CSC 4103 - Operating Systems
Spring 2008

LECTURE - I

INTRODUCTION

Tevfik Koşar

Louisiana State University
January 15th, 2007

Contact Information

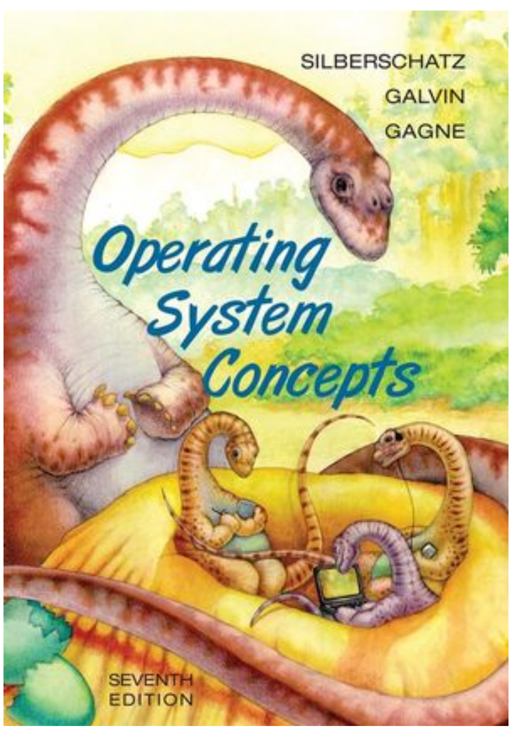
- Instructor: Prof. Tevfik Kosar
  - Office: 292 Coates (also 333 Johnston)
  - Phone: 578-9483
  - Email: kosar@csc.lsu.edu
  - Web: http://www.cct.lsu.edu/~kosar
  - Office hours: Tue & Wed, 11:00am – noon
    (Or anytime by appointment)
- Teaching Assistant: TBD

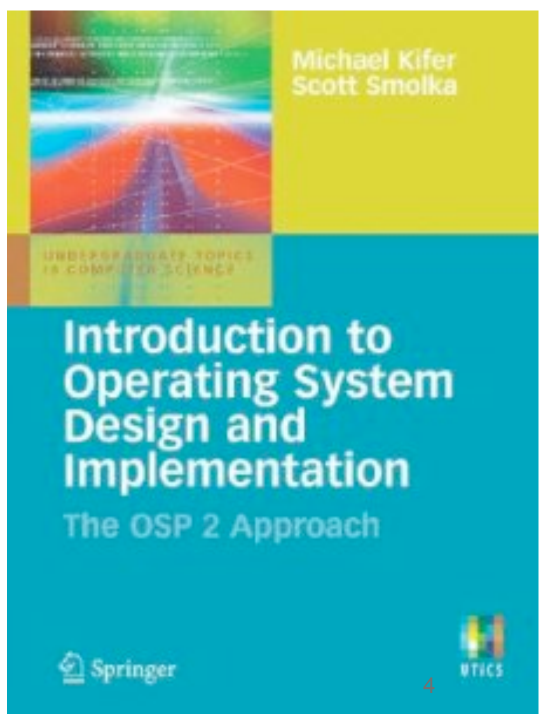
Logistics

- Course web page: http://www.cct.lsu.edu/~kosar/csc4103
  - All lecture notes will be available online
  - As well as homework assignments, projects and other important course information

- Course mailing list: csc4103@cct.lsu.edu
  - Important course announcements including projects, homework assignments, and exams will be sent to this mailing list
  - Provide me with your active email address to be added to the class mailing list

Textbooks





Grading

- The end-of-semester grades will be composed of:

– Pop Quizzes	: 10%	(?)
– Homework	: 15%	(5)
– Projects	: 20%	(2)
– Midterm	: 25%	(1)
– Final	: 30%	(1)

You are expected to attend the classes and actively contribute via asking and/or answering questions.

Rules

- No late homework/project submissions accepted!
- No computers/laptops will be allowed in regular class as well as exam.
- Exams will be closed book.
- You are only responsible from material covered in the class, homework, and projects.
- Academic dishonesty will be treated seriously.

What Expect to Learn?

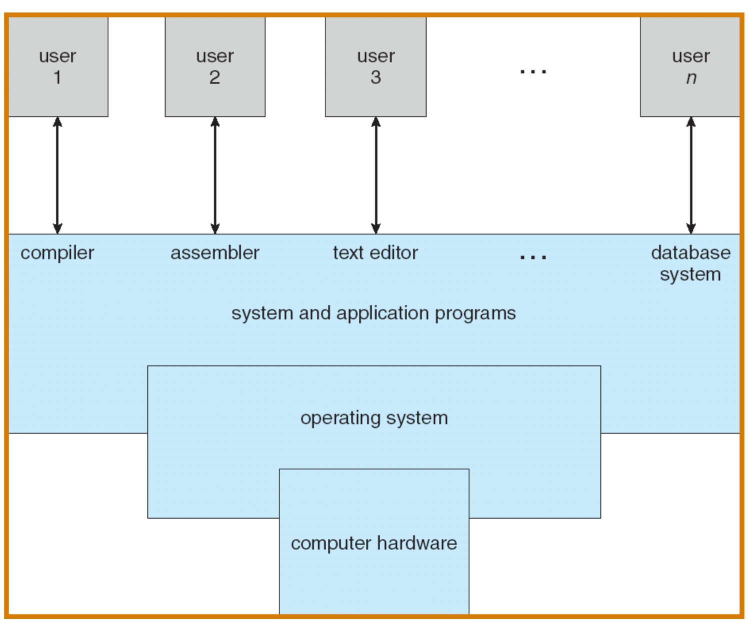
- Basic Concepts of Operating Systems
- Operation, Resource Utilization, Management
- Processes, Threads and Concurrency
- CPU and I/O Scheduling
- Memory and Storage Management
- File System Structures
- Synchronization and Deadlocks
- Protection and Security
- Distributed Computing & Related Issues

Introduction

What is an Operating System?

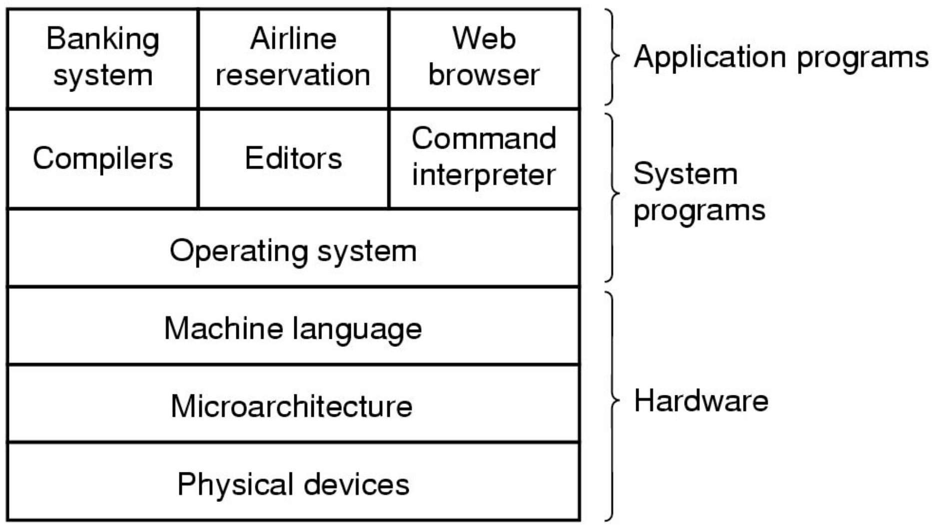
- A program that manages the computer hardware.
- An intermediary between the computer user and the computer hardware.
- Manages hardware and software resources of a computer.

Role of an Operating System



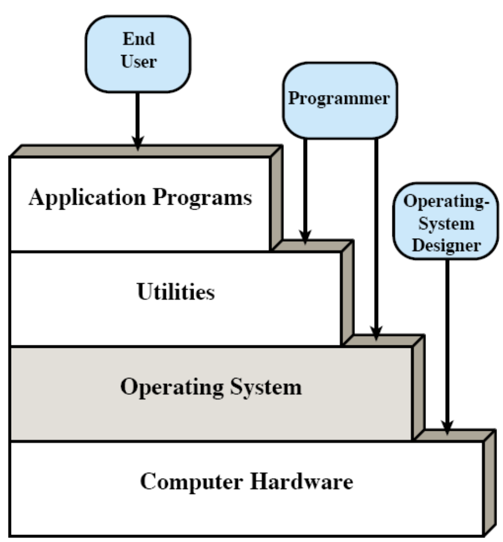
“Pyramid” View - Silberschatz

Role of an Operating System



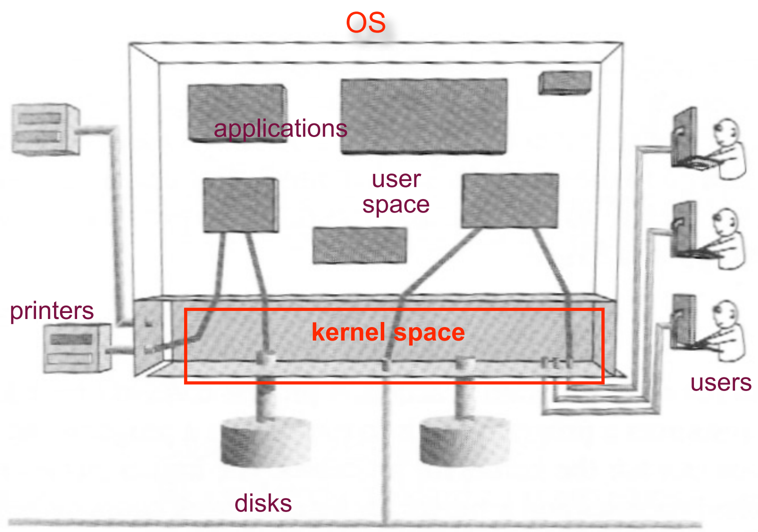
“Layered” View - Tanenbaum

Role of an Operating System



“Layered & stairs” View - Stallings

Role of an Operating System



"Aquarium" View - Molay

In Short

- An operating system is a program that acts as an intermediary between user (applications) and the computer hardware.

Operating System Goals

- From the user perspective
  - Execute user programs and make solving user problems easier
  - Make the computer system convenient to use
- From the System/HW Perspective
  - Manage the resources
  - Use the computer hardware in an efficient manner

OS Services for Users

- Program Execution
- Access to I/O Devices
- Controlled Access to Files
- Communications
- Error Detection and Response

OS Services for Users

- Program Execution
  - The OS loads programs and data into memory, initializes I/O devices and files, schedules the execution of programs
- Access to I/O Devices
  - The OS hides I/O device details from applications (direct I/O access is forbidden) and offers a simplified I/O interface
- Controlled Access to Files
  - The OS organizes data into files, controls access to the files (i.e. create, delete, read, write) and preserves their integrity
  -

OS Services for Users

- Communications
  - The OS allows exchange of information between processes, which are possibly executing on different computers
- Error Detection and Response
  - The OS properly handles HW failures and SW errors with the least impact to running applications (i.e. terminating, retrying, or reporting)

OS Services for System/HW

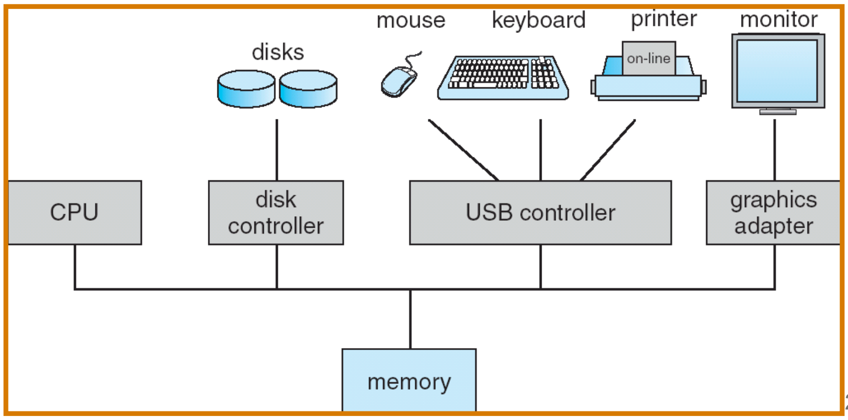
- Resource Allocation
- Operation Control
- System Access
- Accounting and Usage Statistics

OS Services for System/HW

- Resource Allocation
  - The OS allocates resources to multiple users and multiple jobs running at the same time
- Operation Control
  - The OS controls the execution of user programs and operations of I/O devices
- System Access
  - The OS ensures that all access to resources is protected, including authorization, conflict resolution etc.
- Accounting and Usage Statistics
  - The OS keeps performance monitoring data

Computer System Organization

- Computer-system operation
  - One or more CPUs, device controllers connect through common bus providing access to shared memory
  - Concurrent execution of CPUs and devices competing for memory cycles



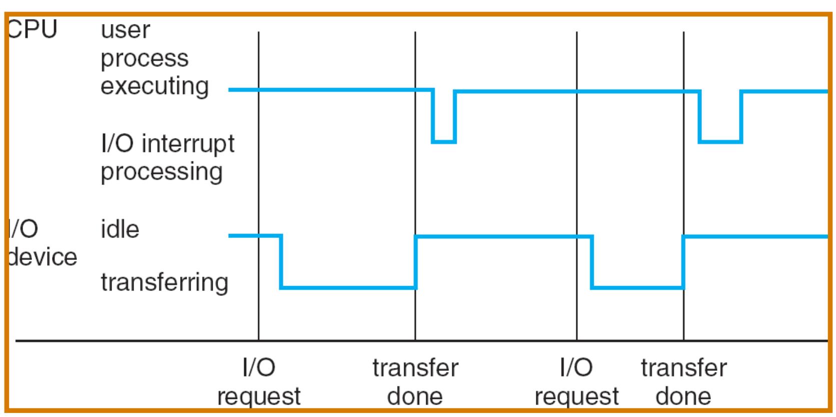
Computer-System Operation

- I/O devices and the CPU can execute concurrently.
- Each device controller is in charge of a particular device type.
- Each device controller has a local buffer.
- CPU moves data from/to main memory to/from local buffers
  - If no CPU involved → DMA
- I/O is from the device to local buffer of controller.
- Device controller informs CPU that it has finished its operation by causing an *interrupt*.

Common Functions of Interrupts

- Interrupt transfers control to the interrupt service routine generally, through the ***interrupt vector***, which contains the addresses of all the service routines (**interrupt handlers**).
- Interrupt architecture must save the address of the interrupted instruction. (also save state of CPU, eg. registers, PC)
- Incoming interrupts are *disabled* while another interrupt is being processed to prevent a *lost interrupt*.
- A ***trap*** is a software-generated interrupt caused either by an error or a user request.
- An operating system is ***interrupt* driven**.

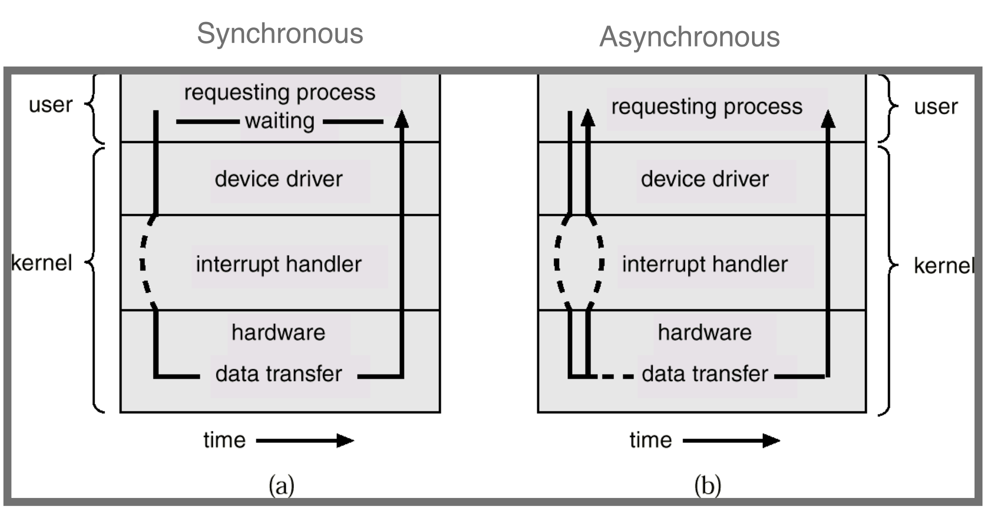
Interrupt Timeline for I/O



I/O Structure

- After I/O starts, control returns to user program only upon I/O completion ➔ synchronous
  - Wait instruction idles the CPU until the next interrupt
  - Wait loop (contention for memory access).
  - At most one I/O request is outstanding at a time, no simultaneous I/O processing.
- After I/O starts, control returns to user program without waiting for I/O completion ➔asynchronous
  - *System call* – request to the operating system to allow user to wait for I/O completion.
  - *Device-status table* contains entry for each I/O device

Two I/O Methods



Operating System Operations

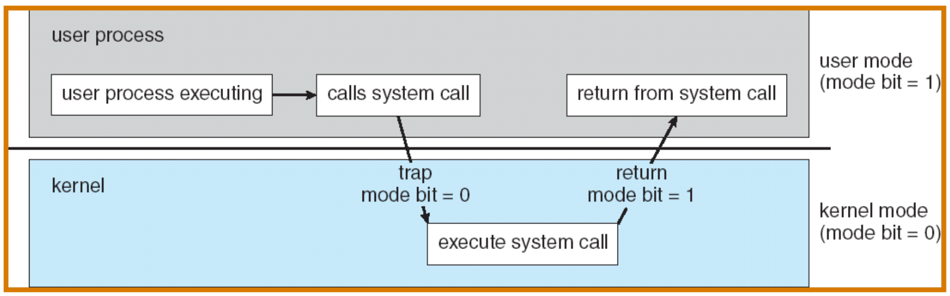
- Interrupt driven by hardware
- Unexpected errors can happen anytime
  - Software error or request creates **exception** or **trap**
    - eg. division by zero, invalid memory access
  - Other process problems include infinite loop, processes modifying each other or the operating system
- OS needs to protects itself
  ➔ Dual-mode operation

Dual-Mode Operation

- **Dual-mode** operation allows OS to protect itself and other system components
  - **User mode** and **kernel mode**
  - **Mode bit** provided by hardware
    - Provides ability to distinguish when system is running user code or kernel code
    - Protects OS from errant users, and errant users from each other
    - Some instructions designated as **privileged**, only executable in kernel mode
    - System call changes mode to kernel, return from call resets it to user

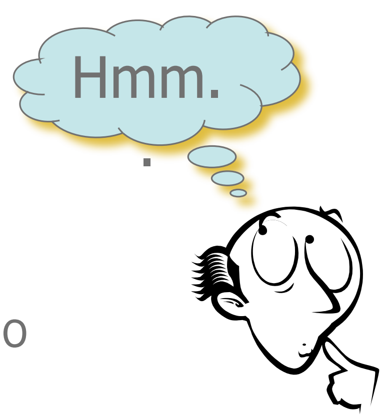
Transition from User to Kernel Mode

- How to prevent user program getting stuck in an infinite loop / process hogging resources
  - ➔ Timer: Set interrupt after specific period (1ms to 1sec)
  - Operating system decrements counter
  - When counter zero generate an interrupt
  - Set up before scheduling process to regain control or terminate program that exceeds allotted time



Summary

- What is an OS?
- Operating System Goals
  - User View vs System View
- Operating System Services
- Computer System Operation
  - Interrupts
- Synchronous vs Asynchronous I/O
- User Mode vs Kernel Mode



- Reading Assignment: Chapter 1 from Silberschatz.

Acknowledgements

- “Operating Systems Concepts” book and supplementary material by A. Silberschatz, P. Galvin and G. Gagne

- “Operating Systems: Internals and Design Principles” book and supplementary material by W. Stallings

- “Modern Operating Systems” book and supplementary material by A. Tanenbaum

- R. Doursat and M. Yuksel from UNR