



Operating System

Introduction
(Ch 1)

Topics

- What is an OS?
- OS History
- OS Concepts
- OS Structures

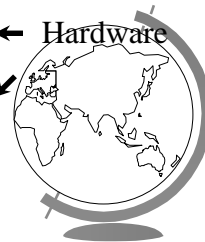
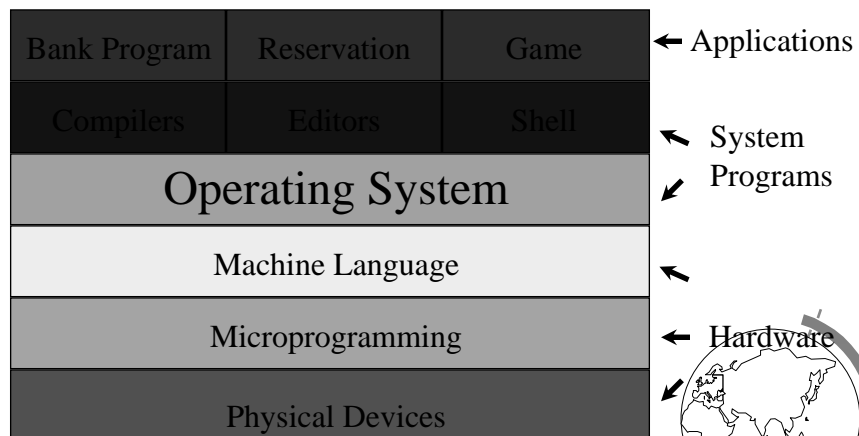


Let's Get Started!

- What are some OSes you know?
 - Guess if you are not sure
- Pick an OS you know:
 - What are some things you like about it?
 - What are some things you don't like about it?



What is an Operating System?



What is an Operating System?

- An Extended Machine (Top-down)
 - Transforming - new resource
 - + ex: Windows device manager
- A Resource Manager (Bottom-up)
 - Multiplexing - illusion of several resources
 - + ex: browse the web AND read email
 - Scheduling - deciding who gets what when
 - + ex: compile fast OR edit fast
- Why have an OS?
 - Convenient and Efficient
 - + Programming hardware difficult
 - + Idle hardware “wasteful”



Topics

- What is an OS? (done)
- OS History (next)
- OS Concepts
- OS Structures



OS History

- Helps understand key requirements
 - Not one brilliant design
 - + (despite what Gates or Torvalds might say)
 - Fixed previous problems, added new ones
 - Tradeoffs
- Closely tied to:
 - Hardware history
 - User history



Hardware History

	<i>1981</i>	<i>1999</i>	<i>Factor</i>
<i>Power</i>	1	250	250
<i>\$/Power</i>	\$100K	\$45	2200
<i>Memory</i>	128K	128M	1000
<i>Disk Capacity</i>	10M	10G	1000
<i>Net Bandwidth</i>	9600b/s	155Mb/s	15K
<i>Users / Mach.</i>	10s	<=1	10

- Comments? Change!



OS History

- Supplement to book
- My version is a brief narrative



Hardware Very Expensive Humans Cheap

- Single program execution (no OS)
- Hardwire “programming”
- Programming slow, not “offline”!
 - Punch cards



Hardware Very Expensive Humans Cheap

- Punch cards
- Fortran or assembler
- Waste computer time walking!
 - Batch programs on tape



Hardware Very Expensive Humans Cheap

- Programs read in from tape
- Two applications:
 - Scientific
 - Data processing
- CPU idle during I/O!
 - Multiprogramming with partitions
 - Spooling as jobs finished



Hardware is Cheap Humans Expensive

- Turn around time 1/2 day
- Programmer time wasted!
“Sigh. In the good old days....”
 - Time-sharing
 - Multics (sorta)
 - New problems
 - + response time
 - + thrashing
 - + file-systems



Hardware Very Cheap Humans Very Expensive

- Personal computers
 - Network operating systems
 - Distributed operating systems
- OSes today
 - size
 - + small == 1 million
 - + large == 10 million
 - need to evolve quickly
 - + hardware upgrades, new user services, bug fixes
 - efficient and/or modular kernels



Windows XP History

- 1988, v1
 - split from joint work with IBM OS/2
 - Win32 API
- 1990, v3.1
 - Server and Workstation versions
- 1997(?), v4
 - Win95 interface
 - Graphics to kernel
 - More NT licenses sold than all Unix combined



Windows 2000 History

- 2000 v5, called “Windows 2000”
 - Micro-kernel
 - Multi-user (with terminal services)
- Four versions (all use same core code)
 - Professional
 - + desktop
 - Server and Advanced Server
 - + Client-server application servers
 - Datacenter Server
 - + Up to 32 processors, 64 GB RAM



Windows XP History

- Released in 2001
- Replacement to 95/98
- Same code-base as Windows 2000
- Client version and Server version
 - Server version called .NET
- Simultaneous users via Windows Terminal Services
- 64-bit version



Windows Today

- Microsoft has 80% to 90% of OS market
 - mostly PC's
- 800 MHz Intel Pentium
- Aiming at robust, server market
 - network, web and database
- Platforms
 - Intel 386+ only (IA32 or IA64)
- WinNT is 12 million lines of code
- Win2000 is 18 million lines of code
- WinXP is 20 million lines of code



Linux History

- Open Source
 - Release Early, Release Often, Delegate
 - “The Cathedral or the Bazaar”
- Bday 1991, Linus Torvalds, 80386 processor
 - v.01, limited devices, no networking,
 - with proper Unix process support!
- 1994, v1.0
 - networking (Internet)
 - enhanced file system (over Minix)
 - many devices, dynamic kernel modules



Linux History

- Development convention
 - Odd numbered minor versions “development”
 - Even numbered minor versions “stable”
- 1995, v1.2
 - more hardware
 - 8086 mode (DOS emulation) included
 - Sparc, Alpha, MIPS support started
- 1996, v2.0
 - multiple architectures, multiple processors
 - threads, memory management



Linux Today

- v2.6
- 3 million lines of code
- 29 million users
 - <http://counter.li.org/estimates.php>
- Growing by 25%/year through 2003
 - all others, 10% combined



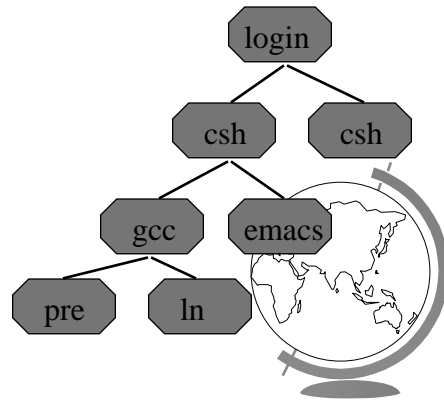
Outline

- Operating System Concepts ←
 - Processes
 - Memory management
 - Input/Output
 - Files
 - System Calls
 - Shells
- Operating System Structures



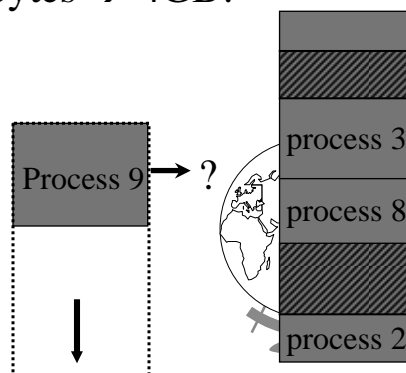
The Process

- Program in execution
- Running -> Suspended -> Running
- Example: the Shell
- Process “Tree”
- Signals
- UID (GID)
- (4 hours)



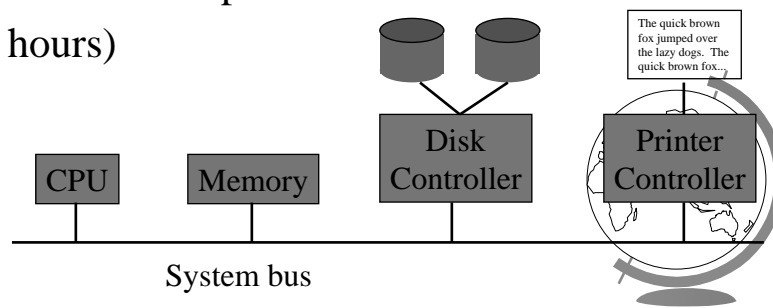
Memory Management

- One chunk of physical memory
- Needs to be shared with all processes
 - multiprocessing
- 32 bit architecture, 2^{32} bytes \rightarrow 4GB!
 - virtual memory
- (8 hours)



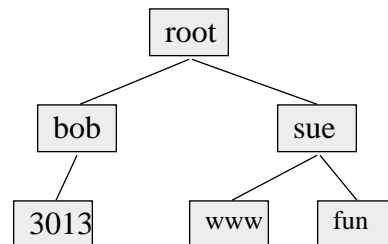
Input/Output

- OS manage resources, including other devices
- Significant fraction of code
 - Up to 90% (complete distribution source)
- Want to be simple to use
- (2 hours)



Files

- Store data on disk
- Directory “Tree”
- Working directory
- Protection bits
 - 9 in Unix: **rwX bits**, ex: `rwXr-x--x`
- Abstraction of I/O device
 - terminal, printer, network, modem
- Pipe
- (4 hours)



System Calls

- Way processes communicate with OS
- example:
`write(file, string, size)`
- OS specific!
- POSIX (1980s)
 - Portable Operating System (unIX-ish)
- (Most of the projects use them)



Shells

- User's interface to OS
- Simple commands
“cd”, “cat”, “top”
- Modifiers
‘&’, ‘|’, ‘>’
- (Hey, do some process and shell examples!)



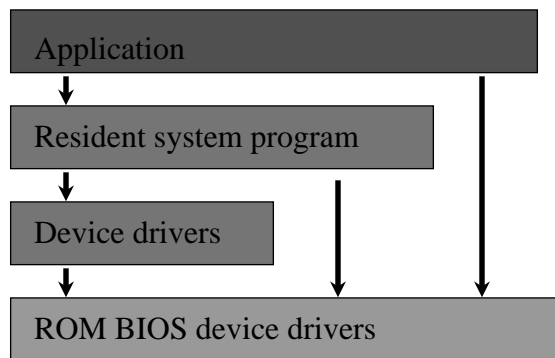
Outline

- Operating System Structure ←
 - Simple Systems
 - Virtual Machines
 - Micro Kernels



Simple Systems

- Started small and grew, no hardware support
- MS-DOS



- Protection!



Simple Systems

- Unix (see /vmunix)

Applications

Signals, File Sys, Swapping, Scheduling ...

Terminal

Device

Memory

- “The Big Mess”
- Some move towards a more modular kernel

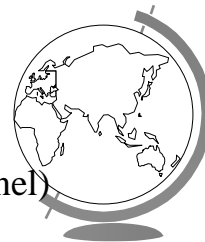


Virtual Machines

- IBM VM/370 → VMWare

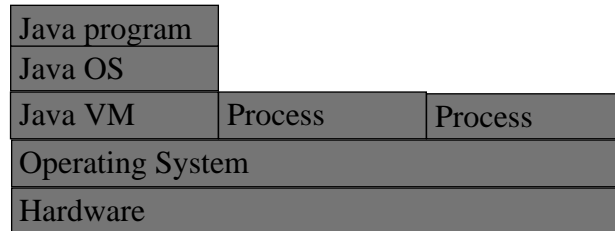
Process	Process	Process
Process	Process	Process
Operating Sys	Operating Sys	Operating Sys
Virtual Machine		
Hardware		

- Complete protection
- OS development, emulation
- Performance!
- (Exokernel says can have subset of kernel)



Virtual Machines

- Java Virtual Machine

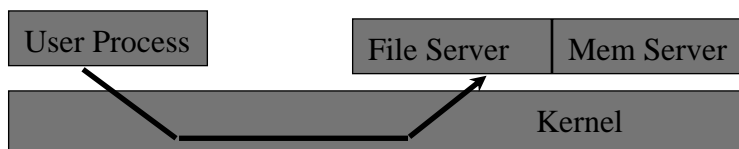


- Platform independence!



Micro Kernel

- Mach



- Client-Server
- Good performance
- Adaptable to distributed OS
- Robust
- Careful about mechanism!



