**Unit - 2**

1. **Cloud Platforms in Industry**

Cloud platforms provide services over the internet, enabling businesses to build, manage, and deploy applications without the need for maintaining physical hardware. These platforms offer a range of services like compute power, storage, networking, and databases. The platforms can be categorized based on deployment models:

**Types of Cloud Platforms:**

1. **Public Cloud:**

* These services are delivered over the internet by third-party providers. Customers share the infrastructure, but their data and services remain isolated. Major public cloud providers include AWS, Microsoft Azure, and Google Cloud.
* **Advantages:**
  + Cost-effective as you pay only for what you use.
  + No need to maintain hardware.
  + High scalability, elasticity, and global reach.

1. **Private Cloud:**

* Cloud infrastructure is used exclusively by a single organization. It can be managed internally or by a third-party and can be hosted on-premises or off-site.
* **Advantages:**
  + Greater control over data and resources.
  + Enhanced security and privacy, making it ideal for sensitive data or industries with strict regulations.
  + Can be customized to the organization’s needs.

1. **Hybrid Cloud:**

* This combines both public and private clouds, allowing data and applications to be shared between them.
* **Advantages:**
  + Flexibility to move workloads between public and private clouds based on business needs.
  + Cost optimization by keeping critical tasks in private clouds and less-sensitive tasks in the public cloud.
  + Ensures scalability and enhanced performance while maintaining security for critical operations.

2. **Major Cloud Vendors and Their Offerings**

a. **Microsoft Azure:**

* **Introduction:**
* Azure is a cloud computing platform provided by Microsoft, offering a wide variety of cloud services, including computing, analytics, storage, and networking. It supports building, testing, deploying, and managing applications through Microsoft-managed data centers.
* **Key Services:**

1. **Azure Virtual Machines (VMs):**
   * Enables the creation of scalable virtual machines within minutes. These VMs can run Linux, Windows, or any other operating system.
   * Supports businesses with dynamic computing needs, allowing them to scale resources on demand.
2. **Azure Blob Storage:**
   * Offers highly scalable object storage for unstructured data like text, images, or videos.
   * Ensures high availability and durability, making it suitable for backup, archival, and big data analytics.
3. **Azure App Services:**
   * Platform-as-a-Service (PaaS) for building, hosting, and scaling web applications and APIs.
   * Supports a range of programming languages like .NET, Java, Node.js, and PHP.
4. **Azure Kubernetes Service (AKS):**
   * Fully managed container orchestration service that simplifies the deployment, management, and operations of Kubernetes.
   * Helps companies manage containerized applications more efficiently and with better resource optimization.
5. **Azure AI and Machine Learning:**
   * Provides powerful tools for data scientists and developers to build AI models and deploy them at scale.
   * Offers pre-built APIs for speech recognition, computer vision, natural language processing, and more.

b. **Amazon Web Services (AWS):**

* **Introduction:**
* AWS is the leading cloud platform globally, offering over 200 fully-featured services from data centers worldwide. It is highly scalable and widely adopted across various industries.
* **Key Services:**

1. **EC2 (Elastic Compute Cloud):**
   * Offers scalable virtual servers in the cloud, allowing businesses to run applications at any scale.
   * EC2 supports autoscaling to automatically adjust capacity to maintain performance at low cost.
2. **S3 (Simple Storage Service):**
   * Scalable object storage service that allows users to store and retrieve data from anywhere.
   * Highly durable, secure, and cost-effective, S3 is used for backup, archival, big data, and content distribution.
3. **RDS (Relational Database Service):**
   * Fully managed database service for relational databases such as MySQL, PostgreSQL, Oracle, and SQL Server.
   * Automates administrative tasks like backups, patching, and scaling.
4. **AWS Lambda:**
   * Serverless computing service that allows developers to run code without provisioning or managing servers.
   * Lambda automatically scales based on the workload and only charges for the time your code is running.
5. **AWS CloudFormation:**
   * Simplifies the management of AWS resources by allowing users to model and provision them using infrastructure-as-code templates.

c. **Google AppEngine (GAE):**

* **Introduction:**
* Google AppEngine is a Platform-as-a-Service (PaaS) from Google Cloud. It allows developers to build and run applications without worrying about managing the underlying infrastructure.
* **Key Features:**

1. **Automatic Scaling:**
   * AppEngine scales automatically depending on traffic. If the app gets a sudden spike in usage, AppEngine ensures the app scales to meet demand without any manual intervention.
2. **Supports Multiple Languages:**
   * Developers can write their applications in a variety of languages like Java, Python, Go, PHP, and Node.js.
3. **Fully Managed Services:**
   * Google handles all infrastructure management, including patching, scaling, and load balancing.
4. **Integrated Tools:**
   * AppEngine integrates well with other Google Cloud services such as Google Cloud SQL (managed relational database) and Google Cloud Storage.
5. **Flexible Deployment:**
   * Allows deploying microservices or even whole applications in isolated environments using containerized services like Docker.

3. **Integration of Private and Public Clouds (Hybrid Cloud)**

**Definition:**

* Hybrid cloud integration refers to combining private and public cloud infrastructures to take advantage of both worlds. Sensitive workloads are handled in the private cloud, while less critical operations can be scaled out to the public cloud as needed.

**Key Characteristics:**

1. **Workload Management:**

* Businesses can dynamically allocate workloads based on cost, security, and performance needs. For example, during peak times, public cloud resources can be used to scale up capacity.

1. **Data Mobility:**

* Hybrid cloud setups often have mechanisms in place for seamless data transfer between public and private clouds. This enables businesses to access data and applications across both environments efficiently.

1. **Security and Compliance:**

* Sensitive workloads can be run in private cloud environments to comply with data security regulations while utilizing the public cloud for less sensitive tasks, ensuring cost efficiency.

**Benefits:**

* **Agility:** Offers greater flexibility and speed to adapt to changing business demands by allowing workloads to be shifted between public and private clouds.
* **Cost Efficiency:** Hybrid cloud ensures that organizations pay for public cloud resources only when needed, thus reducing costs.
* **Security:** Sensitive data can remain within the private cloud, ensuring compliance with regulations such as GDPR or HIPAA, while still leveraging the scale and power of public cloud resources.

4. **Cloud Applications**

Cloud platforms are widely used across various industries to provide scalable and flexible infrastructure for a range of applications. Here are some significant applications:

a. **Protein Structure Prediction:**

* **Use Case:**
* Predicting protein structures involves complex computational algorithms, which require vast processing power. Cloud platforms like AWS, Google Cloud, and Azure provide the scalable infrastructure needed for running these algorithms quickly and efficiently.
* **Benefits:**
* Cloud services allow researchers to analyze massive datasets and perform simulations in real-time without the need for local supercomputing resources.

b. **Data Analysis:**

* **Use Case:**
* Companies and research institutions leverage cloud-based data analysis platforms like AWS Redshift, Google BigQuery, and Azure Data Lake to analyze large datasets.
* **Benefits:**
* Cloud platforms enable organizations to process, analyze, and gain insights from vast amounts of data, leading to better decision-making and faster research progress.
* It also reduces the time and cost associated with managing physical data centers and hardware.

c. **Satellite Image Processing:**

* **Use Case:**
* Satellite images are used in areas such as environmental monitoring, disaster management, and urban planning. Cloud platforms provide the computational power to process and analyze these images efficiently.
* **Example:**
* Google Earth Engine utilizes cloud computing to store and analyze vast amounts of satellite data in real-time, allowing for detailed environmental and geographical analysis.

d. **CRM and ERP:**

* **Use Case:**
* Cloud-based CRM (Customer Relationship Management) and ERP (Enterprise Resource Planning) systems such as Salesforce, SAP on Azure, and Oracle Cloud provide businesses with the tools to manage their customers, resources, and operations.
* **Benefits:**
* These cloud-based solutions offer flexibility, scalability, and cost savings. They enable businesses to access their systems from anywhere, providing real-time updates and analytics for better decision-making.

e. **Social Networking:**

* **Use Case:**
* Social media platforms such as Facebook, Twitter, and Instagram heavily rely on cloud infrastructure to manage billions of users and petabytes of data.
* **Benefits:**
* Cloud computing provides these platforms with the ability to scale quickly, handle large amounts of real-time data, and support millions of simultaneous connections across the globe.

f. **Scientific Applications:**

* **Use Case:**
* Cloud platforms are used extensively in scientific research for data analysis, simulations, and modeling. Examples include climate simulations, genomics research, and astrophysics.
* **Benefits:**
* Cloud computing offers scientists access to

powerful computing resources without the need for expensive hardware, enabling faster and more efficient research.

g. **Business Applications:**

* **Use Case:**
* Cloud platforms power various business applications such as financial analysis, supply chain management, marketing automation, and e-commerce platforms.
* **Examples:**
* Platforms like Shopify, SAP Cloud, and Salesforce leverage cloud services to provide scalable and secure business solutions.
* **Benefits:**
* Cloud-based business applications offer greater flexibility, lower costs, and improved collaboration, as users can access them from anywhere and at any time.