

Network Operating Systems

Kazunori Sugiura

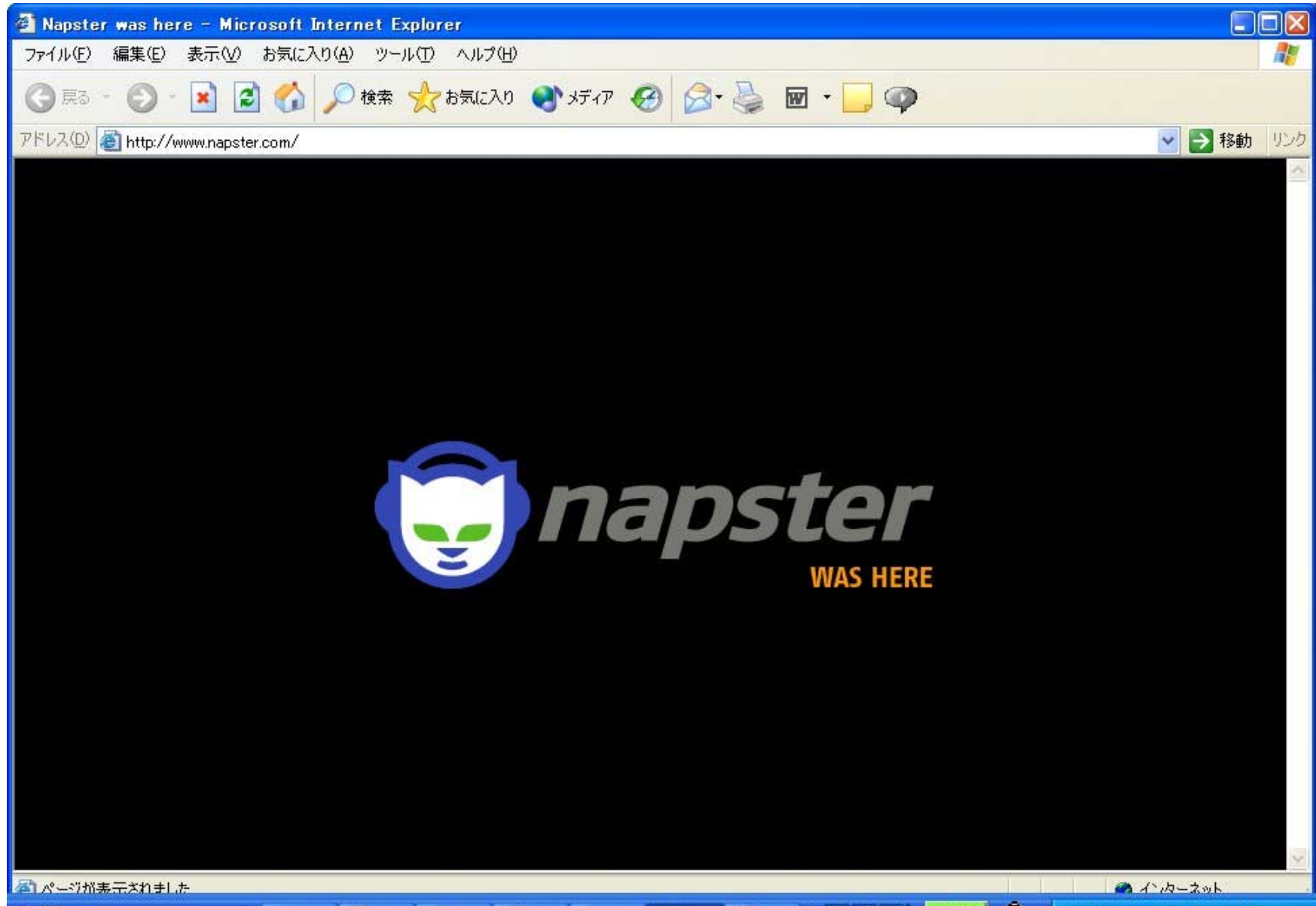
(uhyo@sfc.wide.ad.jp)

Sept. 5th, 2002

Theme of my lecture today

- Technology based on the Internet environment
 - Computer Technology
 - Network technology
- Computers and network operating systems
 - Introduction to UNIX operating system
 - Let's install and configure FreeBSD

Before we start



WinMX : P2P sharing applications

The screenshot displays the WinMX 'Transfers' window, which is divided into two main sections: 'Transfers' (top) and 'Queue' (bottom). Both sections feature a table with columns for File, User, Speed, Bytes, Status, k/s, and Time L.

Transfers Section:

File	User	Speed	Bytes	Status	k/s	Time L.
...	boy0948261	DSL	219,456,047 of 236,298,244	Progressing (30%)	7.90	34.42
...	ak1711412	Cable	80,650,944 of 299,720,728	Progressing (27%)	7.16	497.43
...	sad122771	DSL	12,284,576 of 507,545,332	Progressing (2%)	6.48	961.04
...	kakokokok	Cable	11,246,712 of 50,061,568	Progressing (22%)	8.77	72.03
...	zwe052c2	Cable	3,581,739 of 87,968,772	Waiting for server response...		
...	buhinh28f	Unkn.	44,896,266 of 309,363,908	Retry in 1:40 (User offline)		
...	BLACKFOX	DSL	54,951,032 of 694,208,888	Retry in 0:47 (Timed out (Waiting for server res...		
...	wakuraku	Cable	7,583,828 of 174,936,776	Retry in 0:59 (Timed out (Waiting for server res...		
...	Tainalpe5	Unkn.	131,534,592 of 477,425,468	Retry in 0:32 (User offline)		
...	rainy610a4	Unkn.	0 of 226,131,968	Retry in 0:11 (Timed out (Waiting for server res...		
...	kyotaka57	Cable	34,549,760 of 666,662,830	Retry in 0:02 (User offline)		
...	nanase-11	DSL	0 of 473,786,924	Remotely queued 20		
...	tec-gode4	Cable	0 of 473,786,924	Remotely queued 6		
...	bikke001f0	Unkn.	0 of 114,253,828	Remotely queued 9		
...	esox66669	Unkn.	0 of 654,928,581	Remotely queued 11		

Queue Section:

File	User	Speed	Bytes	Status	k/s	Time L.
...	boy0948261	DGL	225,069,751 of 608,398,876	Progressing (37%)	8.02	778.16
...	ak17114126	Cable	87,142,311 of 87,777,290	Progressing (98%)	7.44	1.23
...	tensae1104	Cable	29,036,588 of 60,698,108	Progressing (47%)	2.86	180.02
...	bikke001f0	Cable	95,808,769 of 499,177,332	Progressing (19%)	5.44	1236.53
...	sad1227716	DGL	12,196,038 of 403,867,652	Progressing (3%)	6.59	742.13
...	kakokokoko	Cable	10,161,502 of 211,898,968	Progressing (4%)	8.02	409.33
...	Departivo84	T1	0 of 59,996,318	Queued		
...	VAVO0nb5	DGL	0 of 608,398,876	Queued		
...	Axlachapell	DSL	0 of 608,398,876	Queued		
...	Axlachapell	DSL	0 of 103,976,219	Queued		
...	fabiolucilla2	DGL	0 of 10,629,120	Queued		
...	fabiolucilla2	DSL	0 of 14,067,712	Queued		
...	train05e67d	DGL	0 of 3,640,538	Queued		
...	icamaheruk	128K	0 of 138,488,080	Queued	0.00	
...	icamaheruk	128K	0 of 53,263,294	Queued		
...	ur077760c3	DGL	0 of 3,440,526	Queued		
...	kakokokoko	Cable	0 of 60,698,108	Queued		
...	3i0s610h4s	DGL	0 of 138,488,068	Queued		
...	toru526491a	DGL	0 of 3,694,592	Queued		
...	icamaheruk	128K	0 of 60,698,108	Queued		

At the bottom of the window, a summary bar shows: 5 DLs @ 37.26 k/s, 6 ULs @ 41.77 k/s.

A small 'Hotlist' window is visible in the bottom right corner, showing a 'Temporary' list with the entry 'kazu2035753dd0'.

What is Napster?

- Peer to Peer File sharing application
 - Audio files
 - Videos
 - Misc. files
- Final court denies continuation of the service

Sega and PS Emulator for PC bleem!
Deceased Nov. 2001



Contents and copyrights

- Digital House appliances Forum, 2002
- Digital information are easy to copy
 - Network enables sharing of the information
- Digital copyright protection
 - CSS (Contents scramble system)
 - AEA (Advanced Encryption standard)
 - CPPM (Content Protection for Prerecorded Media)
 - CPRM (Content Protection for Recordable Media)
 - DTCP (Digital Transmission Content Protection)
 - DDCP (High-bandwidth Digital Content Protection)

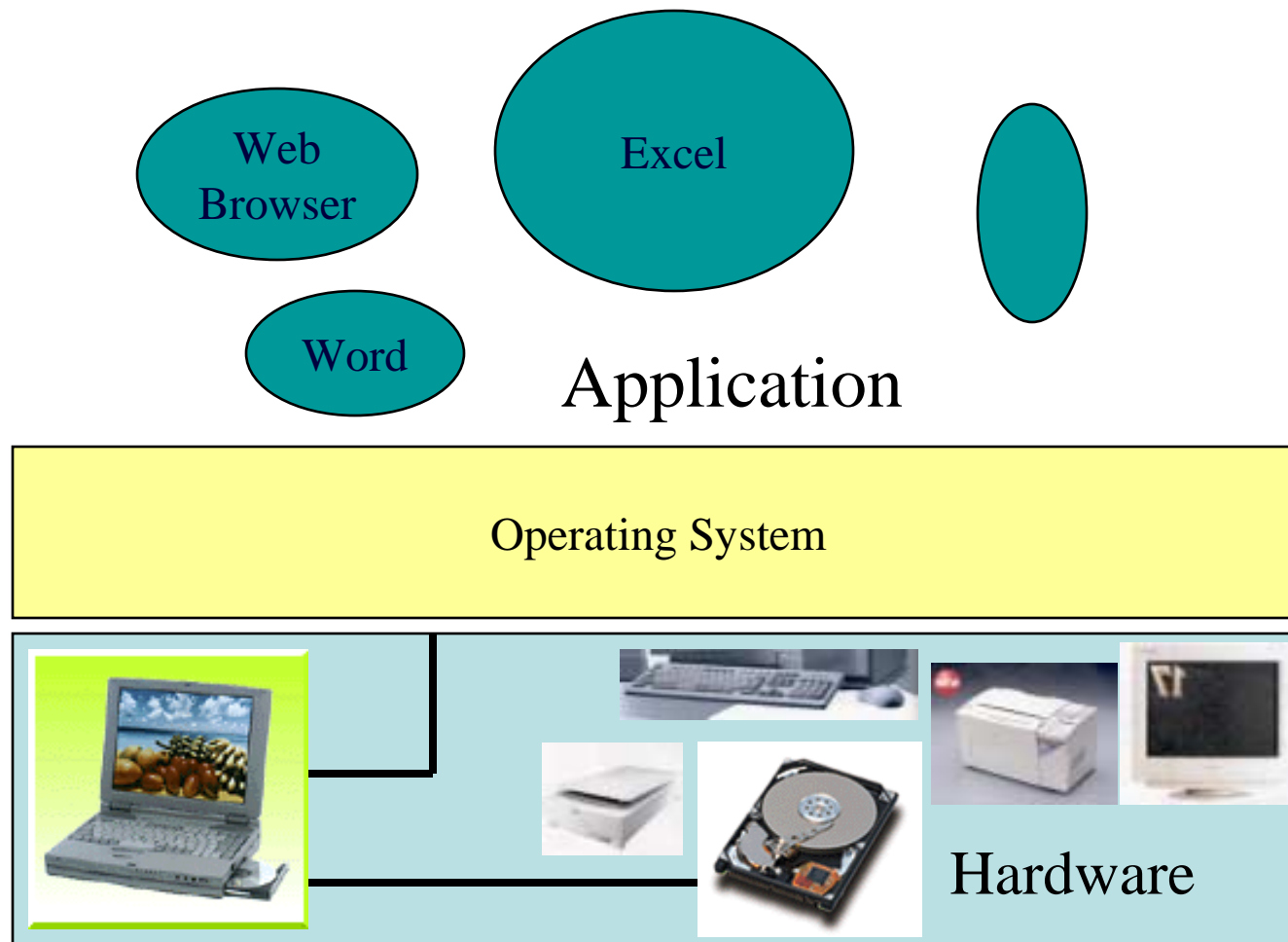
Lawsuits in Florida

- AT&T Broadband is providing 100% broadband service to white residents while African American citizen residents applies only 1%. Federal Communications Act in 1934, and Telecommunications Act in 1996 prohibits discrimination of any kind in ways of communication servicing.
- As of Sept. 1st 2002

What is an Operating system?

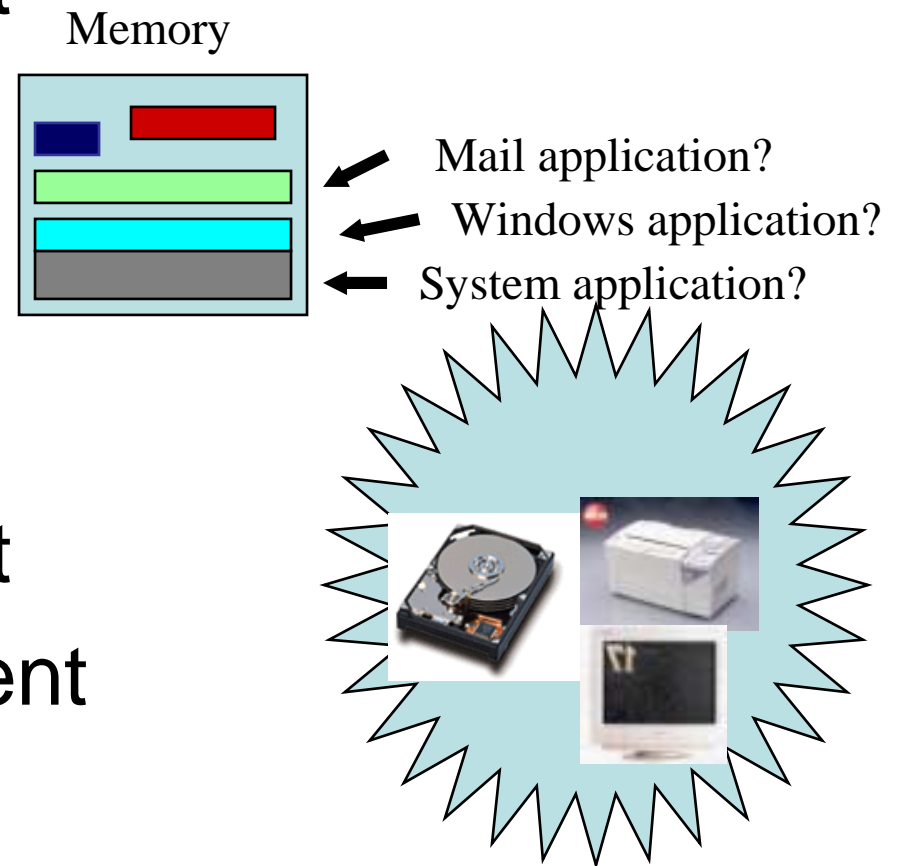
- 2 kinds of a software
 - Application Software
 - Word processors, database manager, compiler, web browser
 - System Software
 - Operating system itself
- Bridges between the hardware and users

Computer, OS, and user applications



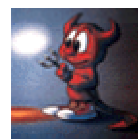
Resource management

- Memory management
- Device management
 - Printer
 - Hard drive
 - display
- Process management
- Processor management



Many kinds of Operating system

- Single User, Single Task
 - MS-DOS, Mac-OS, CPM/86
- Single User, Multiple Task
 - OS/2, Windows 95
- Multiple User, Multiple Task
 - Windows NT, UNIX, Windows 2000, Windows XP

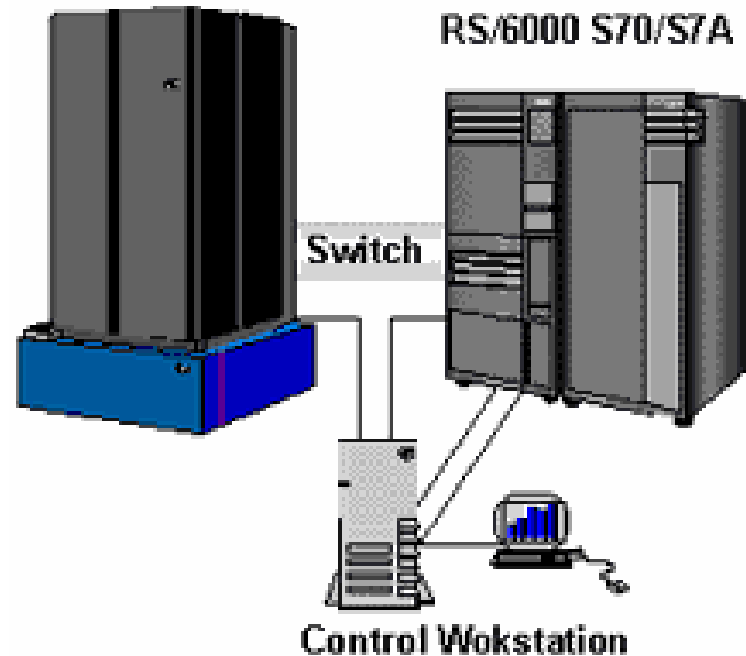


BSDI

BSD/OS
Internet Gateway Server

Using multiple computers at once

- Multiple processor



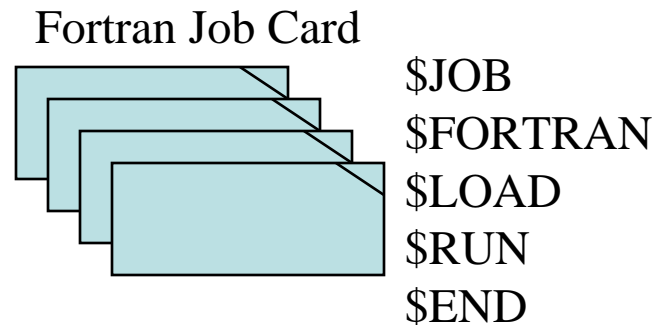
IBM: SP-2

Why OS was born?

- Batch processing
 - Resident Monitor, JCL, IOCS



Single job
Single program

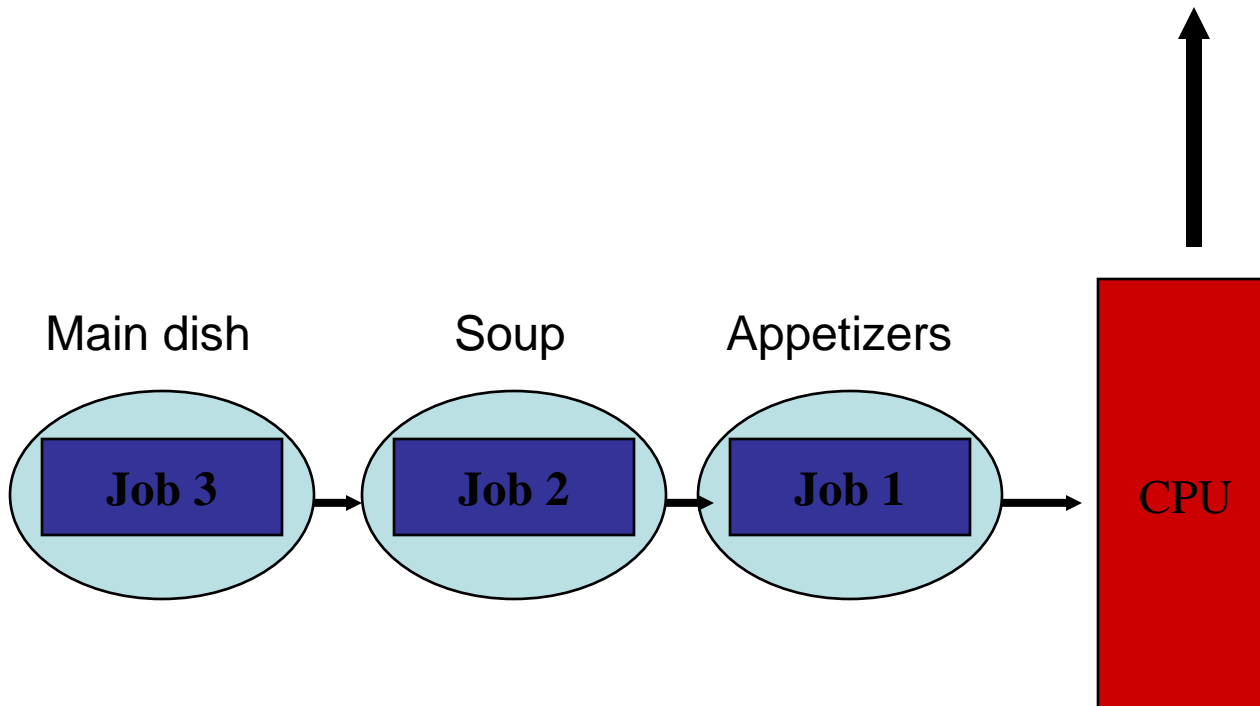


Minimum controlling mechanism

Batch Process

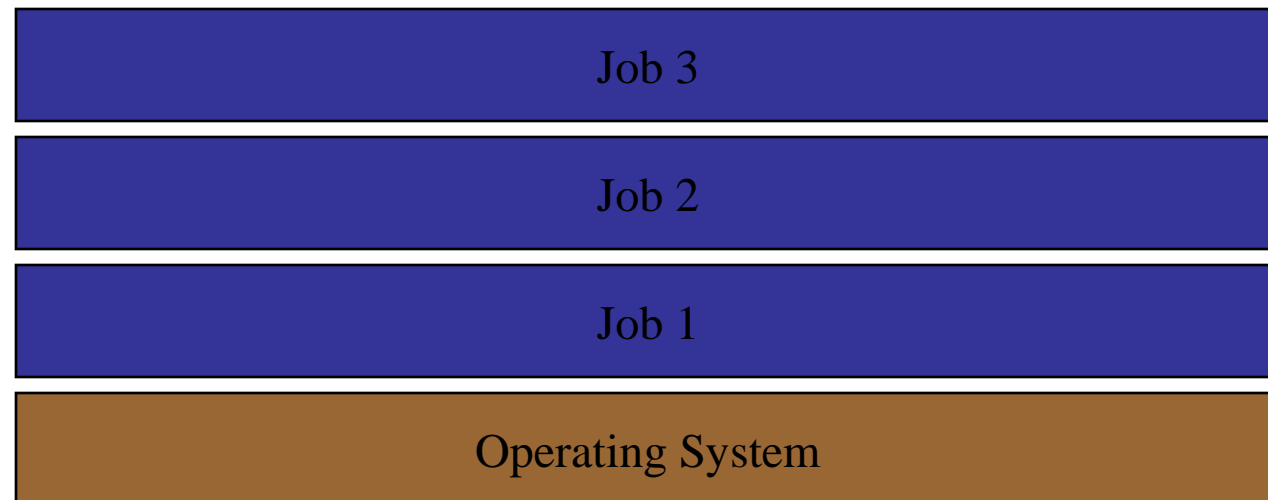
Courses in Restaurants

Eat one dish at a time



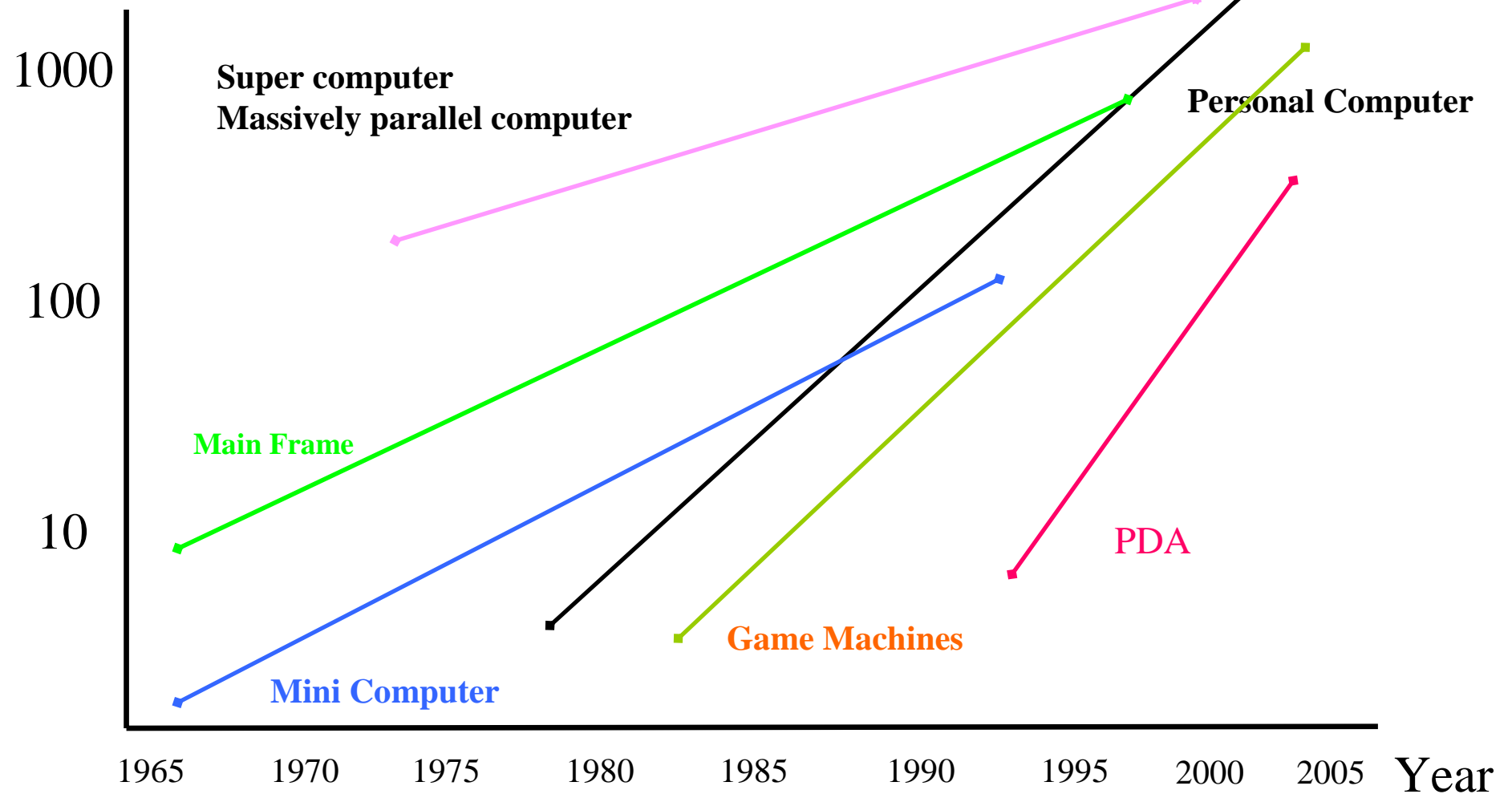
Multi Programming

- Multi programming system
 - THE system
 - MFT/MVT/TSO/CMTS



Performance

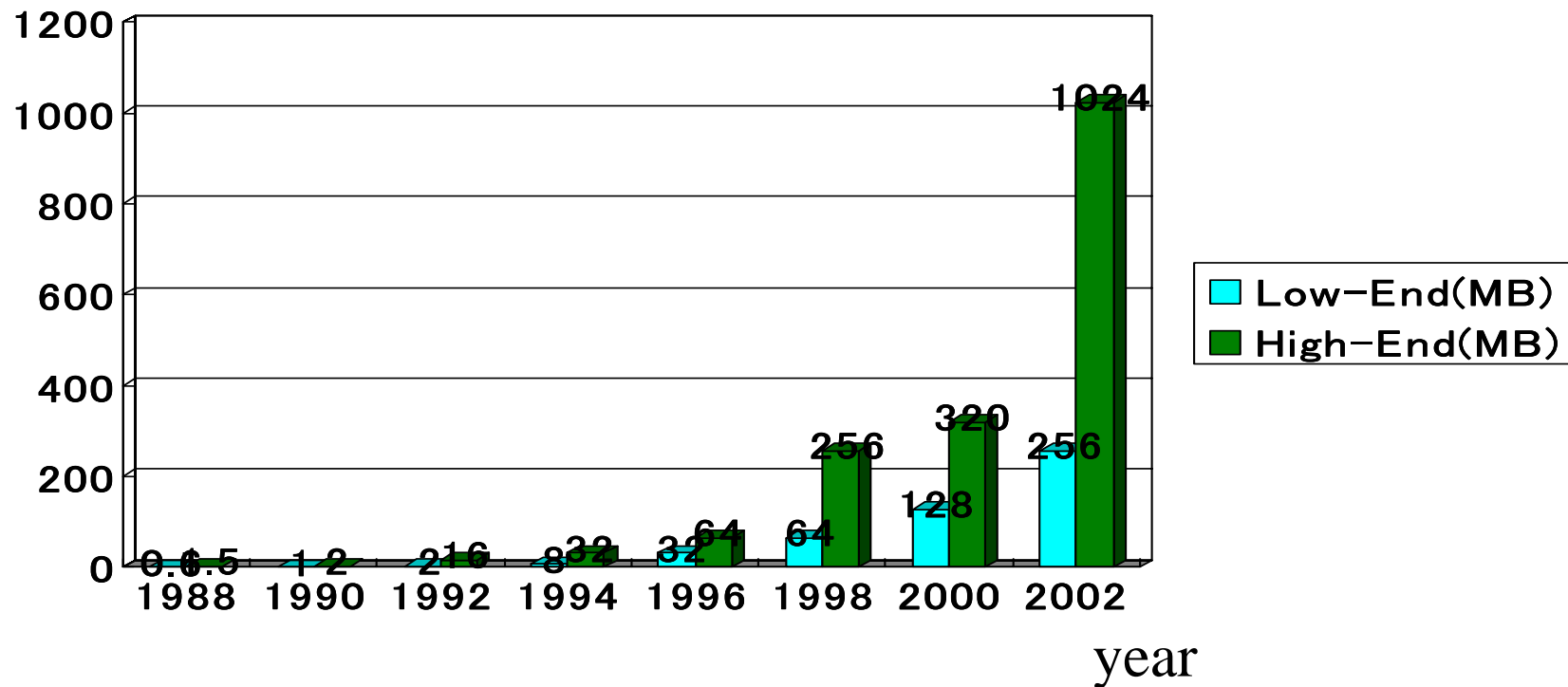
Performance index



Increase in Memory

Complex operating system and applications
Graphics, audio, video

MB



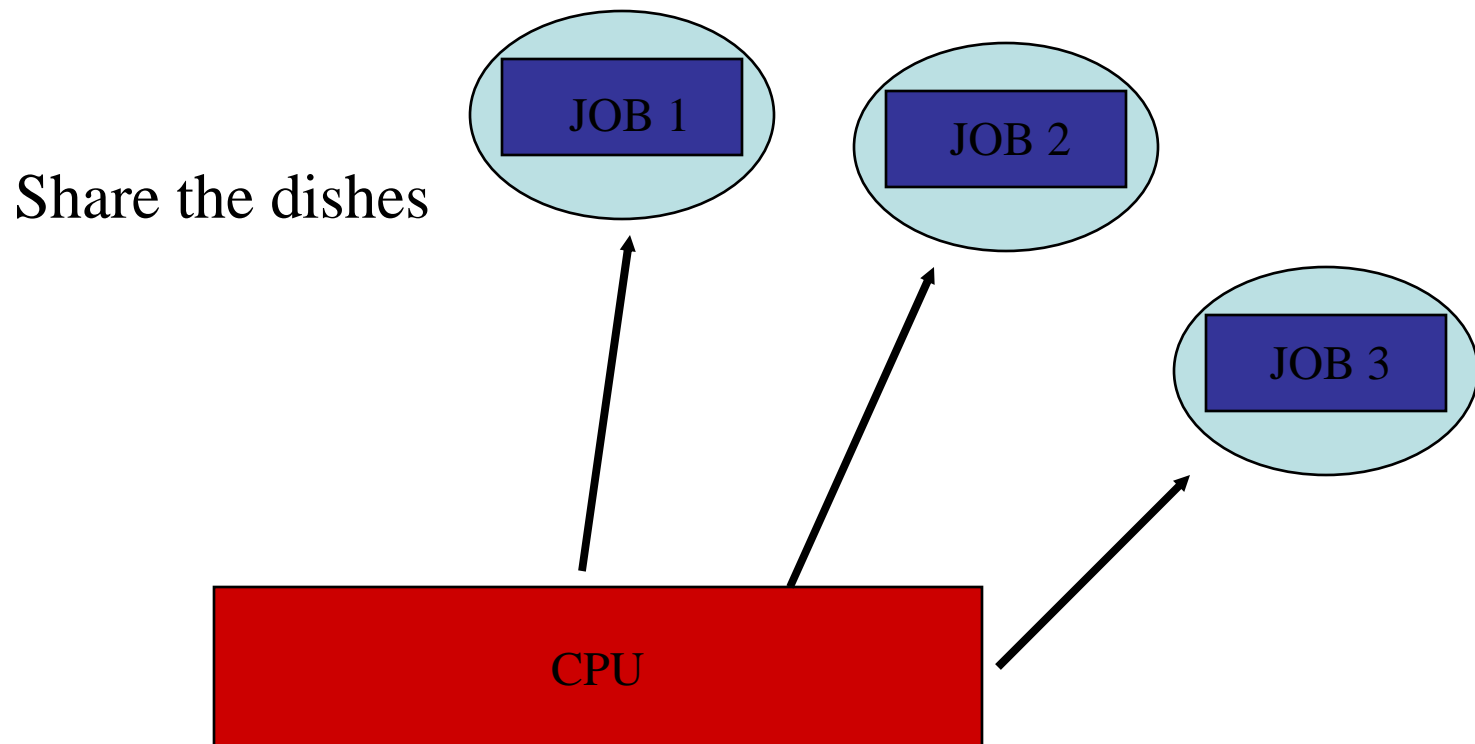
Memory space

- Enlargement of memory spaces

16 Bit address space	$65536\text{Byte} = 64\text{KByte}$
24 Bit address space	$16777216\text{Byte} = 16\text{MByte}$
32 Bit address space	$4294967296\text{Byte} = 4\text{GByte}$
48 Bit address space	$2814749710656\text{Byte} = 256\text{TByte}$

Time Sharing System

Welcome to the UNIX world



History of UNIX

- Development of TSS @ Multix
 - TSS development : AT&T, GE, MIT
- 1976 Bell Lab. UNIX Version 6
 - Mini Computer
 - DEC: PDP-9(16bit, 256K)
 - Small TSS
 - Free source code for the Software
 - Abstraction based on the file system

UC. Berkeley

- PDP 2BSD, VAX 3BSD, 4BSD
- New functions
 - Virtual memory system
 - Network (TCP/IP, Socket interface)
 - Full Screen capability (termcap)
 - csh, vi

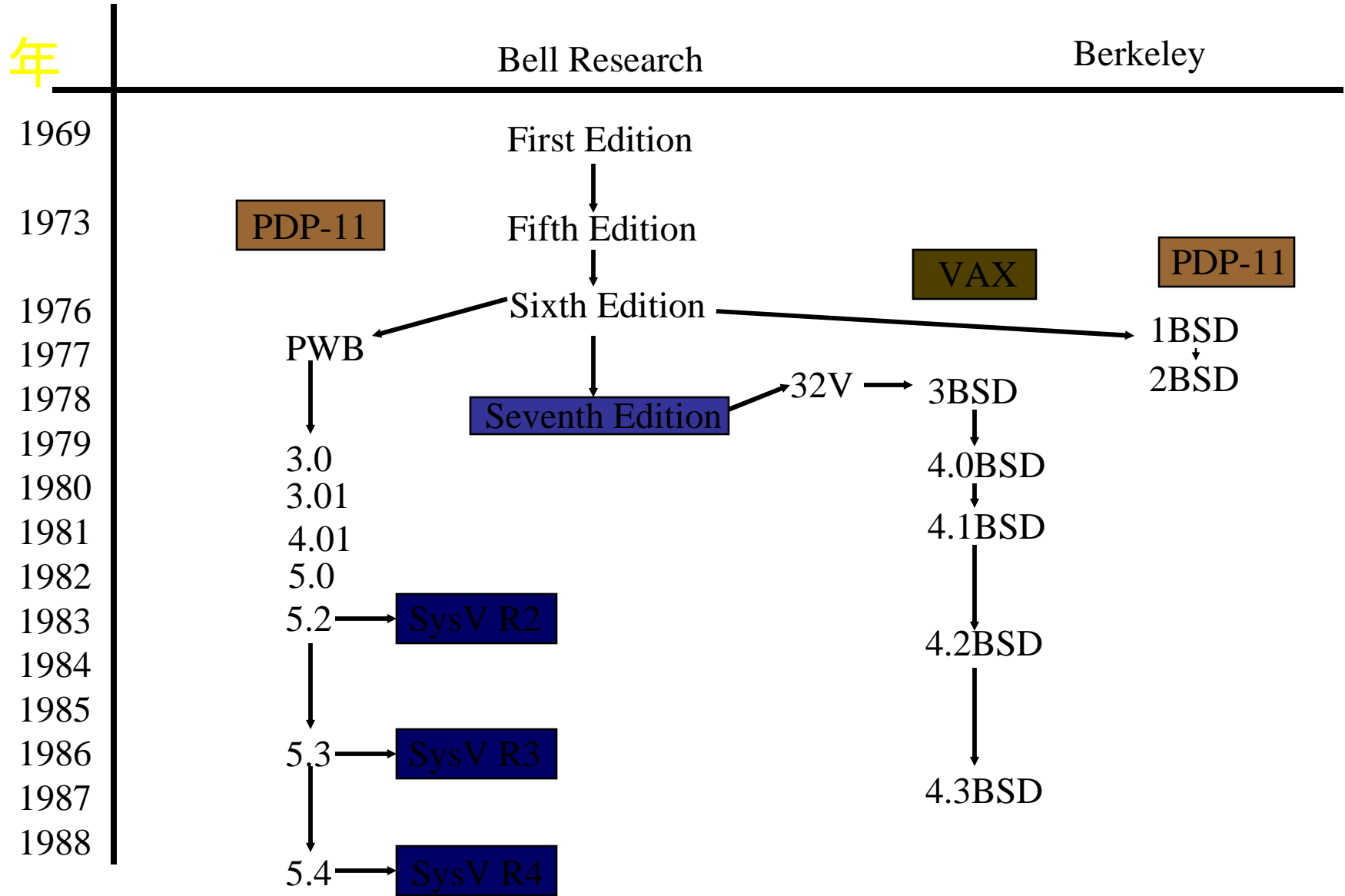
Sun Microsystems

- Project from Berkeley
 - Target: Workstation
 - Windows System(Xwindowsは、MIT)
 - NFS, NIS.....

AT&T

- System III, System V
- Commercial UNIX
- Stream Interface

History of UNIX



Some Unix distributions

- Sun:
 - SunOS:
BSD(Solaris1.x)
 - Solaris 2.x: SystemV
- DEC:
 - Ultrix: OSF/1
- HP:
 - HP-UX: System V
- BSDi
 - BSD/OS: BSD
- FreeBSD
- NetBSD
- Linux
- OpenBSD
- Mach 2.x: BSD
- Mach 3.x: Micro kernel + Unix Server

Definition of UNIX

users

application

Standard library

System calls

UNIX Operating system

(Process management, Memory management, file systems, networks...)

Hardware

(CPU, memory, disks, terminals, NIC)

Difference between FreeBSD and Linux

- Distribution process
 - Based on Minix = Linux
 - Linus Torvalds first developed Linux back in August of 1991
 - No Network capability
 - Many distribution package
 - Red Hat, Debian, Kondora, Vine, SuSE, Caldera, Mandrake, Alpha...
 - Many supported processors, machines, environments
 - Intel, PPC, Nomad, Playstation 1, 2, 68000...
 - From PDA to Mainframes
 - <http://www.linux.org>
 - Based on Berkeley distribution (BSD4.4)
 - One of the distribution tree based on BSD
 - FreeBSD
 - x86 compatible, DEC Alpha, and PC-98 architectures
 - <http://www.freebsd.org>

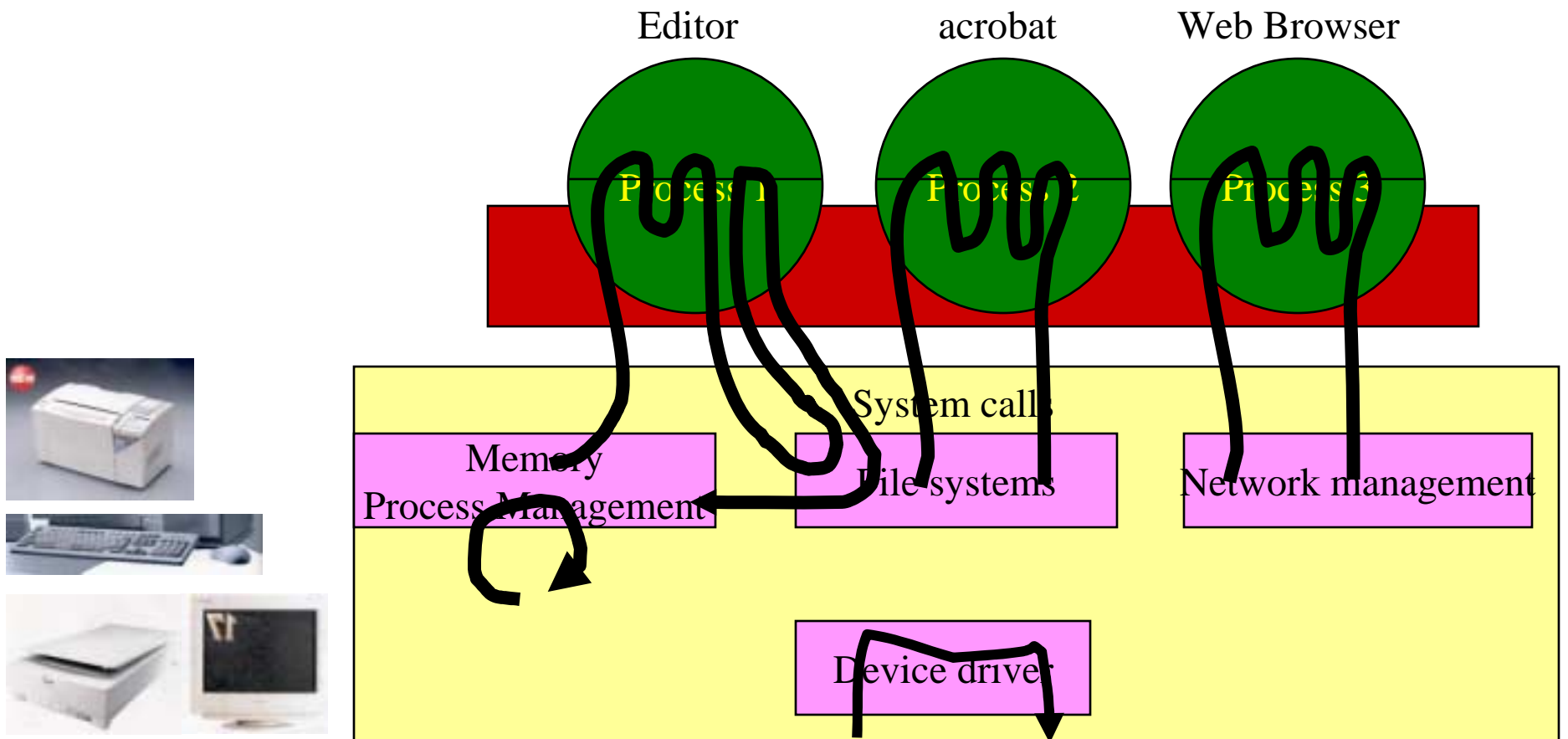
Difference between Windows and UNIX

- Bill Gates technology
 - = Windows (a.k.a Windoze)
 - Based on End users
 - Fancy windows, user interface
- UNIX
 - Truly network aware operating system
 - For network management
 - Distribute computing and management
 - Character base user interface
 - All we care is a running code!

Current FreeBSD distribution

- Current release
 - 4.6.2 release
 - 5.0 release

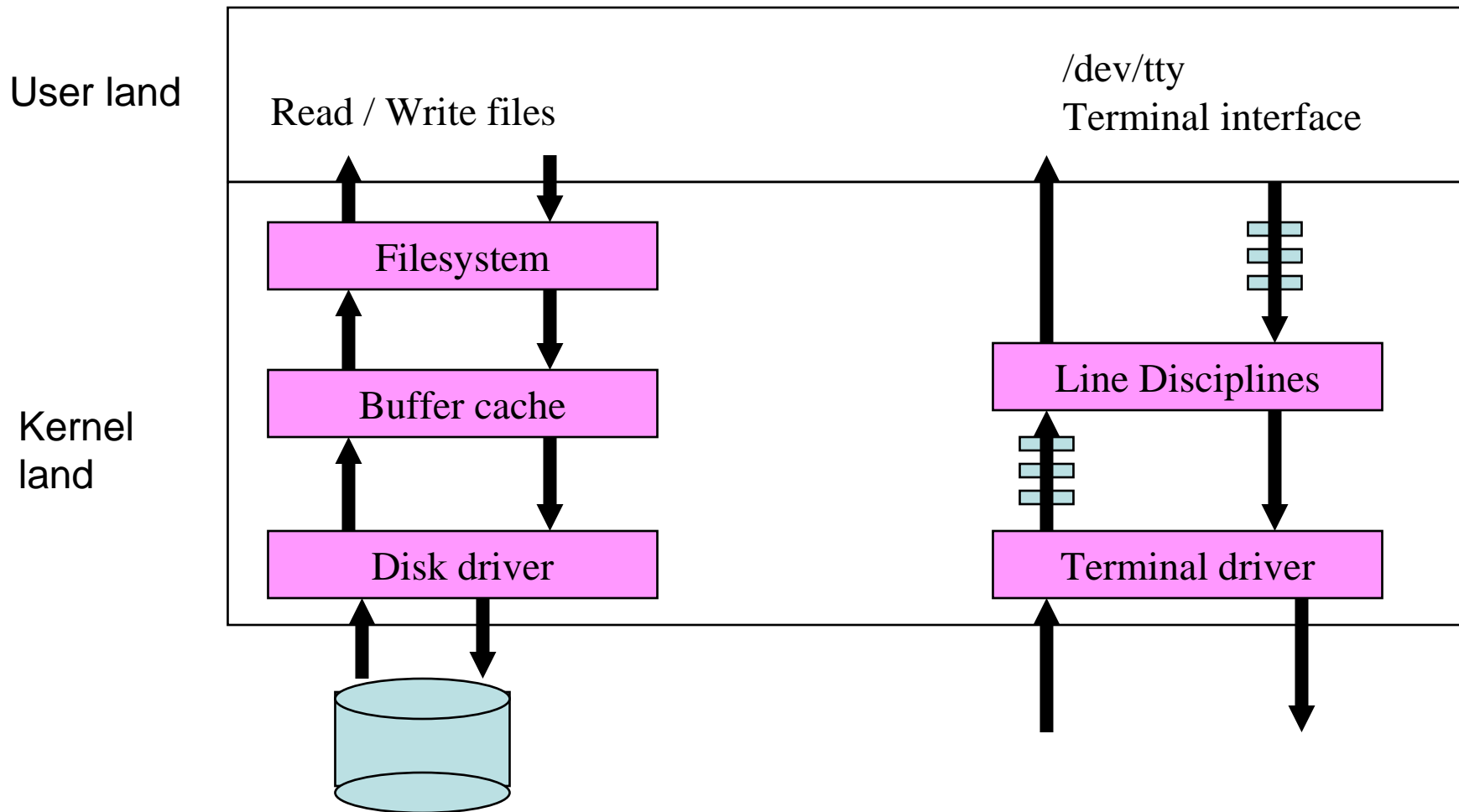
How application runs under UNIX?



Interrupts

- When you...
 - Type your keyboard
 - Move your mouse
 - Access hard drive
- Interrupts from software

Input Output system

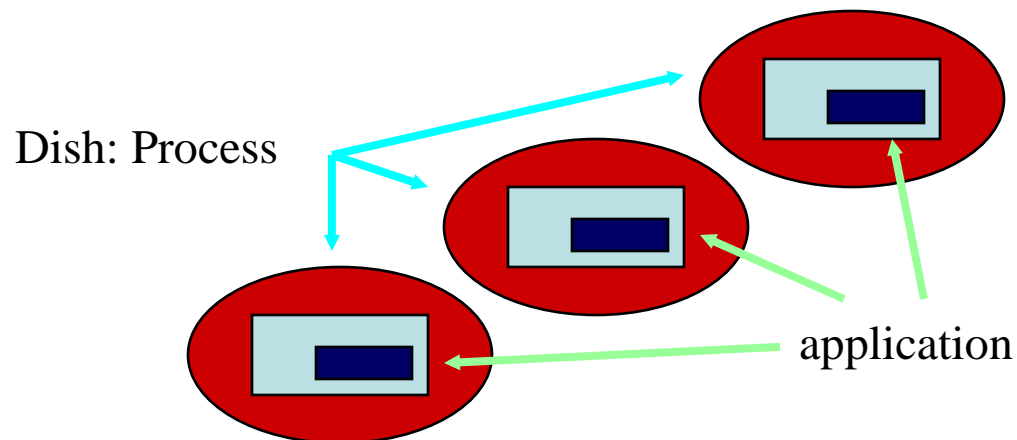


dmesg command

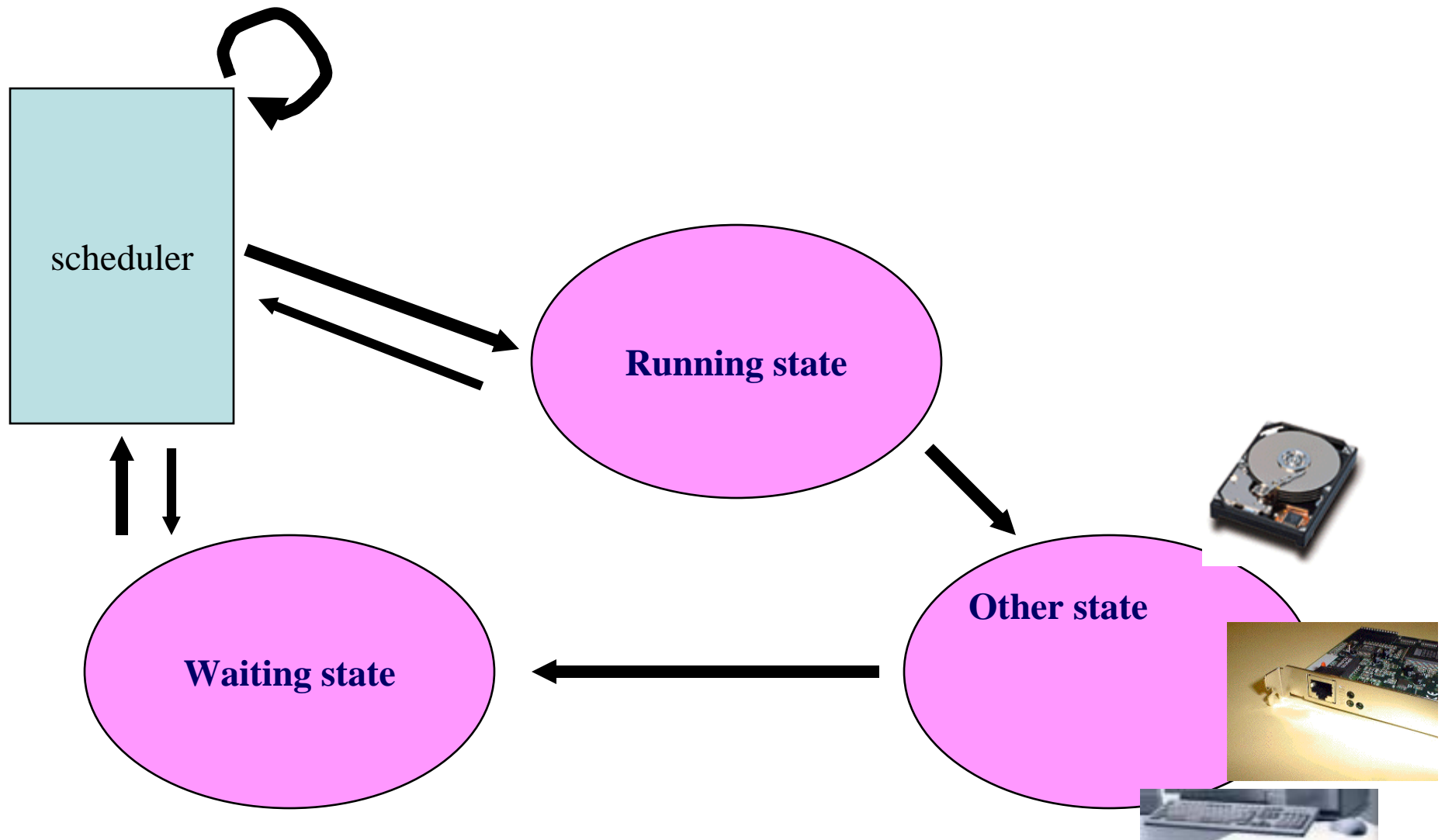
```
cpu0: SUNW,UltraSPARC-II (upaid 0 impl 0x11 ver 0x20 clock 296 MHz)
SunOS Release 5.6 Version Generic_105181-08 [UNIX(R) System V Release 4.0]
Copyright (c) 1983-1997, Sun Microsystems, Inc.
mem = 655360K (0x28000000)
avail mem = 647847936
root nexus = Sun Ultra 30 UPA/PCI (UltraSPARC-II 296MHz)
glm0: Rev. 3 Symbios 53c875 found.
PCI-device: scsi@3, glm #0
glm0 is /pci@1f,4000/scsi@3
sd0 at glm0: target 0 lun 0
sd0 is /pci@1f,4000/scsi@3/sd@0,0
    <SUN4.2G cyl 3880 alt 2 hd 16 sec 135>
root on /pci@1f,4000/scsi@3/disk@0,0:a fstype ufs
PCI-device: ebus@1, ebus #0
keyboard is </pci@1f,4000/ebus@1/su@14,3083f8> major <37> minor <0>
mouse is </pci@1f,4000/ebus@1/su@14,3062f8> major <37> minor <1>
stdin is </pci@1f,4000/ebus@1/su@14,3083f8> major <37> minor <0>
SUNW,ffb0 at root: UPA 0x1e 0x0
SUNW,ffb0 is /SUNW,ffb@1e,0
stdout is </SUNW,ffb@1e,0> major <34> minor <0>
NOTICE: alt1: Alteon PCI NIC found
NOTICE: alt1: Using system MAC address 8:0:20:91:b5:87
PCI-device: ethernet@2, alt #1
pci12ae,11 is /pci@1f,4000/ethernet@2
NOTICE: alt1: Gigabit Ethernet link is up
dump on /dev/dsk/c0t0d0s1 size 524832K
```

Process?

- Job = application = command = program
- Running the applications
 - Run program as a process
- Dish to put foods in



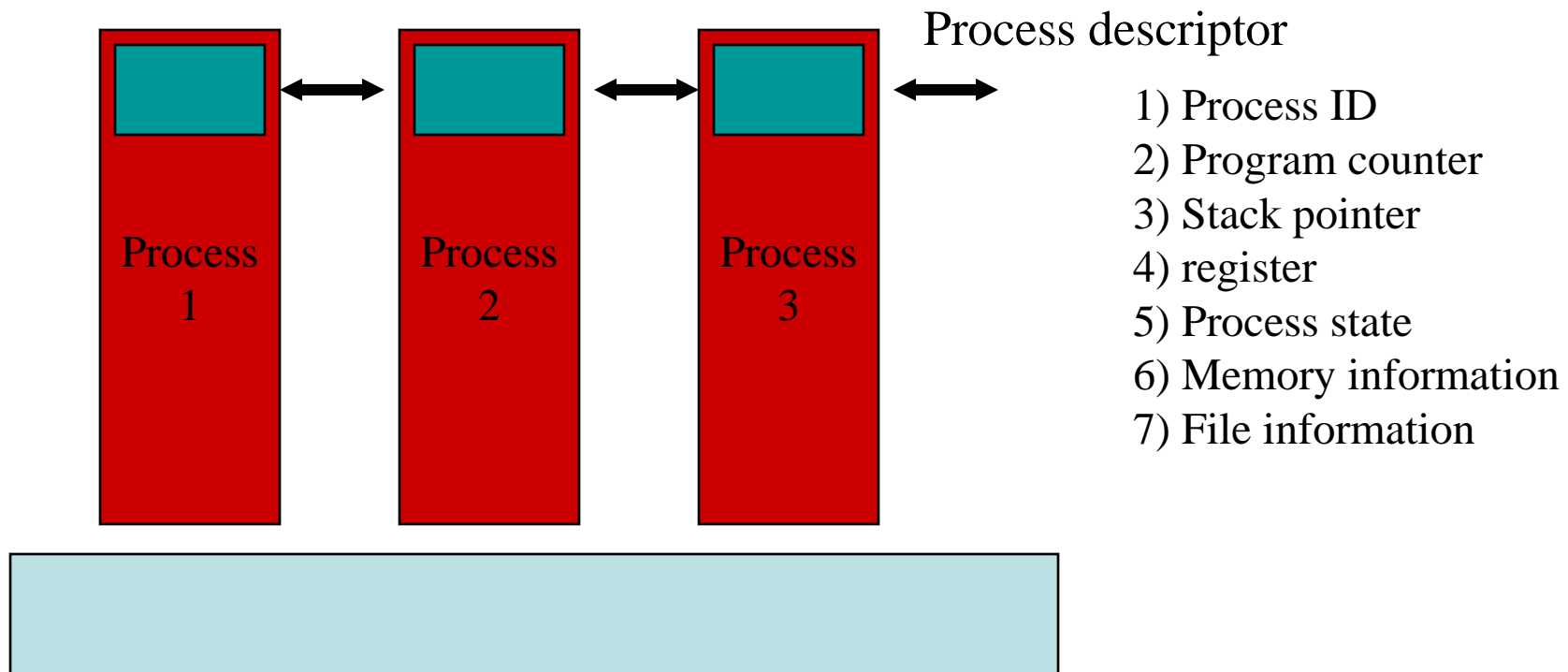
States of process



Construction of a process

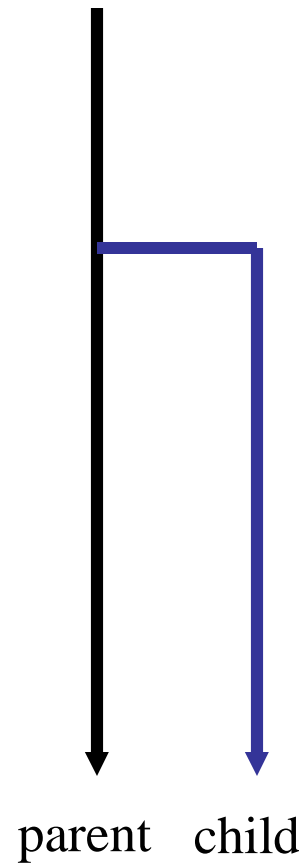
Process control block

Process table or process descriptor



Fork

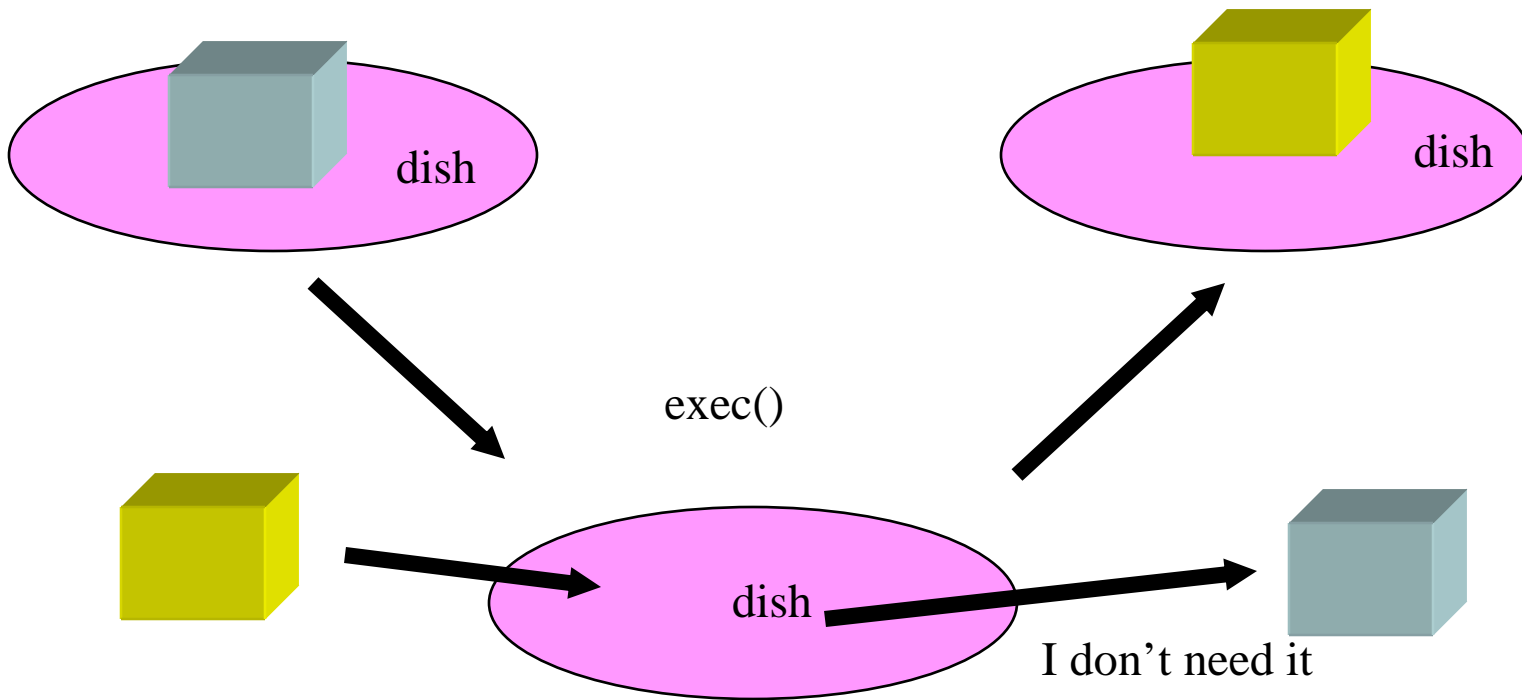
```
main()
{
    .....
    .....
    if ( fork() == 0 ) {
        /* Child Process */
        child_process();
    }
    /* Parent Process */
    wait(0);
    .....
    .....
}
```



fork() makes a clone of
itself

Same programs will run in
parallel

exec

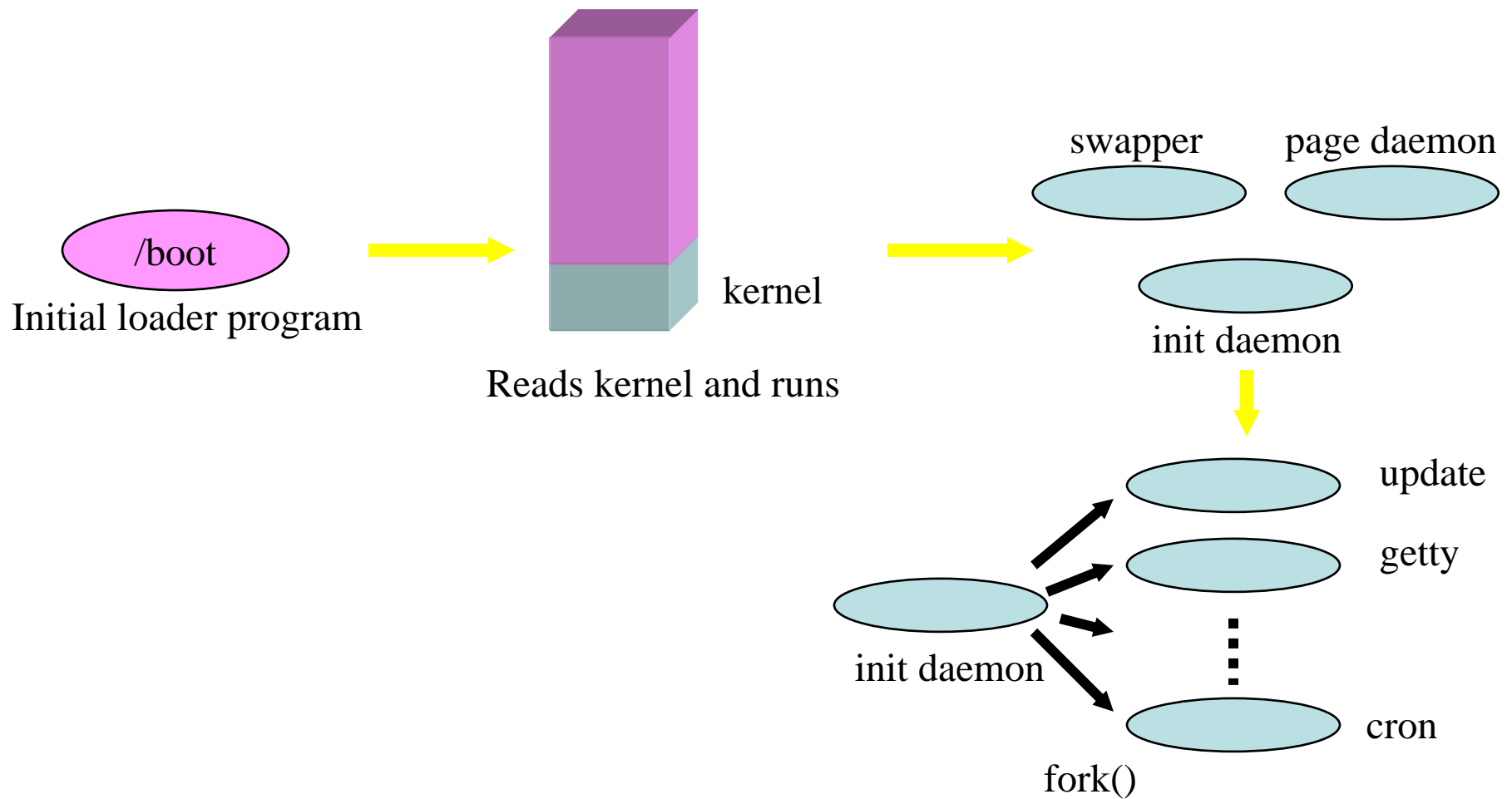


How PC Boots up?

- Tie up your own boot
- **POST**
 - Power On Self Test
- **When you power on the computer**
 - Clears the CPU memory register
 - Sets the CPU program counter to F000
 - Reads the program fixed in f000 from the BIOS
 - Which is the check program for basic systems
 - Checks system bus
 - Checks its own memory

Booting UNIX

- /boot



ps command

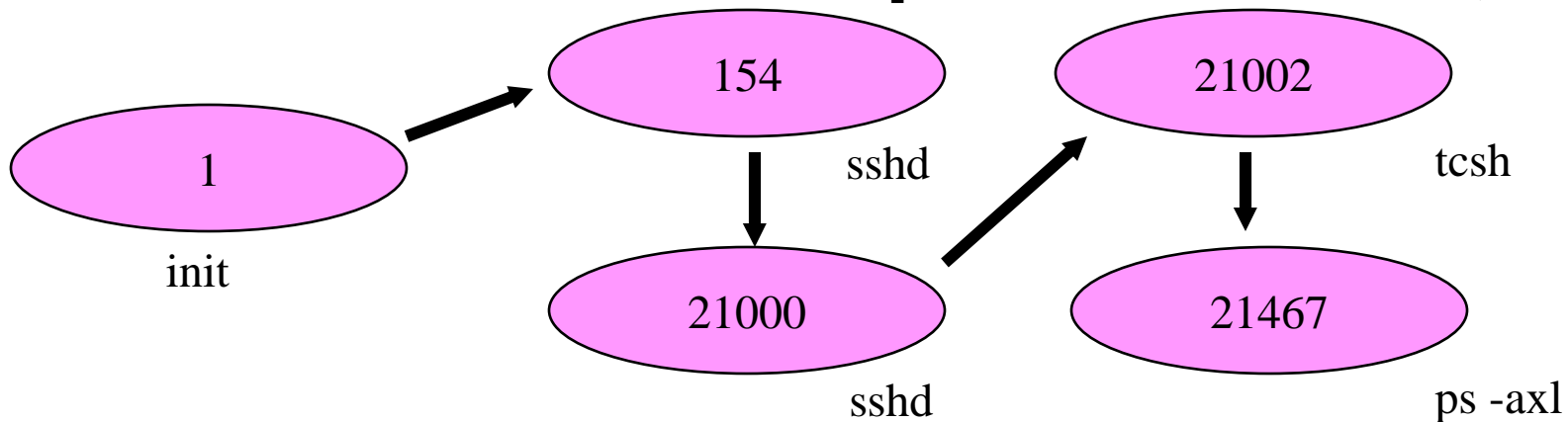
```
uhyo@nadja.sfc.wide.ad.jp % ps -axl
```

UID	PID	PPID	CPU	PRI	VSZ	RSS	WCHAN	STAT	TTY	TIME	COMMAND
0	0	0	0	-18	0	0	schedu	DLs	??	0:02.17	(swapper)
0	1	0	0	10	160	304	wait	Ss	??	0:00.21	/sbin/init
0	2	0	0	-18	0	12	thrd_s	DL	??	0:00.00	(pagedaemon)
0	63	1	0	2	156	300	select	Is	??	0:05.87	syslogd -l
1	66	1	0	2	108	184	select	Is	??	0:00.01	portmap
0	109	1	0	18	72	76	pause	Ss	??	2:01.30	update
0	111	1	0	2	332	288	select	Is	??	0:09.90	cron
0	126	1	0	2	176	240	select	Is	??	0:00.03	lpd
0	132	1	0	2	452	308	netcon	Is	??	0:03.28	(sendmail)
0	139	1	0	2	184	220	select	Is	??	0:00.09	inetd -u int
0	154	1	0	2	604	280	select	Is	??	0:57.69	sshd
0	21000	154	0	2	736	540	select	S	??	0:02.57	sshd
9052	21002	21000	0	18	776	656	pause	Ss	p2	0:00.35	-tcsh (tcsh)
9052	21467	21002	0	28	144	256	-	R+	p2	0:00.00	ps -axl
0	21466	1	0	3	156	304	ttyin	Ss+	co	0:00.01	/usr/libexec

ps command

uhyo@nadja.sfc.wide.ad.jp % **ps -axl**

UID	PID	PPID	CPU	PRI	VSZ	RSS	WCHAN	STAT	TTY	TIME	COMMAND
0	0	0	0	-18	0	0	schedu	DLs	??	0:02.17	(swapper)
0	1	0	0	10	160	304	wait	Ss	??	0:00.21	/sbin/init
0	2	0	0	-18	0	12	thrd_s	DL	??	0:00.00	(pagedaemon)
0	154	1	0	2	604	280	select	Is	??	0:57.69	sshd
0	21000	154	0	2	736	540	select	S	??	0:02.57	sshd
9052	21002	21000	0	18	776	656	pause	Ss	p2	0:00.35	-tcsh (tcsh)
9052	21467	21002	0	28	144	256	-	R+	p2	0:00.00	ps -axl
0	21466	1	0	3	156	304	ttyin	Ss+	co	0:00.01	/usr/libexec



signal

SIGNALS

SIGHUP
SIGINT
SIGQUIT
SIGILL
SIGTRAP
SIGABRT
SIGFPE
SIGKILL
SIGBUS
SIGSEGV
SIGSYS
SIGPIPE
SIGALRM
SIGTERM
SIGURG
SIGSTOP
SIGTSTP
SIGCONT
SIGCHLD
SIGTTIN
SIGTTOU
SIGWINCH
SIGINFO
SIGUSR1
SIGUSR2

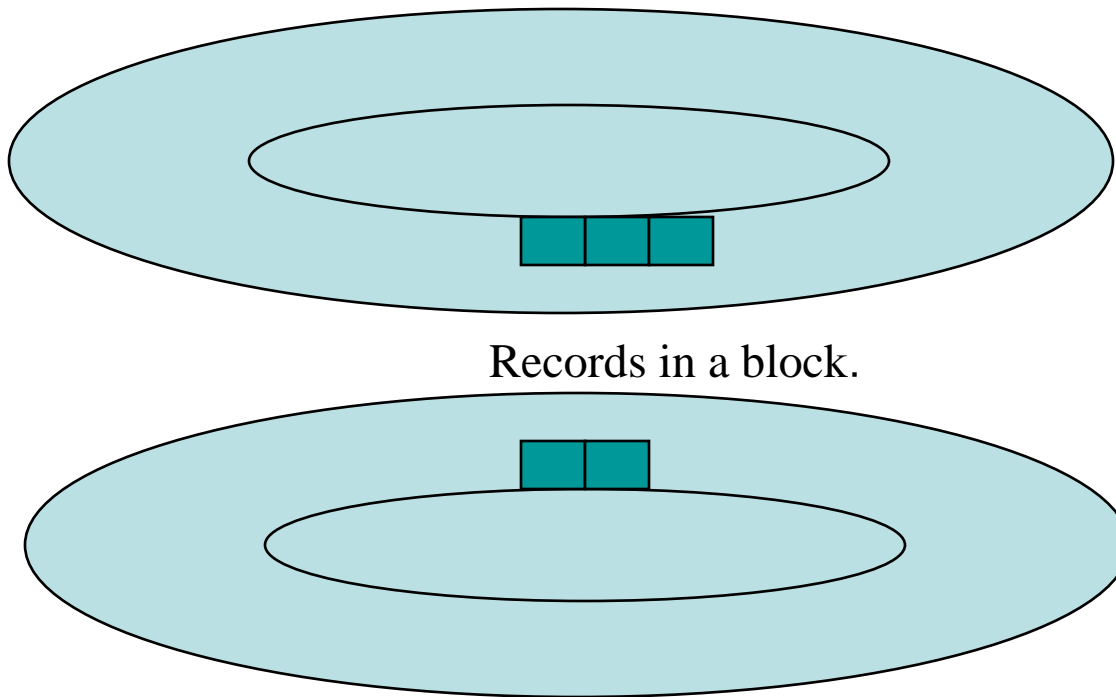
ACTION

terminate process
terminate process
create core image
create core image
create core image
create core image
terminate process
create core image
create core image
create core image
terminate process
terminate process
terminate process
discard signal
stop process
stop process
discard signal
discard signal
stop process
stop process
discard signal
discard signal
terminate process
terminate process

Definition

terminal line hangup
interrupt program
quit program
illegal instruction
trace trap
abort(2) call
floating-point exception
kill program
bus error
segmentation violation
system call given invalid argument
write on a pipe with no reader
real-time timer expired
software termination signal
urgent condition present on socket
stop (cannot be caught or ignored)
stop signal generated from keyboard
continue after stop
child status has changed
background read attempted from control term.
background write attempted to control term.
Window size change
status request from keyboard
User defined signal 1
User defined signal 2

File and file systems

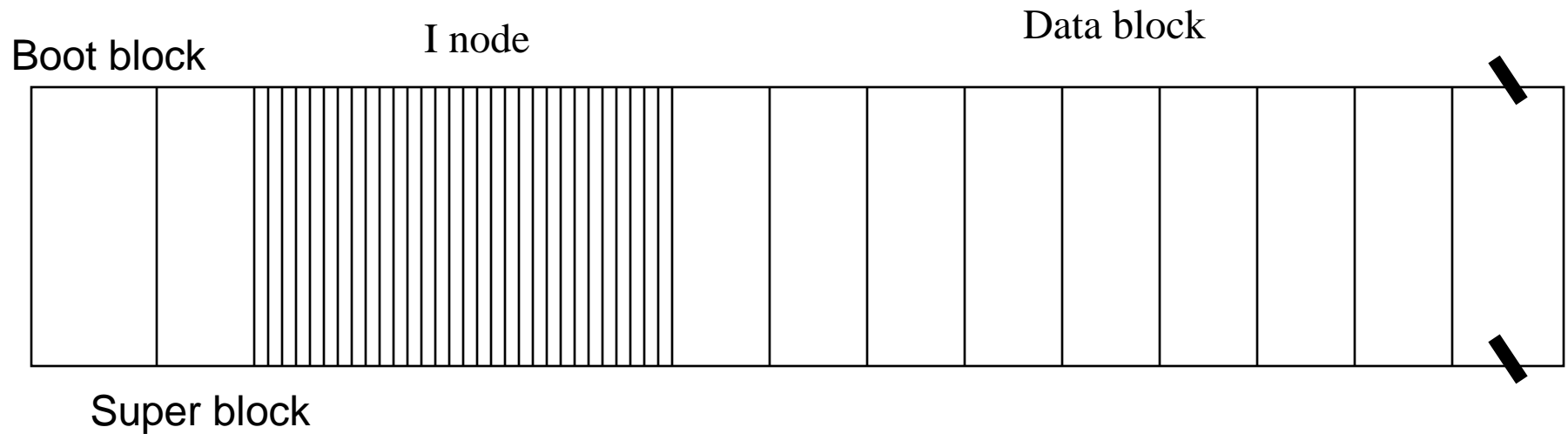
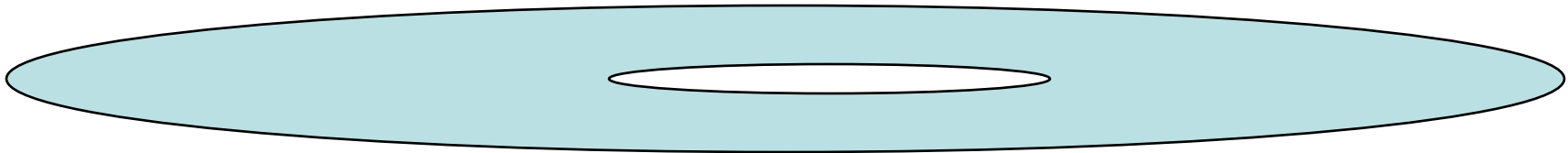


Abstract in recording

Information of

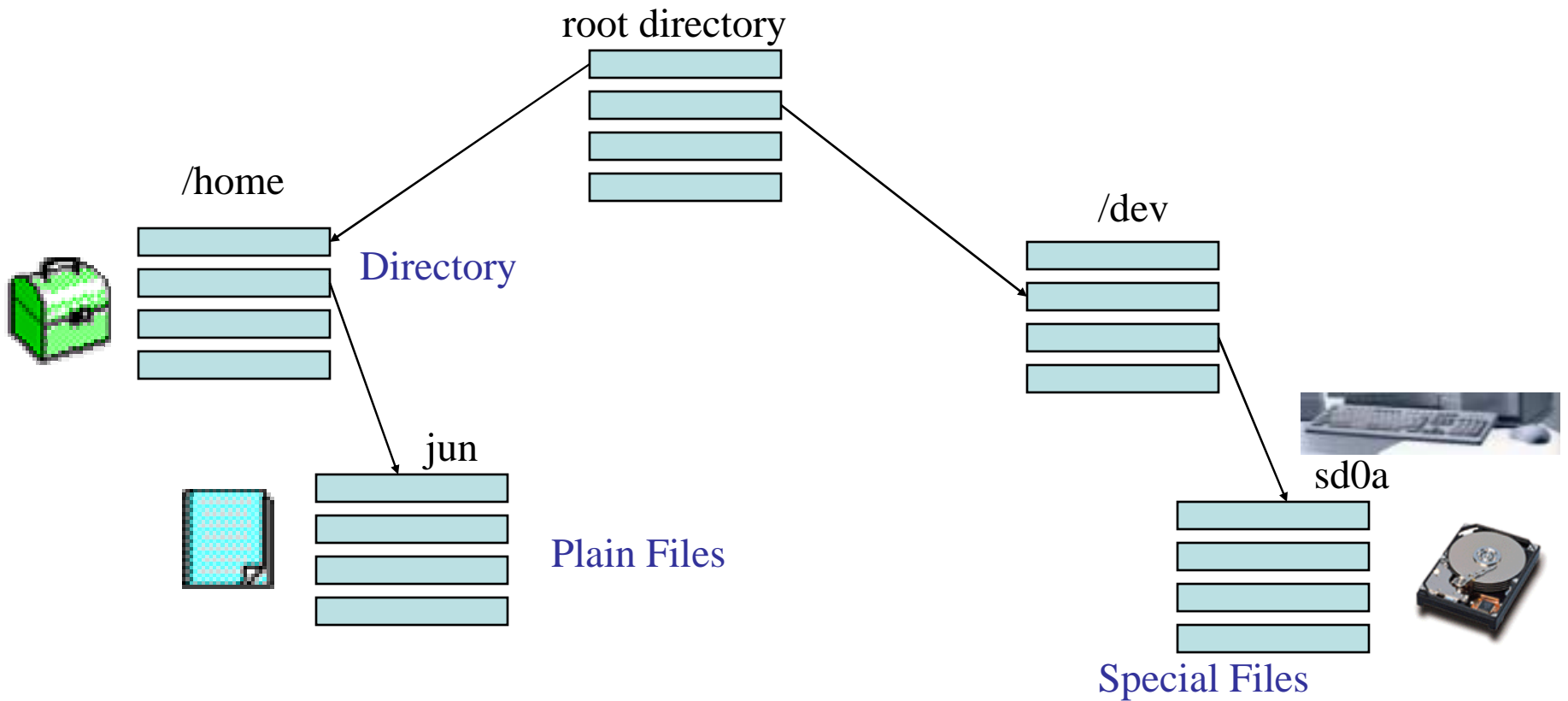
- 1) Names
- 2) Places
- 3) Amounts
- 4) Security
- 5) Information

File system in UNIX



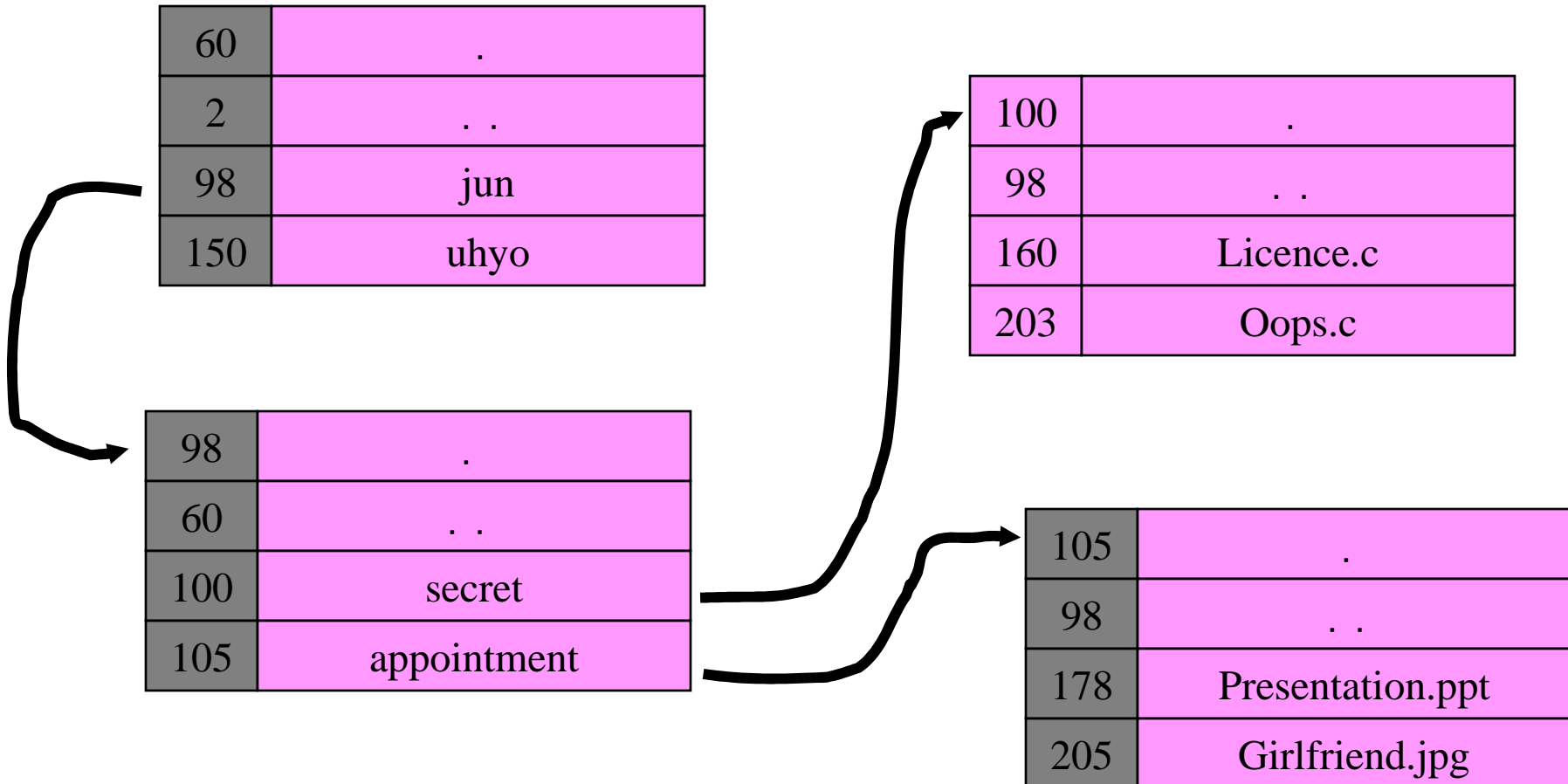
File system

- Abstraction based on files



Index node

I node number



UNIX file system

<code>st_mode</code>	Protection bit matrix
<code>st_ino</code>	I node number
<code>st_dev</code>	I node device
<code>st_nlink</code>	Number of hard links
<code>st_uid</code>	User ID
<code>st_gid</code>	Group ID
<code>st_size</code>	File size in bytes
<code>st_atime</code>	Last access time
<code>st_mtime</code>	Last modified time
<code>st_ctime</code>	Last file status changed time

Installing FreeBSD

- Requirements of PC
 - Processor: Intel 386 Architecture
 - 80386 and higher
 - FPU (Floating point processor 80387) may
 - Memory: 16MByte and higher
 - 8Mbyte and higher recommended
 - With X Windows, 32MB and higher is recommended
 - Storage
 - More than 100MB

Installation medium

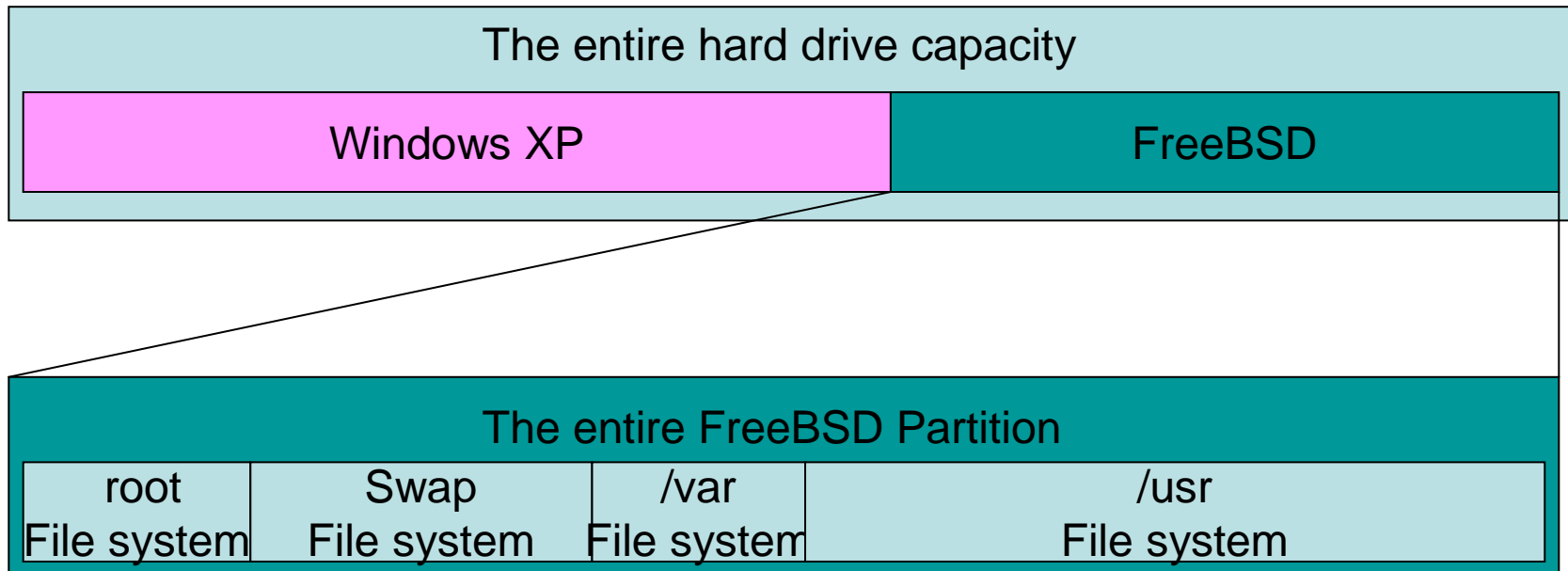
- Floppy drive
 - 2 floppy
 - Kernel floppy (boot floppy)
 - MFSroot floppy (file system floppy)
- CD-ROM
 - Bootable CD with standard archives
 - Application CD for additional software

Steps

- Booting FreeBSD kernel
- Reading mfsroot filesystem
- /stand/sysinstall configuration tool
- Fdisk partition configuration
- FreeBSD partition configuration
- Distribution configuration
- Media configuration
 - (network configuration)
- Commit
- Post install configuration

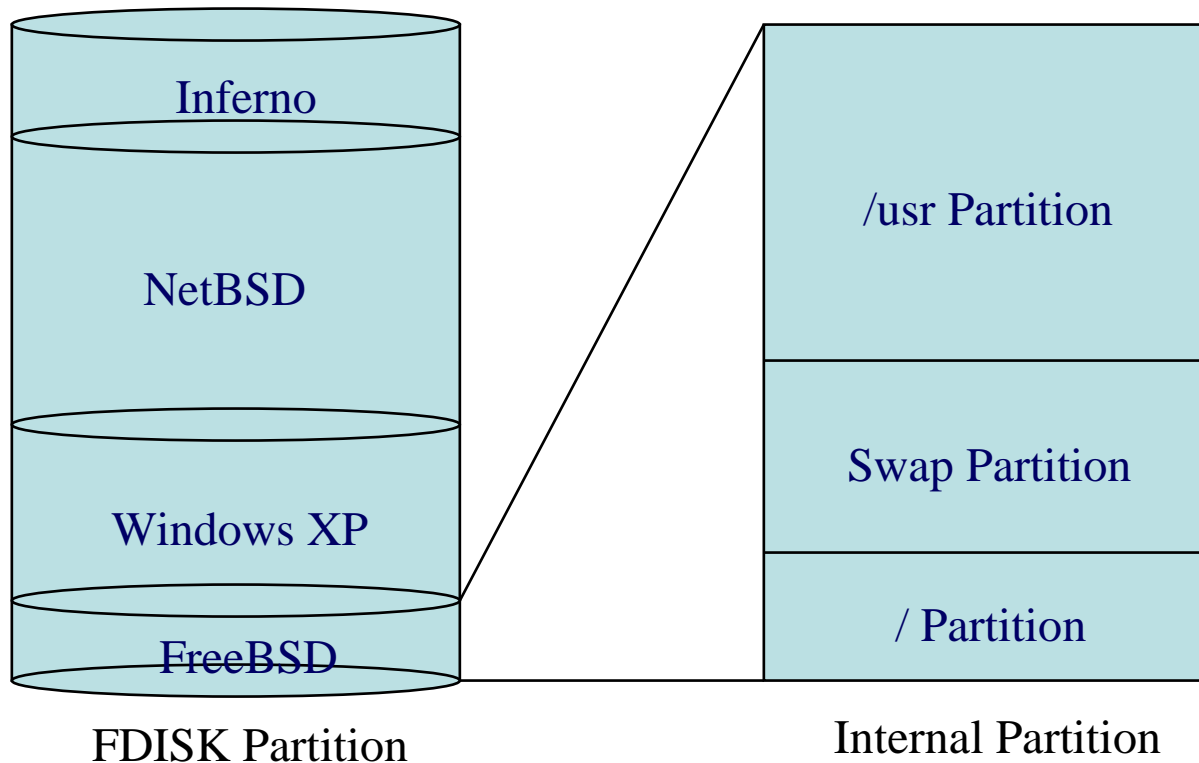
File systems

- FDISK Partition and BSD Partition



Partition

```
cp3540|Conner Peripherals 540MB SCSI:\  
:ty=winchester:dt=SCSI:se#512:nt#12:ns#49:nc#1806:rm#4500: \  
:pa#18816:oa#0:ta=4.2BSD:ba#4096:fa#512: \  
:pb#75264:ob#18816:tb=swap: \  
:pc#1061928:oc#0: \  
:pf#217560:of#94080:tf=4.2BSD:bf#4096:ff#512: \  
:pg#199920:og#311640:tg=4.2BSD:bg#4096:fg#512: \  
:ph#550368:oh#511560:th=4.2BSD:bh#4096:fh#512:
```



Distribution package

- Developer
- X-Developer
- Kern-Developer
- X-Kern-Developer
- User
- X-User
- Minimal
- Custom

Installation via network

- Network interface to connect to the network
- IP address, netmask, Default router
- Destination distribution server

Post installation configuration

- Pre packaged software installation
- Password and user configuration
- Time zone configuration
- X window configuration
- Start up service configuration

Important files and commands

- `/etc/rc.conf`
- `/etc/defaults` directory
- `/etc/inetd.conf` and `/etc/services`
- `/etc/X11/XF86Config`
- `.cshrc` files
- `/usr/src/sys` files

Updating releases

- CVSUP update
 - FreeBSD-current release
 - Accessing cvsup server

Using DVTS

- Changing the kernel configuration
- Installing the package

User Interface

- Systematic operating system
 - Especially used for network and computer engineers

What's for the next lecture

- We will discuss about the network and computer infrastructure in USP
- The importance of configuring the better infrastructure for USP and
- Collaboration of some of our projects in Japan and USP