Unit-4

Block chain technology:-

Block chain is a shared, immutable digital ledger, enabling the recording of transactions and the tracking of assets within a business network and providing a single source of truth.

In blockchain technology, each transaction is grouped into blocks, which are then linked together, forming a secure and transparent chain. This structure guarantees data integrity and provides a tamper-proof record, making blockchain ideal for applications like cryptocurrencies and supply chain management.

Today, blockchain continues to evolve, with ongoing advancements aimed at improving scalability, privacy and its integration with emerging technologies like artificial intelligence (AI) and the Internet of Things (IoT).

Benefits:

The key benefit of blockchain lies in its ability to provide security, transparency and trust without relying on traditional intermediaries, such as banks or other third parties. Its design reduces the risk of fraud and errors, making it especially valuable in industries where secure transactions are critical, including finance and healthcare.

Blockchain technology offers various benefits that transform businesses' operations, enhancing trust, security, traceability and efficiency across multiple industries.

Here are some top benefits of blockchain:

- Greater trust
- Enhanced security
- Better traceability
- Increased efficiency
- Automated transactions

Features:

Block chain technology contains several key features that enhance security, transparency and efficiency in transactions and data management:

- Distributed ledger technology
- Immutable records
- Smart contracts
- Public key cryptography

How block chain works:
Blockchain technology records transactions securely by linking data blocks together. Each block contains important details about asset movements and ensures the integrity of the entire process. Here's how it works-

Records transactions as blocks

Each transaction is recorded as a "block" of data on the blockchain. These blocks capture key details about the movement of assets, whether tangible (such as a product) or intangible (such as intellectual property). The data within each block includes critical information, such as who, what, when, where, the transaction amount, and specific conditions like the temperature of a food shipment.

In addition, each block contains a timestamp, which records the exact moment the transaction is added to the block chain. This timestamp ensures the chronological order of transactions and adds an additional layer of verifiability to the data, preventing any retrospective alterations to the recorded information.

Types of block chain networks-

- **Public block chain networks:** A public block chain is open for anyone to join and participate in, such as the Bitcoin block chain. While it offers decentralization, it also comes with drawbacks, including high computational power requirements, lack of transaction privacy and potentially weaker security.

- **Private block chain networks:** A private block chain network, similar to a public block chain network, is a decentralized peer-to-peer network. However, one organization governs the network, controlling who is allowed to participate, run a consensus protocol and maintain the shared ledger.
- **Permissioned block chain networks:** Businesses that set up a private block chain set up a permissioned block chain network. It is important to mention that public block chain networks can also be permissioned. This places restrictions on who is allowed to participate in the network and in what record transactions. Participants need to obtain an invitation or permission to join.
- **Consortium blockchain networks:** A group of preselected organizations actively manages a consortium blockchain network and shares the responsibility of maintaining the blockchain. These organizations determine who can submit transactions and access data. This type of network is ideal when multiple parties must collaborate with shared responsibilities.

Limitations & Application areas:

Limitations of block chain include scalability **and** performance **issues,** high energy consumption**, and the** difficulty of changing data **once it's on the ledger. Other challenges are high implementation costs, the need for specialized expertise, and regulatory uncertainty.**

Key Applications of Block chain-
Financial Services and Banking: Block chain provides secure and fast peer-to-peer transaction processing, eliminating the need for intermediaries like traditional banks.

Supply Chain Management: It offers end-to-end traceability and transparency, allowing all participants to track a product's journey from origin to destination in real-time.

Healthcare: Blockchain secures and manages sensitive patient data, enhancing security and privacy while allowing authorized providers to share records efficiently.

Identity Management: It enables decentralized digital identity systems, where individuals control their personal information and share it securely without relying on a central authority, reducing the risk of identity theft.

Real Estate: Block chain can streamline real estate transactions by providing a transparent and secure record of property ownership and contracts, potentially reducing the need for intermediaries and speeding up processes.

Voting Systems: Block chain technology can be applied to create secure, transparent, and auditable voting systems that maintain voter anonymity and reduce the potential for fraud.

Crypto currencies:-

Cryptocurrency is a digital payment system that does not rely on banks to verify transactions. Cryptocurrency payments exist purely as digital entries to an online database. When cryptocurrency funds are transferred, the transactions are recorded in a public ledger.

- In cryptocurrency, “coins” (which are publicly agreed-on records of ownership) are generated or produced by "miners".
- Cryptocurrencies can be used for buying goods just like fiat currency.
- Cryptocurrencies use encryption to verify and protect transactions.
- It does not exist in physical form and is not typically issued by any central authority.
- They use decentralized control in contrast to central bank digital currency.

Popular Examples

- **Bitcoin (BTC):** The original and most well-known cryptocurrency, often considered "digital gold" and a store of value.
- **Ethereum (ETH):** A blockchain platform focused on smart contracts and decentralized applications (dApps), with its own currency called Ether.
- **Litecoin (LTC):** An early alternative to Bitcoin, known for faster transaction confirmation times.
- **Stablecoins:** Such as Tether (USDT) and USD Coin (USDC), these are pegged to a stable asset (like the US dollar) to reduce volatility.

Applications and Use Cases

- **Payments and Remittances**: The foundational use case of cryptocurrency is enabling peer-to-peer transactions without the need for traditional intermediaries like banks, providing cost-effective and efficient transfers, especially for cross-border payments.
- **Decentralized Finance (DeFi)**: This rapidly growing sector uses smart contracts to offer financial services such as lending platforms, decentralized exchanges (DEXs), and asset management, accessible to any user with an internet connection.
- **Supply Chain Management**: Blockchain can track goods from production to the end-user, enhancing transparency, ensuring authenticity, and reducing fraud. Companies like Walmart have used it for food tracking.
- **Healthcare**: The technology is used to securely store and share patient medical records across different facilities while maintaining privacy, and for managing supply chains for pharmaceuticals and medical devices..
- **Smart Contracts**: These self-executing contracts with the terms directly written into code automatically enforce the terms of an agreement, which has applications in various fields, from legal agreements to automated insurance payouts.

Cloud computing:-

Cloud Computing has fundamentally changed how businesses and individuals store, access, and manage data. It is a technology that allows you to use data and applications over the internet, moving beyond the limitations of a local computer's hard drive or a private server. But to truly understand its impact, we must first look at the problems it solved.

The Problem Cloud Computing Solves: The "Old Way" vs. The "New Way"
Before the cloud, if a company wanted to launch a website or an application, it had to follow a slow and expensive process:

- **The "Old Way" (On-Premises):** The company had to buy powerful physical servers, storage disks, and networking equipment. This required a huge upfront investment, known as **Capital Expenditure (CapEx)**. They had to guess their peak traffic needs, often buying far more capacity than they used day-to-day, leading to wasted resources. If they needed a new server, the process of ordering, installing, and configuring it could take weeks or even months.
- **The "New Way" (Cloud Computing):** The cloud changes this model entirely. Instead of buying hardware, you rent computing power from a cloud provider (like AWS, Google, or Microsoft). This shifts the cost from a large upfront investment to a manageable monthly bill, known as an **Operational Expenditure (OpEx)**. This model eliminates guesswork, long waiting times, and wasted resources.

What is Cloud Computing?

Cloud Computing is a technology that allows you to store and access data and applications over the internet instead of using your computer's hard drive or a local server.

5 Core Characteristics of Cloud Computing

All cloud services share five fundamental characteristics that define them:

1. **On-Demand Self-Service:** Users can provision computing resources like servers and storage automatically, without requiring human intervention from the service provider.
2. **Broad Network Access:** Capabilities are available over the network and can be accessed through standard mechanisms by any device, such as laptops, tablets, and mobile phones.
3. **Resource Pooling:** The provider's computing resources are pooled to serve multiple customers using a multi-tenant model. Resources are dynamically assigned and reassigned according to demand.
4. **Rapid Elasticity (Scalability):** Resources can be scaled up or down quickly and, in some cases, automatically, to meet demand. This ensures you have enough power during traffic spikes and aren't paying for idle resources during quiet periods.
5. **Measured Service (Pay-as-you-go Model):** Cloud systems automatically control and optimize resource use. Usage is monitored, controlled, and reported, providing transparency for both the provider and the consumer. You only pay for what you use.

Types of Cloud Computing Services

The following are the types of Cloud Computing:

1. Infrastructure as a Service (IaaS)
2. Platform as a Service (PaaS)
3. Software as a Service (SaaS)
4. Function as as Service (FaaS)

Infrastructure as a Service (IaaS)

Infrastructure as a Service (IaaS) is a type of cloud computing that gives people access to IT tools like virtual computers, storage, and networks through the internet. You don't need to buy or manage physical hardware. Instead, you pay only for what you use.

Here are some key benefits of using IaaS:

- **Flexibility and Control:** IaaS comes up with providing virtualized computing resources such as VMs, Storage, and networks facilitating users with control over the Operating system and applications.
- **Reducing Expenses of Hardware**: IaaS provides business cost savings with the elimination of physical infrastructure investments making it cost-effective.
- **Scalability of Resources:** The cloud provides in scaling of hardware resources up or down as per demand facilitating optimal performance with cost efficiency.

Platform as a Service (PaaS)

Platform as a Service (PaaS) is a cloud computing model where a third-party provider offers the software and hardware tools needed to develop, test, and run applications. This allows users to focus on building their applications without worrying about managing servers or infrastructure

Here are some key benefits of using PaaS:

- **Simplifying the Development:** Platform as a Service offers application development by keeping the underlying Infrastructure as an Abstraction. It helps the developers to completely focus on application logic (Code) and background operations are completely managed by the AWS platform.
- **Enhancing Efficiency and Productivity:** PaaS lowers the Management of Infrastructure complexity, speeding up the Execution time and bringing the updates quickly to market by streamlining the development process.

Software as a Service (SaaS)

Software as a Service (SaaS) is a way of using software over the internet instead of installing it on your computer. The software is hosted by a company, and you can use it just by logging in through a web browser. You don't need to worry about updates, maintenance, or storage the provider takes care of all that.

A common example is Google Docs. You can write and share documents online without downloading any software.

Here are some key benefits of using SaaS:

- **Collaboration And Accessibility:** Software as a Service (SaaS) helps users to easily access applications without having the requirement of local installations. It is fully managed by the AWS Software working as a service over the internet encouraging effortless cooperation and ease of access.
- **Automation of Updates:** SaaS providers manage the handling of software maintenance with automatic latest updates ensuring users gain experience with the latest features and security patches.
- **Cost Efficiency:** SaaS acts as a cost-effective solution by reducing the overhead of IT support by eliminating the need for individual software licenses.

Function as a Service (FaaS)

Function as a service (FaaS) is a cloud-computing service that allows customers to run code in response to events, without managing the complex infrastructure. You just write the code, upload it and the cloud provider runs it only when it's needed. You pay only for the time your code runs.

Here are some key benefits of using FaaS:

- **Event-Driven Execution:** FaaS helps in the maintenance of servers and infrastructure making users worry about it. FaaS facilitates the developers to run code as a response to the events.
- **Cost Efficiency:** FaaS facilitates cost efficiency by coming up with the principle "Pay as per you Run" for the computing resources used.

Use Cases of Cloud Computing

Cloud computing is used across all industries for various applications:

- **Scalable Websites and Applications:** Host applications that can handle millions of users.
- **Data Storage, Backup, and Recovery:** Cost-effectively store vast amounts of data and ensure it can be recovered in case of a disaster.
- **Big Data Analytics:** Process and derive insights from enormous datasets efficiently.

- **Software Development and Testing:** Create and dismantle development environments quickly.
- **Artificial Intelligence and Machine Learning:** Access powerful GPU resources to train complex AI models.

Types of cloud deployment

- **Public cloud:**

  Services are available to the general public over the internet and are owned by a third-party provider.

- **Private cloud:**

  Infrastructure is dedicated to a single organization, which can manage it themselves or have a third party do so.

- **Hybrid cloud:**
  Combines both public and private clouds, allowing data and applications to be shared between them.

Amazon Web Services:-
Amazon Web Services (AWS) was started in 2006 to help companies avoid the high cost and effort of buying and managing their servers. Before AWS, businesses had to set up physical computers and storage to run websites or apps, which took time and money. AWS came into the market to solve this problem by offering these resources over the internet.

AWS and Its Core Capabilities
Amazon Web Services (AWS) is a cloud platform offered by Amazon that lets people and companies use IT services like storage, servers, and databases through the internet. Instead of buying and maintaining physical computers, you can "rent" these services online and only pay for what you use.
AWS offers over 200 services including:
- **EC2:** Virtual servers for running applications.
- **S3:** Object storage for files and media.
- **RDS:** Managed relational databases.
- **Lambda:** Run code without managing servers.

From startups to large enterprises like **Netflix**, **Airbnb**, and **NASA**, AWS is widely adopted for its flexibility, scalability, and security.

How AWS Delivers Cloud Services
Amazon Web Services (AWS) delivers cloud computing through a network of globally distributed data centers connected by high-speed fiber. These centers host a wide range of services from storage and compute power to databases and machine learning that users can access on demand via the internet.
Whether you are a startup or an enterprise, AWS allows you to build and run applications without managing physical servers. AWS handles:

- Server maintenance
- Security patching
- Resource scaling
- High availability.

Real-World Use Cases of AWS
AWS services are used by both startups and large enterprises based on their specific needs. Startups use AWS to overcome hardware infrastructure costs and deploy applications efficiently. Whereas large scale companies are using AWS cloud services for the management of their Infrastructure to completely focus on the development of products widely.

Google Cloud Platform (GCP):-
Google Cloud Platform (GCP) is a cloud computing service by Google that helps businesses, developers, and enterprises run applications, store data, and manage workloads on a secure, scalable, and high-performance infrastructure. Whether you're building a website, handling large datasets, or running AI models, GCP provides the tools and flexibility to do it efficiently.

What makes GCP stand out is its global network, strong security, and seamless integration with other Google services. It offers everything from virtual machines and Kubernetes for containerized applications to data analytics and machine learning tools like BigQuery and TensorFlow. Companies of all sizes use GCP to cut costs, improve performance, and scale their operations without worrying about server management.

Use Cases of Google Cloud Platform
Google Cloud Platform is well suited for the build and deploy and manage the applications.

- **E-commerce:** You deploy and manage the e-commerce websites by autoscaling and load balancing you can manage the millions of users and transactions.
- **Media and entertainment:** You can store the static and dynamic data can deliver it to the across the world with out any latency to the end users.
- **Financial services:** Google Cloud Platform is well suited for the sinical application because of the level of security it is offering.
- **Healthcare:** You can store the data of patient and take care the outcomes of the health of patient.

Why Choose Google Cloud Platform?
- GCP allows you to choose between computing, storage, big data, machine learning, and application services for your web, mobile, analytics, and, back-end solutions.
- It's global and it is cost-effective.
- It's open-source friendly.
- It's designed for security.

Microsoft Azure:-

Designed by Microsoft in 2010, Microsoft Azure is one of the widely used cloud computing platforms. Azure provides a wide variety of services such as cloud storage, compute

services, network services, cognitive services, databases, analytics, and IoT. It makes building, deploying, and managing applications very easy.

What is Azure?
Azure is Microsoft's cloud platform, just like Google has its Google Cloud and Amazon has its Amazon Web Services, or AWS. Generally, it is a platform through which we can use Microsoft's resources.

For example, to set up a huge server, we will require a huge investment, effort, physical space, and so on. In such situations, Microsoft Azure comes to our rescue. It will provide us with virtual machines, fast processing of data, analytical and monitoring tools, and so on, to make our work simpler. The pricing of Azure is also simpler and more cost-effective. Popularly termed as *"Pay As You Go"*, which means how much you use, pay only for that.

What Are the 3 Service Categories Provided by Microsoft Azure?
Microsoft Azure is a cloud computing platform that offers the following three categories of services:

- Infrastructure as a service (IaaS)
- Platform as a service (PaaS)
- Software as a service (SaaS)

What is Microsoft Azure Used For?
Following are the some the use cases that Microsoft Azure Used.

- **Deployment Of applications:** You can develop and deploy the application in the azure cloud by using the service called Azure App Service and Azure Functions after deploying the applications end users can access it.
- **Identity and Access Management:** The application and data which is deployed and stored in the Microsoft Azure can be secured with the help of Identity and Access Management. It's commonly used for single sign-on, multi-factor authentication, and identity governance.
- **Data Storage and Databases:** You can store the data in Microsoft azure in service like blob storage for unstructured data, table storage for NoSQL data, file storage, and Azure SQL Database for relational databases. The service can be scaled depending on the amount of data we are getting.

IBM Cloud:
IBM cloud is the cloud that is given by the IBM to their user it includes infrastructure as a service (IaaS), software as a service (SaaS) and platform as a service (PaaS) offered through public, private and hybrid cloud delivery models, in addition to the components that make up those clouds. Different services that are given by the IBM Cloud :

1. IAAS (infrastructure as a service)
2. SAAS (software as a service)
3. PASS (platform as a service)

How it works

- **Deployment:** Resources can be deployed across public cloud infrastructure, on-premises, or a combination of both.

- **Hybrid Cloud:** Businesses can use IBM Cloud to manage a mix of their own data centers and public cloud services.
- **Public Cloud:** Resources are made available to users over the public internet.
- **Private Cloud:** All resources are isolated and dedicated to a single customer, providing high security and control.

Key features-

- **Advanced Capabilities:** Offers advanced AI for analytics and automation, robust security, compliance, and data protection.
- **Industry Expertise:** Provides deep expertise across various industries and offers solutions for specific needs like finance or healthcare.
- **Scalability:** Designed to support both small development teams and large enterprise businesses, with globally deployed data centers.
- **Developer Tools:** Offers tools and services for building cloud-native applications, speeding up software delivery with DevOps, and managing data and AI.

IBM Bluemix was IBM's cloud computing platform as a service (PaaS) for building and managing applications, built on the open-source Cloud Foundry. It provided developers with tools and services to rapidly deploy and scale web, mobile, and other applications without managing the underlying infrastructure.