Question:

What is blockchain technology? Explain its features with a practical example.

Answer:

Blockchain is a **decentralized digital ledger** that records transactions transparently and immutably across a distributed network. Each block contains transaction data, a timestamp, and a cryptographic hash linking it to the previous block, ensuring security and integrity. For example, **Bitcoin** uses blockchain to allow users to transfer digital currency without a central authority. Every transaction is recorded permanently and can be tracked by anyone, preventing tampering and fraud. geeksforgeeks +1

Question:

How is data stored in a blockchain? Illustrate with examples.

Answer:

Data in blockchain is stored in blocks linked chronologically. Small, essential data such as transaction details or smart contract variables are stored **on-chain** for security and transparency. For instance, **Ethereum smart contracts** store critical contract data directly on the blockchain. Larger files, like images or medical records, use **hybrid storage**, with references stored on-chain and actual data off-chain. An example is **Filecoin**, which uses blockchain to record file metadata and off-chain storage for large files. upgrad

Applications of Blockchain

Question:

Mention three real-world applications of blockchain with suitable examples.

Answer:

- **Finance:** Banks use blockchain for fast and secure cross-border payments, as seen with **Ripple**. webisoft
- **Healthcare:** Systems like **MedRec** store validated patient records, improving data privacy.
- **Supply Chain: IBM Food Trust** employs blockchain to trace food origins and movements from farm to table, ensuring transparency and safety. kanerika +1

Advantages and Disadvantages of Blockchain

Question:

Explain the advantages and disadvantages of blockchain technology with examples.

Answer:

Advantages:

- **Decentralization:** No single point of failure; e.g., **Bitcoin**, where the network is resistant to censorship. `delubac`
- **Transparency:** All transactions are recorded and viewable; e.g., public charity donations through **Binance Charity**.

Disadvantages:

- **Scalability:** Limited speed and size due to decentralized validation.
- **Energy Consumption:** Block validation—particularly in networks like Bitcoin—requires significant resources. `delubac`

Public vs. Private Blockchains

Question:

Compare public and private blockchains with examples.

Answer:

Public blockchains are open for anyone to participate and are highly decentralized; examples include **Ethereum** and **Bitcoin**. They offer transparency but sometimes sacrifice privacy and efficiency. **Private blockchains**, such as **Hyperledger** and **Corda**, restrict access to authorized users, offering higher speed and privacy but less decentralization. Financial institutions often use private blockchains for secure asset management. `investax +1`

Fundamental Pillars of Blockchain Technology

Question:

Describe the fundamental pillars of blockchain technology with real-world applications.

Answer:

The three pillars are:

- **Decentralization:** No central control, improving trust; e.g., **DeFi ecosystems** allow peer-to-peer financial transactions without banks.
- **Transparency:** All records are visible; e.g., **Georgia's government** uses blockchain for public land records.
- **Immutability:** Data, once entered, cannot be altered; e.g., **De Beers** tracks diamond origins to prevent fraud. `clustox`

Physical and Digital Money

Question:

Explain the differences between physical money and digital money with examples.

Answer:

Physical money refers to tangible currency such as coins and banknotes that people can hold and use for transactions, while **digital money** exists purely in electronic form and is used for online payments or transfers. `investopedia +1`

For example, paying with cash to buy groceries involves physical money, whereas transferring funds through a banking app represents digital money. Digital money includes cryptocurrencies, central bank digital currencies (CBDCs), and electronic payment systems like PayPal or mobile wallets. `testbook +1`

Digital money is more efficient for international transactions and enables features like instant transfer and easy storage in digital wallets, but it depends on technology and requires robust security measures. `cleartax +1`

Notable Cryptocurrencies

Question:

List and describe five notable cryptocurrencies and their unique features.

Answer:

- **Bitcoin (BTC):** The first cryptocurrency, known as digital gold, functions primarily as a store of value and medium of exchange. `investopedia`
- **Ethereum (ETH):** Supports smart contracts and decentralized applications, making it more functional than Bitcoin. `coinbase`
- **Tether (USDT):** A stablecoin pegged to the US dollar, used to reduce volatility in trading. `investopedia`
- **Solana (SOL):** Known for high transaction speed and low fees; used for decentralized applications. `investopedia`
- **Dogecoin (DOGE):** Originated as a meme coin but is now used widely for tipping and payments; notable for community-driven growth. `investopedia`
  These cryptocurrencies differ in their consensus mechanisms, use cases, and market capitalization, contributing various innovations to the digital asset ecosystem. `coinbase +1`

Bitcoin: From Bitcoin to Ethereum

Question:

Compare and contrast Bitcoin and Ethereum in terms of their purpose, technology, and examples of use.

Answer:

Bitcoin is designed as a store of value and medium of exchange, working as "digital gold" with a fixed supply and proof-of-work (PoW) consensus mechanism. `coinbase`
Ethereum, on the other hand, is a platform for decentralized applications (dApps) and smart contracts, using Ether as its native token. Ethereum is transitioning to proof-of-stake (PoS) for scalability and energy efficiency. `coinbase`
Example: Bitcoin is commonly used for wealth preservation and peer-to-peer payments, while Ethereum enables services like decentralized finance (DeFi) applications and NFT marketplaces due to its smart contract capabilities. `coinbase`

Concept of Hashing

Question:

Define hashing and explain its importance in computer science with real-life examples.

Answer:

Hashing is the process of generating a fixed-size output (a hash) from an input of variable size using mathematical hash functions. `geeksforgeeks`
It is important for fast data retrieval, security, and data integrity verification. For example, student roll numbers in universities or book numbers in libraries are unique identifiers created through hashing, allowing quick access and efficient storage. `hackerearth +1`
In computer science, hashing is crucial for implementing data structures like hash tables and securing passwords through cryptographic hashes. `geeksforgeeks`

Introduction to MD5 and SHA Algorithm

Question:

Discuss the differences between MD5 and SHA algorithms, including an example of each hash output.

Answer:

MD5 produces a 128-bit hash value and is known for speed but is now considered insecure due to vulnerabilities to collisions. `codesigningstore +1`
SHA (Secure Hash Algorithm) refers to a family of algorithms (SHA-1, SHA-2, SHA-3) that produce hash values of greater length (e.g., SHA-256 outputs 256 bits) and offer better security against attacks. `codesigningstore`
Example:

- An MD5 hash output for the word "hello": `5d41402abc4b2a76b9719d911017c592`
- A SHA-256 hash output for "hello": `2cf24dba5fb0a30e26e83b2ac5b9e29e1b161e5c1fa7425e73043362938b9824`. `codesigningstore`
  SHA is preferred for critical security functions such as verifying file integrity and storing secure passwords. `codesigningstore`

Generation of Hash Values using Java Cryptography Architecture API

Question:

Explain the process of generating hash values using the Java Cryptography Architecture API with a code example.

Answer:

To generate hash values in Java, use the `MessageDigest` class from the Java Cryptography Architecture API. geeksforgeeks
The following code demonstrates generating a SHA-256 hash for a string:

```java
import java.security.MessageDigest;

public class HashExample {
    public static void main(String[] args) throws Exception {
        String input = "example";
        MessageDigest md = MessageDigest.getInstance("SHA-256");
        byte[] hash = md.digest(input.getBytes());
        System.out.println(javax.xml.bind.DatatypeConverter.printHexBinary(hash));
    }
}
```

In this example, "example" is hashed using SHA-256, and the output is displayed as a hexadecimal string. geeksforgeeks