→ Cloud Computing

a. cloud refers to network or internet, and Computing refers to accessing data, doing modification on that data
b. Cloud computing is delivery on demand services over the internet on pay-as-use basis (the user only has to pay for the services that he/she uses)
c. The 'Cloud' refers to internet and computing means to process the data, the processing of data can take place on hardware, database, storage, network & server
d. This refers to delivery of services like processing storage, database, manipulation, networking and server-side programs, to users & organizations based on their requirements
e. few cloud service providers are Amazon Web Services (AWS), Microsoft Azure, Google Cloud Platform(GCP), IBM Cloud, VMWare

→ Benefits of using Cloud Services

a. This reduces the maintenance cost as we don't have to invest in hardware
b. You only have to pay for the services that you use
c. By using cloud services, we can eliminate the setup cost
d. This offers you data storage space and provides you more secure data storage
e. By using cloud based services, it is more scalable
f. the services/data can be accessed globally
g. we can have less number of staff or employees

→ Types of data centers

a. On-premise : it is traditional approach where all data, hardware, software are hosted at physical location
b. Off-premise: it used cloud provider premises, which means that you've to pay for the services that you use

→ Difference between On-Premise & Off-Premise Data Centers

On-Premise	Off-Premise
You've to buy all the hardware, software, license, security, servers and provide maintenance & security	You don't have to buy the software, hardware, security, servers, and you don't have to bother about maintenance & security
A lot of server space is required, physical space and security is required to maintain the server room	As the server are in data center so there is no need for physical space & security
it is difficult to do team-collaboration	It is much easier to do team-collaboration
Deployment of projects/implementation of projects takes longer time	It is much faster in off-premise, since we don't have to worry about underlying hardware

Data recovery is difficult	Data recovery is easier
Data can't be accessed remotely	Data can be accessed from anywhere
A team is required to maintain the hardware, software & server	No team is required for maintenance

→ Data Centres

a. Data Centres are a facility that are used to store, manage & distribute large amount of data
b. it typically includes large number of computers, servers, networking equipments, storage devices which work together to support processing and storage of data
c. A data center can be used for various purposes
    i. *Storing & Processing Data* - A data center is used to store & process large amount of data including file, database & other digital information
    ii. *Running applications & Service* - we can run many applications and services like email, online banking & social media platforms.
    iii. *Backup & Data Recovery* - Data center can also be used to backup important data and provide disaster recovery in event of system failure or natural disaster
    iv. *Cloud Computing* - This allows businesses to access & compute the resources over internet
d. To maintain a data center, we require a lot of electricity, cooling system, power backup
e. The largest data center in world is China Telecom, Beijing-Tianjin
f. The largest data center in India is YottaD1, Noida, U.P.
g. The largest data center of AWS is in East-Northern Virginia

→ Different types of Data Centers

a. **Traditional Data Centres**
    i. These kind of data centers are established/setup within the organization itself where organization owns all the hardware, software & server

b. **Colocation Data Centres**
    i. These data centers are used by an organization, is hosted by a third party firm.
    ii. The Third party firm provides power, cooling to the data center and the organization provides, server, hardware, storage & networking.
    iii. The company can have equipments located at multiple geographical locations
    iv. The company can have its own devices and maintenance, security and power will be handled by a third party.
    v. *Benefits of Colocation Data Centres:*
        1. It is low cost as some of the resources are rented
        2. As few resources are rented, we need less manpower
        3. We have freedom to set up data center in any geographical region

c. **Enterprise Data Centres**
    i. These kinds of data centers are built only for a particular organization
    ii. The organization owns their own infrastructure like storage, server, networking equipment, IT components.
    iii. These kinds of data centers can be on-premises or off-premises.
    iv. The primary function of an enterprise data center is to provide secure, reliable access to data and applications that are critical to an organization operating a business.
    v. These kinds of data centers can range from small server rooms to large complex multiple buildings & thousands of servers.
    vi. These kinds of data centers are owned by company itself, e.g. Amazon, Apple, IBM, Tesla, Microsoft, Meta.
    vii. The key components for enterprise data centers are
        1. Power & Cooling Systems - These are critical to maintain optimal operating conditions, for the computing infrastructure & prevent hardware failure
        2. Server hardware - These are physical server that runs the organization's application and store the data
        3. Backup & Disaster Recovery - It ensures that critical data & applications can quickly be restored in the event of system failure

→ Service provided by data centers

Service provided by data centers can be divided into four tiers

a. Tier 1: basic capacity that includes power supply
b. Tier 2: basic capacity that includes power supply and cooling facilities
c. Tier 3: basic capacity that includes power supply, cooling facilities along with maintenance
d. Tier 4: basic capacity that includes power supply, cooling facilities along with maintenance & backup/protection of data

→ Difference between Cloud & Data Centres

Cloud	Data Centers
Cloud is used only to fetch the resources when needed	Data centers are physically present
Maintenance cost in cloud is much lesser	Maintenance cost in data center is higher
It is much easier to operate, and anyone can operate	Data Centers are handled by much experienced developers and it is much complex to operate than cloud
Full time internet connection is required	Power supply is required for working

→ Components of Data Centers

Data centers comprises of:

a. **Server**
   i. Server is designed to process the request and deliver the response over the cloud

b. **Networking Equipment**
   i. Switch
      1. Switch are used to connect multiple devices
   ii. Router
      1. Routers are used to connect multiple switches.
      2. A router is used to receive and send data over a network
   iii. Server Rack
      1. Server racks are used to organize multiple servers and internet equipments
   iv. Cooling Devices & backup generators

→ Different types of cloud

a. **Public Cloud**
   i. This kind of cloud is open for all
   ii. The cloud infrastructure is available to the general public over the internet and owned by cloud providers.
   iii. These kind of clouds can be accessed by any user, they can access the information or store the information by paying per use
   iv. These cloud computing resources are managed and operated by cloud server providers
   v. Examples:
      Amazon EC2, Google App
   vi. *Advantages of Public Cloud* :
      1. Highly Scalable: It offers the user to scale up & down as per the usage and demand of the resource
      2. Cost Effective: It is also cost effective, the user only has to pay for the resources they have used
   vii. Disadvantages of Public Cloud :
      1. As the users are public, there are chances of security breach
      2. It cannot be 100% customized as per organizations requirements
   viii. Key Points of Public Cloud :
      1. Resources owned & operated by third Party
      2. Resources & services provided to the users or companies over the internet

3. used for hosting a website or an application or adding data to a storage or a database
4.

b. Private Cloud

i. Cloud resources are operated by a single organization

ii. The cloud is operated by the organization itself or a third party

iii. It is further divided into two types
   1. On-Premise Private Cloud
   2. Outsource Private Cloud

iv. *Examples:*
   IBM, Oracle, VMWare, etc.

v. Advantages of Private Cloud :
   1. It provides high security as only authorized users can access the resources
   2. These kind of infrastructure is generally preferred in financial institutions like banking sector
   3. In this , organization has full control over the cloud resources

vi. Disadvantages of Private cloud :
   1. Skilled people are required to manage the cloud
   2. Scaling up & scaling down is bit difficult in this type of cloud
   3. This type of cloud is accessible only within the organization, so the area of operation is limited

vii. Key Points of Private Cloud :
   1. It is operated by single organization
   2. It is used by organization with sensitive information(banking sector)

c. Hybrid Cloud

i. It is a combination of public & private clouds

ii. It allows the organization to share the data between them.

iii. It is partially secure, because services running on public cloud can be accessed by anyone while services running on private acan be accessed by organization users.

iv. These kind of clouds can be combination of
   1. At Least One-Public & One-Private Cloud
   2. Two or more Private Clouds
   3. Two or more Public Clouds

v. These kind of cloud should be able to move workload as it is a combination of two or more kinds of clouds

vi. Performance of hybrid cloud depends on development & management of its connection (networking connection)

vii. The linking between private & public cloud is done either through LAN , API or VPN

viii. Cloud Provider gives the customer a Pre-Configured connection.

ix. Types of connections in Cloud :

1. Dedicated Interconnection - Google cloud
2. Direct Connected - AWS
3. Express Cloud - Microsoft Azure

x. Advantage of Hybrid Cloud:

1. Private cloud is secure hence public is also secure
2. As public cloud is used, so it is scalable
3. User can access both the cloud, as it provides flexibility
4. Hybrid cloud helps to deliver new products and services more effectively in less time

xi. Disadvantages of Hybrid Cloud:

1. As we have both public & private clouds, the connection can be a bit complex. Hence, there are chances of security breach

d. Community

i. It allows system & services to be accessible by group of several organizations to share information between organization or any specific group

ii. It is owned, managed & operated by many and more organizations in a community (even third party can be involved in this)

iii. The infrastructure can be shared between organizations which have common concerns or interests like healthcare department, media, etc

iv. Advantages of Community Cloud :

1. The maintenance can be shared by different organizations which fall under same community or group
2. It is more secure than public cloud and less expensive than private cloud

v. Disadvantages of Community Cloud :

1. It is difficult to distribute responsibilities among and organization between different communities
2. It is difficult to segregate data between organizations of a community

vi. Key Points of Community Cloud :

1. Different cloud services are integrated into single cloud
2. These are designed for specific need of an industry or a community or a group
3. Infrastructure is shared among the different organizations in the community

→ Public Cloud vs. Private Cloud vs. Hybrid Cloud vs. Community Cloud

	Public Cloud	Private Cloud	Hybrid Cloud	Community Cloud
Host	Service Provider	Third Party	Third Party	Third Party
User	General Public	Authorized Users only	Authorized Users, Interest Group & Community	Belongs to same
Access	through internet	internet or VPN	internet or VPN	internet or VPN
Owners	Owners & Public is Service Provider	Organization	Organization	Group / Community

→ Multi Cloud Strategy

a. Multi Cloud strategy is the use of cloud services from more than one cloud vendor.
b. It can be as simple as using software-as-a-service (SaaS) from different cloud vendors
c. e.g., Salesforce and Workday.
d. But in the enterprise, multicloud typically refers to running enterprise applications on platform-as-a-service (PaaS) or infrastructure-as-a-service (IaaS) from multiple cloud service providers, such as Amazon Web Services (AWS), Google Cloud Platform, IBM Cloud and Microsoft Azure.