

**UNIT 4 : Computing Paradigms :** Introduction to Client server computing; basics of distributed computing, Introduction to Grid computing, parallel computing, cloud computing, Mobile computing; Difference between various computing paradigms and functionalities Introduction to soft computing, applications and scope; Future computing techniques.

## What is computing?

Operation of computers

## What is Client and Server?

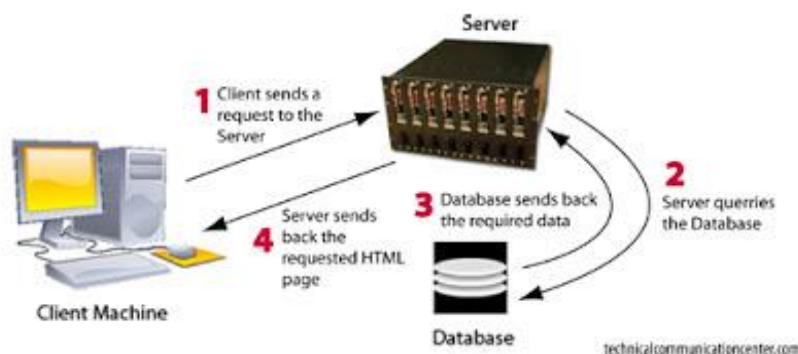
### Client

A client is a single-user workstation that provides presentation services, database services and connectivity along with an interface for user interaction to acquire business needs.

### Server

A server is one or more multi-user processors with a higher capacity of shared memory which provides connectivity and the database services along with interfaces relevant to the business procedures.

**Note :** Client/Server computing provides an environment that enhances business procedures by appropriately synchronizing the application processing between the client and the server.

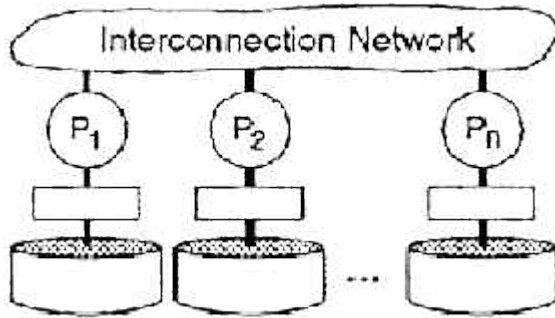


## Advantages and Disadvantages of Client/Server

Advantages	Disadvantages
All files are stored in a central location	A specialist network operating system is needed
Network peripherals are controlled centrally	The server is expensive to purchase
Backups and network security is controlled centrally	Specialist staff such as a network manager is needed
Users can access shared data which is centrally controlled	If any part of the network fails a lot of disruption can occur

## Distributed Network

Distributed Networking is a distributed computing network system, said to be "distributed" when the computer programming and the data to be worked on are spread out over more than one computer. Usually, this is implemented over a network.



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### Key characteristics of distributed systems

- Resource sharing
- Openness
- Concurrency
- Scalability
- Fault Tolerance
- Transparency

### Resource Sharing

In computing, a shared resource, or network share, is a computer resource made available from one host to other hosts on a computer network. It is a device or piece of information on a computer that can be remotely accessed from another computer, typically via a local area network or an enterprise intranet, transparently as if it were a resource in the local machine.

### Openness

Be able to interact with services from other open systems, irrespective of the underlying environment:

- Systems should conform to well-defined interfaces
- Systems should support portability of applications
- Systems should easily interoperate

### Concurrency

Execution of several instruction sequences at the same time

## Scalability

**Scalability** is the capability of a **system**, network, or process to handle a growing amount of work, or its potential to be enlarged in order to accommodate that growth.

## Fault Tolerance

**Fault tolerance** is the property that enables a **system** to continue operating properly in the event of the failure of (or one or more **faults** within) some of its components.

## Transparency

A **transparency** is some aspect of the **distributed system** that is hidden from the user (programmer, **system** developer, user or application program). A **transparency** is provided by including some set of mechanisms in the **distributed system** at a layer below the interface where the **transparency** is required.

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## What is the need for Distributed System

A distributed system may have a common goal, such as solving a large computational problem

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## Difference between Parallel computing and Distributed computing

- In **parallel computing**, all processors may have access to a shared memory to exchange information between processors.
  - In **distributed computing**, each processor has its own private memory (distributed memory). Information is exchanged by passing messages between the processors.
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## Advantages and Disadvantages of Distributed Computing

### Advantages of Distributed System :

**Sharing Data** : There is a provision in the environment where user at one site may be able to access the data residing at other sites.

**Autonomy** : Because of sharing data by means of data distribution each site is able to retain a degree of control over data that are stored locally.

**Availability** : If one site fails in a distributed system, the remaining sites may be able to continue operating. Thus a failure of a site doesn't necessarily imply the shutdown of the System.

### Disadvantages of Distributed Systems :

**Software Development Cost** : It is more difficult to implement a distributed database system; thus it is more costly.

**Greater Potential for Bugs** : Since the sites that constitute the distributed database system operate parallel, it is harder to ensure the correctness of algorithms, especially operation during failures of part of the system, and recovery from failures. The potential exists for extremely subtle bugs.

**Increased Processing Overhead** : The exchange of information and additional computation required to achieve intersite co-ordination are a form of overhead that does not arise in centralized system.

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### What is Grid ?

Grid is a shared collection of reliable (cluster-tightly coupled) & unreliable resources (loosely coupled machines) and interactively communicating researchers of different virtual organisations (doctors, biologists, physicists).

Grid System controls and coordinates the integrity of the Grid by balancing the usage of reliable and unreliable resources among its participants providing better quality of service.

### Grid Computing

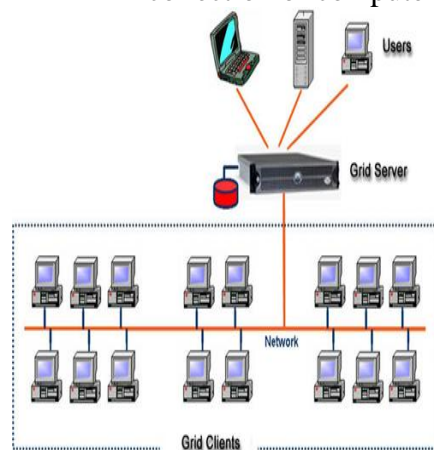
Grid computing is a method of harnessing the power of many computers in a network to solve problems requiring a large number of processing cycles and involving huge amounts of data

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### How Grid Computing Works ?

In general, a grid computing system requires:

- At least one computer, usually a server, which handles all the administrative duties for the System
- A network of computers running special grid computing network software.
- A collection of computer software called middleware



### Advantages and Disadvantages of Grid Computing

#### Advantages

- Can solve larger, more complex problems in a shorter time
- Easier to collaborate with other organizations

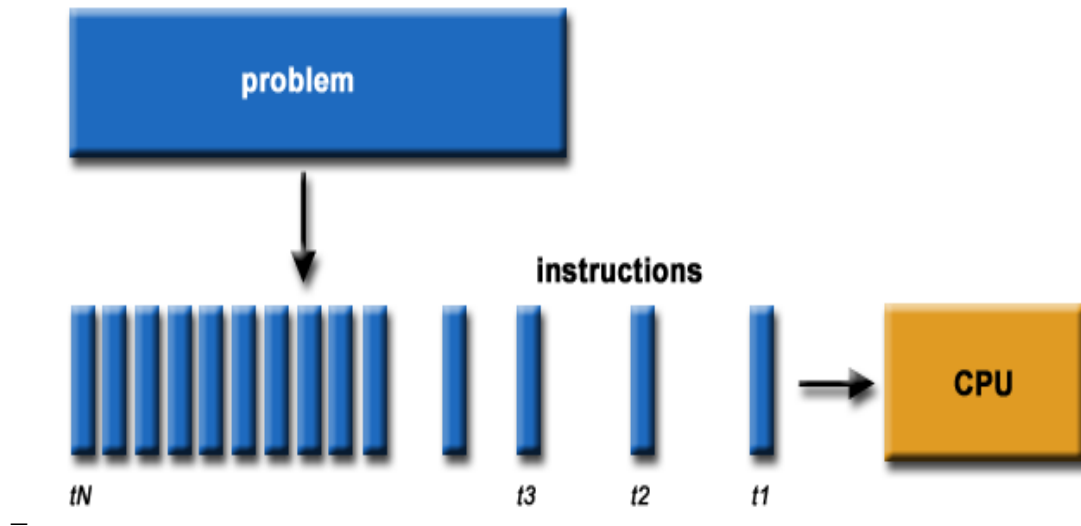
- Make better use of existing hardware
- Optimal usage of installed CPU power
- Cheap (compared to buying supercomputers)
- CPU-intensive tasks can be processed (e.g. better weather forecast)
- Reliability

### Disadvantages

- Complex software needed (administration of the grid, distribution of tasks to the computers attached to the net)
  - Not all tasks are suitable for grids (complex parallelism)  
Grid software and standards are still evolving
  - Learning curve to get started
  - Non-interactive job submission
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### Serial Computing

- Traditionally, software has been written for *serial* computation:
  - To be run on a single computer having a single Central Processing Unit (CPU);
  - A problem is broken into a discrete series of instructions.
  - Instructions are executed one after another.
  - Only one instruction may execute at any moment in time.

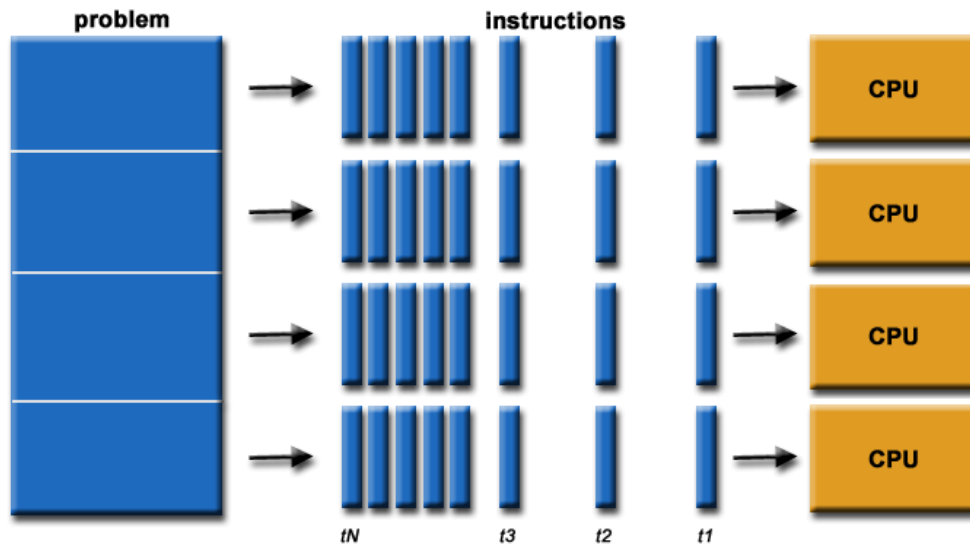


### Parallel Computing

**Parallel computing** is the simultaneous use of multiple compute resources to solve a computational problem.

- To be run using multiple CPUs
- A problem is broken into discrete parts that can be solved concurrently
- Each part is further broken down to a series of instructions

Instructions from each part execute simultaneously on different CPUs



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### Parallel Computing Resources

- The compute resources can include:
  - A single computer with multiple processors;
  - A single computer with (multiple) processor(s) and some specialized computer resources (GPU, FPGA ...)
  - An arbitrary number of computers connected by a network;
- A **field-programmable gate array (FPGA)** is an integrated circuit designed to be configured by a customer or a designer after manufacturing – hence "field-programmable".
- A **GPU**, or **graphics processing unit**, is used primarily for 3-D applications. It is a single-chip processor that creates lighting effects and transforms objects every time a 3D scene is redrawn

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### Applications of Parallel Computing

- Parallel computing is an evolution of serial computing that attempts to emulate what has always been the state of affairs in the natural world: many complex, interrelated events happening at the same time, yet within a sequence.
  - Weather and Ocean patterns
  - Rush hour traffic
  - Automobile assembly line

- Daily opérations within a business
- Building a shopping mall
- Ordering a hamburger at the drive through.
- Weather and Climate
- Chemical and Nuclear reactions
- Biological, Human genome (set of chromosomes in a microorganism)
- Geological, Seismic activity (relating to earthquakes or other vibrations of the earth and its crust.)
- Mechanical devices - from prosthetics (n artificial body part; )to spacecraft electronic circuits
- Manufacturing processes

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## **Advantages and Disadvantages of Parallel Computing**

### **Advantages**

Parallel processing is much faster than sequential processing when it comes to doing repetitive calculations on vast amounts of data

Cost savings - using multiple "cheap" computing resources instead of paying for time on a supercomputer.

Overcoming memory constraints - single computers have very finite memory resources. For large problems, using the memories of multiple computers may overcome this obstacle.

### **Disadvantages**

- Limits to serial computing - both physical and practical reasons pose significant constraints to simply building ever faster serial computers.
  - Transmission speeds - the speed of a serial computer is directly dependent upon how fast data can move through hardware.
  - Limits to miniaturization - processor technology is allowing an increasing number of transistors to be placed on a chip. However, even with molecular or atomic-level components, a limit will be reached on how small components can be.
  - Economic limitations - it is increasingly expensive to make a single processor faster. Using a larger number of moderately fast commodity processors to achieve the same (or better) performance is less expensive.
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## What is Cloud ?

The term Cloud refers to a Network or Internet.

In other words, we can say that Cloud is something, which is present at remote location.

Cloud can provide services over network, i.e., on public networks or on private networks, i.e., WAN, LAN or VPN.

Applications such as e-mail, web conferencing, customer relationship management (CRM), all run in cloud.

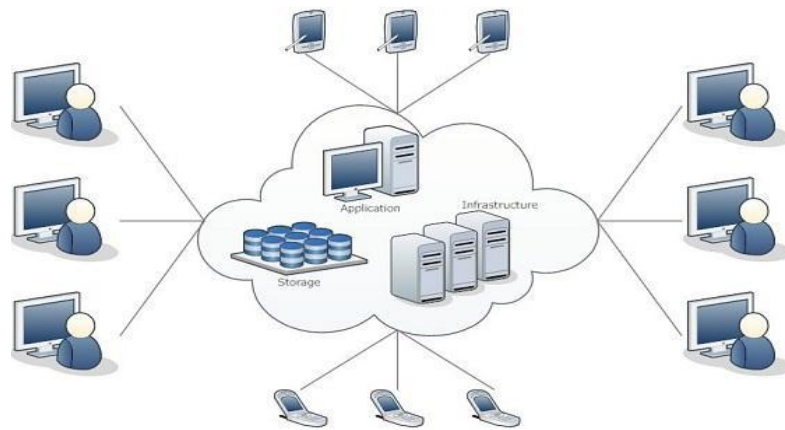
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## What is Cloud Computing?

**Cloud Computing** refers to **manipulating, configuring, and accessing** the applications online.

It offers online data storage, infrastructure and application.

**Cloud Computing** is both a combination of software and hardware based computing resources delivered as a network service.



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## Basics Concepts of Cloud Computing

There are certain services and models working behind the scene making the cloud computing feasible and accessible to end users. Following are the working models for cloud computing:

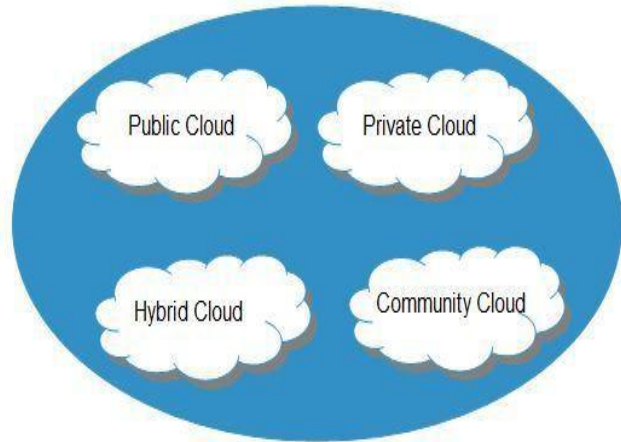
### Deployment Models

#### Service Models

#### Deployment Models

Deployment models define the type of access to the cloud, i.e., how the cloud is located? Cloud can have any of the four types of access: Public, Private, Hybrid and Community.





**PUBLIC CLOUD :** The **Public Cloud** allows systems and services to be easily accessible to the general public. Public cloud may be less secure because of its openness, e.g., e-mail.

**PRIVATE CLOUD :** The **Private Cloud** allows systems and services to be accessible within an organization. It offers increased security because of its private nature.

**COMMUNITY CLOUD :** The **Community Cloud** allows systems and services to be accessible by group of organizations.

**HYBRID CLOUD :** The **Hybrid Cloud** is mixture of public and private cloud. However, the critical activities are performed using private cloud while the non-critical activities are performed using public cloud.

### Service Models

**Service Models** are the reference models on which the Cloud Computing is based. These can be categorized into three basic service models as listed below:

1. **Infrastructure as a Service (IaaS)**
2. **Platform as a Service (PaaS)**
3. **Software as a Service (SaaS)**

### Infrastructure as a Service (IaaS)

**IaaS** is the delivery of technology infrastructure as an on demand scalable service.

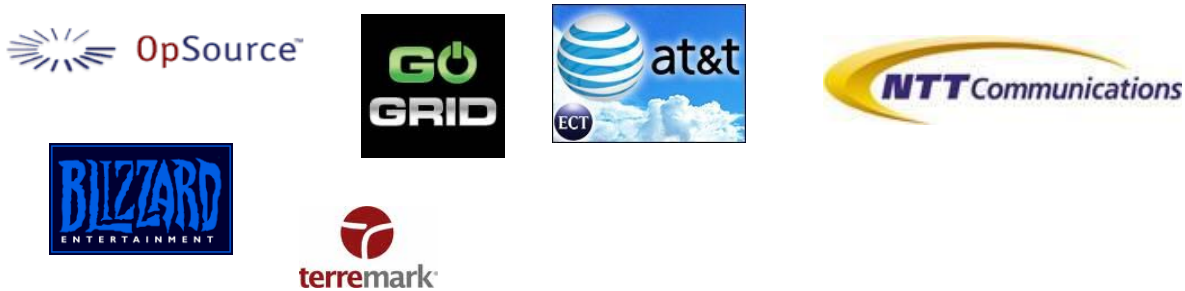
**IaaS** provides access to fundamental resources such as physical machines, virtual machines, virtual storage, etc.

Usually billed based on usage

Usually multi tenant virtualized environment

Can be coupled with Managed Services for OS and application support

### IaaS Examples



### Platform as a Service (PaaS)

**PaaS** provides the runtime environment for applications, development & deployment tools, etc.

**PaaS** provides all of the facilities required to support the complete life cycle of building and delivering web applications and services entirely from the Internet.

Typically applications must be developed with a particular platform in mind

- Multi tenant environments
- Highly scalable multi tier architecture

### PaaS Examples



### Software as a Service (SaaS)

**SaaS** model allows to use software applications as a service to end users.

**SaaS** is a software delivery methodology that provides licensed multi-tenant access to software and its functions remotely as a Web-based service.

- Usually billed based on usage
- Usually multi-tenant environment
- Highly scalable architecture

## SaaS Examples



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## Advantages of Cloud

- Lower computer costs
- Improved performance:
- Reduced software costs
- Instant software updates
- Improved document format compatibility
- Unlimited storage capacity
- Increased data reliability
- Universal document access
- Latest version availability
- Easier group collaboration
- Device independence

## Disadvantages of Cloud

- Requires a constant Internet connection
- Does not work well with low-speed connections
- Features might be limited
- Can be slow
- Stored data can be lost
- Stored data might not be secure

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## What is Mobile ?

**Someone /something can move or be moved easily and quickly from place to place**

## What is mobile computing?

**Mobile Computing** is an umbrella term used to describe technologies that enable people to access network services anyplace, anytime, and anywhere with portable and wireless computing and communication devices.

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### Characteristics of Mobile Computing

- **User mobility:** User should be able to move from one physical location to another location and use same service
  - **Network mobility:** User should be able to move from one network to another network and use same service
  - **Device mobility:** User should be able to move from one device to another and use same service
  - **Session mobility:** A user session should be able to move from one user-agent environment to another.
  - **Service mobility:** User should be able to move from one service to another
  - **Host mobility:** The user should can be either a client or server.
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### What is the need for mobile computing ?

- Enable anywhere/anytime connectivity
  - Bring computer communications to areas without pre-existing infrastructure
  - Enable mobility
  - Enable new applications
  - An exciting new research area
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### Types of Mobile Devices

- Laptops
  - Palmtops
  - PDAs
  - Cell phones
  - Pagers
  - Sensors
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### Applications of Mobile Computing

- **Emergency services**
- **For Estate Agents**
- **In courts**
- **In companies**
- **Stock Information Collection/Control**
- **Credit Card Verification**
- **Taxi/Truck Dispatch**

- **Electronic Mail/Paging**

**Other applications**

■ **Vehicles**

- ☐ transmission of news, road condition, weather, music via DAB
- ☐ position via GPS
- ☐ vehicle data (e.g., from busses, high-speed trains) can be transmitted in advance for maintenance

■ **Medical**

- ☐ Nurses/Doctors in Medical offices are now using Wireless Tablet PCs/WLAN to collect and share patient information.

■ **Sales**

- ☐ Sales representatives are using Tablet PCs with Smart phones for presentation, transmitting/access information among office, hotel, and customer location.

■ **Emergencies**

- ☐ Early transmission of patient data to the hospital, current status, first diagnosis
  - ☐ Provide mobile infrastructure in dealing with Natural Disaster (earthquake, hurricane, fire), terrorist attacks, war, ...
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**Advantages of Mobile Computing**

**Advantages:–**

**Increase in Productivity-** Mobile devices can be used out in the field of various companies, therefore reducing the time and cost for clients and themselves.

**Entertainment-** Mobile devices can be used for entertainment purposes, for personal and even for presentations to people and clients.

**Portability-** this would be one of the main advantages of mobile computing, you are not restricted to one location in order for you to get jobs done or even access email on the go

**Cloud Computing-** This service is available for saving documents on a online server and being able to access them anytime and anywhere when you have a connection to the internet and can access these files on several mobile devices or even PCs at home.

**Disadvantages:–**

**Quality of connectivity-** as one of the disadvantages, mobile devices will need either WiFi connectivity or mobile network connectivity such as GPRS, 3G and in some countries even 4G connectivity that is why this is a disadvantage because if you are not near any of these connections your access to the internet is very limited.

**Security concerns-** Mobile VPNs(Virtual Private Networks) are unsafe to connect to, and also syncing devices might also lead to security concerns.

**Accessing a WiFi** network can also be risky because security can be bypassed easily.

**Power Consumption-** due to the use of batteries in these devices, these do not tend to last long, if in a situation where there is no source of power for charging then that will certainly be a let down.

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### **Soft Computing**

*Soft computing* is an emerging approach to computing which parallel the remarkable ability of the human mind to reason and learn in a environment of uncertainty and imprecision.

Some of it's principle components includes:

- ❖ Neural Network(NN)
- ❖ Fuzzy Logic(FL)
- ❖ Genetic Algorithm(GA)

These methodologies form the core of soft computing.

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### **Goals of Soft Computing**

- ❖ The main goal of soft computing is to develop intelligent machines to provide solutions to real world problems, which are not modeled, or too difficult to model mathematically.
  - ❖ It's aim is to exploit the tolerance for Approximation, Uncertainty, Imprecision, and Partial Truth in order to achieve close resemblance with human like decision making.
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### **Application of Soft Computing**

- ❖ Consumer appliance like AC, Refrigerators, Heaters, Washing machine.
  - ❖ Robotics like Emotional Pet robots.
  - ❖ Food preparation appliances like Rice cookers and Microwave.
  - ❖ Game playing like Poker, checker etc.
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### **Future Scope of Soft Computing**

- ❖ Soft Computing can be extended to include bio- informatics aspects.
- ❖ Fuzzy system can be applied to the construction of more advanced intelligent industrial systems.
- ❖ Soft computing is very effective when it's applied to real world problems that are not able to solved by traditional hard computing.

- ❖ Soft computing enables industrial to be innovative due to the characteristics of soft computing: tractability, low cost and high machine intelligent quotient.
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#### Advantages of Soft Computing

- ☐ Models based on human reasoning.
  - ☐ Closer to human thinking
  - ☐ Models can be
    - Linguistic ( Verbal)
    - simple (no number crunching),
    - fast when computing,
    - effective in practice.
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#### **Future computing techniques:**

##### **Predictive Analytics**

Predictive analytics uses statistical methods to mine intelligence, information and patterns in structured, unstructured and streams of data. Predictive analytics will be applied across many domains, including banking, insurance, retail, telecom and energy.

##### **Cognitive Computing**

The most famous technological product in the domain of cognitive computing is IBM's supercomputer, Watson, an artificial intelligence computer system capable of answering questions posed in natural language.

##### **Autonomic Computing**

This is another computing trend that is set to become prevalent in the networks of tomorrow. Autonomic computing refers to the self-managing characteristics of a network. Typically, it signifies the ability of a network to self-heal in the event of failures or faults.

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