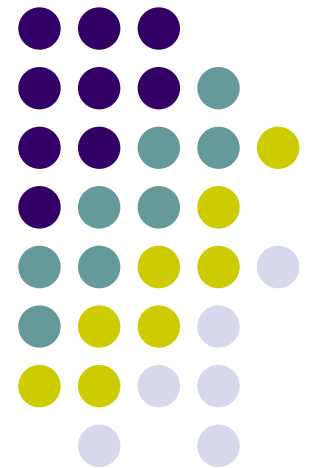


# CS30002: Operating Systems

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Spring 2012



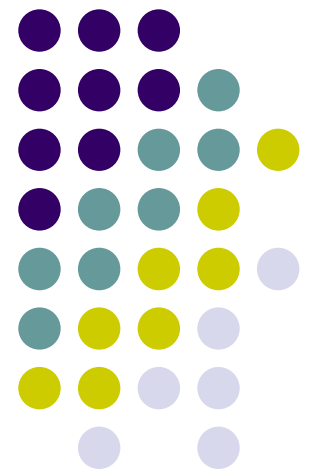


# General Information

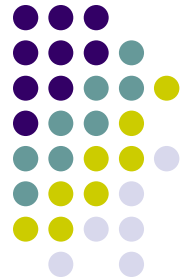
- Textbook:
  - Operating System Concepts, 8<sup>th</sup> Ed, by Silberschatz, Galvin, and Gagne
  - I will use materials from other books as and when needed
- Course Webpage
  - <http://cse.iitkgp.ac.in/~agupta/OS>
- Grading Policy
  - Midsem – 30%
  - Endsem – 50%
  - TA – 20% (Two class tests, may also have assignments)

# Introduction

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# What is an Operating System?



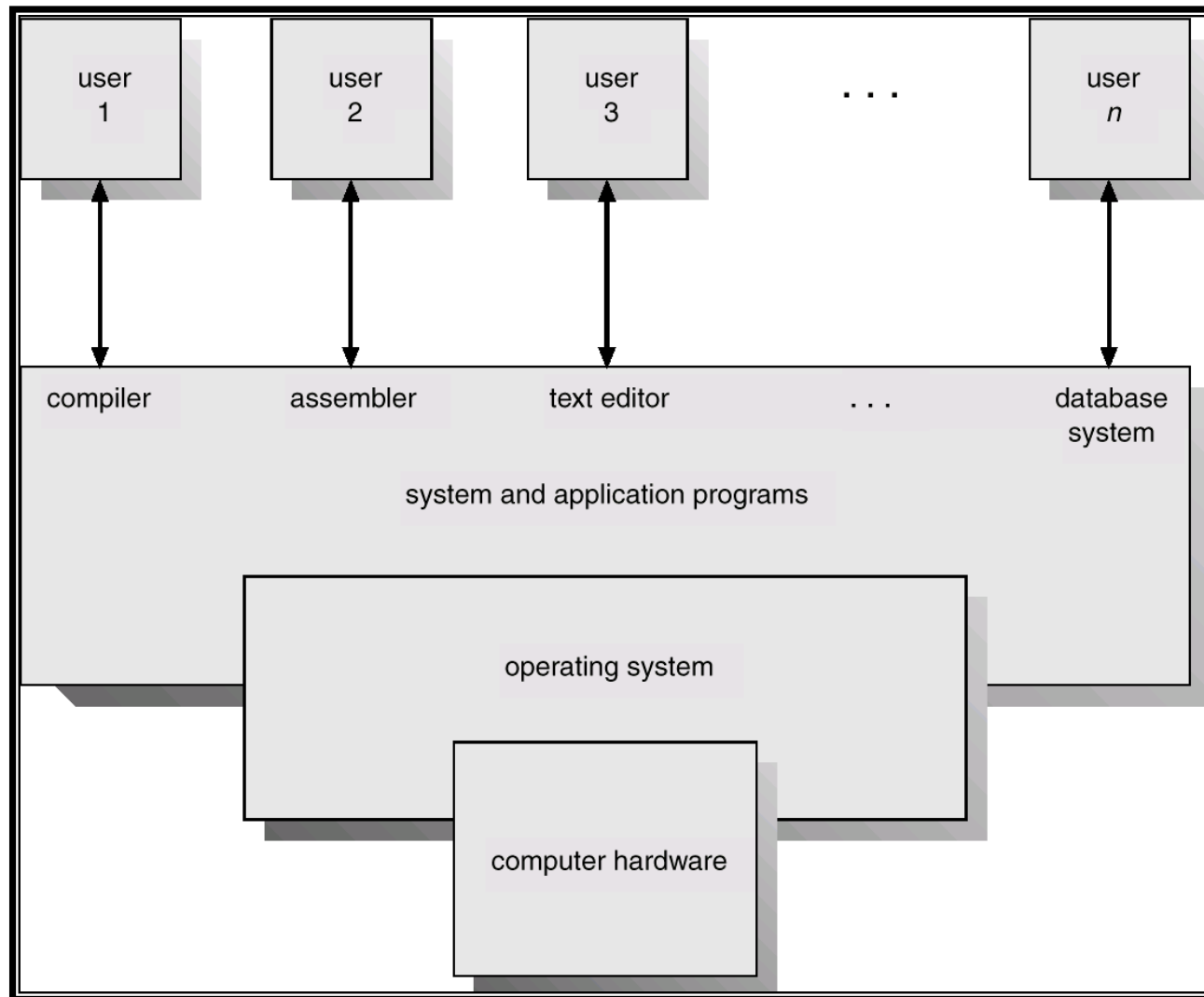
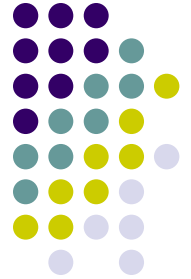
- User-centric definition
  - A program that acts as an intermediary between a user of a computer and the computer hardware
  - Defines an interface for the user to use services provided by the system
  - Provides a “view” of the system to the user
- System-centric definition
  - Resource allocator – manages and allocates resources
  - Control program – controls the execution of user programs and operations of I/O devices

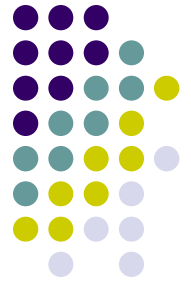
# Computer System Components



1. Hardware – provides basic computing resources (CPU, memory, I/O devices).
2. Operating system – controls and coordinates the use of the hardware among the various application programs for the various users.
3. Applications programs – define the ways in which the system resources are used to solve the computing problems of the users (compilers, databases, games, ...).
4. Users (people, machines, other computers).

# Abstract View of System Components





# Types of Systems

- Batch Systems
  - Multiple jobs, but only one job in memory at one time and executed (till completion) before the next one starts
- Multiprogrammed Batch Systems
  - Multiple jobs in memory, CPU is multiplexed between them
  - CPU-bound vs I/O bound jobs
- Time-sharing Systems
  - Multiple jobs in memory and on disk, CPU is multiplexed among jobs in memory, jobs swapped between disk and memory
  - Allows interaction with users



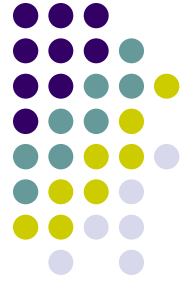
- Personal Computers
  - Dedicated to a single user at one time
- Multiprocessing Systems
  - More than one CPU in a single machine to allocate jobs to
  - Symmetric Multiprocessing, NUMA machines ...
  - Multicore
- Other Parallel Systems, Distributed Systems, Clusters...
  - Different types of systems with multiple CPUs/Machines
- Real Time Systems
  - Systems to run jobs with time guarantees
- Other types possible depending on resources in the machine, types of jobs to be run...





- OS design depends on the type of system it is designed for
- Our primary focus in this course:
  - Uniprocessor, time-sharing systems running general purpose jobs from users
  - Effect of multicore/multiprocessors
- Will discuss some other topics at end

# Resources Managed by OS

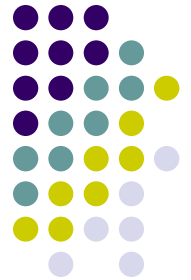


- Physical
  - CPU, Memory, Disk, I/O Devices like keyboard, monitor, printer
- Logical
  - Process, File, ...



# Main Components of an OS

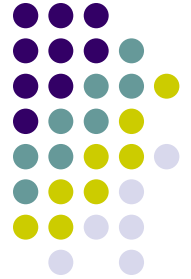
- Resource-Centric View
  - Process Management
  - Main Memory Management
  - File Management
  - I/O System Management
  - Secondary Storage Management
  - Security and Protection System
  - Networking (this is now integrated with most OS, but will be covered in the Networks course)
- User-centric view
  - System Calls
  - Command Interpreter (not strictly a part of an OS)



# Process Management

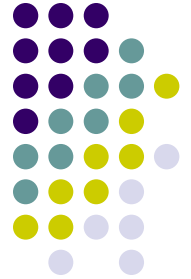
- A *process* is a program in execution.
- Needs certain resources to accomplish its task
  - CPU time, memory, files, I/O devices...
- OS responsibilities
  - Process creation and deletion.
  - Process suspension and resumption.
  - Provide mechanisms for:
    - process synchronization
    - interprocess communication

# Main-Memory Management



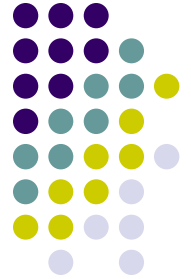
- OS responsibilities
  - Keep track of which parts of memory are currently being used and by whom
  - Decide which processes to load when memory space becomes available
  - Allocate and deallocate memory space as needed

# File Management



- OS responsibilities
  - File creation, deletion, modification
  - Directory creation, deletion, modification
  - Support of primitives for manipulating files and directories
  - Mapping files onto secondary storage.
  - File backup on stable (nonvolatile) storage media

# I/O System Management



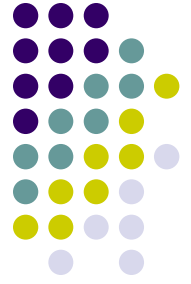
- The I/O system consists of:
  - A buffer-caching system
  - Device driver interface
  - Drivers for specific hardware devices

# Secondary-Storage Management



- Most modern computer systems use disks as the principle on-line storage medium, for both programs and data.
- OS responsibilities
  - Free space management
  - Storage allocation
  - Disk scheduling

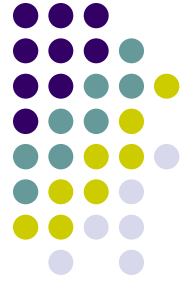




# Security and Protection System

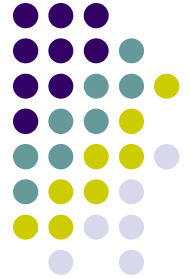
- *Protection* refers to a mechanism for controlling access by programs, processes, or users to both system and user resources.
- The protection mechanism must:
  - distinguish between authorized and unauthorized usage
  - specify the controls to be imposed
  - provide a means of enforcement

# System Calls



- System calls provide the interface between a running program and the OS
  - Think of it as a set of functions available to the program to call (but somewhat different from normal functions, we will see why)
  - Generally available as assembly-language instructions.
  - Most common languages (e.g., C, C++) have APIs that call system calls underneath
- Passing parameters to system calls
  - Pass parameters in *registers*
  - Store the parameters in a table in memory, and the table address is passed as a parameter in a register
  - *Push* (store) the parameters onto the *stack* by the program, and *pop* off the stack by operating system

# Command-Interpreter System



- Strictly not a part of OS, but always there
  - the *shell*
- Allows user to give commands to OS, interpretes the commands and executes them
  - Calls appropriate functions/system calls
  - You will write one in your lab