

## CS323 Operating Systems

### Overview

Yuanyuan Zhou  
Lecture 2  
Jan 24, 2003

## Content of this lecture

- Announcements and reminders
- Hardware overview
- A peek at Unix
- Criteria to evaluate an OS
- Overview of OS components
- Design tradeoffs

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## Announcement

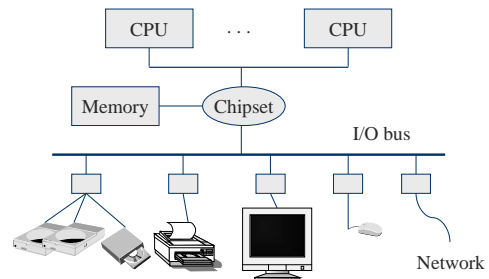
- Have you subscribe uiuc.class.cs323?
- Have you visited the web page?
- Nacho tutorial date:
- Reading assignment:
  - Chapter 2.1 & 2.4
- Clarification
  - Starting from Fall 2004, cs323 is very likely to split into 2 courses: cs323 and cs241
  - So don't panic!

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## A Typical Computer from a Hardware Point of View

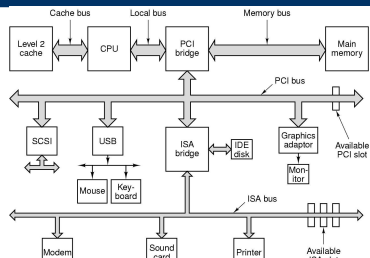


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## Pentium System: can you read it?



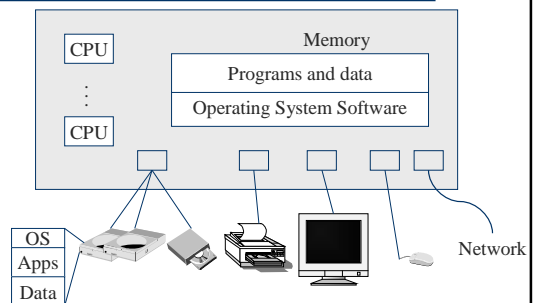
Structure of a large Pentium system

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## A Typical Computer System (black box)

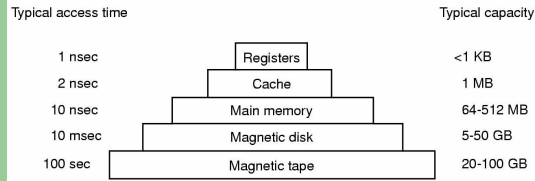


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## Memory-Storage Hierarchy



### Real life analogy?

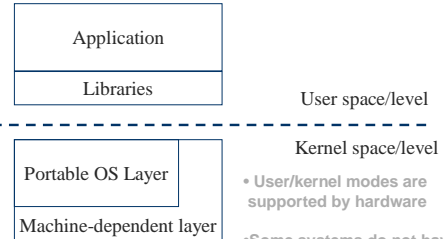
- company personnel management pyramid, the "workers" know all the information
- Human, the younger the faster, the older the richer

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## A peek into Unix



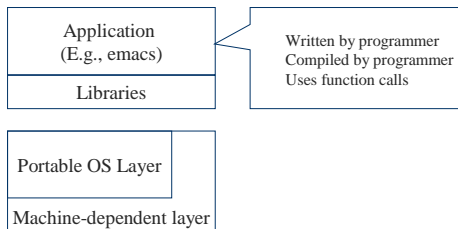
- User/kernel modes are supported by hardware
- Some systems do not have clear user-kernel boundary

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## Unix: Application

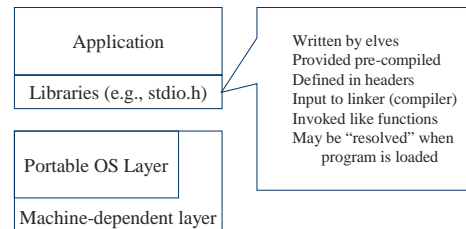


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## Unix: Libraries

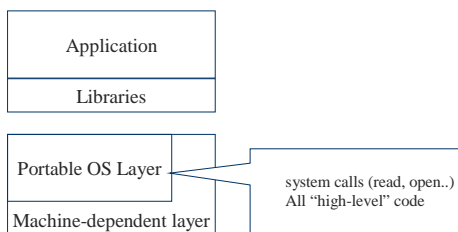


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## Typical Unix OS Structure

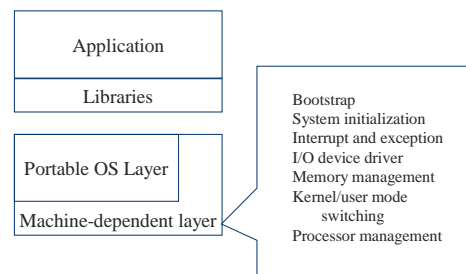


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## Typical Unix OS Structure

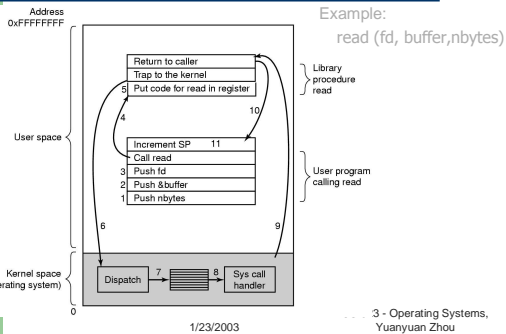


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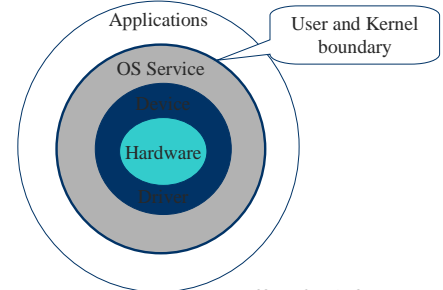
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## Steps in Making a System Call



## Another Look: Unix “Onion”



## OS Service Examples

- Examples that are not provided at user level
  - System calls: file open, close, read and write
  - Control the CPU so that users won't stuck by running `while ( 1 ) ;`
  - Protection:
    - Keep user programs from crashing OS (sorry, not include windows)
    - Keep user programs from crashing each other
- Examples that can be provided at user level
  - Read time of the day

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## Criteria to evaluate an OS?

- (Criteria to evaluate a government?)
- 2 minutes group discussions

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## Is Any OS Complete?

Portability  
Security  
Fairness  
Robustness  
Efficiency  
Interfaces

- government
- Not bound by land
  - Home-land security
  - Created equal
  - Against war and terrorism
  - No Corruption!
  - Service (be nice!)

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## OS Major Components

- Process and thread management
- Resource management
  - CPU
  - Memory
  - Device
- File system
- Bootstrapping

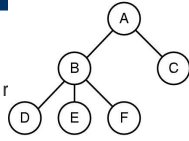
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## Process: a running program

- A process includes
  - Address space
  - Process table entries (state, r
- A process tree
  - A created two child processes, B and C
  - B created three child processes, D, E, and F



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## Some System Calls For Process Management

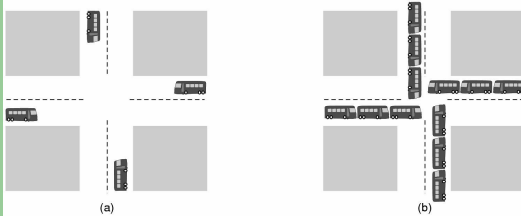
Process management	
Call	Description
<code>pid = fork( )</code>	Create a child process identical to the parent
<code>pid = waitpid(pid, &amp;statloc, options)</code>	Wait for a child to terminate
<code>s = execve(name, argv, environp)</code>	Replace a process' core image
<code>exit(status)</code>	Terminate process execution and return status

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## Deadlock

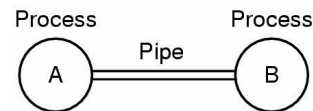


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## Process communication



Two processes connected by a pipe

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## Processor (CPU) Management

- Goals
  - Time sharing
  - Multiple CPU allocations
- Issues
  - Do not waste CPU resources
  - Synchronization and mutual exclusion
  - Fairness
  - deadlock free



Analogy: Video Games

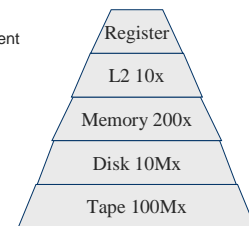
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## Memory Management

- Goals
  - Support programs to run
  - Allocation and management
  - Transfers from and to secondary storage
- Issues
  - Efficiency & convenience
  - Fairness
  - Protection



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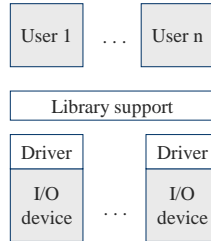
## I/O Device Management

- Goals

- Interactions between devices and applications
- Ability to plug in new devices

- Issues

- Efficiency
- Fairness
- Protection and sharing

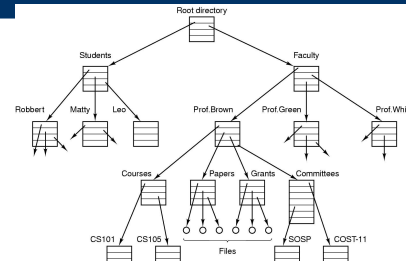


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## File System Example



File system for a university department

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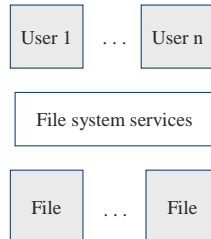
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## File System

- A typical file system

- Open a file with authentication
- Read/write data in files
- Close a file

- Can the services be moved to user level?



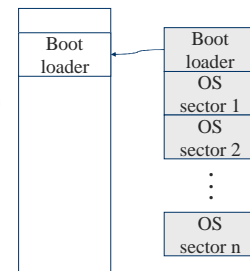
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## Bootstrapping

- Power up a computer
- Processor reset
  - Set to known state
  - Jump to ROM code
- Load in the boot loader from stable storage
- Jump to the boot loader
- Load the rest of the operating system
- Initialize and run



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## Design Tradeoffs

- All in the kernel (Windows)

- Pros: efficient?
- Cons: difficult to develop new services

- All at user level

- Pros: easy to develop new apps
- Cons: protection

- Split between user and kernel (Unix)

- Kernel: display driver and mouse driver
- User: the rest

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## May You Live in Interesting Times...

- Processors double in 18 months
- Disk doubling every 12 months
- Global bandwidth every 6 months
- "Sweet spot" constantly decaying

- What will the future OS be?

(If population doubles every year, or people can move twice faster every year, what does the government do?)

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## Summary

- Hardware overview
- A peek at Unix
- Criteria to evaluate an OS
- Overview of OS components
- Design tradeoffs
- Next lecture: Process (Chapter 2)

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## Reminder

- Nacho Tutorial, 27<sup>th</sup>
- Read Chapter 2
- Test Quiz

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