

Intro to Operating Systems

CSE 410 - Computer Systems
November 9, 2001

Readings and References

- Reading

- Chapter 1, *Operating System Concepts*, Silberschatz, Galvin, and Gagne

- Other References

- *Inside Microsoft Windows 2000*, Third Edition, Solomon and Russinovich

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What is an Operating System?

- Makes using the computer convenient
 - does a lot of the dirty work for you
 - hides details about the system behind a clean interface
- Makes using the computer efficient
 - expertly manages and allocates resources
- These goals are often contradictory

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Views of the OS

- The OS is a context
 - An environment for user applications to run in
 - Provides the services that applications need
 - All programs on the system use this context
- The OS is a controller
 - Controls the I/O devices and user programs
 - Prevents and handles errors

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Views of the OS, cont.

- The OS is a resource allocator
 - A system has many resources: CPU time, memory, disk space, access to I/O devices
 - The OS allocates these resources
 - Policies are generally configurable
 - allocate evenly among all uses, *or*
 - give more to those who pay more, *or*
 - prefer to give it to uses with high priority, *or* ...

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What makes up the OS?

- “Just the kernel”
 - the program that starts running at boot time, manages all user programs, and runs until shutdown
- *or* “All the code you didn’t write”
 - all system libraries, compilers, assemblers
 - all the software shipped with the machine
- This issue goes to court; controversial

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OS issues for the user

- how are resources shared among users?
- what level of performance is available?
- how are failures prevented and dealt with?
- how are resources named and assigned?
- how is the flow of information restricted?
- how do we control and charge for resource usage?

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OS issues for the sysadmin

- how are programs protected from others?
- how are new features added?
- what happens as resource needs increase?
- are new versions always compatible with old?
- can the components of the system be geographically separated?

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OS issues for the programmer

- how can the data for a program persist?
 - from one execution to the next
 - from one generation to the next
- how is information exchanged?
 - between systems, applications, users, ...
- how are parallel activities controlled?
- how is the OS organized?

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In Olden Times...

- The first operating systems were known as *batch systems*
 - OS was loaded once into a portion of memory
 - Programs stored on punch cards or paper tape
 - One by one, programs were loaded and run
 - Each program came with *control cards* telling the OS what to do

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Multiprogramming

» Increase utilization of the processor

- Enabling technology
 - decrease in memory prices
- Keep multiple jobs loaded in memory
- While one program waits for I/O, run another one for a while

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Timesharing

» Allow multiple users/programs to share a single system concurrently

- Based on time-slicing (1960s)
 - divide the CPU equally among the users
- For the first time, users could view, edit, and debug programs “on-line”
- Multics was first large timesharing system

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Minicomputers

- » Enable “small scale” applications
- Low cost hardware could run sophisticated applications (1970s)
 - didn’t need all the overhead of large mainframe system installations
 - small businesses, science and engineering
 - still focussed on efficient multi-user services

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Microcomputers

- » Enable “small scale” applications
- Low cost hardware could run sophisticated applications (1980s)
 - didn’t need all the overhead of minicomputer systems
 - very small businesses, scientists and engineers
 - very focussed on the individual user

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Networked Workstations

- » Enable enterprise and web applications
- Individual workstation is only part of the system
- Connectivity and security very important
- Rebirth of sophisticated operating systems for the end user

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Real-Time Operating Systems

- Specialized operations: subway systems, flight control, factories, nuclear power plants, ...
- OS must guarantee response to physical events in a fixed time interval
- Problem is to schedule all activities in order to meet all of the critical requirements
 - over-capacity and careful design

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Tightly-coupled Systems

- Support parallel applications wishing to get speedup of computationally complex tasks
- Needs basic primitives for dividing one task into multiple parallel activities
- Supports efficient communication between those activities
- Supports synchronization of activities to coordinate sharing of information

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Loosely-coupled Systems

- Sharing of distributed resources, hardware, and software to improve utilization and performance
 - speedup through parallelism
 - improved reliability
- Supports communication between parts of a job or different jobs
- Incorporate commodity processors

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Some loosely coupled systems

- SETI@Home
 - using Internet connected machines (> 3 million) to analyze astronomical data
- distributed.net
 - using Internet connected machines (>100K) to solve intensive math problems in cryptography
- Beowulf
 - connected computers form a parallel processing supercomputer

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