Module 1

Definition of Cloud Computing:
According to NIST, cloud computing is a model that enables *ubiquotous*, *convenient*, *on-demand* network access to *shared pool* of configurable *computing resources* (network, servers, storage, applications and services) that can be *rapidly provisioned* and released with *minimal management effort* or service provider intervention.

Cloud computing enables accessing and storing data and programs on remote servers that are hosted on the internet instead of a computer's hard drive or local server. It provides resources as a service to the user via the internet. The data stored can be files, images, documents or any other storable document. Cloud computing uses a virtualized platform with elastic, on-demand resources, dynamically provisioning hardware, software, and data.

Some of the operations that can be performed through cloud computing are:

- Storage, backup and recovery of data.
- Delivery of software on demand.
- Development of new applications and servers.
- Streaming of audios and videos.

Highlights of the Definition:

- **Ubiquitous:** Cloud computing is accessible from anywhere in the world with an active internet connection, enabling users to work remotely and access data and applications without geographical constraints.
- **Convenient:** It reduces the complexities of traditional IT infrastructure by eliminating the need for physical server rooms, hardware setup, cooling systems, and often software installations, simplifying deployment and maintenance.
- **On-demand:** Cloud resources can be accessed immediately whenever needed, without delays, and can also be scheduled for specific timeframes to meet operational requirements.
- **Shared Pool:** Multiple users (tenants) share the same pool of cloud resources, such as storage and processing power, which are efficiently allocated and prioritized automatically based on demand.
- **Computing Resources:** Cloud platforms offer a variety of resources, including processing power (CPU), memory (RAM), storage (data repositories), networking capabilities, and specialized hardware like GPUs for high-performance tasks.

- **Rapidly Provisioned:** Cloud services enable quick deployment of resources through single-click launch, pre-designed templates and template based launch, or solution-based launch, making it easy to launch multiple instances or applications simultaneously and with a single click.
- **Minimal Management:** Cloud platforms handle automatic system updates, patch installations, integrated monitoring and reporting, automatic scaling and scheduled availability, reducing the burden on users to manage these aspects manually.

Characteristics of Cloud Computing:

1. **On-demand self-service:**A consumer can unilaterally provision computing capabilities, such as server time and network storage, as needed automatically without requiring human interaction with each service provider.
2. **Broad network access:** Capabilities are available over the network and accessed through standard mechanisms that promote use by heterogeneous thin or thick client platforms (e.g., mobile phones, tablets, laptops, and workstations).
3. **Resource pooling:** The provider's computing resources are pooled to serve multiple consumers using a multi-tenant model, with different physical and virtual resources dynamically assigned and reassigned according to consumer demand. There is a sense of location independence in that the customer generally has no control or knowledge over the exact location of the provided resources but may be able to specify location at a higher level of abstraction (e.g., country, state, or datacenter). Examples of resources include storage, processing, memory, and network bandwidth.
4. **Rapid elasticity:**Capabilities can be elastically provisioned and released, in some cases automatically, to scale rapidly outward and inward commensurate with demand. To the consumer, the capabilities available for provisioning often appear to be unlimited and can be appropriated in any quantity at any time.
5. **Measured service:** Cloud systems automatically control and optimize resource use by leveraging a metering capability1 at some level of abstraction appropriate to the type of service (e.g., storage, processing, bandwidth, and active user accounts). Resource usage can be monitored, controlled, and reported, providing transparency for both the provider and consumer of the utilized service.

Benefits of Cloud Computing

1. **Pay-as-you-go:** Cloud computing operates on a consumption-based pricing model, allowing users to pay only for the resources and services they use. This eliminates the need for upfront capital expenses for hardware and reduces costs associated with underutilized resources.

2. **Off-Site Data Storage:** Data is stored on remote servers managed by cloud service providers, reducing the dependency on local storage devices. This ensures data is backed up securely and is accessible even if local systems fail or are compromised.

3. **Access from Anywhere:** Cloud computing is accessible from anywhere in the world with an active internet connection, enabling users to work remotely and access data and applications without geographical constraints.

4. **Security and Disaster Assistance:** Cloud providers offer robust security measures, including encryption, firewalls, and regular updates to protect data from breaches. They also provide disaster recovery options, ensuring quick data recovery and business continuity in case of unforeseen events.

5. **Lower Cost of Ownership:** By outsourcing hardware and software management to cloud vendors, organizations save on costs related to purchasing, maintaining, and upgrading IT infrastructure. This results in lower operational expenses and reduced overheads.

6. **Automatic and Easy Upgrades:** Cloud providers handle automatic system updates, including software patches and hardware upgrades. This ensures users always have access to the latest features and security enhancements without manual intervention or additional expenses.

Concerns for Cloud Computing:

- Automatic upgrades may sometime introduce unforeseen issues
- Mounting costs for large organizations
- Need for an always-on Internet connection
- Service disruption due to cloud provider outage
- Non-negotiable terms & conditions specified by the cloud service provider
- Possibility of user data access by the government
- Loss of in-house technical staff
- Difficulty in moving back from the cloud
- Possibility of hacking