

## Why Are We Learning Cloud Computing?

### 1. Traditional IT vs Cloud (Problem Statement)

Earlier, companies had to:

- Buy physical servers
- Set up data centers
- Manage hardware, power, and cooling
- Hire teams for maintenance

This approach was expensive, slow, and difficult to scale.

Cloud computing solves these problems.

### 2. What Cloud Computing Provides

Cloud computing offers:

- Servers (Compute)
- Storage
- Databases
- Networking
- AI and Machine Learning services

All resources are available over the internet on a pay-as-you-go basis.

Example: Using food delivery services instead of cooking everything at home.

### 3. Importance of Cloud for MLOps

#### a) High Resource Requirements

Machine Learning requires:

- High CPU and GPU power
- Large storage
- Heavy computation

Cloud provides powerful machines within minutes.

Example:

- Training on a local laptop: 2 days
- Training on cloud GPU: 2 hours

#### b) Scalability

Applications may have:

- 100 users today
- 1 million users tomorrow

Cloud automatically scales resources up or down.

Users pay only for what they use.

#### c) End-to-End ML Lifecycle on Cloud

In real-world companies, the complete ML lifecycle runs on the cloud:

- Data Storage: Amazon S3, Azure Blob, Google Cloud Storage
- Model Training: EC2, Azure ML, Vertex AI

- Deployment: Kubernetes, Cloud Run
  - Monitoring: CloudWatch, Prometheus
  - CI/CD: GitHub integrated with cloud services
- MLOps combines Machine Learning, DevOps, and Cloud Computing.

#### 4. Real-World Use Cases

Companies like Netflix, Amazon, Swiggy, and Uber use cloud computing to:

- Train ML models
- Recommend content and products
- Handle millions of users
- Deploy applications globally

Without cloud computing, this scale is not practical.

#### 5. Career and Industry Demand

- Most companies follow a cloud-first approach
- Cloud skills combined with ML increase job opportunities

Common job roles include:

- MLOps Engineer
- Machine Learning Engineer
- Data Engineer
- Cloud Engineer

#### 6. Key Summary

Cloud computing is essential because Machine Learning systems cannot scale, deploy, or run in production without it.

#### 7. Teaching Analogy

If Machine Learning is the brain, cloud computing is the body that runs it.

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## Google Colab vs Jupyter Notebook vs Cloud Platforms

### Google Colab

- Online notebook hosted by Google
- Used for learning and quick experiments
- Limited and shared resources
- Temporary storage
- Session timeouts
- Not suitable for deployment or production

### Jupyter Notebook

- Notebook tool running locally or on a server
- Used for development and experimentation
- Resource availability depends on local hardware
- No automatic scalability
- Limited production support

## Cloud Platforms (AWS, Azure, GCP)

- Complete cloud infrastructure
- Used for production and scalable systems
- Full control over resources
- Scalable CPU, GPU, RAM, and storage
- Supports deployment, CI/CD, monitoring, and security

### Summary:

Google Colab and Jupyter are mainly for building and testing models, while cloud platforms are used to run models in real-world production environments.

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## What Is Cloud Computing?

### Definition

Cloud computing is the on-demand availability of computing resources such as servers, storage, databases, networking, and AI tools over the internet, where users pay only for what they use.

### In Simple Terms

Cloud computing allows users to rent computing resources instead of buying and maintaining physical servers.

## Core Cloud Services

1. Compute: Virtual machines and containers
2. Storage: Object, block, and file storage
3. Networking: Virtual networks, load balancers
4. Databases: SQL and NoSQL databases
5. AI and ML services
6. Security: Identity management, encryption, firewalls

## Why Cloud Exists

Traditional IT required high upfront cost, long setup time, and was difficult to scale.

Cloud computing enables:

- Faster provisioning
  - Instant scalability
  - Global access
  - Pay-as-you-go pricing
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## On-Premise vs Cloud

On-Premise:

- Company owns and manages hardware
- High initial investment
- Limited scalability
- Complex disaster recovery
- Difficult to support ML and AI workloads

Cloud:

- Infrastructure managed by cloud provider
  - Low or no upfront cost
  - Instant scalability
  - Built-in disaster recovery
  - Rich ML and AI services
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## Cloud Providers

A cloud provider is a company that owns and manages data centers and offers computing resources over the internet.

Major Cloud Providers:

- Amazon Web Services (AWS)
- Microsoft Azure
- Google Cloud Platform (GCP)

Cloud providers offer:

- Compute services
  - Storage services
  - Networking
  - Databases
  - AI and ML platforms
  - Security and monitoring tools
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## What Is Microsoft Azure?

Microsoft Azure is a cloud computing platform provided by Microsoft that offers computing, storage, networking, databases, and AI/ML services over the internet.

Key Benefits:

- Strong integration with Microsoft tools
- Enterprise-grade security and compliance
- Global data center presence

Azure Services (Beginner Level):

- Compute: Azure Virtual Machines
  - Storage: Azure Blob Storage
  - Networking: Virtual Network
  - Databases: Azure SQL Database
  - ML: Azure Machine Learning
  - DevOps: Azure DevOps
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## Azure Resource Group

A Resource Group is a logical container in Azure that holds related resources such as virtual machines, storage accounts, databases, and networks.

Key Points:

- Logical grouping (not physical)
- All resources belong to one region
- Deleting a resource group deletes all resources inside it
- Used to manage access, policies, and monitoring

Analogy:

A resource group is like a project folder that contains all related files.

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## Azure Subscription

An Azure Subscription is a billing and management boundary that contains Azure resources.

Key Features:

- Tracks billing and costs
- Controls access using role-based access control
- Defines service limits and quotas
- Multiple subscriptions can be used for different projects or environments

Analogy:

Azure is like a shopping mall.

A subscription is like a shop inside the mall.

All resources are items inside the shop, and billing applies to that shop only.

