

# Distributed Systems

Lecture 2

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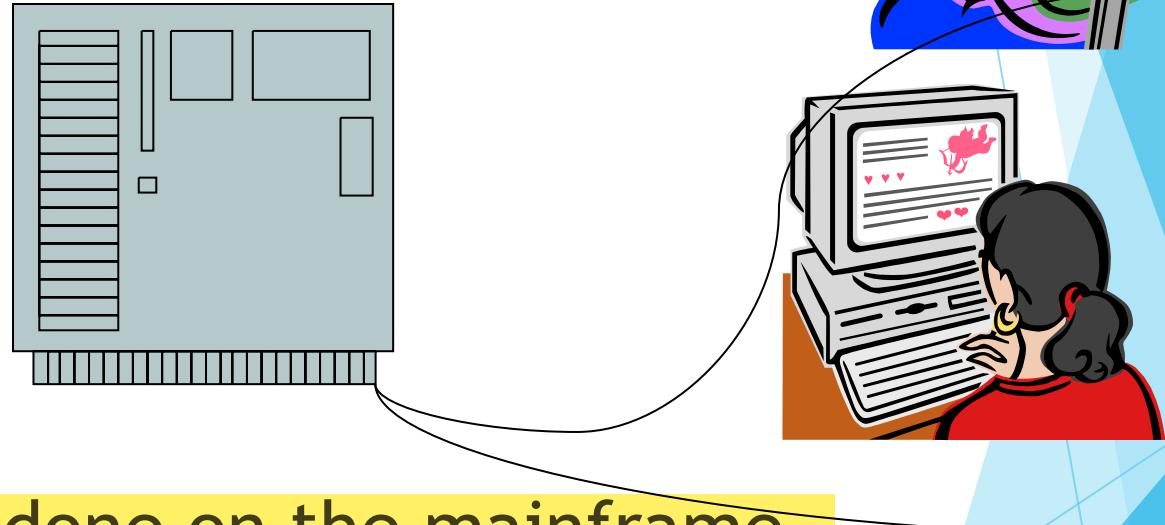
Reference: Prof.Dr.Hisham Arafat 2014

# Agenda

- ▶ Centralized VS. Distributed Systems
- ▶ Types of Distributed Systems
- ▶ Distributed Computing Systems Examples  
(Cluster/Grid/Cloud)
- ▶ Distributed Information Systems Examples
- ▶ Distributed Pervasive Systems Examples

# Centralized Systems

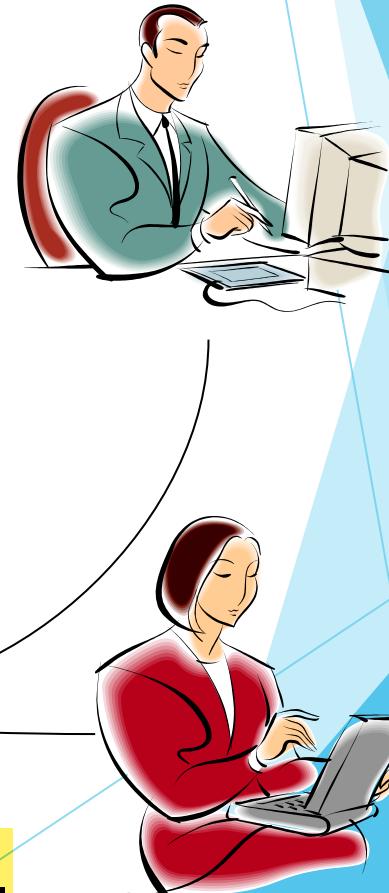
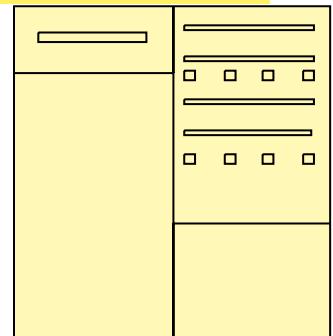
Centralized: mainframe and dumb terminals



- ▶ All of the computation is done on the mainframe.  
Each line or keystroke is sent from the terminal to  
the mainframe.

# Moving Towards Distribution

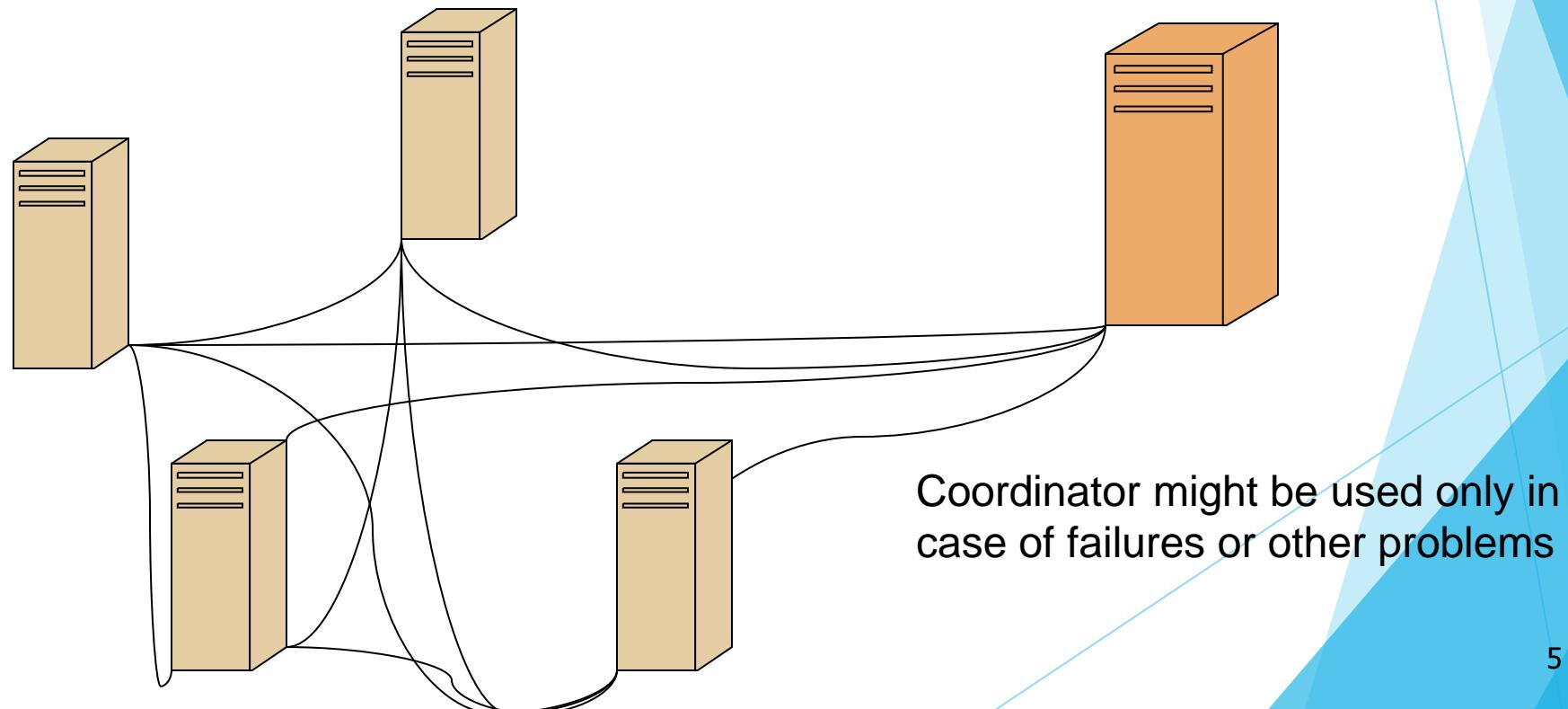
In a **client-server** system, the clients are workstations or computers in their own right and perform computations and formatting of the data.



However, the **data** and the **application** which manipulates it ultimately resides on the server.

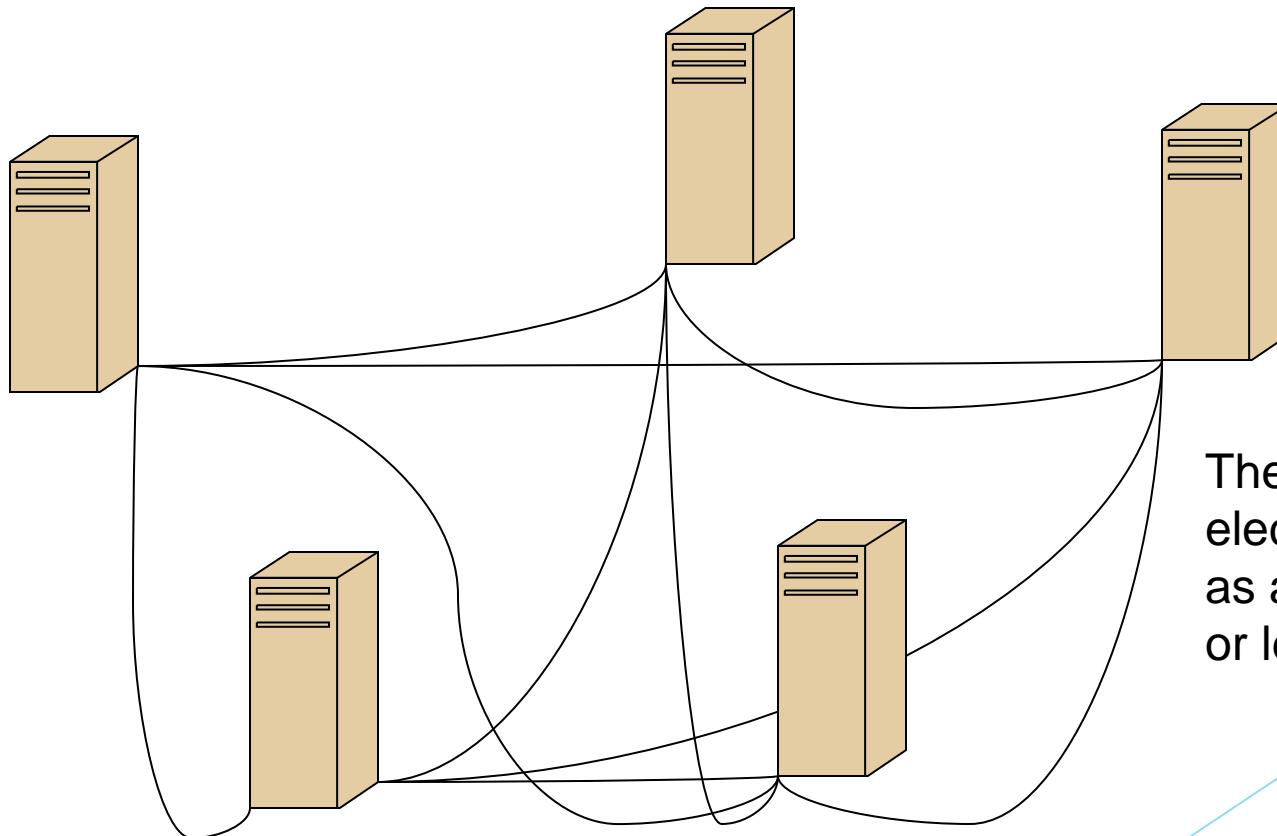
# More Decentralization

- In **Distributed-with-Coordinator**, the nodes or sites depend on a coordinator node with extra knowledge or processing abilities



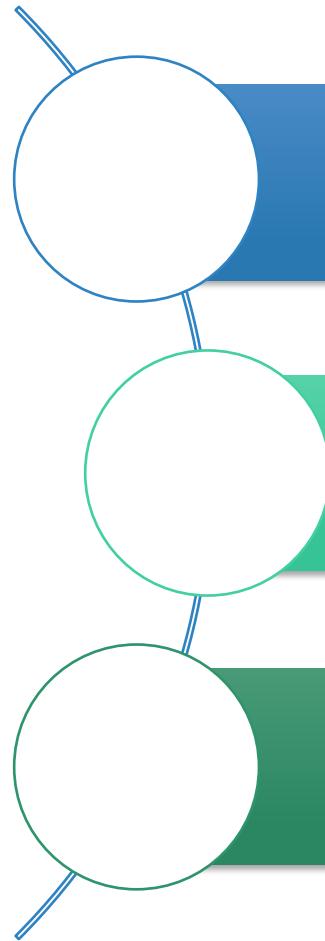
# True Decentralization

- ▶ A true **Distributed** system has no distinguished node which acts as a coordinator and all nodes or sites are equals.



The nodes may choose to elect one of their own to act as a temporary coordinator or leader

# Types of Distributed Systems



Distributed Computing Systems

Distributed Information Systems

Distributed **Pervasive** Systems

# Types of Distributed Systems

- **Distributed Computing Systems.**
  - Cluster Computing Systems.
  - Grid Computing Systems.
- **Distributed Information Systems.**
- **Distributed Pervasive Systems.**

A **Cluster** is a group of interconnected whole computers working together as a unified computing resource that can create an illusion of being one single machine .

NASA 128-processor Beowulf cluster: A cluster built from 64 ordinary PC's.



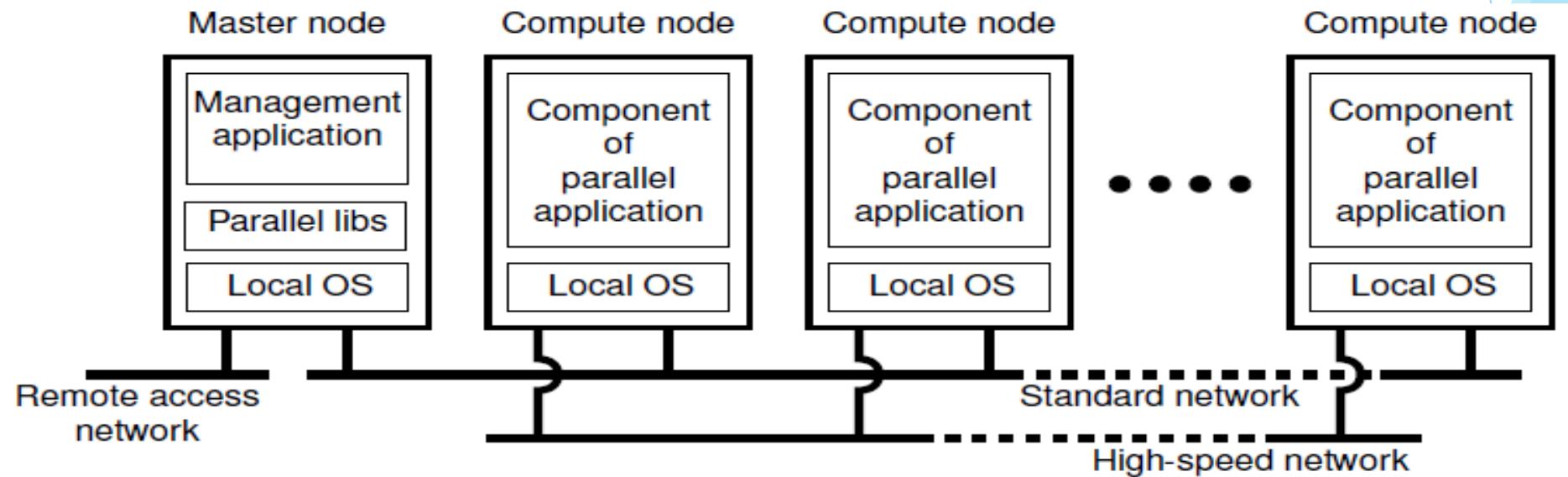
Computer cluster technology puts clusters of systems together to provide better system reliability and performance .



**Connected through LAN**

# 1- Distributed Computing Systems

- ▶ Used for high-performance computing tasks.
- ▶ Cluster computing: Essentially a group of high-end systems connected through a LAN:
  - ▶ Homogeneous: same OS, near-identical hardware
  - ▶ Single managing node (head node)

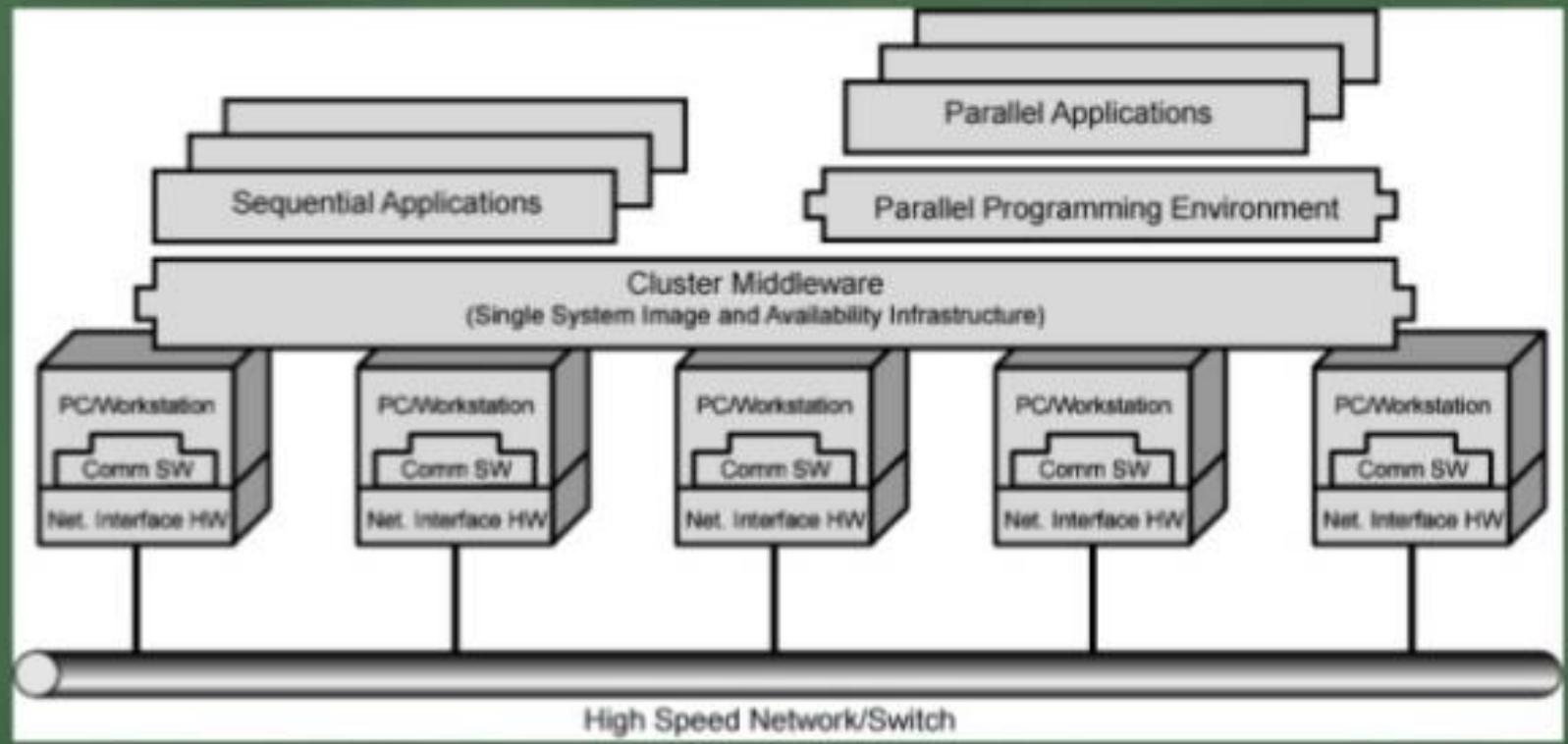


A **master node** provides management services and controls the worker nodes in a cluster.

Master nodes host **processes** that are responsible for

- resource allocation
- state maintenance
- scheduling
- monitoring.

# Cluster Computer Architecture



# Cluster Middleware

*Cluster middleware is a set of programs which provide SSI*

## **Cluster middleware Duties/Functional Components:**

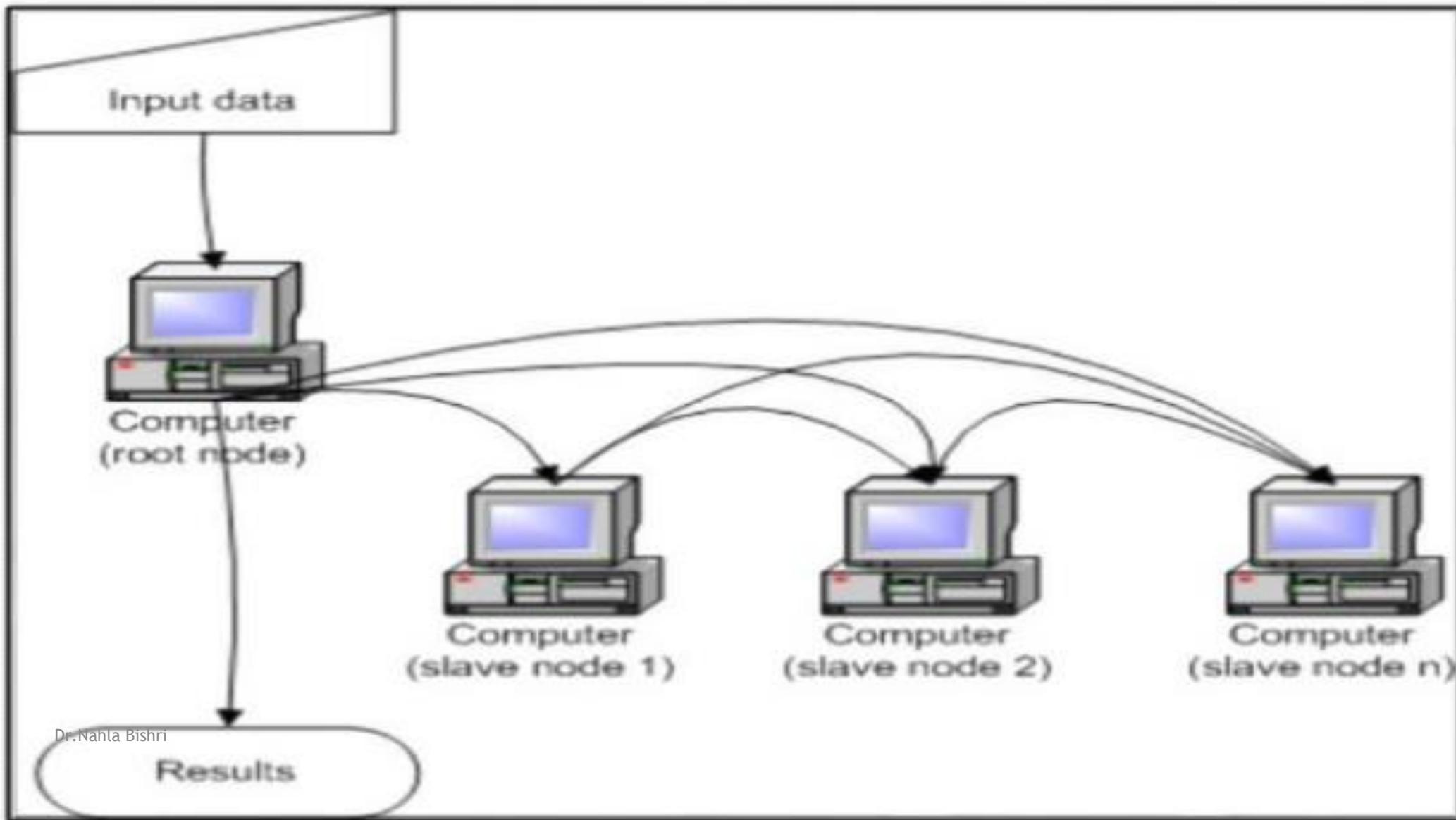
- job management system
- cluster monitoring system
- parallel libraries
- automatic client installation systems
- cluster management tools
- distributed and parallel file systems
- global process space

# **Operating System Issues**

Enhancement to the single system OS

- Failure management
- Load Balancing
- Parallelizing Computation

## ***A SIMPLE CLUSTER LAYOUT***

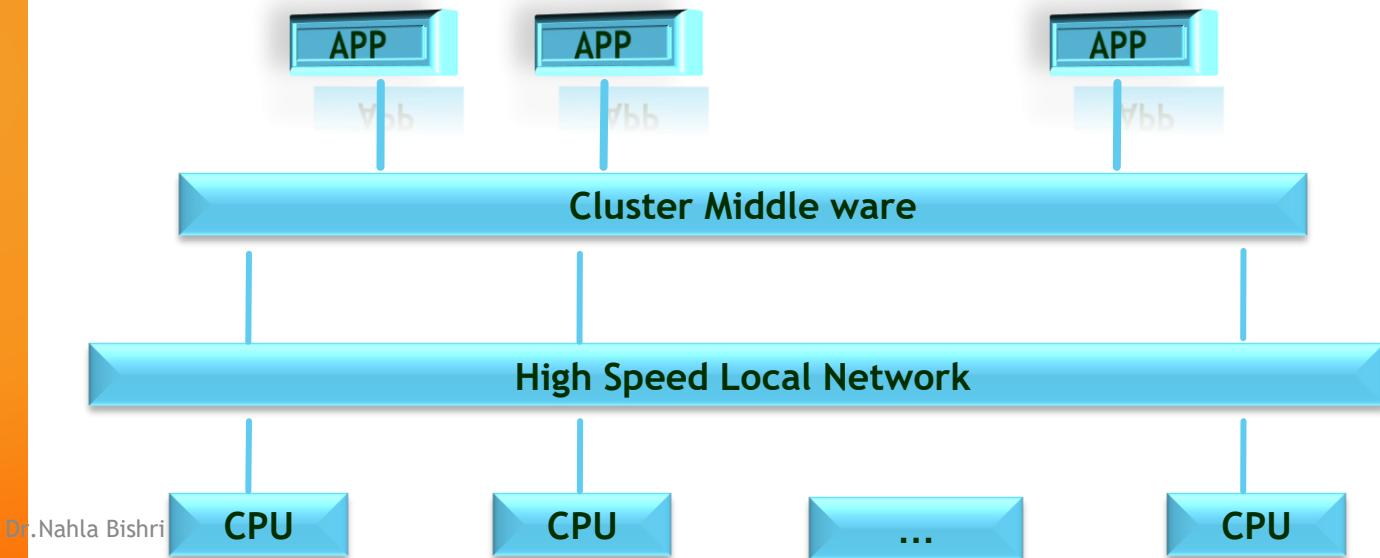


# Cluster Computing Systems

- A “supercomputer” built from “off the shelf” computer in a high-speed network (usually a LAN)
- Most common use: a single program is run in parallel on multiple machines

# Cont.Cluster computing

A cluster is a type of parallel or distributed processing system, which consists of a collection of interconnected homogenous stand-alone computers cooperatively working together as a single, integrated computing resource



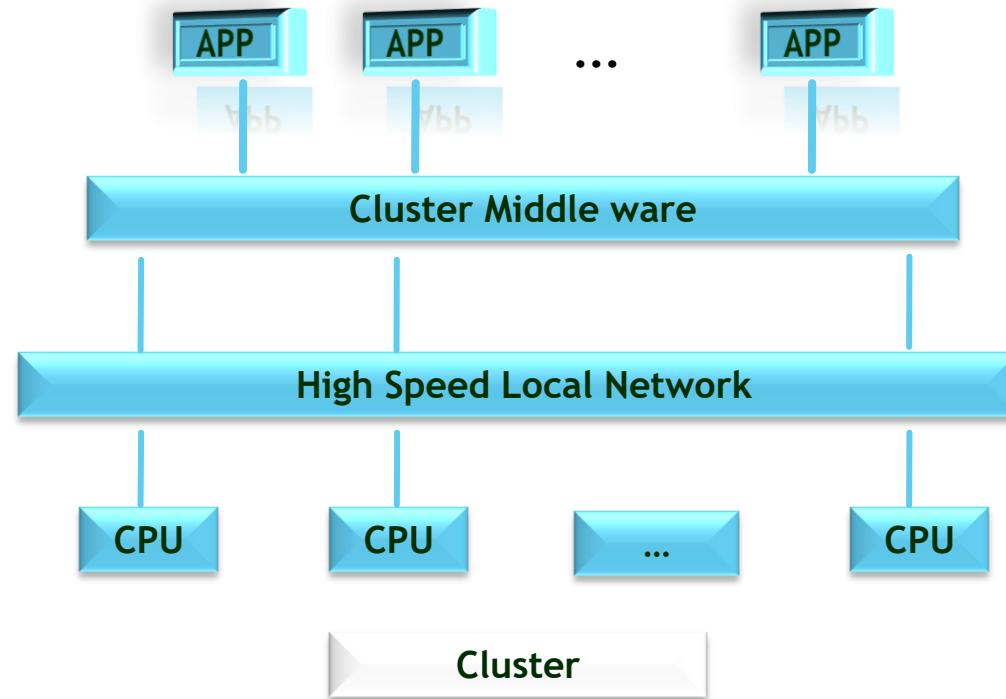
# **Cluster computing summary**

- ▶ A computer cluster is a group of linked computers, working together closely so that in many respects they form a single computer. The components of a cluster are commonly connected to each other through fast local area networks. Clusters are usually deployed to improve performance and/or availability over that provided by a single computer, while typically being much more cost-effective than single computers of comparable speed or availability.

## Cluster consists of:

- Nodes(master+computing)
- Network
- OS
- **Cluster middleware:**

Middleware such as **MPI** which permits compute clustering programs to be portable to a wide variety of clusters



# Cluster classification

## *High availability clusters (HA) (Linux)*

**Mission critical applications**

High-availability clusters (also known as Failover Clusters) are implemented for the purpose of improving the availability of services which the cluster provides.

**provide redundancy**

**eliminate single points of failure.**

## *Network Load balancing clusters*

operate by distributing a workload evenly over multiple back end nodes.

Typically the cluster will be configured with multiple redundant load-balancing front ends.

**all available servers process requests.**

**Web servers, mail servers,..**

## *Parallel/Distributed processing Clusters*

**Beowulf**

# High Availability/ Failover Cluster

**These clusters are designed to provide**

- uninterrupted availability of data / services .**
- service restoring .**
- Improving performance .**
- single instance of an application is running .**

**USES -**

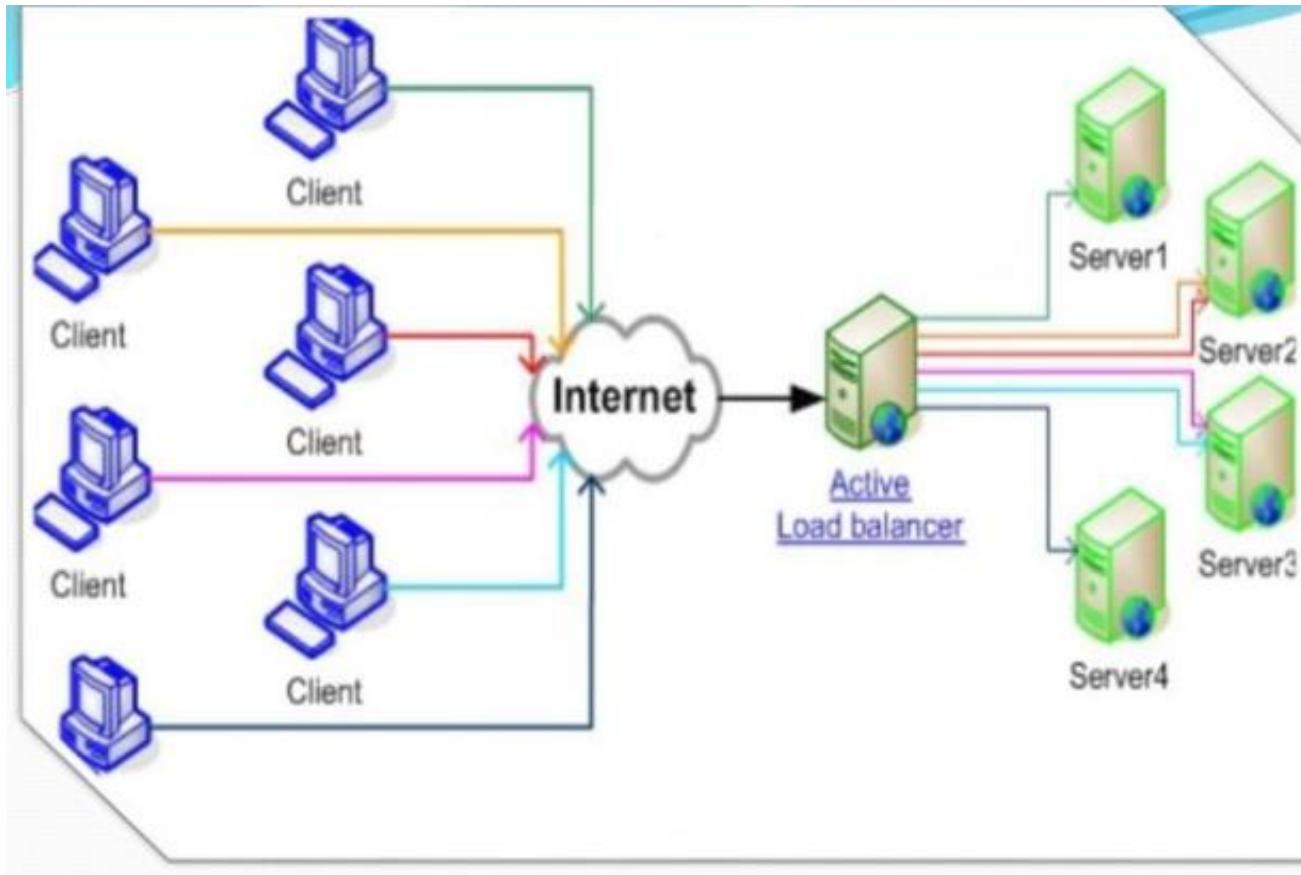
**High-availability clusters implementations are best for mission-critical applications or databases, mail, file and print, web, or application servers.**

# Load Balancing

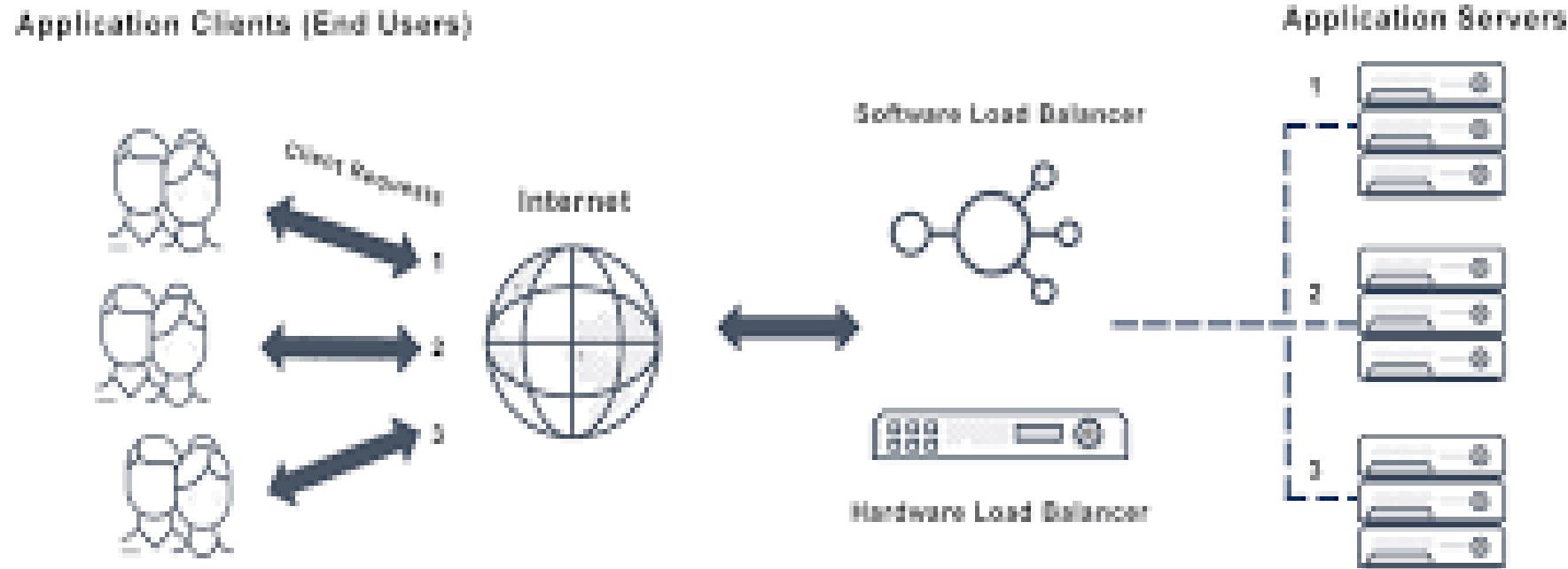
This type of cluster distributes incoming requests for resources or content among multiple nodes running the same programs or having the same content.

Every node in the cluster is able to handle requests for the same content or application.

# Load Balancing Cluster



# Load Balancing Cluster



# Thank you