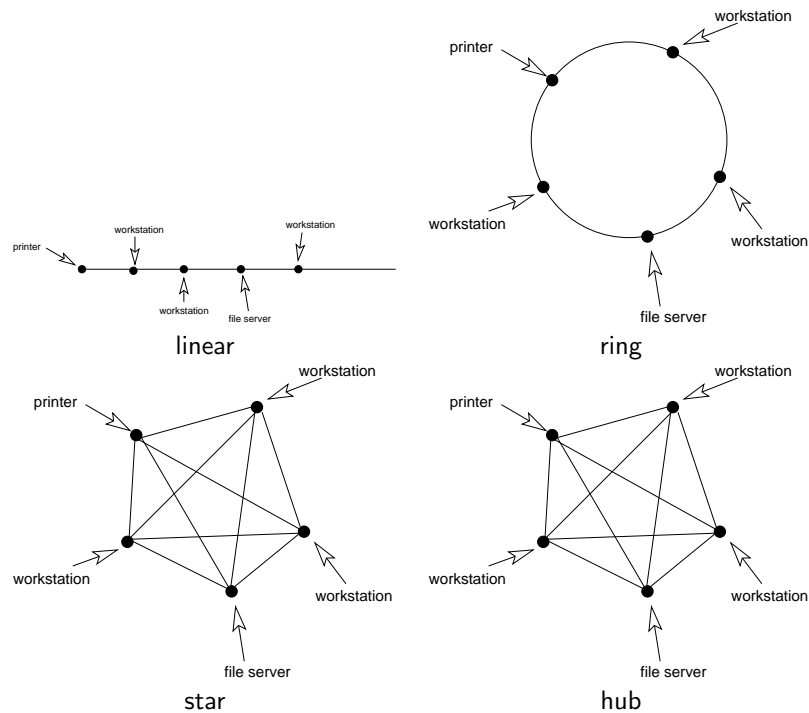
network architecture

- Open System Interconnection (OSI) reference model

- also called the 7-layer model:

  1. application layer (displays data, communicates with lower layers via presentation layer)

  2. presentation layer (link between app and lower layers; converts application layer data to forms understandable by other layers, and back; translates the "meaning" of the bits)

  3. session layer (exchange of data between applications – "dialog" – and synchronization between applications)

  4. transport layer (transfer of data through network; effects flow control; provides some error recovery)

  5. network layer (physical routing of data from one computer to another; facilitates sender finding receiver)

  6. data link layer (manages transmissions of low-level data; detects and corrects transmission errors)

  7. physical layer (sends electronic signals, or "bits" − 0's and 1's)

- "**A**ll **P**eople **S**eem **T**o **N**eed **D**ata **P**rocessing."

network information units and formats

- "information units" are passed from one layer to another

- "headers" are added as information passes from upper to lower layer

- terminology is defined below (it is often not used clearly or precisely):

  - *frame* = information unit whose source and destination are the *data link* layer
  - *packet* = information unit whose source and destination are the *network* layer
  - *segment* = information unit whose source and destination are the *transport* layer
  - *message* = information unit whose source and destination are the *application*, *presentation* or *session* layers
  - *datagram* = information unit in a "connectionless" network

network/internet protocols

- *protocol* = set of rules for how computers communicate with each other

- IP: internet protocol, i.e., moving data via TCP or UDP

- TCP: transmission control protocol (computer ↔ computer); can re-transmit if errors

- UDP: user datagram protocol; no error checking, fast messaging

- HTTP: hypertext transfer protocol (computer ↔ browser)

- FTP: file transfer protocol

- SMTP: simple mail transfer protocol

internet addresses

- *IP address* = Internet Protocol address

- every computer on the internet has a unique address

- *dotted quad notation* = four numbers separated by dots (.); e.g., 146.245.250.131 (which is the address of the CIS dept web server...)

- address can be stored in 32 bits; there are four formats, depending on the size of the network (i.e., the size of each of the numbers in the dotted quad notation is defined by the format...)

- "subnetting" is a standard (defined in 1985) to divide a large network into a number of smaller networks (this is what a *router* does)

- example:

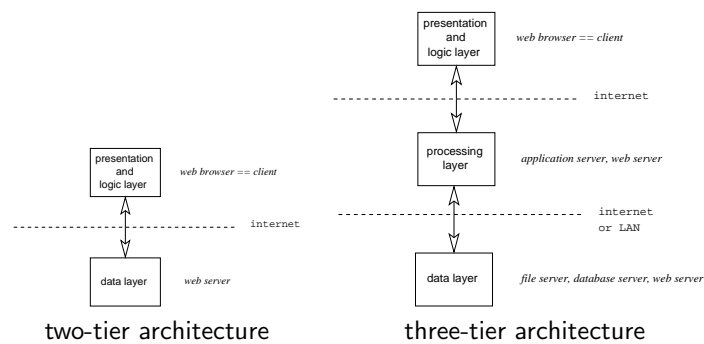|	network prefix	subnet number	host number
IP address 130.5.5.25 →	130.5.	.5	.25

domain names

- provides a more convenient way to address a computer on the internet than the numeric IP address

- structured hierarchically

- example: `www.sci.brooklyn.cuny.edu`

- common *domain names*: `com`, `edu`, `gov`, `uk` and other country-based domains

- *name server*: maintains correspondance between numeric IP address and domain names;

- DNS = internet domain name system = group of domain name servers

clients and servers

- *server*:

  - computer on a network which carries out some service for another computer

- *client*:

  - the other computer for whom the server is carrying out the service

- types of servers:

  - file servers (provides files for clients)
  - database servers (specialized file server: provides databases – structured files – for clients)
    * what is a *database*?
    * key concepts: SQL (structured query language), hierarchy, *records*, *fields*
  - web servers (specialized file server: provides files that make up the components of a web site, e.g., html documents, video clips, etc)
  - groupware
    * manages scheduling for individuals and groups of co-workers/collaborators
    * provides reports (e.g., billing) for collaborators

* supports mailing lists for collaborators
* e.g. Lotus Notes
- mail servers (provides mail sending, receiving, storage)
- object servers (provides access to "distributed objects")
- print servers (manages a print *queue*)
    * adds requests to the queue
    * schedules requests
    * instructs printer regarding requests
    * provides status on requests to clients
- application servers (provides access to particular applications, e.g., game servers)

client-server architectures

| presentation and logic layer | *web browser == client* |
| internet |
| data layer | *web server* |

two-tier architecture

| presentation and logic layer | *web browser == client* |
| internet |
| processing layer | *application server, web server* |
| internet or LAN |
| data layer | *file server, database server, web server* |

three-tier architecture

- advantages:
    - isolates data storage technology
    - places more burden on server (instead of client) and distributes tasks amongst server(s)
    - follows object-oriented and modular paradigms