Lecture - I
Introduction

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University at Buffalo
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Contact Information

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  - Office hours: Tue noon - 1:00pm, Wed 11:00am - noon
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Recitations

- You need to attend one of the following recitations:
  - Tue 10:00am-11:50am (Talbert 115)
  - Wed 10:00am-10:50am (Copen 10)
  - Fri 3:00pm-3:50pm (Knox 04)

- Recitations will include:
  - Clarification of some important course material
  - Solutions of some exercise questions
  - Project & HW guidance
  - Programming tips

Course Web Page

- Course web page:
  - [http://www.cse.buffalo.edu/faculty/tkosar/cse421-521/](http://www.cse.buffalo.edu/faculty/tkosar/cse421-521/)
  - All lecture notes will be available online
  - As well as homework assignments, projects and other important course information
Textbook: Required

Operating System Concepts Update
Silberschatz, Galvin, Gagne

Recommended Supplementary Text

THE C PROGRAMMING LANGUAGE
SECOND EDITION
BRIAN W. KERNIGHAN
DENNIS M. RITCHIE
PRENTICE HALL SOFTWARE SERIES

Advanced Programming in the UNIX Environment
Second Edition
W. Richard Stevens
Stephen A. Rago
Foreword by Dennis Ritchie
Grade Components

- The end-of-semester grades will be composed of:
  - Pop Quizzes : 5% (4-5)
  - Homework : 10% (4)
  - Projects : 30% (3)
  - Midterm : 25% (1)
  - Final : 30% (1)

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

• Final grades will be given according to this scale:

<table>
<thead>
<tr>
<th>Point Range</th>
<th>Letter Grade</th>
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<tbody>
<tr>
<td>95.00-100</td>
<td>A</td>
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<tr>
<td>90.00-94.99</td>
<td>A-</td>
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<tr>
<td>85.00-89.99</td>
<td>B+</td>
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<tr>
<td>80.00-84.99</td>
<td>B</td>
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<tr>
<td>75.00-79.99</td>
<td>B-</td>
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<tr>
<td>70.00-74.99</td>
<td>C+</td>
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<tr>
<td>65.00-69.99</td>
<td>C</td>
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<tr>
<td>60.00-64.99</td>
<td>C-</td>
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<tr>
<td>55.00-59.99</td>
<td>D+</td>
</tr>
<tr>
<td>50.00-54.99</td>
<td>D</td>
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<tr>
<td>0.00-49.99</td>
<td>F</td>
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</tbody>
</table>

I may use a “curve” to adjust grades to this scale.

Rules

• No late homework/project submissions accepted!

• Exams will be closed book.

• You are only responsible from material covered in the class, homework, and projects.

• Academic dishonesty will be treated “very” seriously!
Passive vs Active Learning

**Passive learning:** learning through reading, hearing & seeing

**Active learning:** learning through saying and doing

After 2 weeks, we tend to remember:

**Passive learning**
- 10% of what we read
- 20% of what we hear
- 30% of what we see (i.e. pictures)
- 50% of what we hear and see

**Active learning**
- 70% of what we say
- 90% of what we say and do

How to Become an Active Learner

- Recall prior materials
- Answer a question
- Guess the solution first (even guessing wrong will help you to remember the right approach)
- Work out the next step before you have to read on
- Think of an application
- Imagine that you were the professor and think about how you would give a test on the subject material so that key concepts and results will be checked.
- Summarize a lecture, a set of homework or a lab in your own words concisely.
What Expect to Learn?

• Key Concepts of Operating Systems
  - Design, Implementation, and Optimization

• Topics will include:
  - 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.

Computer System Overview

- **A computer system consists of (bottom-up):**
  1. hardware
  2. firmware (BIOS)
  3. operating system
  4. system programs
  5. application programs
  6. users
Computer System Overview

1. **Hardware**
   - provides basic computing resources
   - CPU, memory, disk, other I/O devices

2. **Firmware (BIOS)**
   - software permanently stored on chip (but upgradable)
   - loads the operating system during boot

3. **Operating system**
   - controls and coordinates the use of the hardware among the various application programs for the various users

4. **System programs**
   - basic development tools (shells, compilers, editors, etc.)
   - not strictly part of the core of the operating system

5. **Application programs**
   - define the logic in which the system resources are used to solve the computing problems of the users
   - database systems, video games, business programs, etc.

6. **Users**
   - people, other computers, machines, etc.
Role of an Operating System

- The Silberschatz "pyramid" view

Abstract view of the components of a computer system

- The Tanenbaum "layered" view

A computer system consists of hardware, system programs and application programs
Role of an Operating System

- **The Stallings “layered & stairs” view**

  ![Diagram of a layered computer system with End User, Programmer, Application Programs, Utilities, Operating System, and Computer Hardware.]

Layers and views of a computer system

- **The Molay “aquarium” view**
  - the only not-layered view
  - everything must transit through the O/S or “kernel”

![Diagram of an aquarium with applications, printers, users, disks, user space, kernel space, and connections.]

How are they all connected? The kernel manages all connections

Key Point

- An operating system is a program that acts as an intermediary between users/applications and the computer hardware.

Operating System Goals

- From the user perspective:
  - Executes user programs and make solving user problems easier
  - Makes the computer system convenient to use
    - hides the messy details which must be performed
    - presents user with a virtual machine easier to use

- From the System/HW Perspective:
  - Manages the resources
  - Uses the computer hardware in an efficient manner
    - time sharing: each program gets some time to use a resource
    - resource sharing: each program gets a portion of a resource
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 & Directories**
  - The OS organizes data into files and directories, controls access to them (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**
  - 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

Summary

- What is an OS?
- Role of an OS
- Operating System Goals
  - User View vs System View
- Operating System Services
  - For Users and HW

*Reading Assignment: Chapter 1 from Silberschatz.*
Acknowledgements


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

- R. Doursat and M. Yuksel from UNR