Basic functions in operating systems

Basic functions in kernel

1. File manager
   - directories (folders) — organization
   - path — ∼joan/WWWpublic/intro/15slide4.pdf
   - allows access, checks rights
2. Device drivers
   - printer, screen, mouse, etc.
   - communicate with controllers

Basic functions

3. Memory manager
   - in multiuser or multitask system, much to do
   - virtual memory — if more data than for physical memory
   - store some pages in physical memory
     — if used often, leave there — paging is slow
4. Scheduler and dispatcher
   — giving time slices to different tasks or users
5. Bootstrap
   - bootstrap program (boot loader) in ROM (non-volatile)
   - loads rest of OS from disk into main memory (volatile)

Processes

program — instructions
process — execution of program
— 2 users use same program = 2 processes

process state

- value of program counter
- values in other registers
- values in memory
- used to restart a process

Processes

OS must

- give needed resources to processes
  — space in memory, files, devices, etc.
- make sure processes don't interfere with each other
- let processes exchange info if needed

Scheduler

The scheduler maintains a process table, with info for each process:

- memory locations assigned
- priority of process
- status of process
    - running
    - ready
    - waiting — for external event
      — completion of read from disk, etc.
    - terminated

Dispatcher

- gets scheduled processes executed by time sharing
- chooses highest priority (given by scheduler)
- gives each process its time slice
- changing processes — process switch/ context switch
  - caused by interrupt
  - dispatcher sets timer to cause interrupt
  - interrupt handler
    - transfers control from process to dispatcher
    - saves and restores process state
    - machine language designed for it

Competition among processors

Allocating access to resources

- sections of code — device driver for printer
- memory addresses

1 process at a time

Competition among processors

flag $\boxed{?}$

0 –	clear	OK
1 –	set	in use

Problem:

Process 1	Is flag clear?
	Yes
interrupt	
Process 2	Is flag clear?
	Yes
	set flag
	use printer
interrupt	
Process 1	set flag
	use printer

Competition among processors

Possible solutions:

1. OS disables interrupts when checking flag
   — re-enables after done with set
2. test-and-set instruction
   — no interrupts in middle of single instruction

The flag is a semaphore (railway signals).
Used to protect critical regions (of code) which require mutual exclusion.

Competition among processors

Another problem:

- Process 1 and Process 2 each need same 2 resources (printer and disk).
- Process 1 gets 1 resource.
- Process 2 gets the other.
- Neither process can continue. — Deadlock

Competition among processors

Deadlock can occur if:

1. There is competition for non-shareable resources
2. Resources requested on partial basis
   — after getting some, may request more
3. Can't take resources back

Possible solutions:

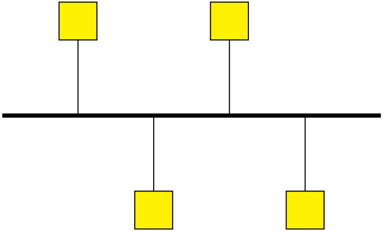
- Deadlock detection and correction — remove condition 3
- Spooling
  - device driver saves data (for printer)
  - sends data later
    — process continues as if printing completed

Networks

LAN — local area network
— mostly Ethernet or wireless — 1 building

WAN — wide area network — ex. Internet

Configurations — topology



bus   older Ethernet

Networks

Many variants of Ethernet.
Original:

- Specify address when sending.
- All processors can check if something is there.
- Wait random amount before trying again.
- Wait longer amount if failure again, etc.
  but send for long enough that all can detect the collision.
- Protocol says how to do this.

Networks

Other topologies:

- ring
- star
  — popular in wireless networks (WLAN)
  — center is access point (AP)
  — center is a switch for Ethernet
- others...

Wireless:

- WiFi (Wireless Fidelity) — one wireless standard
- WPA2 — security standard

Networks

In a ring topology with N processors, how many rounds does it take for one processor to send a message to another in the worst case? Same question for a star topology.

A. ring – 1; star – 1;

B. ring – 2; star – 2;

C. ring – $\lfloor N/2 \rfloor$; star – 2;

D. ring – $\lfloor N/2 \rfloor$; star – $\lfloor N/2 \rfloor$;

E. ring – N; star – $\lfloor N/2 \rfloor$;

Vote at m.socrative.com. Room number 415439.

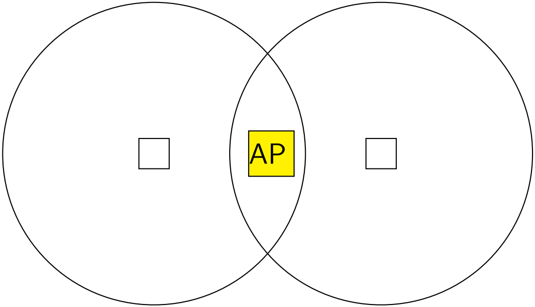
Networks

In a ring topology with N processors, how many rounds does it take for one processor to send a message to another in the worst case? Same question for a star topology.

C. ring – $\lfloor N/2 \rfloor$; star – 2;

Wireless networks

Hidden terminal problem:



Can't tell if another sends at same time.

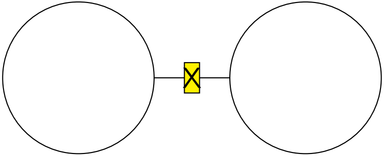
Protocol could say: Need OK from AP before sending

collision avoidance

Ethernet — collision detection

Connecting networks

Connecting networks:



X:

- repeater — sends further, required by physical limitations
- bridge — only sends further if sent to address on other side
- switch — like bridge, but connecting more than 2

Connecting networks

Connecting dissimilar networks into internet (small i)
— point where connected is gateway

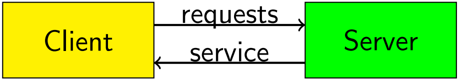
- Connect with routers - often have firewall packet filters, checking source, destination, port
- Home wireless — AP and router in 1 box = gateway
  - Have network in home
  - Router connects to Internet
- Router forwards messages towards proper destination
- Forwarding table — used to figure out from address where to send next

Networks

Peer-to-peer model (P2P) vs. Client server model

— depends on what you are doing

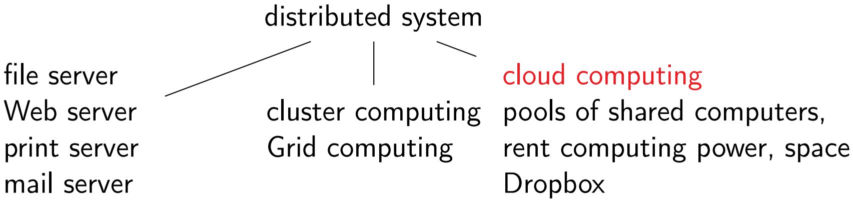
Client/server model



Interprocess communication example:
Parts of OS share time and communicate
— scheduler needs help from memory manager to start a process

Server could be on same machine or same network
(distributed system).

Distributed computing



distributed system

file server
Web server
print server
mail server

cluster computing
Grid computing

cloud computing
pools of shared computers,
rent computing power, space
Dropbox

Peer–to–peer (P2P)

Example: 2 processes communicating over the network

Example: file sharing

- due to legality? — copyright can be enforced, even without server
- due to efficiency — with one server (star), have bottleneck

Internet

Internet — an internet

- links together LANs, MANs, WANs, WLANs, globally
- not new — saw in mid 1970s, sent e-mail in early 80s
- Internet was before WWW

Example: wireless connection — similar to cell phone technology

- Wireless device connects to AP (access point)
- AP's range — hot spot
- AP connected to access ISP
  — Internet service provider: TDC, AOL, SDU, etc.
- often connect via cable or telephone

Internet

domain — region of Internet operated by 1 entity (university, company, etc.)

domain name — assigned by registrars

Top-level domains — .edu, .com, .dk
Example: login.imada.sdu.dk — imada is a subdomain
IP addresses:

- IPv4: 32 bits: 10.110.4.199
- IPv6: 128 bits: 2001:0DB8:AC10:FE01 — hexadecimal (first half shown)

Domain name server (DNS) — Internet directory

212.97.129.250 vs. www.sdu.dk