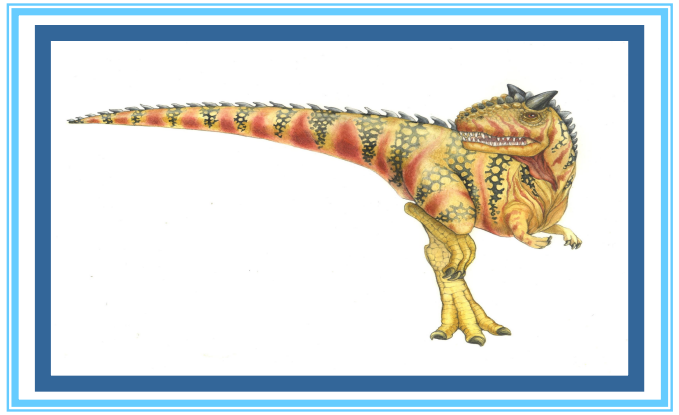
Chapter 1: Introduction



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Computer System Architecture

- Single-Processor System
  - One main CPU capable of executing a general purpose instruction set
  - Almost all system has special purpose processor
  - Special purpose processors are mostly device specific processors. (Disk, keyboard, Graphics controller, etc.)
  - In mainframe, one of the special purpose processor is the I/O processor
    - I/O processors moves data rapidly among the components of the computer.
  - All the special purpose processors run limited instruction sets.
  - Special purpose processors do not run user processes.
  - Some times Special purpose processors are managed by the operating system
    - OS sends them information about their next task and monitors their status.
  - In Other system, special purpose processors are the low level components built in the hardware.
    - The operating system can not communicate with these processor.
    - They do their jobs autonomously.
  - Special purpose processors do not make the system into a multiprocessor

Computer System Architecture (Cont..)

- Multi-processor Systems
  - Also known as **Parallel Systems** or **Tightly Coupled Systems**.
  - Systems have two (2) or more processors in close communication.
  - Share the computer bus, and sometimes the clock, memory and peripheral devices.
  - Have three (3) main advantages
    4. Increased throughput
       - The Speed-up ratio with N processors is not N (less than N)
    4. Economy of scale
       - Can cost less than equivalent multiple single-processor systems.
       - They can share peripherals, mass storage, and power supplies.
    4. Increased reliability
       - The failure of one processor will not halt the system.

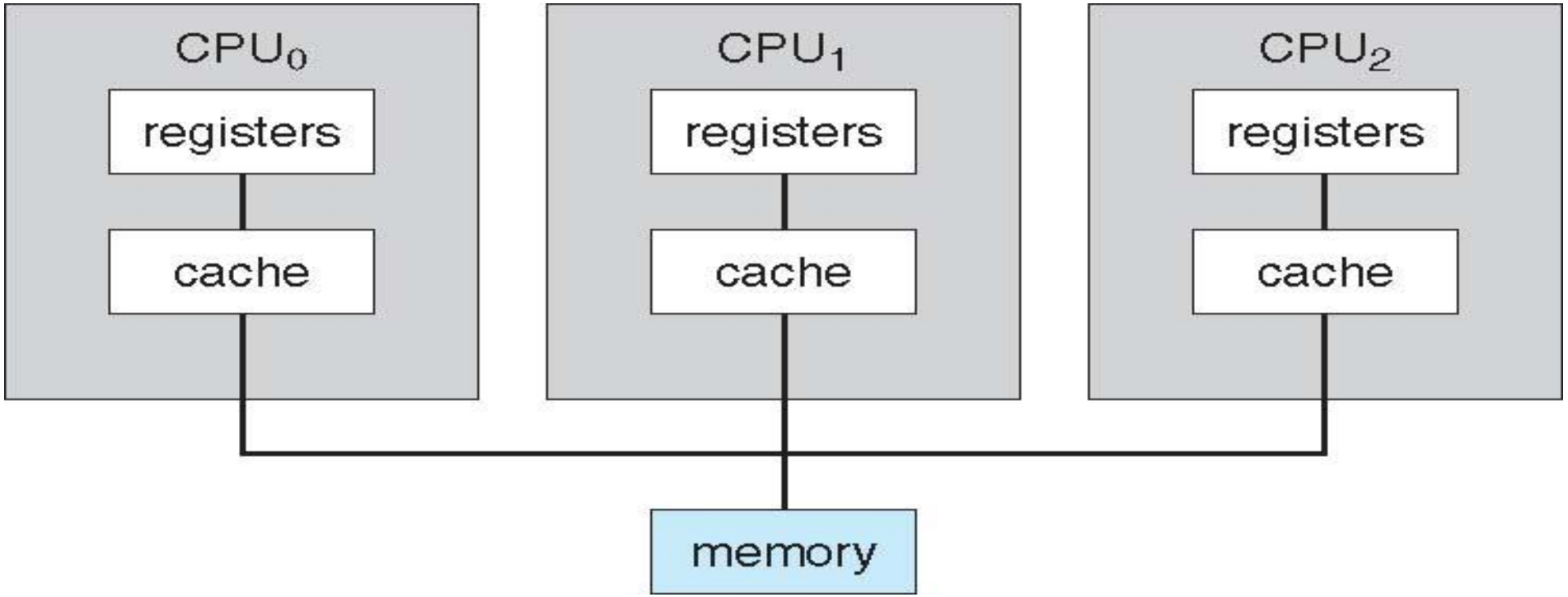
Computer System Architecture (Cont..)

- Graceful Degradation
  - The ability to continue providing service proportional to the level of surviving hardware.
- Fault Tolerant
  - The ability to continue operating without interrupting when one or more components fail
  - Requires a mechanism to allow the failure to be detected, diagnosed and, if possible, corrected.

Computer System Architecture (Cont..)

- Multiple-processor Systems
  - Are of two (2) types
    - Asymmetric Multiprocessing
      - Master – Slave relationship
      - Master processor controls the system; the other processors either look to the master for instruction or have predefined tasks.
      - Master processor schedules and allocates works to the slave processors
    - Symmetric Multiprocessing (SMP)
      - Most common systems use SMP
      - Each processors can perform all the task within the OS.
      - No Master-Slave relationship exists between processors.

Symmetric Multiprocessing Architecture

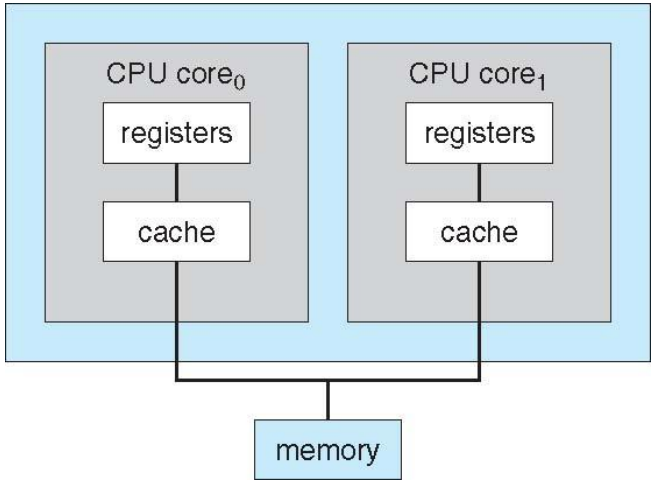


Symmetric Multiprocessing Architecture

- Notes
  - Must carefully control I/O to ensure that the data reach the appropriate processors
  - Load should also be balanced carefully
    - Resources should be shared dynamically
    - System must be written carefully
  - Uniform Memory Access (UMA) vs Non-Uniform Memory Access (NUMA)
    - Access to any RAM from any CPU takes same amount of time with UMA
    - Some parts take longer time than other parts, creating a performance penalty.
      - Can minimize penalty through resource management.

Multi-Core vs Multi-Processor

- Multi-Core vs Multi-Processor
  - Multiple cores on a single chip (multiprocessor chips) in Multi-core while each chips are separated from one another in Multi-processor.
  - On chip communication is faster than between-chip communication
  - One chips with multiple cores uses significantly less power than multiple single-core chips.
  - Multicore systems are especially well suited for server systems (Database and Web Server)

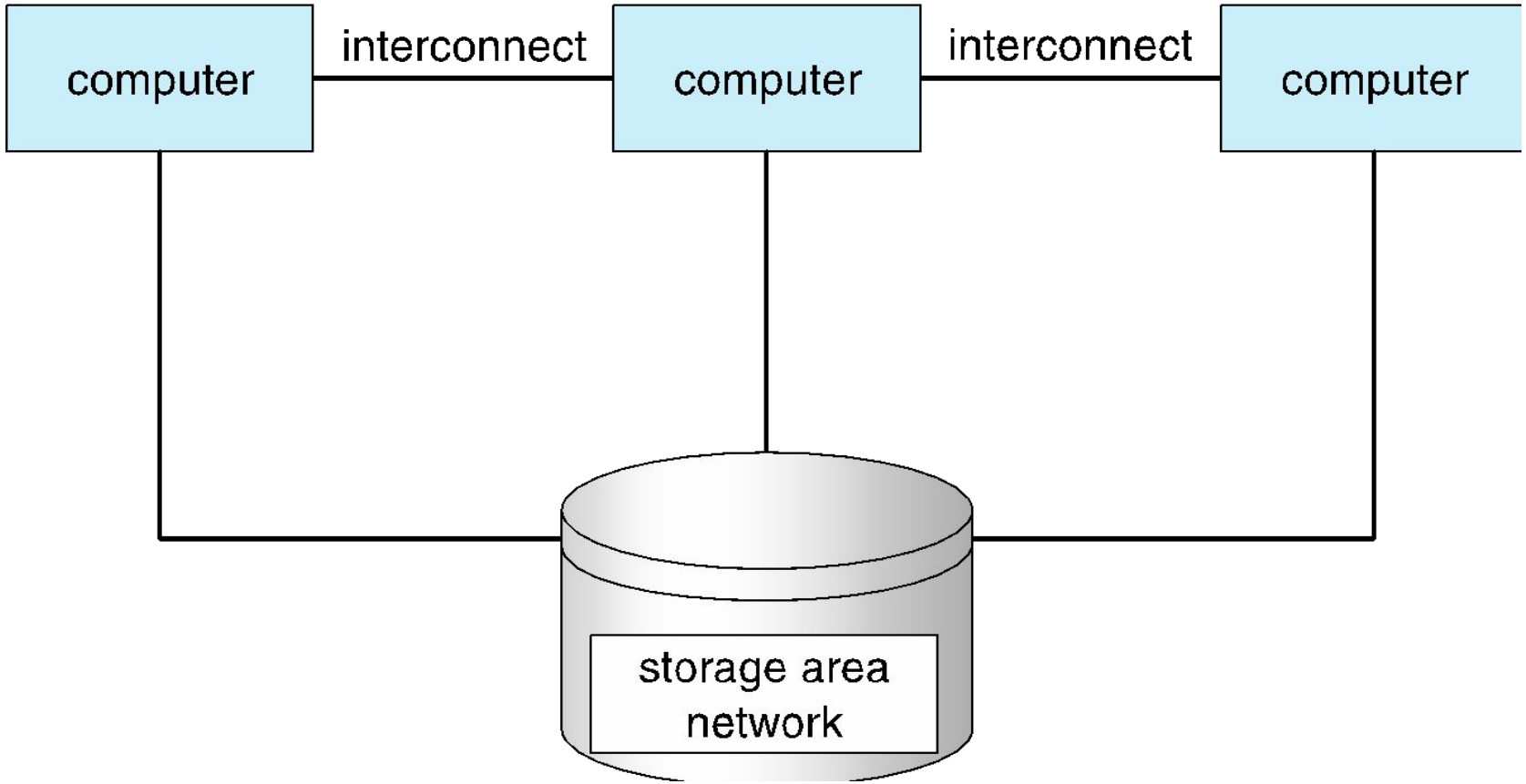


Computer System Architecture (Cont..)

- Clustered Systems
  - They are composed of two or more individual systems
  - Clustered computers share storage.
  - Closely linked via a **Local Area Network (LAN)**
  - Usually used to provide **high-availability service**.
  - A layer of cluster software run on the cluster nodes.
  - Clustering can be structured asymmetrically or symmetrically
  - In Asymmetric Clustering, one machine is in **Hot-Standby Mode** while others run the applications.
  - In Symmetric Mode, two or more nodes run the applications and monitor each other.
  - Other form of Clusters include parallel clusters and clustering over wide-area network.

Computer System Architecture (Cont..)

- Clustered Systems



Thank you