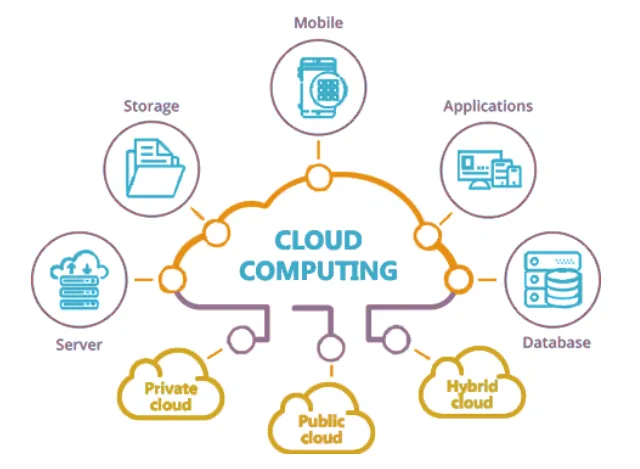
**What is cloud computing?**

Cloud computing is a transformative technology that has revolutionized the way we access and utilize computing resources. It involves delivering computing services, such as servers, storage, databases, networking, software, analytics, and intelligence, over the internet on demand. Instead of owning and maintaining physical hardware and software, users can access these resources from a cloud provider, typically on a pay-as-you-go basis.



**Evolution of Cloud Computing**

The evolution of cloud computing is characterized by several distinct eras, each marked by significant advancements and changes in how computing resources are delivered and consumed.

**Early Days (1950s-1990s)** During this period, the foundations of cloud computing were laid. Mainframe computers emerged as powerful centralized systems, enabling multiple users to share computing resources. This concept evolved into distributed computing, where tasks were divided and processed across multiple interconnected machines. Grid computing further expanded this idea, connecting geographically dispersed computers to tackle complex problems collaboratively.

**The Rise of the Cloud (2000s)** The 2000s witnessed the birth of modern cloud computing. Amazon Web Services (AWS) launched in 2002, offering storage and computing services over the internet. The introduction of AWS Elastic Compute Cloud (EC2) in 2006 marked a pivotal moment, allowing users to rent virtual servers on demand. This paradigm shift democratized access to computing resources and paved the way for widespread cloud adoption. Other major players like Google and Microsoft entered the market, offering their own cloud platforms and services.

**Cloud Computing Goes Mainstream (2010s-Present)** The 2010s saw cloud computing become an integral part of the digital landscape. The emergence of SaaS, PaaS, and IaaS models provided businesses and individuals with a wide range of options for leveraging cloud services. Mobile cloud computing enabled seamless access to cloud resources from mobile devices, while edge computing brought processing power closer to the source for faster response times. Serverless computing further streamlined development by automating resource management. Additionally, the rise of multi-cloud and hybrid cloud strategies allowed organizations to optimize their cloud deployments by using multiple providers or combining on-premises and cloud infrastructure.

**The Future of Cloud Computing** Looking ahead, cloud computing is poised for continued evolution. Quantum computing holds the potential to revolutionize cloud capabilities, offering unprecedented processing power. The Internet of Things (IoT) will generate massive amounts of data that will be processed and stored in the cloud. Blockchain technology promises to enhance security and transparency in cloud-based transactions. Edge computing is expected to expand its reach, supporting more complex applications and real-time data processing. As these technologies mature, cloud computing will continue to transform the way we compute, work, and live.

**Drobox**: Started by using traditional servers but moved to a hybrid cloud approach to handle storage and sync data more efficiently. This transition allowed them to provide seamless file synchronization and sharing services to millions of users.

**Characteristics of Cloud Computing**

**On-Demand Self-Service**: Users can allocate computing capabilities, such as server time and network storage, as needed automatically without requiring human interaction with each service provider.

Eg: AWS allows users to launch virtual servers on-demand via their web portal.

**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).

Eg: Google Cloud services are accessible from anywhere with an internet connection.

**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.

Eg: Microsoft Azure uses virtualization to pool resources for efficiency.

**Rapid Elasticity:** Cloud computing resources can be quickly provisioned or released as needed, allowing organizations to scale up or down their computing capacity in response to demand fluctuations.

Eg: Netflix uses AWS to scale their services based on the number of viewers.

**Measured Service**: Cloud systems automatically control and optimize resource use by leveraging a metering capability 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.

Eg:Amazon CloudWatch monitors AWS cloud resources and applications, allowing for detailed usage

reports.

**Types of cloud and its cloud services:**

1. **Infrastructure as a Service (IaaS)**

Infrastructure as a Service (IaaS) is a cloud computing model that provides on-demand access to fundamental computing resources, such as servers, storage, networking, and virtualization, over the internet

* **User Control:** Offers high levels of control and flexibility, allowing organizations to deploy and manage operating systems, applications, data, and other software.
* **Key Characteristics:**
  + **Scalability:** Easily adjust resources to meet fluctuating demands.
  + **Cost-Effectiveness:** Pay-as-you-go pricing and reduced capital expenditure on hardware.
  + **Agility:** Rapidly provision resources to support new initiatives.
* **Examples:** Amazon EC2, Microsoft Azure Virtual Machines, Google Compute Engine.

**2. Platform as a Service (PaaS)**

* **Platform as a Service (PaaS)** is a cloud computing model that provides a complete development and deployment environment in the cloud. Think of it as a ready-to-go kitchen where you, the chef (developer), bring your ingredients (code) and the kitchen (PaaS) provides everything else you need to cook (develop and deploy) your dish (application).
* **Abstraction:** Abstracts away the complexities of managing underlying infrastructure, allowing developers to focus on application development.
* **Key Characteristics:**
  + **Simplified Development:** Streamlines the development lifecycle with built-in tools and services.
  + **Enhanced Productivity:** Reduces time-to-market for new applications.
  + **Innovation:** Fosters experimentation and rapid prototyping.
* **Examples:** AWS Elastic Beanstalk, Microsoft Azure App Service, Google App Engine.

**3. Software as a Service (SaaS)**

* **Delivery Model:** Delivers software applications over the internet on a subscription basis.
* **User Experience:** Provides a user-friendly interface accessible via web browsers or mobile devices.
* **Key Characteristics:**
  + **Ease of Use:** Minimal setup and maintenance required.
  + **Accessibility:** Access applications from anywhere with an internet connection.
  + **Cost-Effectiveness:** Predictable subscription costs and reduced IT overhead.
  + **Examples:** Salesforce, Microsoft 365, Google Workspace

**Advantages of Cloud Computing**

Cloud computing offers numerous advantages, driving its rapid adoption across industries.

**Cost Efficiency**: No need to invest in physical hardware; pay for what you use.

**Scalability**: Easily scale resources up or down based on demand.

**Flexibility:** Access services and data from anywhere with an internet connection.

**Accessibility:** Services are available 24/7.

**Disaster Recovery**: Built-in disaster recovery solutions, with backups often stored in multiple locations.

Challenges in Cloud Adoption

Despite its benefits, cloud computing poses challenges that organizations must address.

**Security Concerns**: Risk of data breaches, unauthorized access, and data loss.

Example: In 2019, Capital One experienced a data breach affecting over 100 million customers due to a vulnerability in their AWS environment.

Compliance Issues: Ensuring adherence to regulations like GDPR, HIPAA, etc.

Example: Healthcare organizations must ensure that their cloud providers comply with HIPAA regulations to protect patient data.

**Downtime**: Possibility of service outages affecting availability.

Example: AWS experienced a significant outage in 2017, affecting numerous websites and services.

Data Loss: Risk of losing data due to failures or attacks.

Example: In 2012, code hosting site GitHub experienced data loss due to a hardware failure in their cloud storage system.

**Vendor Lock-In:** Difficulty in switching providers due to dependencies on proprietary services and APIs.

Example: A company heavily invested in AWS's unique services might find it difficult and costly to migrate

to another cloud provider like Azure.

**Applicatuon of cloud Computing**

**Industry-Specific Applications**

 **Healthcare:** Cloud computing facilitates secure storage and sharing of patient data, telemedicine, and remote monitoring.

 **Education:** Cloud-based learning platforms provide access to educational resources and tools, enabling personalized learning experiences.

 **Financial Services:** Cloud computing enables secure online banking, fraud detection, and risk management.

 **Retail:** Cloud-based e-commerce platforms and inventory management systems streamline retail operations.

 **Manufacturing:** Cloud computing facilitates supply chain management, predictive maintenance, and quality control.

**Personal Applications**

 **Online Storage:** Cloud storage services like Google Drive, Dropbox, and iCloud provide convenient storage for personal files and photos.

 **Email and Messaging:** Cloud-based email and messaging services offer accessibility from any device.

 **Entertainment:** Cloud-based streaming services like Netflix and Spotify deliver on-demand entertainment content.

 **Social Networking:** Cloud computing powers social media platforms, enabling users to connect and share content.

**Business Applications**

 **Data Storage and Backup:** Cloud platforms provide secure and scalable storage for businesses of all sizes, enabling easy data backup and disaster recovery.

 **Collaboration and Communication:** Cloud-based tools facilitate seamless collaboration and communication among teams, regardless of location.

 **Business Applications:** Cloud-based software applications, such as CRM, ERP, and project management tools, offer enhanced accessibility and affordability.

 **Big Data Analytics:** Cloud computing provides the infrastructure and tools needed to process and analyze large datasets, enabling data-driven decision-making.

 **Artificial Intelligence (AI) and Machine Learning (ML):** Cloud platforms offer powerful AI and ML capabilities, enabling businesses to develop and deploy intelligent applications.

**Cloud Storage**

Cloud storage is a type of online data storage that allows users to store and access data over the internet. There are three main types of cloud storage

**Object Storage:** This type of storage is designed for storing large amounts of unstructured data, such as images, videos, and backups. Object storage is highly scalable and cost-effective, making it a popular choice for businesses and individuals who need to store large amounts of data.

Stores data as objects, each with a unique identifier.

Example: Amazon S3 is an object storage service used for backup, archive, and data lake solutions**.**

**File Storage:** This type of storage is similar to traditional file systems, allowing users to store and access files in a hierarchical structure. File storage is often used for sharing files and collaborating on projects.

Example: Google Drive allows users to store, share, and collaborate on files and folders.

**Block Storage:** This type of storage provides low-level access to data blocks, making it suitable for applications that require high performance and low latency. Block storage is often used for databases and other high-performance applications.

**Cloud Services requirements**

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**Cloud and dynamic infrastructure**

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**Cloud Adoption**

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