CS343 - Operating Systems

Module-1B

Types of Operating Systems

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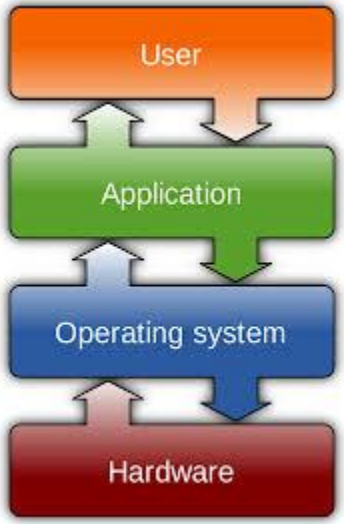
Session Outline

- Review of basic operating system concepts
- Desktop PCs
- Parallel Systems
- Multiprogramming Systems
- Clustered Systems
- Real-time Systems
- Embedded Systems

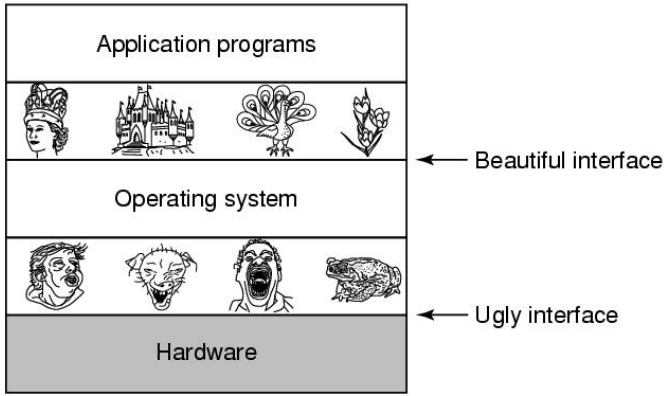
What is an Operating System?

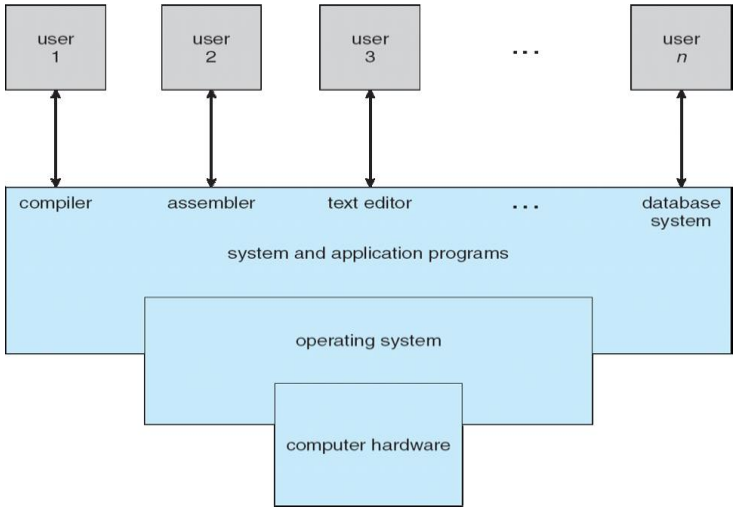
- A program that acts as an intermediary between a user of a computer and the computer hardware
- Operating system goals:
  - Execute user programs on hardware
  - Make the computer system convenient to use
  - Use the computer hardware in an efficient manner



Computer System Structure

- Computer system can be divided into four components:
  - **Hardware** -- CPU, memory, I/O devices
  - **Operating system** -- Controls and coordinates hardware/software
  - **Application programs** -- Word processors, compilers, web browsers, database systems, video games, apps
  - **Users** – People or devices





Operating System Definition

- OS is a **resource allocator**
  - Manages all resources
  - Decides between conflicting requests for efficient and fair resource use
- OS is a **control program**
  - Controls execution of programs to prevent errors and improper use of the computer
  - The one program running at all times on the computer RAM is the **kernel of the OS**.

Types of Operating Systems

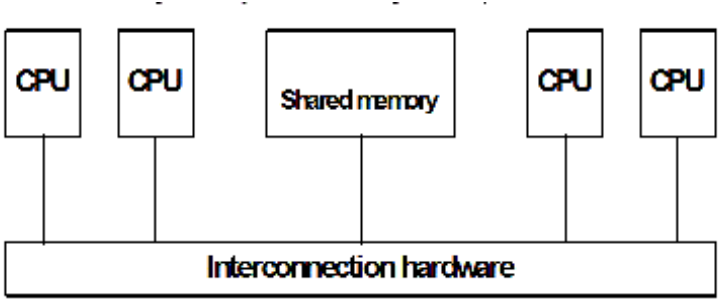
- Most systems use a single general-purpose/special purpose processor
- There are several architectures which all require a different OS:
  - Desktop PCs
  - Parallel Systems
  - Distributed Systems
  - Clustered Systems
  - Real-time Systems
  - Embedded Systems

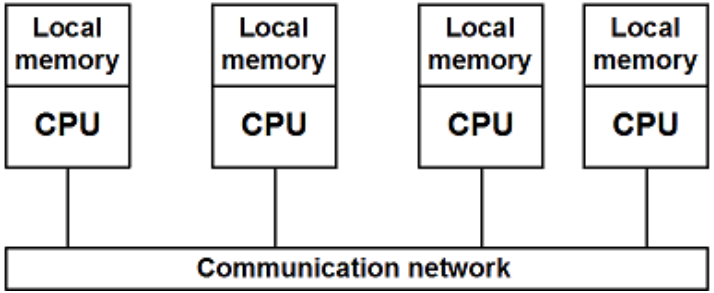
Desktop PCs

- Personal Computers – computer system dedicated to a single user.
- I/O devices – keyboards, mice, display screens, small printers.
- User convenience and responsiveness.
- Mostly single user - do not need advanced CPU utilization or protection features.
- May run several different types of operating systems (Windows, MacOS, UNIX, Linux)

Parallel Systems

- Multiprocessor systems with more than one CPU in close communication.
- **Tightly coupled system** – processors share memory and the internal clock; communication usually takes place through the shared memory.
- **Loosely coupled system** – multiple processors/computers with its own memory connected together for efficiency and throughput.



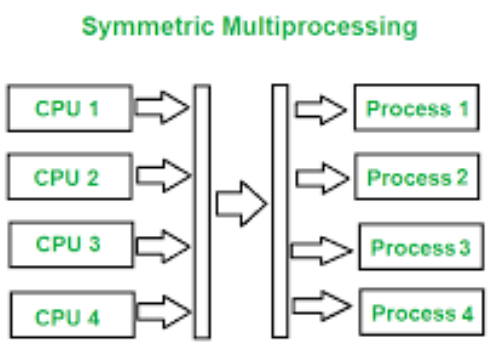


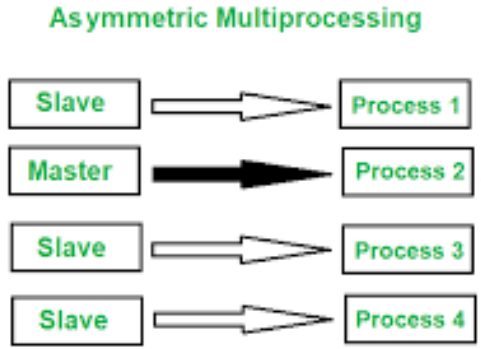
Multiprocessor Systems

- Most systems use a single general-purpose/special purpose processor
- **Multiprocessors** systems growing in use and importance
  - **Increased throughput**
  - **Economy of scale**
  - **Increased reliability** – graceful degradation or fault tolerance
  - **Asymmetric Multiprocessing**
  - **Symmetric Multiprocessing**

Multiprocessor Systems

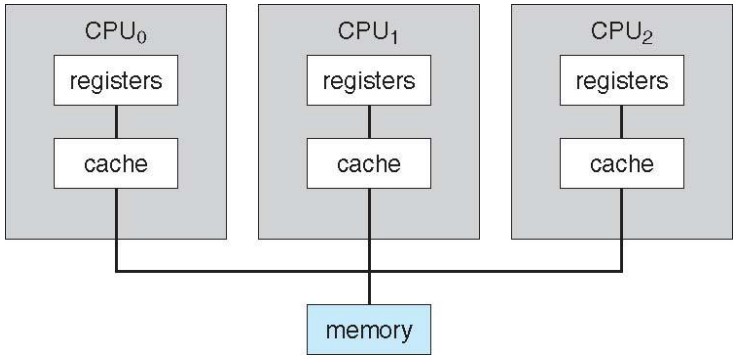
- **Asymmetric Multiprocessing**
- Each processor is assigned a specific task; master processor schedules and farms work to slave processors.
- More common in extremely large systems like mainframes with hundreds of processors.





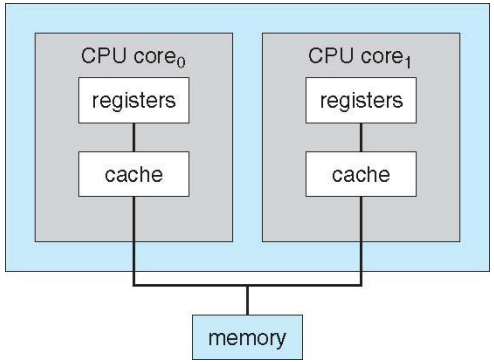
Multiprocessor Systems

- **Symmetric Multiprocessing**
- Each processor runs an identical copy of the operating system.
- The OS code is usually shared.
- Many processes can run at once without performance deterioration.
- Most modern operating systems have SMP support.
- OS has to cater for protection of data.



Multicore Design

- Multi-chip and multicore is a special case of tightly coupled parallel system.
- A single chip containing multiple separate systems

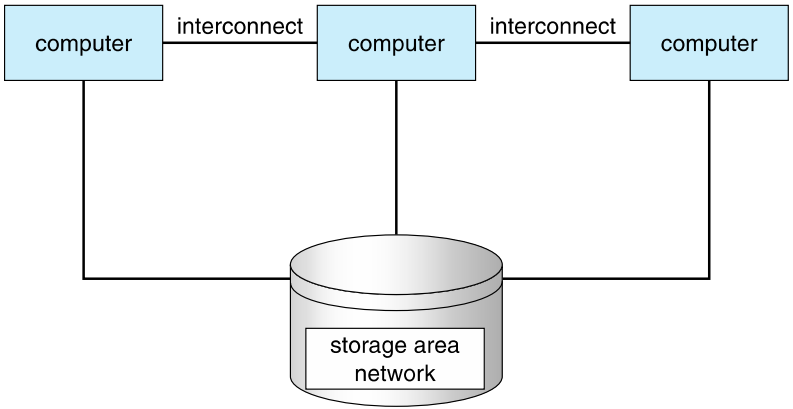


Clustered Systems

- Like multiprocessor systems working together
  - Usually sharing storage via a **storage-area network (SAN)**
  - Provides a **high-availability** service which survives failures
    - **Asymmetric clustering** has one machine in hot-standby mode
    - **Symmetric clustering** has multiple nodes running applications, monitoring each other

Clustered Systems

- Some clusters are for **high-performance computing (HPC)**
  - Applications must be written to use **parallelization**
- Some have **distributed lock manager** (**DLM**) to avoid conflicting operations



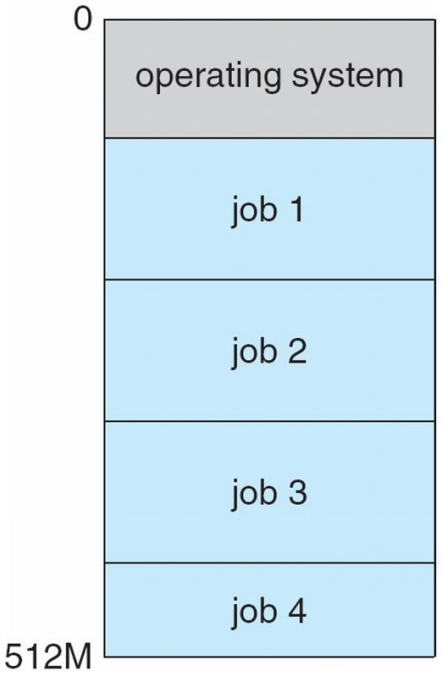
Multiprogramming Systems

- **Multiprogramming** (**Batch system**) needed for efficiency
  - Single user cannot keep CPU and I/O devices busy at all times
  - Multiprogramming organizes jobs (code and data) so CPU always has one to execute
  - A subset of total jobs in system is kept in memory
  - One job selected and run via **job scheduling**
  - When it has to wait (for I/O), OS switches to another job

Timesharing Systems

- **Timesharing** (**multitasking**) is logical extension in which CPU switches jobs so frequently that users can interact with each job while it is running, creating **interactive** computing
  - **Response time** should be < 1 second
  - Each user has at least one program executing in memory
  - If several jobs ready to run at the same time ⇨ **CPU scheduling**
  - If processes don’t fit in memory, **swapping** moves them in and out to run
  - **Virtual memory** allows execution of processes not completely in memory

Memory Layout for Multiprogrammed System



Real-Time Systems

- Often used as a control device in a dedicated application such as controlling scientific experiments, medical imaging systems, industrial control systems, and some display systems.
- Well-defined fixed-time constraints.
- Real-Time systems may have either hard or soft real-time.

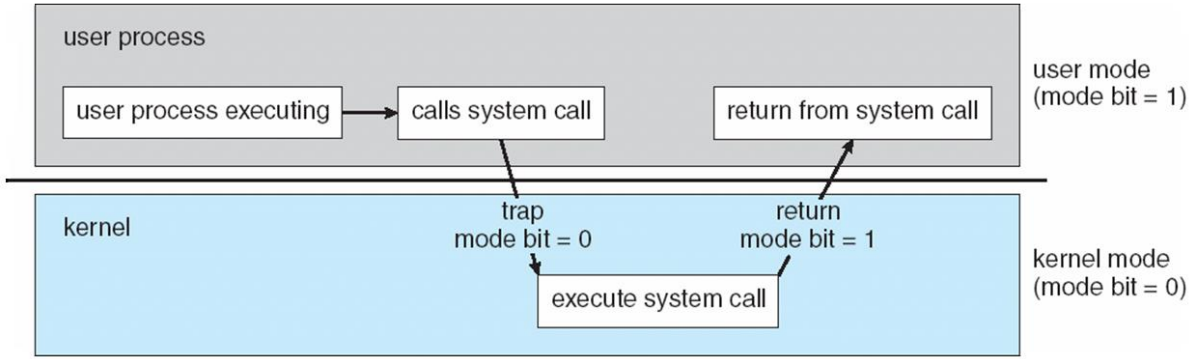
Embedded Systems

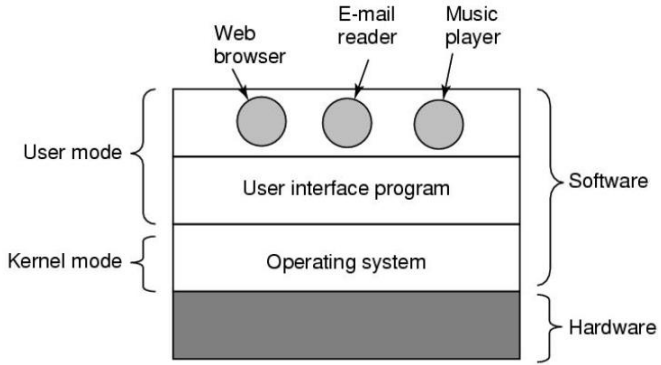
- Personal Digital Assistants (PDAs)
- Smart telephones
- Issues:
  - Limited memory, Slow processors, Small display screens.
  - Emphasis is on I/O operations.
  - Limited memory management and protection

Operating System in Dual Mode

- **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
  - Some instructions designated as **privileged**, only executable in kernel mode
  - System call changes mode to kernel, return from call resets it to user

Operating System in Dual Mode





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