CSE 421/521 - Operating Systems
Fall 2012

LECTURE - I
INTRODUCTION

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University at Buffalo
August 28th, 2012

Contact Information

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    (Or anytime by appointment)

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Recitations

• You need to attend one of the following recitations:
  - Tue 11:00am - 11:50am  (Capen 260)
  - Wed 10:00am - 10:50am (Obrian 112)

• 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/
  - All lecture notes will be available online
  - As well as homework assignments, projects and other important course information

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<tr>
<th>Date</th>
<th>Lect.</th>
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<th>Notes</th>
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<tr>
<td>Aug 28</td>
<td>1</td>
<td>Introduction</td>
<td>Read Ch.1</td>
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<td>Aug 30</td>
<td>2</td>
<td>Operating System Structures</td>
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<tr>
<td>Sep 4</td>
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<td>Processes</td>
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<td>Sep 6</td>
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<td>Threads</td>
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<td>Sep 11</td>
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<td>CPU Scheduling - I</td>
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<td>Sep 13</td>
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<td>CPU Scheduling - II</td>
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<td>Sep 18</td>
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<td>Project-I Discussion</td>
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<td>Sep 20</td>
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<td>Process Synchronization - I</td>
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<td>Sep 25</td>
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<td>Sep 27</td>
<td>10</td>
<td>Deadlocks – I</td>
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<td>Oct 2</td>
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<td>Deadlocks – II</td>
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<td>Oct 4</td>
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<td>Main Memory – I</td>
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<td>Oct 9</td>
<td>13</td>
<td>Main Memory – II</td>
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<td>Oct 11</td>
<td>14</td>
<td>Midterm Review</td>
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<td>Oct 16</td>
<td>MIDTERM EXAM (Room: Davis 101)</td>
<td>9:30am-10:50am</td>
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<td>Oct 18</td>
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<td>Oct 23</td>
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Textbook: Required

Recommended Supplementary Text
Recommended Supplementary Text

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>
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<tr>
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<tr>
<td>0-49.99</td>
<td>F</td>
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* I will use “curve” to adjust grades (up) to this scale.
* There will be separate curves for graduate & undergraduate students.

Rules

- No use of laptops/phones during the lectures!
- 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 showing layers and views of a computer system](image)

  - End User
  - Programmer
  - Application Programs
  - Utilities
  - Operating System
  - Computer Hardware

  Layers and views of a computer system

Role of an Operating System

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

  ![Diagram showing connections and kernel management](image)

  - 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