CS 372
Introduction to Operating Systems

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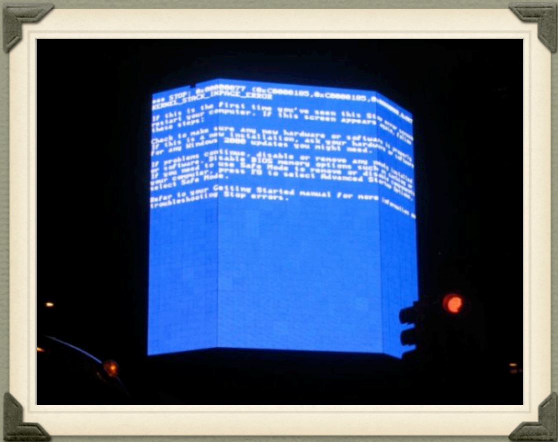
Why study Operating Systems?

- Can't I just buy a couple $5 CD at the Campus Store and be done with it?

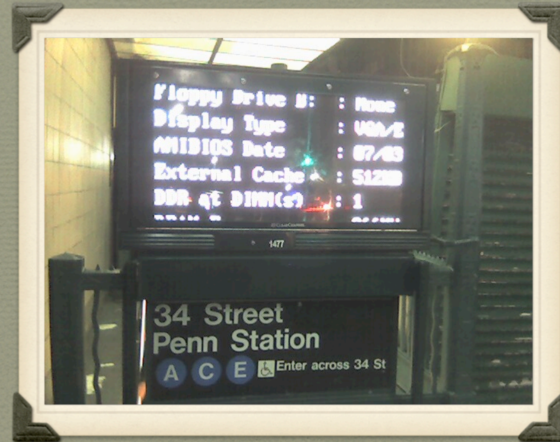
Why study Operating Systems?

Why study Operating Systems?

- To learn how computers work
- To learn how to manage complexity through appropriate abstractions
  - infinite CPU, infinite memory, files, semaphores, etc.
- To learn about system design
  - performance vs. simplicity, HW vs. SW, etc.
- Because OSs are everywhere!



Where's the OS?
Las Vegas



Where's the OS?
New York

Why study Operating Systems?

Because you are worth it!

CS 372

- A capstone course
  - PL meets Data Structures meets HW meets Algorithms meets Software Engineering...and they all meet you!
- Projects
  - build components of an OS
  - enhance software engineering skills

Three levels of learning

How to approach problems

- Example: problem definition, design-space exploration, case studies
- Goal: When faced with a similar problem, you should be able to devise a solution
- Time-scale: big, long-term payoff

Three levels of learning

How to apply specific techniques

- Example: time-tested solutions to hard problems such as concurrent programming, two-phase commit, transactions...
- Goal: Become a good engineer
- Time-scale: useful both now and in 20 years

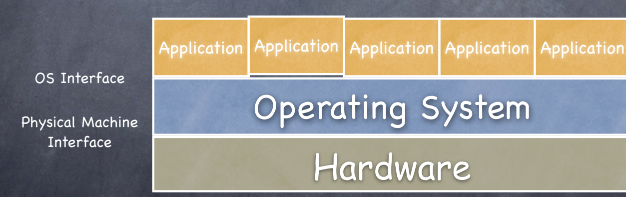
Three levels of learning

How, in detail, current OSs work

- Example: FS, network stack, internal data structures, VM, ... of Linux, XP, Solaris, etc.
- Goal: Well... know, in detail. how current OSs work!
- Time-scale: Better be now, because all will have changed tomorrow

What is an OS?

- An Operating System implements a virtual machine whose interface is more convenient* that the raw hardware interface



* easier to use, simpler to code, more reliable, more secure...

Operating System Services

- Manager
- Poet
- Coordinator

Operating System Services

- Manager
  - of physical resources such as CPU, memory, disks, networks, displays, cameras, etc.
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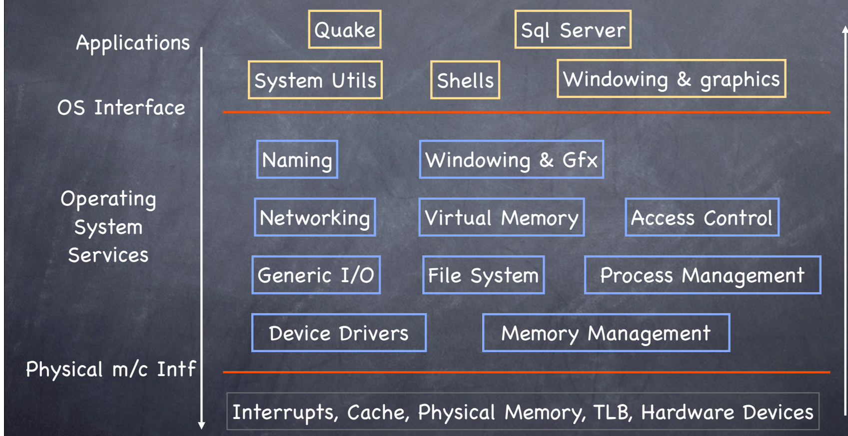
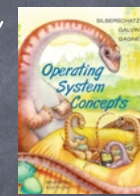
- Poet
  - abstracts physical resources to create processes, threads, files, directories, users, etc.
- Coordinator
  - allows multiple applications/users to work together in efficient and fair ways

Logical OS Structure?



Administrivia

- Textbook
  - Operating Systems Concepts, 7th edition, by Silberschatz, Galvin and Gagne, Wiley (6th or 5th edition ok too)
  - Further readings, notes, as distributed in class



- Other useful texts
  - Operating System Principles, Bic & Shaw, 2nd edition
  - Modern Operating Systems, Tanenbaum, Prentice Hall

Grading Policy

- Exams (closed books)
  - Midterm: 25%
  - Final: 35%
- Projects: 40%
- No formal homework
  - Practice problems and solutions posted on web site

Where to go for help

- Ask questions in class
- Attend office hours
  - Lorenzo: T/TH 1:30-2:30
  - Amit: M: 12:00-1:00; W: 4:30-530; F 9:30-10:30
- Don't send questions by email
  - I want to know you
  - I don't want to be subject to DOS attacks
- Your primary avenue for resolving questions is office hours

Academic Integrity

- Submitted work should be your own
- Encouraged collaboration:
  - discuss problem sets, projects
  - point of confusion, question interpretation, solution approaches
- Dishonesty has no place in any community
  - You may NOT copy code from another group, or any course project material similar to the one used in this class
  - It is never OK to look at the written work of another student or show them yours until grading is done–including whiteboard discussions, or help in debugging.
  - Use the "Gilligan Island" rule.
  - When in doubt, ask!

Issues in OS Design

- **Structure:** how is an operating system organized ?
- **Sharing:** how are resources shared among users ?
- **Naming:** how are resources named by users or programs ?
- **Protection:** how is one user/program protected from another ?
- **Security:** how to authenticate, control access, secure privacy ?
- **Performance:** why is it so slow ?
- **Reliability and fault tolerance:** how do we deal with failures ?
- **Extensibility:** how do we add new features ?

Issues in OS Design

- **Communication:** how can we exchange information ?
- **Concurrency:** how are parallel activities created and controlled ?
- **Scale, growth:** what happens as demands or resources increase ?
- **Persistence:** how can data outlast processes that created them ?
- **Compatibility:** can we ever do anything new ?
- **Distribution:** accessing the world of information
- **Accounting:** who pays bills, and how to control resource usage

Why is this material critical?

- Concurrency
  - Therac-25, Ariane 5 rocket (June 96)
- Communication
  - Air Traffic Control System
- Persistence
  - Denver Airport
- Virtual Memory
  - Blue Screens of Death
- Security
  - Data Theft at McCombs School of Business