Lecture 2

Introduction/Overview II

Lecture Information

Ceng328 *Operating Systems* at February 23, 2010

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Computer Engineering Department
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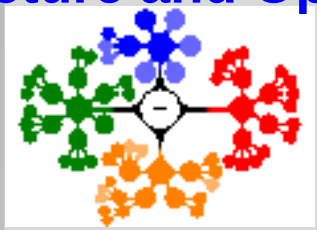

Evolution of Operating Systems, Computer-System Architecture and Operating-System Structure

- Mainframe Systems
- Batch and Multiprogrammed Systems
- Time Sharing
- Personnel Computers and Single-Processor Systems
- Multiprocessor Systems; Parallel Processing Systems - Tightly coupled systems
- Multiprocessor Systems; Distributed Systems - Loosely coupled systems
- Real–Time Embedded Systems
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Operating-System Operations

- Dual-Mode Operation
- Timer

Process Management

Memory Management

Storage Management

Evolution of Operating Systems, Computer-System Architecture and Operating-System Structure I

- **The Operating System Zoo**: Mainframe OSs, Server OSs, Multiprocessor OSs, Personal computer OSs, Handheld OSs, Embedded OSs, Sensor node OSs, Real-time OSs, Smart card OSs,...

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  - Next generation ??, personal digital assistants (PDA), information appliances

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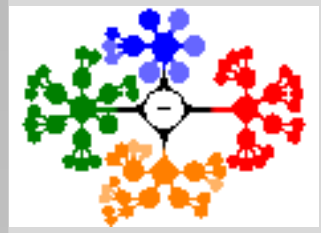
- Poor *throughput* (like amount of useful work done per hour) and poor *utilization* (keeping all devices busy). Inefficient use of hardware.



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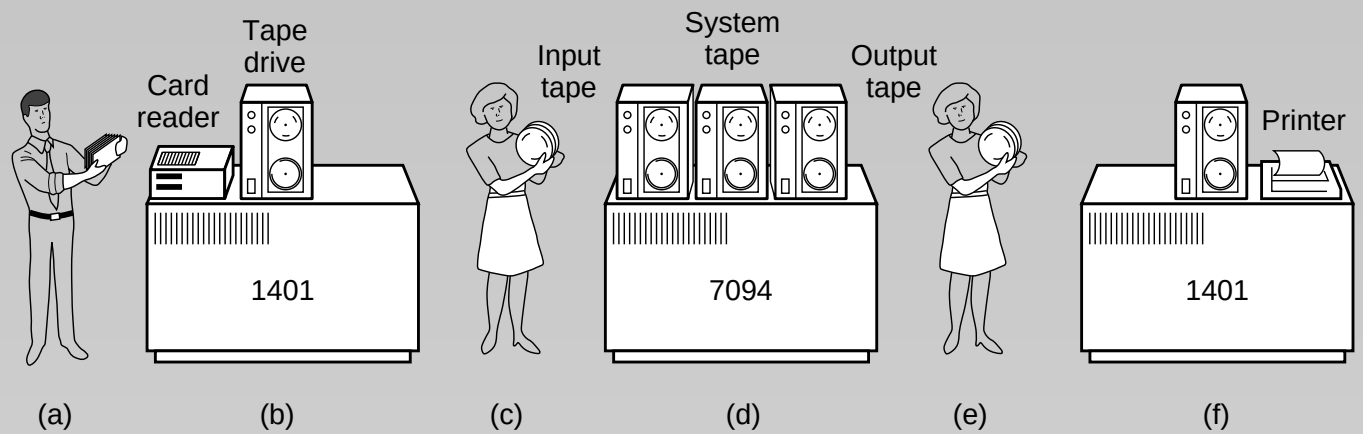

Figure: An early batch system.(a) Programmers bring cards to 1401. (b) 1401 reads batch of jobs onto tape. (c) Operator carries input tape to 7094. (d) 7094 does computing. (e) Operator carries output tape to 1401. (f) 1401 prints output.

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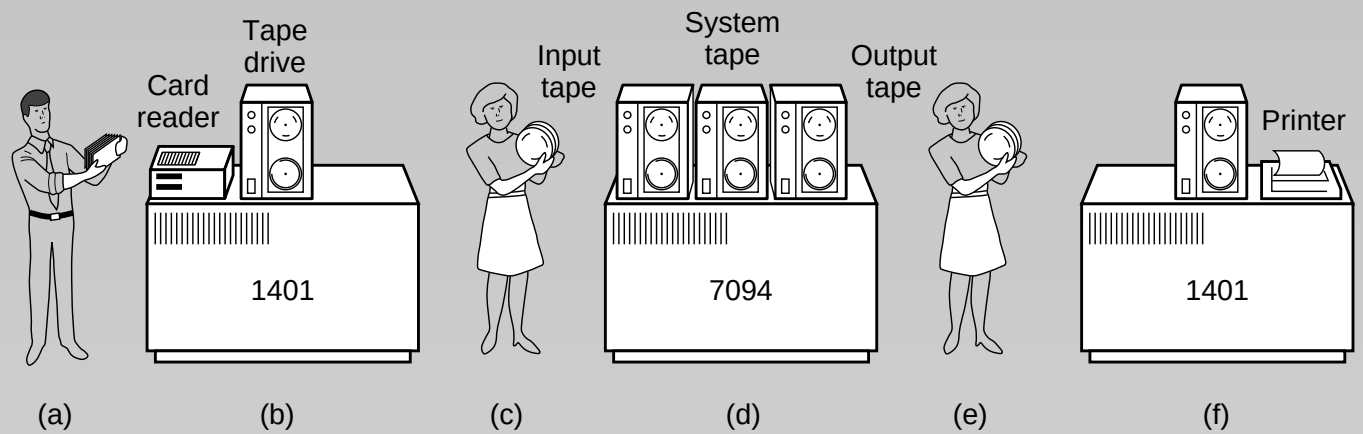

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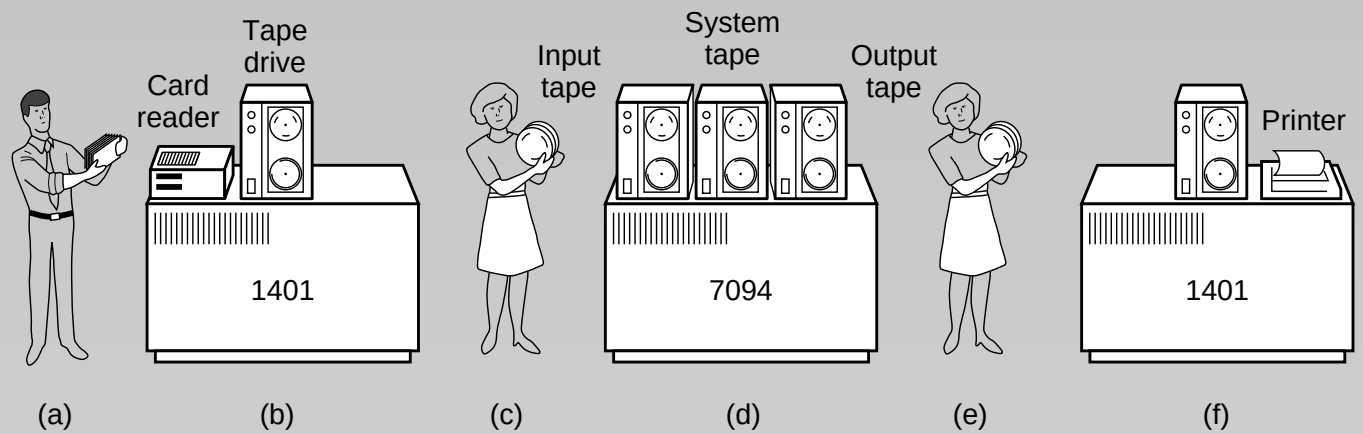

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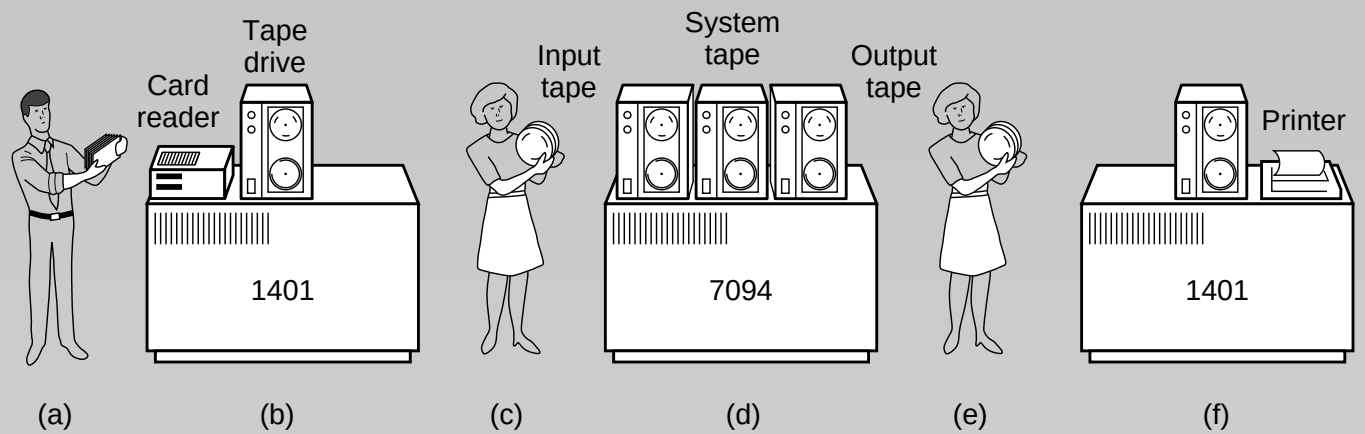
- *Result*: Improved system throughput and utilization, but lost interactivity.



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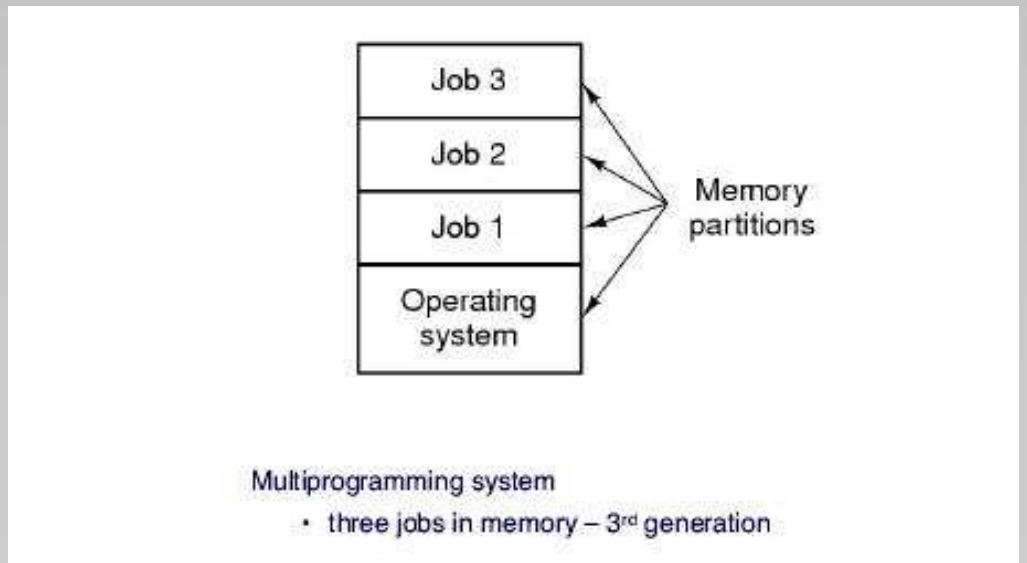

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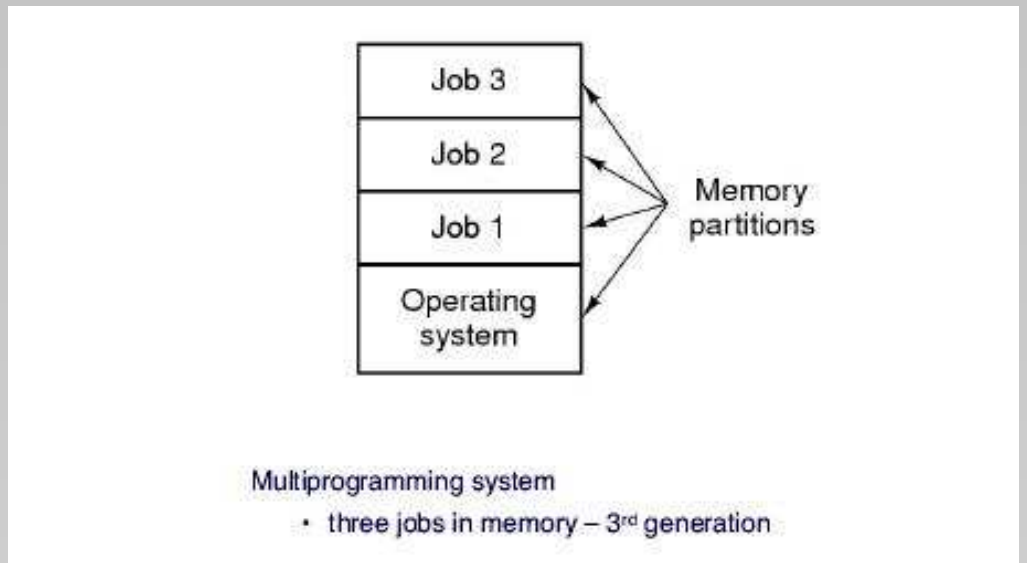

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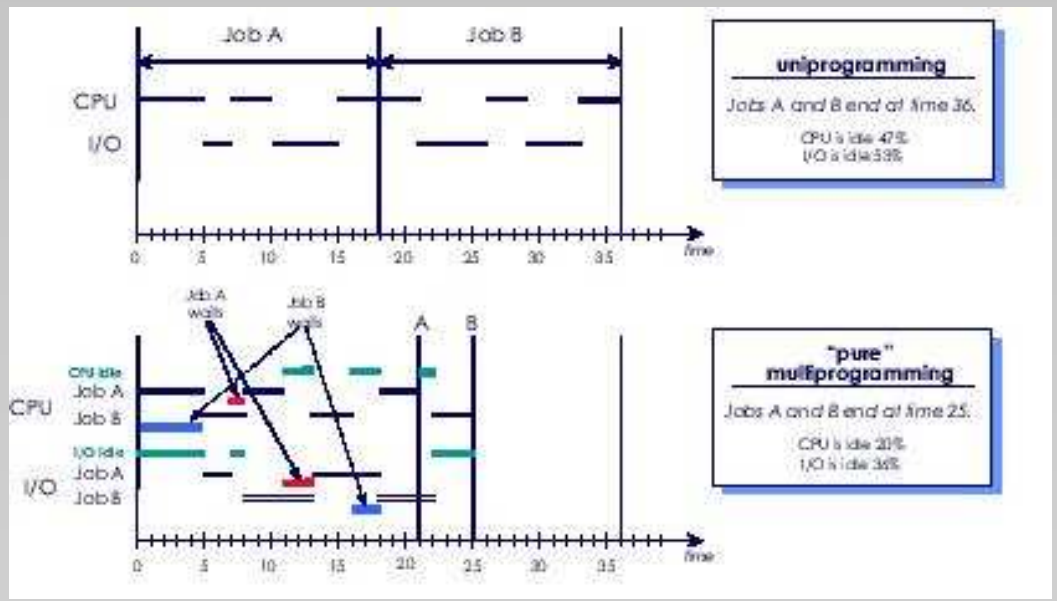
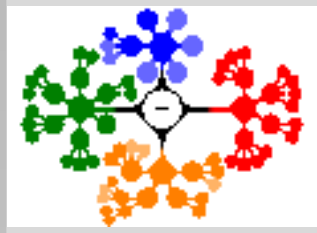


Figure: Job Interleaving



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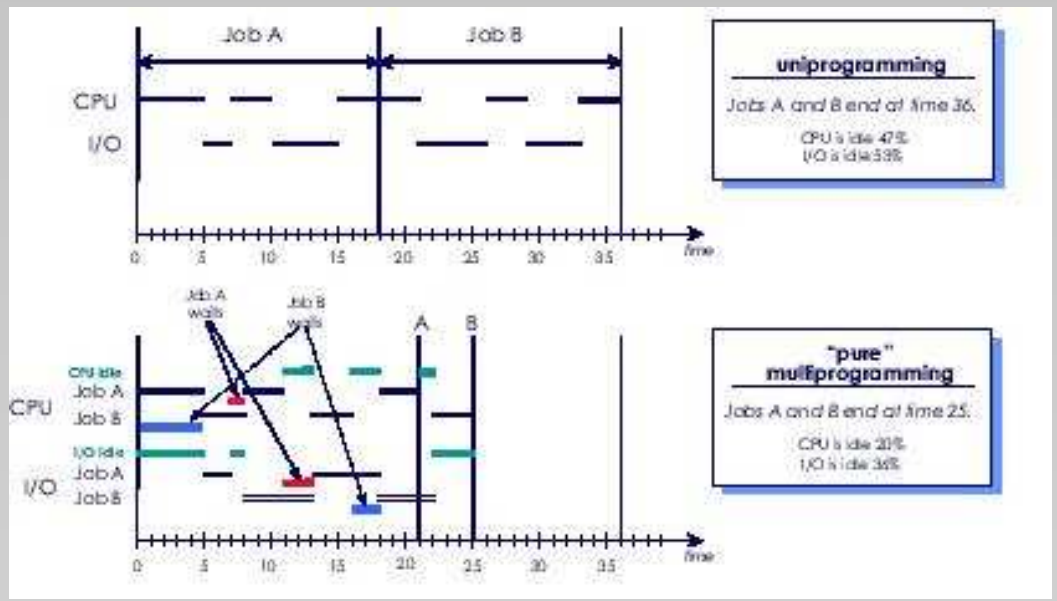

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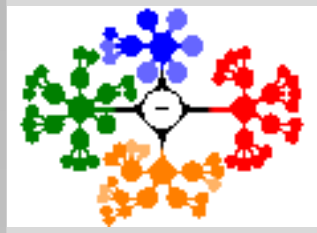

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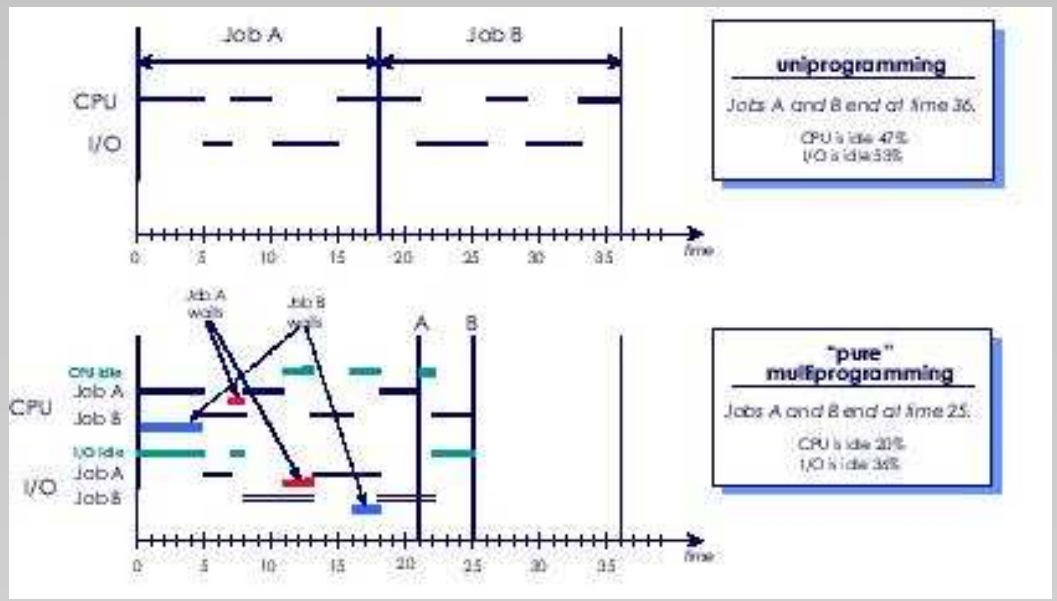
- Improves throughput and utilization. New OS functionalities evolved. Buffering, Direct Memory Access (DMA), interrupt handling, job scheduling policies, memory management and protection. Still not interactive.



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- The CPU switches to the next job that can be run whenever the current job enters a wait state or after the current job has used a standard unit of time.
- A time-shared OS uses *CPU scheduling* and *multiprogramming* to provide each user with a small portion of a time-shared computer.

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- When the OS selects a job from the job pool, it loads that job into memory for execution. Having several programs in memory at the same time requires some form of **memory management**.
- In addition, if several jobs are ready to run at the same time, the system must choose among them. Making this decision is **CPU scheduling**.

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- The sensible sharing of resources such as CPU time and memory must be handled by the OS. For this control program to always be in control, we require that it never be blocked from running.
- The OS will lock itself into memory and then control CPU allocation priority in order that it never be blocked from running.

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Figure: IBM PC XT.

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- Not still true. May run several different types of OS (Windows, Mac OS X, UNIX, Linux) which offer multitasking and virtual memory on PC hardware.

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- The use of special-purpose microprocessors is common and does not turn a single-processor system into a multiprocessor.
- If there is only one general-purpose CPU, then the system is a single-processor system.

Multiprocessor Systems; Parallel Processing Systems - Tightly coupled systems I

- The desire for increased throughput has led to system designs in which multiple streams of processing occurs in parallel.

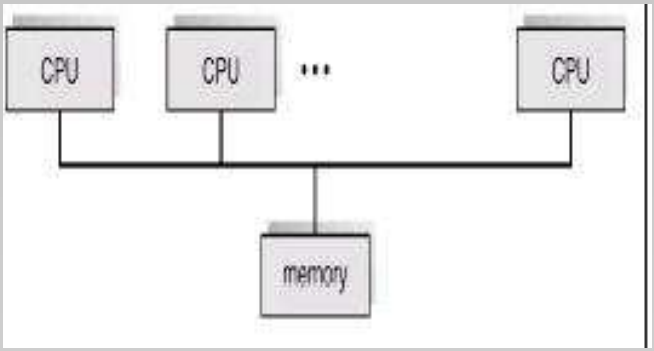
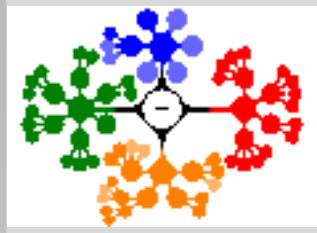


Figure: Left: Tightly coupled system. Right: The Cray-2, the world's fastest computer from 1985 to 1989.



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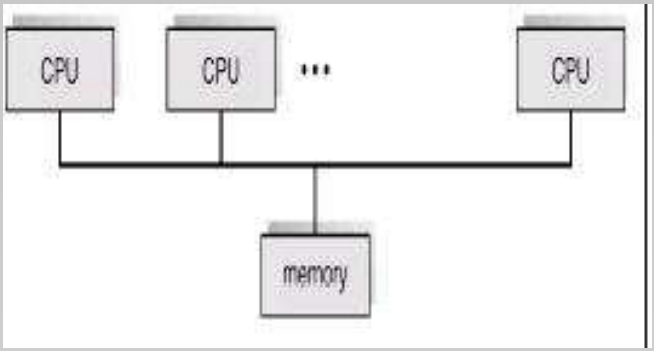

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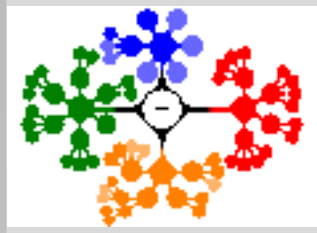

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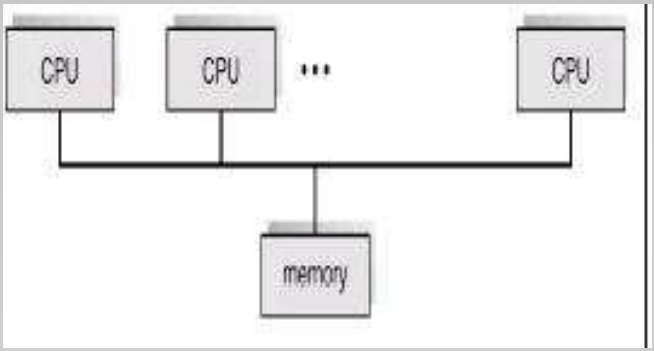
- Communication usually takes place through the shared memory. (see Fig. 6left)



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  3. *Increased reliability.* If functions can be distributed properly among several processors, then the failure of one processor will not halt the system, only slow it down. If we have ten processors and one fails, then each of the remaining nine processors can pick up a share of the work of the failed processor. Thus, the entire system runs only 10 percent slower, rather than failing altogether.

Multiprocessor Systems; Parallel Processing Systems - Tightly coupled systems III

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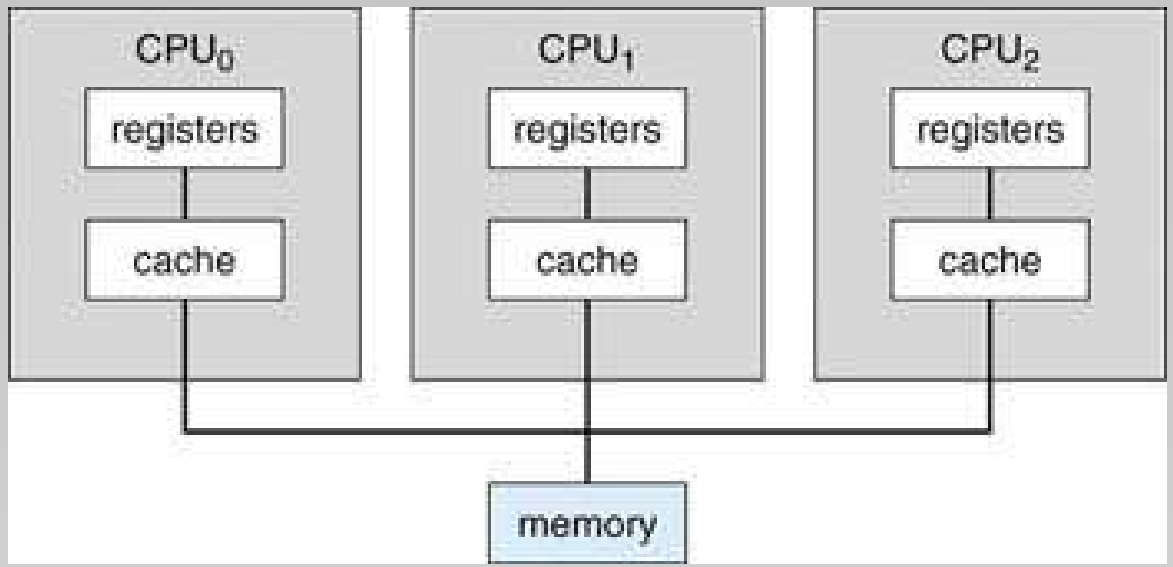

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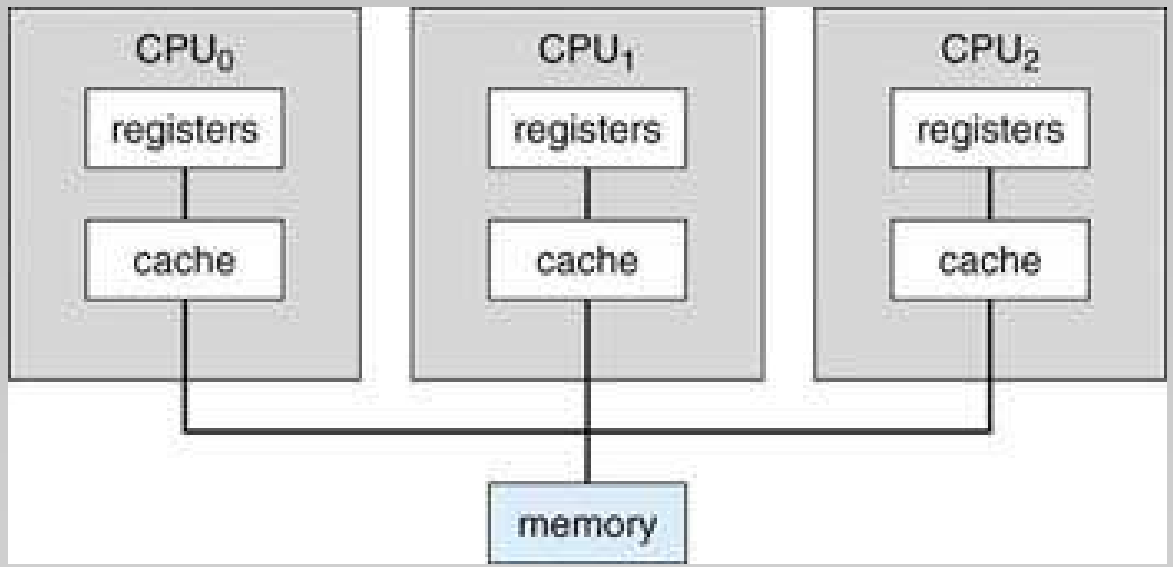

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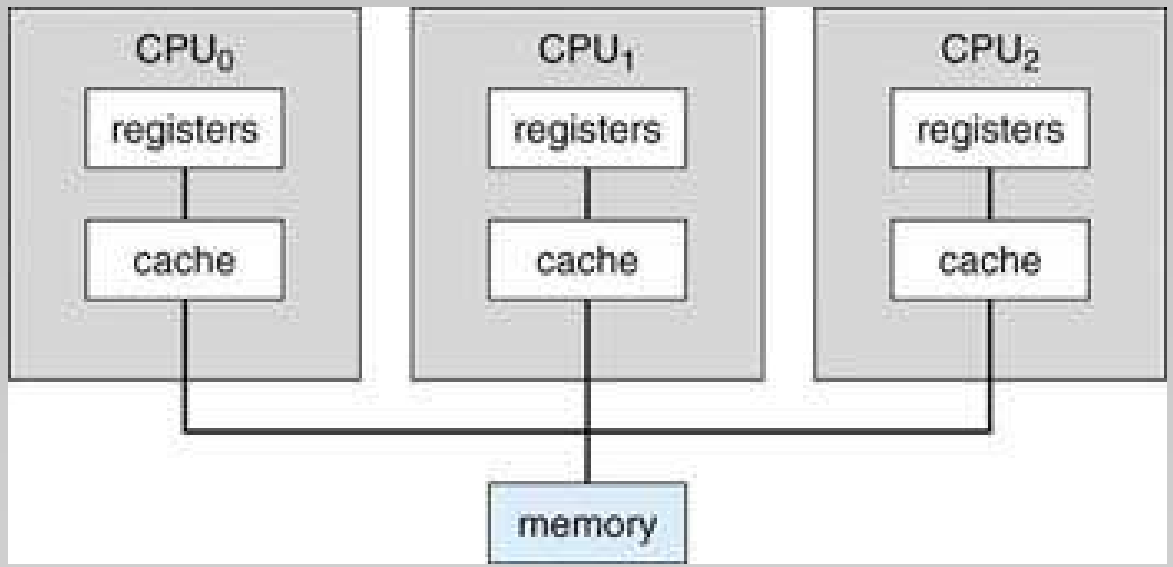

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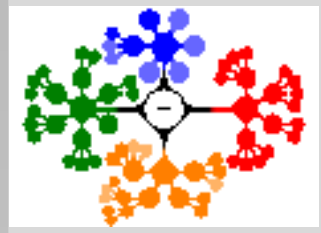

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- A recent trend in CPU design is to include multiple compute cores on a single chip (see Fig. 8). In essence, these are multiprocessor chips.

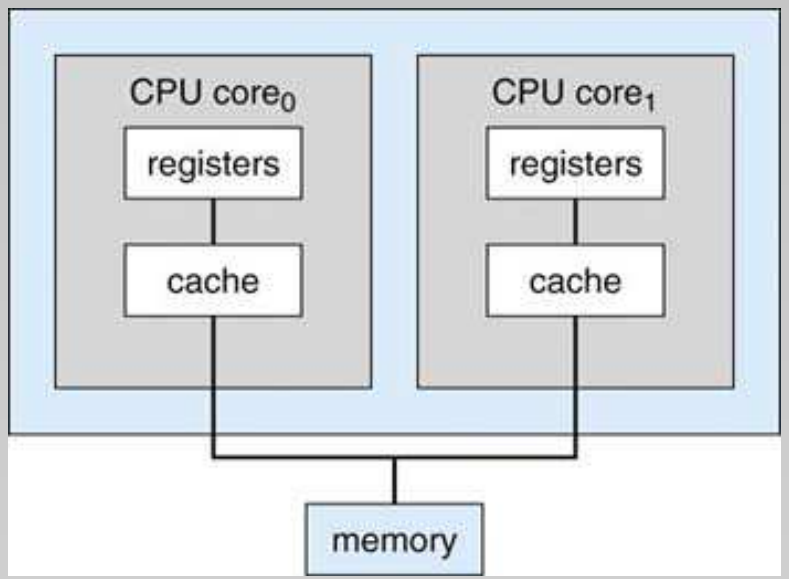
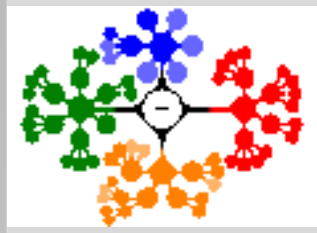


Figure: A Dual-Core Design.



Multiprocessor Systems; Distributed Systems - Loosely coupled systems I

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- Access to a shared resource increases computation speed, functionality, data availability, and reliability.

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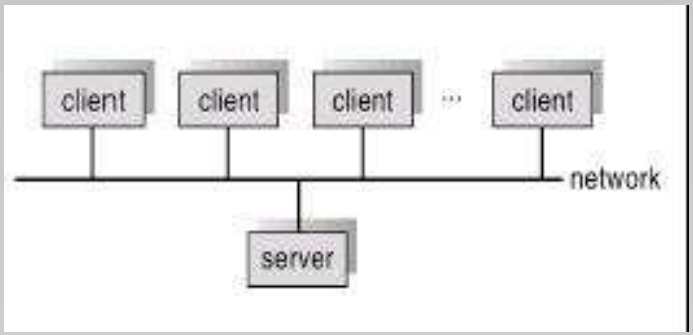

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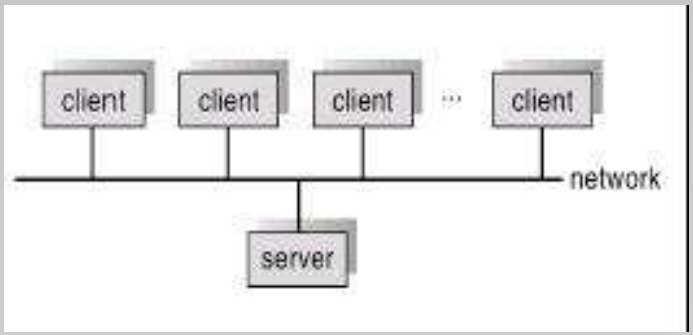

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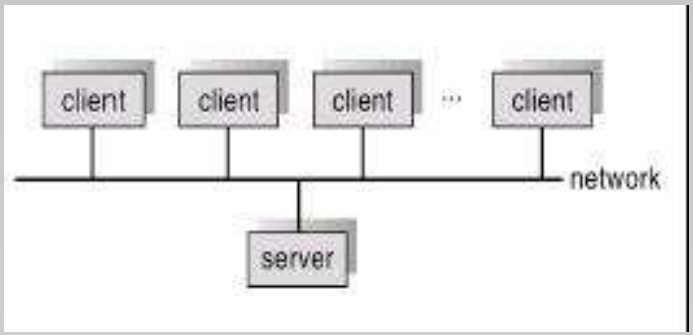
- A server running a database that responds to client requests for data is an example of such a system.



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- A distributed OS provides a less autonomous environment: The different OSs communicate closely enough to provide the illusion that only a single OS controls the network.

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    - Useful in applications (multimedia, virtual reality) requiring advanced operating-system features.

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- More subtle errors can occur in a multiprogramming system, where one erroneous program might modify another program, the data of another program, or even the OS itself.

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- The dual mode of operation provides us with the means for protecting the OS from errant users-and errant users from one another.

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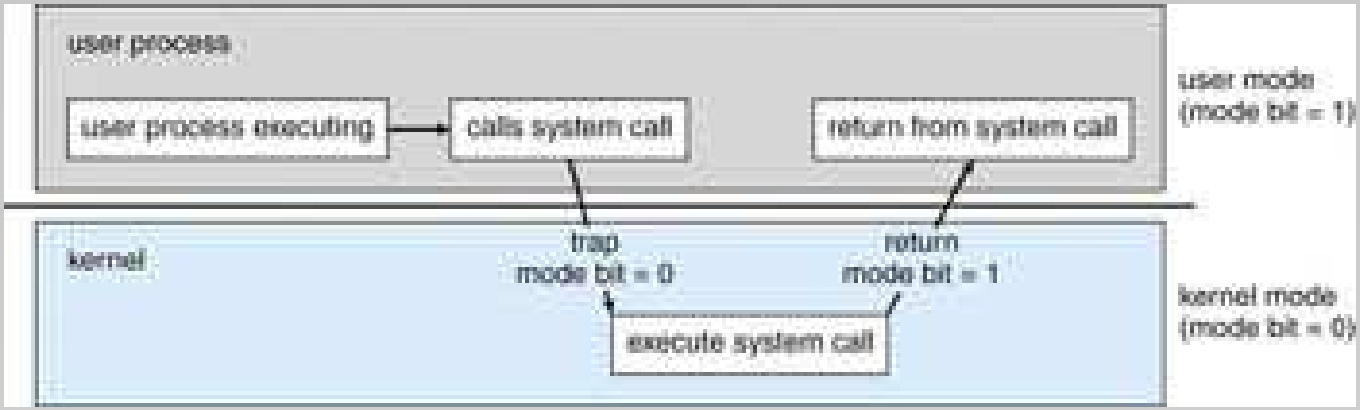

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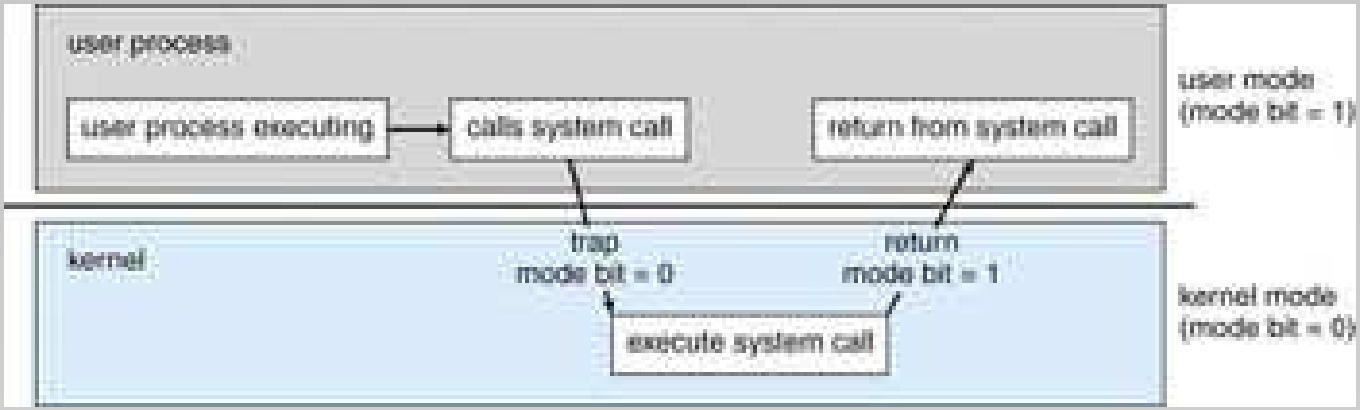

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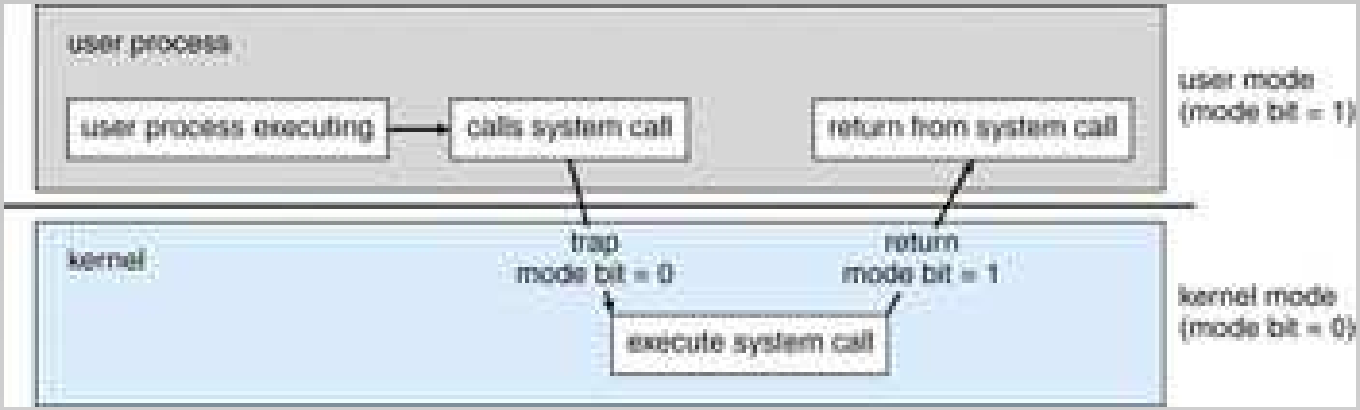

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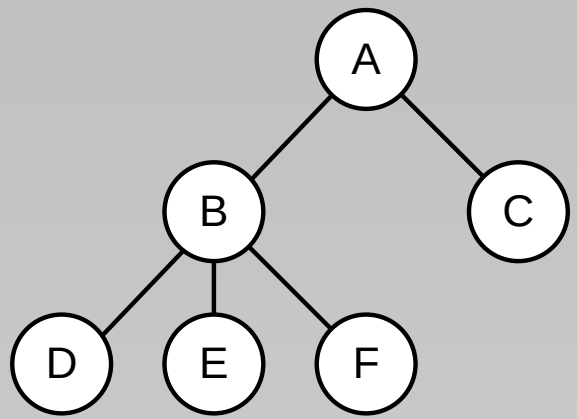
- All these information about each process is stored in a table called the **process table**, which is an array (or linked list) of structures, one for each process currently in existence.

Process Management II

- if a process can create one or more other processes (referred to as **child processes**) and these processes in turn can create child processes, we quickly arrive at the process tree structure of Fig. 11.



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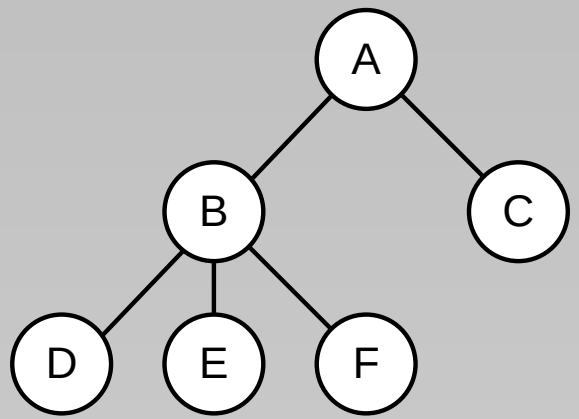

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- Related processes that are cooperating to get some job done often need to communicate with one another and synchronize their activities. This communication is called **interprocess communication** (IPC).

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- Each medium is controlled by a device, such as a disk drive or tape drive, that also has its own unique characteristics. These properties include access speed, capacity, data-transfer rate, and access method (sequential or random).

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- Only the device driver knows the peculiarities of the specific device to which it is assigned.

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- One approach to implementing resource allocation is to have at least two modes of CPU operation (see 1)