



# Operating Systems (Design Approach)

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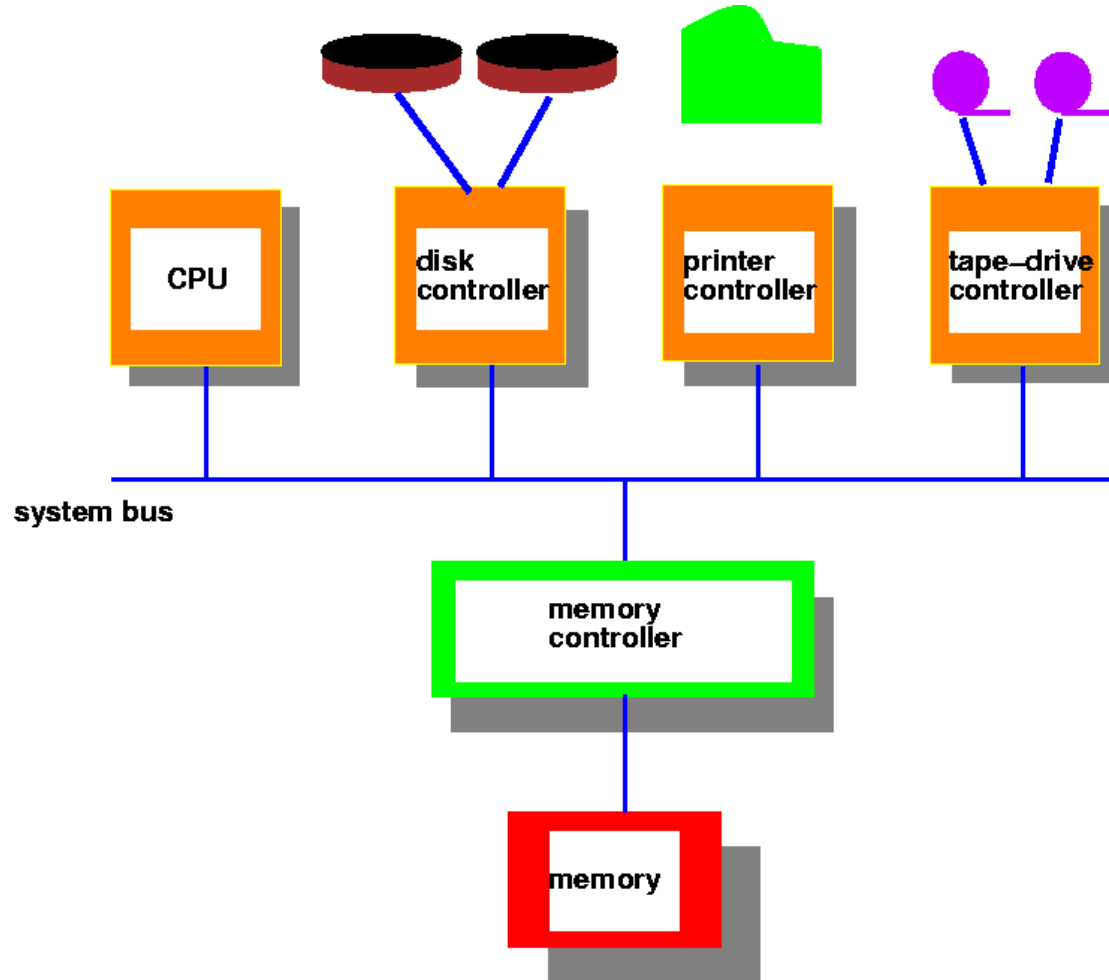
## **Lecture 3 - Operating System Structures**

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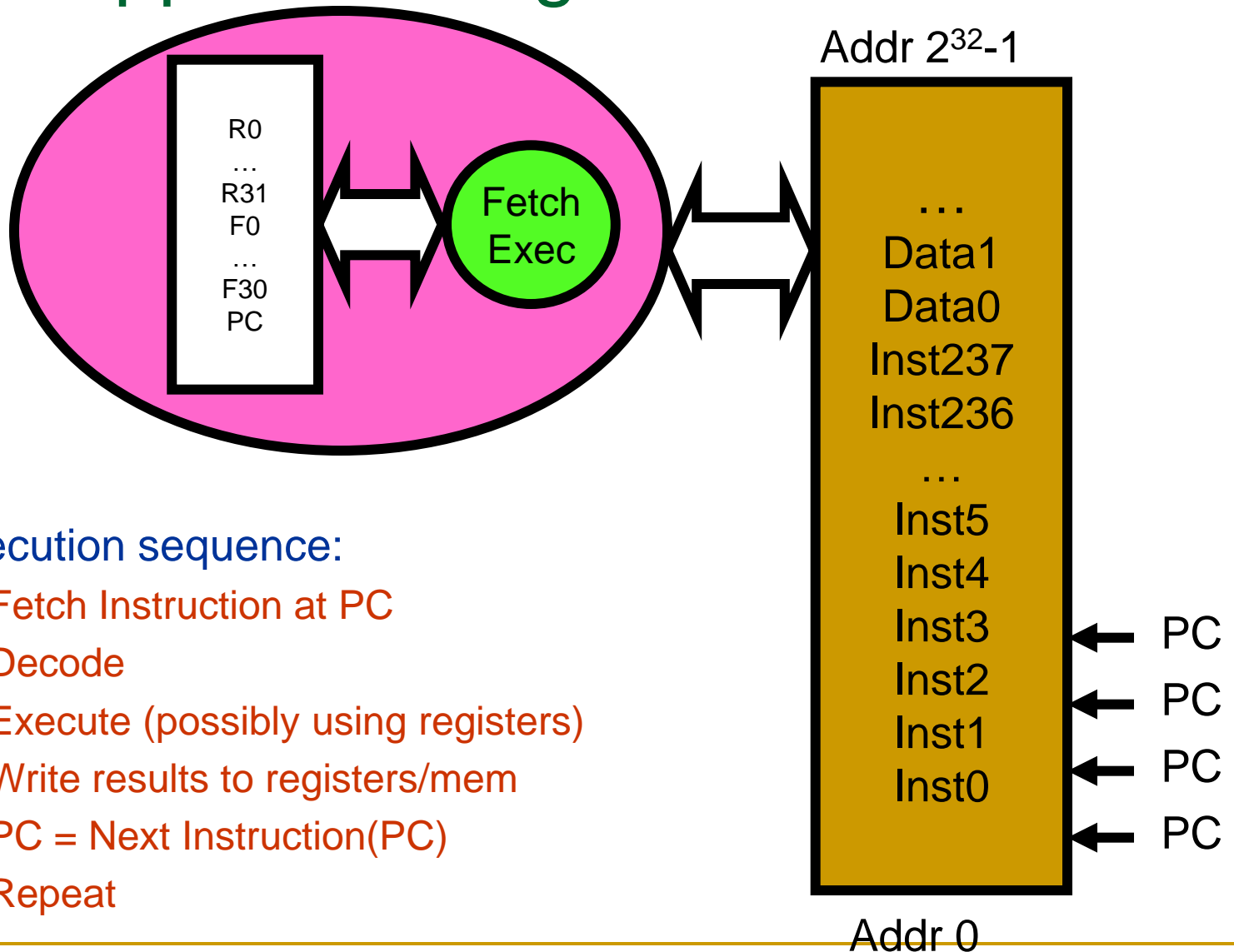
# Computer System & OS Structures

- Computer System Operation
    - I/O Structure
    - Storage Structure, Storage Hierarchy
    - Hardware Protection
  - Operating System Services, System calls, System Programs
  - Structuring OS
    - Virtual Machine Structure and Organization
  - OS Design and Implementation
    - Process Management, Memory Management, Secondary Storage Management, I/O System Management, File Management, Protection System, Networking, Command-Interpreter.
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# Computer System Architecture



# What happens during execution?



## Execution sequence:

- ❑ Fetch Instruction at PC
- ❑ Decode
- ❑ Execute (possibly using registers)
- ❑ Write results to registers/mem
- ❑ PC = Next Instruction(PC)
- ❑ Repeat

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# Computer System Organization

- I/O devices and the CPU execute concurrently.
  - Each device controller is in charge of a particular device type
    - Each device controller has a local buffer. I/O is from the device to local buffer of controller
  - CPU moves data from/to main memory to/from the local buffers
  - Device controller interrupts CPU on completion of I/O
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# Storage Structure

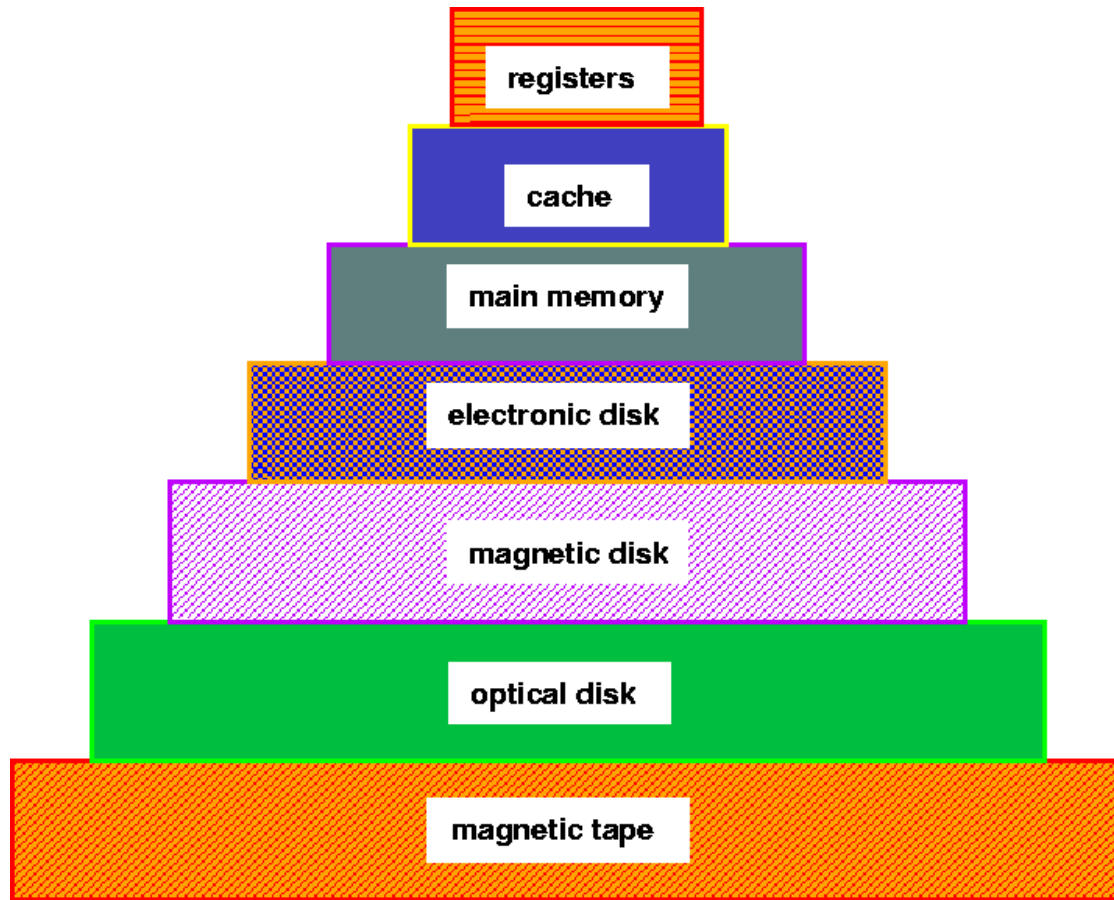
- Main memory - only large storage media that the CPU can access directly.
  - Secondary storage - extension of main memory that has large nonvolatile storage capacity.
    - Magnetic disks - rigid metal or glass platters covered with magnetic recording material.
      - Disk surface is logically divided into tracks, subdivided into sectors.
      - Disk controller determines logical interaction between device and computer.
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# Storage Hierarchy

- Storage systems are organized in a hierarchy based on
    - Speed
    - Cost
    - Volatility
  - Caching - process of copying information into faster storage system; main memory can be viewed as fast cache for secondary storage.
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# Storage Device Hierarchy





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# Operating System Services

- **Services that provide user-interfaces to OS**
    - Program execution - load program into memory and run it
    - I/O Operations - since users cannot execute I/O operations directly
    - File System Manipulation - read, write, create, delete files
    - Communications - interprocess and intersystem
    - Error Detection - in hardware, I/O devices, user programs
  - **Services for providing efficient system operation**
    - Resource Allocation - for simultaneously executing jobs
    - Accounting - for account billing and usage statistics
    - Protection - ensure access to system resources is controlled
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# OS Task: Process Management

- Process - fundamental concept in OS
    - Process is a program in execution.
    - Process needs resources - CPU time, memory, files/data and I/O devices.
  - OS is responsible for the following process management activities.
    - Process creation and deletion
    - Process suspension and resumption
    - Process synchronization and interprocess communication
    - Process interactions - deadlock detection, avoidance and correction
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# OS Task: Memory Management

- Main Memory is an array of addressable words or bytes that is quickly accessible.
  - Main Memory is volatile.
  - OS is responsible for:
    - Allocate and deallocate memory to processes.
    - Managing multiple processes within memory - keep track of which parts of memory are used by which processes. Manage the sharing of memory between processes.
    - Determining which processes to load when memory becomes available.
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# OS Task: Secondary Storage and I/O Management

- Since primary storage is expensive and volatile, secondary storage is required for backup.
  - Disk is the primary form of secondary storage.
    - OS performs storage allocation, free-space management and disk scheduling.
  - I/O system in the OS consists of
    - Buffer caching and management
    - Device driver interface that abstracts device details
    - Drivers for specific hardware devices
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# OS Task: File System Management

- File is a collection of related information defined by creator - represents programs and data.
  - OS is responsible for
    - File creation and deletion
    - Directory creation and deletion
    - Supporting primitives for file/directory manipulation.
    - Mapping files to disks (secondary storage).
    - Backup files on archival media (tapes).
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# OS Task: Protection and Security

- Protection mechanisms control access of programs and processes to user and system resources.
    - Protect user from himself, user from other users, system from users.
  - Protection mechanisms must:
    - Distinguish between authorized and unauthorized use.
    - Specify access controls to be imposed on use.
    - Provide mechanisms for enforcement of access control.
    - Security mechanisms provide trust in system and privacy
      - authentication, certification, encryption etc.
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# OS Task: Networking

- Connecting processors in a distributed system
  - Distributed System is a collection of processors that do not share memory or a clock.
  - Processors are connected via a communication network.
  - Advantages:
    - Allows users and system to exchange information
    - provide computational speedup
    - increased reliability and availability of information
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# Summary of OS Structures

- Operating System Concepts
  - Operating System Services
  - Operating System Design and Implementation
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