UNIVERSITY of WISCONSIN-MADISON
Computer Sciences Department

CS 537
Introduction to Operating Systems

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INTRODUCTION

Questions answered in this lecture:

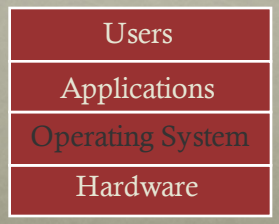
- What will you do in this course?
- What is an OS and why do you want one?
- Why study operating systems?

To do:

- Take a look at course web page and first programming project

WHAT IS AN OPERATING SYSTEM?

Not easy to define precisely…



Operating System (OS):
Software that converts hardware into a useful form for applications

WHAT DOES OS PROVIDE?

Role #1: Abstraction - Provide standard library for resources

What is a resource?
Anything valuable (e.g., CPU, memory, disk)

What abstraction does modern OS typically provide for each resource?
- CPU:
  - process and/or thread
- Memory:
  - address space
- Disk:
  - files

Advantages of OS providing abstraction?
- Allow applications to reuse common facilities
- Make different devices look the same
- Provide higher-level or more useful functionality

Challenges
- What are the correct abstractions?
- How much of hardware should be exposed?

WHAT DOES OS PROVIDE?

Role #2: Resource management – Share resources well

Advantages of OS providing resource management?
- Protect applications from one another
- Provide efficient access to resources (cost, time, energy)
- Provide fair access to resources

Challenges
- What are the correct mechanisms?
- What are the correct policies?

OS ORGANIZATION

- How to cover all the topics relevant to operating systems?

THREE PIECES: FIRST

- **Virtualization**
  - Make each application believe it has each resource to itself
- Demo
  - Virtualize CPU and memory

THREE PIECES: SECOND

- **Concurrency:**
  Events are occurring simultaneously and may interact with one another
- OS must be able to handle concurrent events
- Easier case
  - Hide concurrency from **independent** processes
- Trickier case
  - Manage concurrency with **interacting** processes
    - Provide abstractions (locks, semaphores, condition variables, shared memory, critical sections) to processes
    - Ensure processes do not deadlock
- Demo
  - Interacting threads must coordinate access to shared data

THREE PIECES: THIRD

- **Persistence:** Access information permanently
  - Lifetime of information is longer than lifetime of any one process
  - Machine may be rebooted, machine may lose power or crash unexpectedly
- Issues:
  - Provide abstraction so applications do not know how data is stored : Files, directories (folders), links
  - Correctness with unexpected failures
  - Performance: disks are very slow; many optimizations needed!
- Demo
  - File system does work to ensure data updated correctly

ADVANCED TOPICS

- Current systems
  - Multiprocessors
  - Networked and distributed systems
  - Virtual machines

WHY STUDY OPERATING SYSTEMS?

Build, modify, or administer an operating system

Understand system performance

- Behavior of OS impacts entire machine
- Tune workload performance
- Apply knowledge across many layers
  - Computer architecture, programming languages, data structures and algorithms, and performance modeling

Fun and challenging to understand large, complex systems

TO DO

Take a look at course web page

Take a look at first programming project

Watch video of previous discussion section before Wednesday's discussion section