L2: Computer system architecture, Operating system structure

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Outline

1. Computer system architecture
   - Single Processor System
   - Multiprocessor or Parallel System
   - Clustered System
2. Operating System Structure
   - Simple Batch System
   - Multiprogramming
   - Time sharing or Multitasking

Computer system architecture

A computer system can be organized in a number of different ways according to the number of general-purpose processors used.

- Single Processor system
- Multiprocessor system
- Clustered System

Single Processor System

- On a single processor system, there is one main CPU capable of executing a general-purpose instruction set, including instructions from user processes.
- These systems have other special-purpose processors such as device-specific processors, graphics controllers and so on.
- All of these special-purpose processors run a limited instruction set and do not run user processes.
- Sometimes, they are managed by the operating system or they do their jobs autonomously.

Multiprocessor or Parallel System

- In Multiprocessors systems (also known as parallel systems, tightly-coupled systems) more than one processors remain in close communication sharing computer bus, clock, sometimes memory and peripheral devices.
- Advantages:
  - Increased throughput :
  - Economy of scale :
  - Increased reliability :

Types of Multiprocessors

- Asymmetric Multiprocessing – Each processor is assigned a specie task. A boss processor controls the system; the other processors either look to the boss for instruction or have pre-defined tasks. This scheme defines a boss–worker relationship. The boss processor schedules and allocates work to the worker processors.
- Symmetric Multiprocessing – Each processor performs all tasks within operating system. All systems are peer.No boss–worker relationship exists between processors.

Multi-core

Multiple computing cores in a single chip (i.e. Multiprocessor chips). Advantage:

- On chip communication is faster than between chip communication.
- Uses significantly less power.

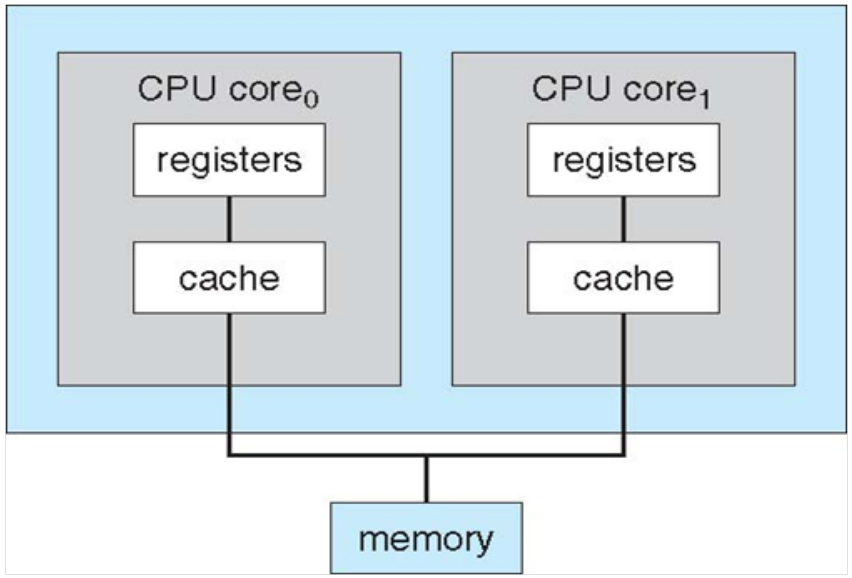

Figure: Dual core design

Clustered System

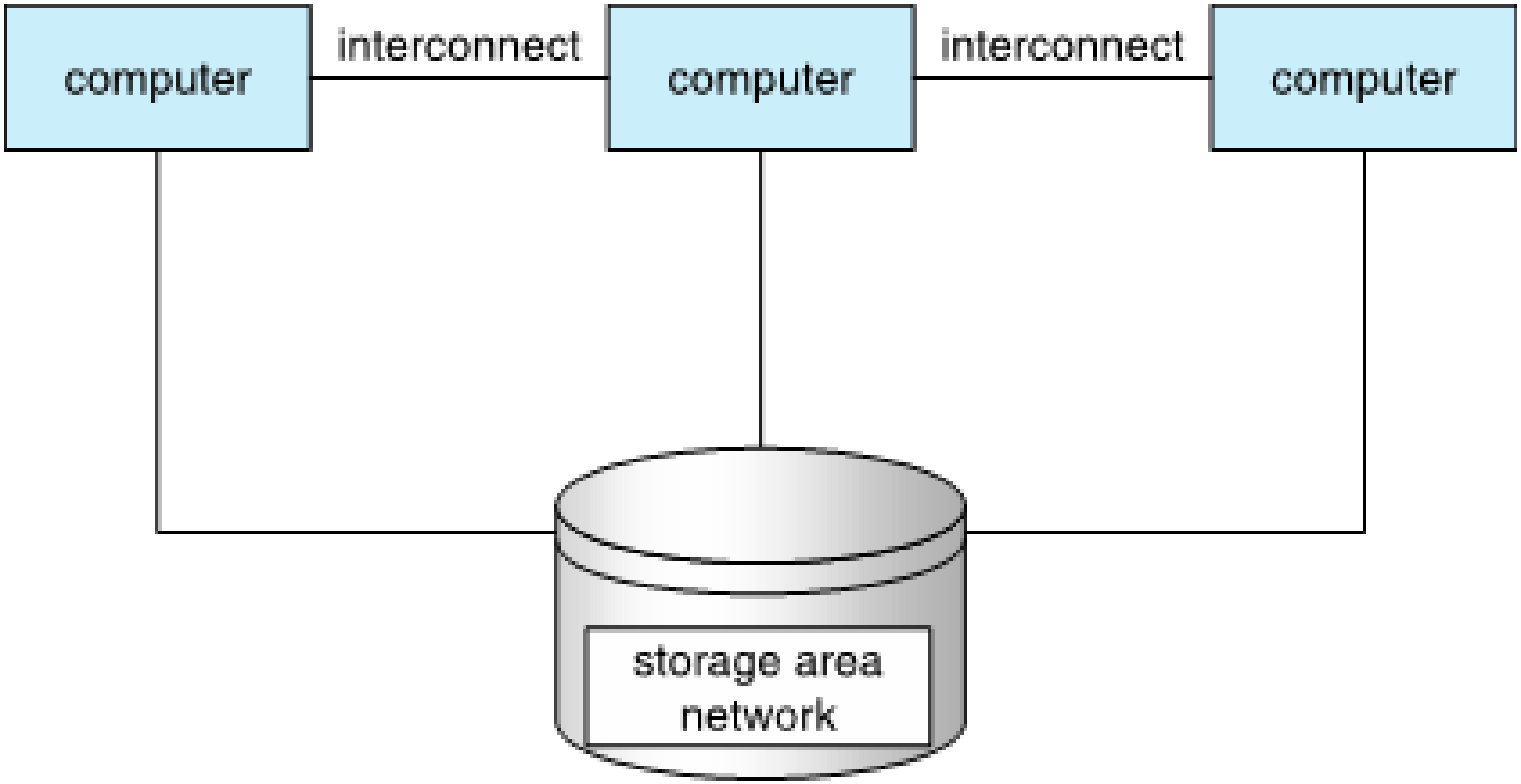

Figure: Structure of Clustered system

Clustered System

- It allows multiple machines to perform computations on data contained on shared storage and let computing continue in the case of failure of some subset of cluster members.
- Like multiprocessor systems, but multiple systems working together.Usually share storage and are closely linked via LAN.
- Provides a high-availability service which survives failures.
- Asymmetric clustering has one machine in hot-standby mode, while others are running the applications. The hot standby host monitor the active server. If server fails it becomes the active server.
- Symmetric clustering has multiple nodes running applications, monitoring each other.
- Cluster technology are also using storage area networks (SANs) which allow many systems to attach to a pool of storage.

Operating System Structure

Internally, operating systems vary greatly in their makeup, since they are organized along many different lines.

- Simple Batch system
- Multiprogrammed system
- Time sharing system

Simple Batch System

- User prepared a job consisting of program , data and some control information about nature of the job and submitted it to the computer operator.At some later time the o/p is appeared consisting result of the program as well as a dump of memory and registers in case of error.
- OS is simple and always in memory. Main task of OS is to transfer control automatically from one job to next.
- To speed up processing, jobs with similar needs were batched together and when computer became available would run each batch.
- Disadvantage:
  - Lack of interaction of user and job while it is executing.
  - CPU is often idle.

Multiprogramming

- Multiprogramming is a technique to execute no. of programs simultaneously by a single processor.
- Many processes are in state of execution at the same time. CPU always has one to execute.
- All jobs are kept in job pool. OS selects a set of job and keeps in main memory. One job is selected and run via CPU scheduling.When it has to wait (for I/O for example), OS switches to another job.
- It increases CPU utilization and decreases total time needed to execute the jobs.
- Multiprogrammed systems provide an environment in which the various system resources are utilized effectively, but they do not provide for user interaction with the computer system.

Time sharing or Multitasking

- Timesharing (multitasking) is logical extension of multi programming, in which CPU switches jobs so frequently that users can interact with each job while it is running, creating interactive computing.
- Response time is very short.
- Each user has at least one program executing in memory.
- If several jobs are ready to be brought into memory, and if there is not enough room for all of them, then the system must choose among them (Job scheduling).

Time sharing or Multitasking

- If several jobs are ready to run at the same time, the system must choose which job will run first (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.
- A time-sharing system must also provide a file system. The file system resides on a collection of disks; hence, disk management must be provided. In addition, a time-sharing system provides a mechanism for protecting resources from inappropriate use.
- To ensure orderly execution, the system must provide mechanisms for job synchronization and communication, and it may ensure that jobs do not get stuck in a deadlock, forever waiting for one another