UNIVERSITY of NICOSIA

Session:

Introduction to Blockchain and Web3

We are here

Session	Session Name	Professor
1	Introduction to Blockchain and Web3	George Giaglis
2	Bitcoin and Digital Money	Garrick Hileman
3	Ethereum and Programmable Blockchains	Apostolos Kourtis
4	Digital Wallet Security and Privacy	Charles Guillemet **(Ledger)**
5	Decentralized Finance (DeFi)	Lambis Dionysopoulos
6	Prediction Markets	Apostolos Kourtis & Lambis Dionysopoulos
7	The Geopolitics of Cryptocurrency	Garrick Hileman
8	Tokenization and Stablecoins	Lambis Dionysopoulos & Lauren Berta **(Ripple)**
Advanced Track & MSc Students		
9	NFTs and Digital Ownership	Punk6529 & Mohsen El-Sayed **(Ledger)**
10	Regulation and Policy of Digital Assets	Jeff Bandman
11	Advanced Topics in Web3	Apostolos Kourtis
12	The Future: Convergence of Blockchain, AI, and IoT	George Giaglis

Session Objectives

By the end of this session, you will be able to:

- Understand the core principles of Web3, including decentralization and trustless systems.
- Differentiate centralized and decentralized models and their implications.
- Explain the three primary functions of money: Medium of Exchange, Unit of Account, and Store of Value.
- Analyze Bitcoin and Ethereum's roles in the evolution of digital money.
- Evaluate the trade-offs between centralization and decentralization in financial and digital ecosystems.
- Explore the significance of consensus mechanisms, including Proof of Work (PoW) and Proof of Stake (PoS), in securing blockchain networks.

Agenda

1. Towards a decentralized world
2. The functions of money
3. A short intro to Bitcoin and Ethereum
4. The 2024-2026 Landscape
5. Conclusions
6. Further Reading

Session: Introduction to Blockchain and Web3

1. Towards a Decentralized World

The prevalence of centralization

Definition: Centralization refers to the concentration of control under a single authority, ensuring efficiency but reducing resilience.

Examples of Centralized Systems:

- **Banks:** Control financial transactions, accounts, and credit issuance.
- **Data Storage:** AWS, Google Cloud, Microsoft Azure
- **Land Registries:** Maintain property ownership records in centralized government databases.
- **Social Media Platforms:** Moderate content, control user data, and monetize engagement.

Key Characteristics:

- **Efficiency:** Centralization streamlines decision-making and resource allocation.
- **Trust Dependency:** Users must rely on the honesty and security of central authorities.
- **Single Points of Failure (SPF):** If a central entity is compromised, the entire system is affected.
- **Regulatory and Political Influence:** Governments and corporations can enforce policies affecting access and privacy.

The risks of centralization

Trust Dependency: Users must rely on centralized entities to act ethically and securely. If these entities fail (e.g., corporate fraud, corruption, data manipulation), users suffer consequences.

- **Censorship & Control**: Centralized platforms can restrict access to financial services (e.g., de-platforming of payment processors banning accounts). Governments can impose financial surveillance, freezing assets or blocking transactions.
- **Security Vulnerabilities**: Large-scale hacks of centralized databases (e.g., 2017 Equifax breach exposing 147 million people's data or the Facebook-Cambridge Analytica scandal, misusing of personal data without consent).
- **Single Points of Failure (SPF):** If a centralized financial institution collapses (e.g., Lehman Brothers in 2008), it can cause a global economic crisis. Even cloud service outages can disrupt critical services across industries.
- **Systemic Risk:** Large centralized organizations hold disproportionate power over digital infrastructure. A failure in a major cloud provider (e.g., AWS, Google Cloud) can paralyze global services.

Lehman Brothers. This Photo by Unknown Author is licensed under CC BY-SA

The internet's evolution: Web1 → Web2 → Web3

Web1 (1990-2005) → **Read-Only:** The first version of the internet, defined by:

- Emails, static web pages and open protocols (e.g., HTTP, SMTP, FTP).
- Users could read and consume content but had limited interaction.

Web2 (2005-2020) → **Read-Write:** The era of centralized platforms:

- Rise of corporations controlling the internet (Google, Facebook, Amazon, etc.).
- User-generated content became dominant, but platforms controlled monetization and visibility.
- Data centralization led to privacy issues and platform-driven economies.

Web3 (2020+) → **Read-Write-Own:** The shift to decentralized digital economies:

- Blockchain-based applications (e.g., DeFi, NFTs, DAOs) remove intermediaries.
- Users have **ownership** over their data, digital assets, and online identities.
- Smart contracts enable automated, trustless transactions without centralized control

Key Difference:

Web3 combines **the openness of Web1** with **the interactivity of Web2**, while eliminating platform dominance.

Web3 Reimagines Digital Systems Around User Sovereignty

Web3 Principle	What It Means	Why It Matters
Permissionless Access	Anyone can participate without approval	Financial inclusion for the unbanked
Decentralization	No single point of control or failure	Resilience against censorship and attacks
Trustless Transactions	Verification through code, not institutions	Reduced counterparty risk
Transparency	Public, auditable transaction records	Accountability and fraud prevention
User Ownership	Assets controlled by private keys, not platforms	True digital property rights
Composability	Protocols can be combined like building blocks	Rapid innovation and interoperability

Blockchain: The backbone of Web3

A **blockchain** is a distributed ledger that records transactions across a network of computers. Once data is added, it becomes extremely difficult to alter, creating a permanent and verifiable record.

The first successful application of Web3 was in cryptocurrencies

- **Cryptocurrencies decentralize money**, removing the need for banks or other intermediaries – but, introducing new challenges along the way.
- **Blockchain technology enables decentralized & immutable record-keeping**, eliminating reliance on traditional centralized authorities for transaction verification.
- Beyond cryptocurrencies, **Web3 users can truly own digital assets**, such as (tokenized) art, music, and virtual real estate.
- As technology advances, tokenized digital goods and virtual worlds may enable **a fully decentralized virtual ecosystem**, where users control platforms, economies, and interactions through blockchain technology.

Bitcoin (2009)
The first blockchain, designed as a peer-to-peer electronic cash system

Ethereum (2015)
Extended blockchain capabilities with smart contracts and decentralized applications

Session: Introduction to Blockchain and Web3

2. The Functions of Money

Money Is a Social Technology for Coordinating Value

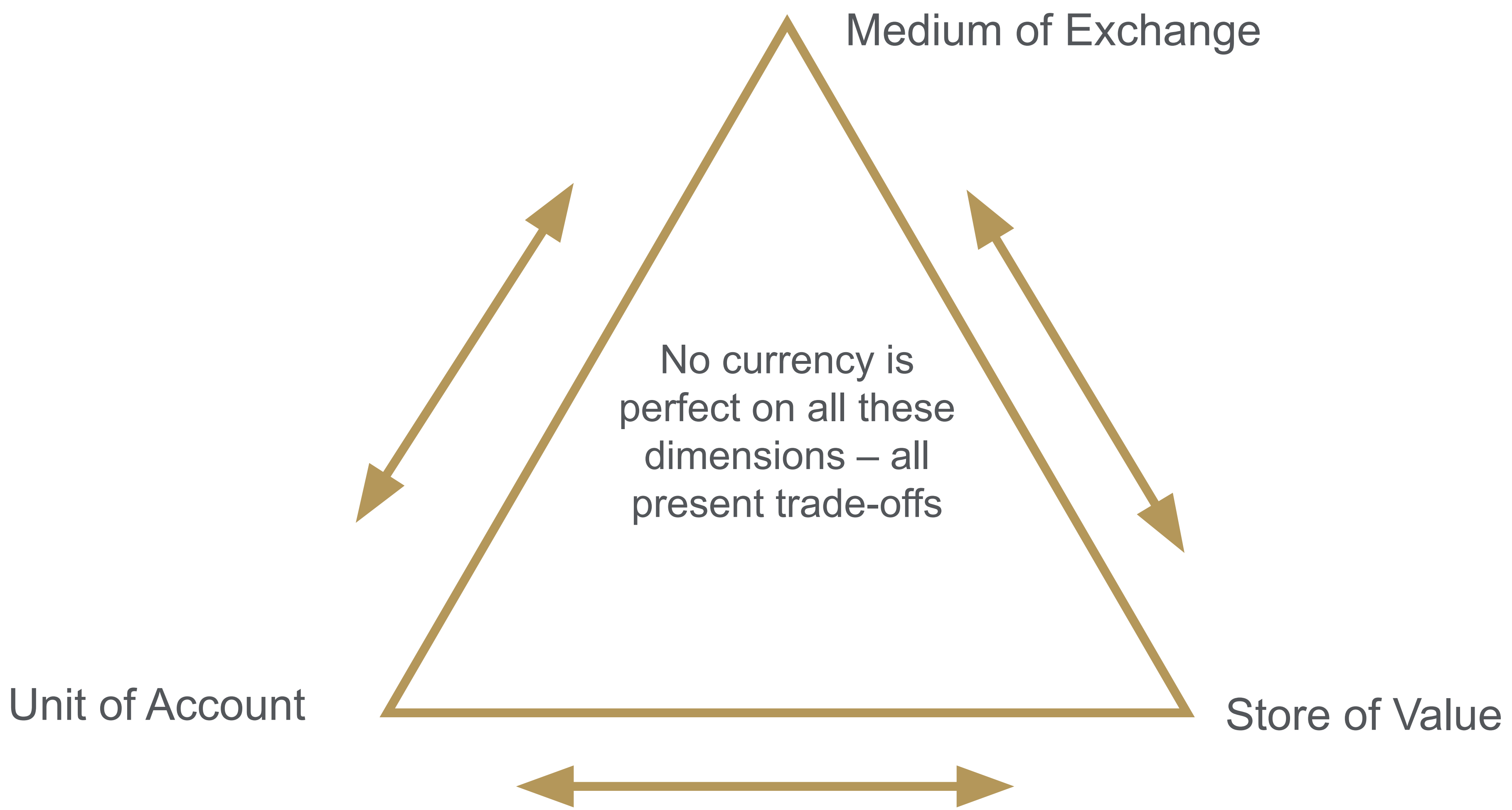
Money is not a fixed concept, it is a social technology that has evolved over millennia. From shells to gold to paper to digital entries, the form of money changes, but its core functions remain.

A Brief History:

- **Commodity Money:** Items with intrinsic value (gold, silver, salt)
- **Representative Money:** Paper backed by a commodity (gold standard)
- **Fiat Money:** Government-issued currency with no intrinsic value, backed by trust
- **Digital Money:** Electronic representations of fiat (bank deposits, mobile payments)
- **Cryptocurrency:** Natively digital money secured by cryptography and decentralized networks

The Key Question: Can Bitcoin and other cryptocurrencies fulfill the functions of money better than existing alternatives?

The 3 Main Functions of Money



What is a **Medium of Exchange**?

A **medium of exchange** is an asset used to facilitate the trade of goods and services.

- In modern economies, national (sovereign) currencies serve this function, replacing barter systems.

Key Properties of a Good Medium of Exchange:

- **Durability** – Must withstand wear and damage. Physical cash deteriorates, but digital currencies do not.
- **Transportability** – Should be easy to transfer. Digital transactions are faster than physical exchanges.
- **Divisibility** – Should be easy to break into smaller units. (E.g., 1 Bitcoin = 100 million satoshis.)
- **Fungibility** – Every unit should be identical and interchangeable. $1 = $1, regardless of serial number.
- **Non-counterfeitability** – Must be difficult to duplicate. Cryptocurrencies use cryptographic security to prevent counterfeiting.

Bitcoin is designed as a digital medium of exchange but faces challenges due to volatility and regulatory constraints.

What is a **Unit of Account?**

A **unit of account** is a standard measure of value used to price goods, services, and assets.

- In each currency zone, the dominant currency serves this role (e.g., USD in the U.S., EUR in the Eurozone).

Key Characteristics of a good Unit of Account:

- **Standardized Measurement** – Prices should be easily comparable across goods and services.
- **Stable Purchasing Power** – A good unit of account maintains a relatively stable value over time.
- **Widely Accepted** – Businesses and individuals must commonly use it for pricing and contracts.

Why Cryptocurrencies Struggle as a Unit of Account:

- **Volatility:** Prices fluctuate too much to provide a stable measure of value.
- **Limited Adoption:** Most goods and services are still priced in fiat currencies.
- **Regulatory Uncertainty:** Governments hesitate to recognize cryptocurrencies as official units of account.

Interestingly, some NFTs are priced in **ETH** rather than fiat, making Ethereum a limited-use unit of account in crypto markets.

What is a **Store of Value**?

A store of value (SoV) is an **asset that retains purchasing power over time**, allowing wealth to be saved and retrieved later. Examples include gold & precious metals, government bonds, real estate, etc.

Key Factors That Make a Good Store of Value:

- **Scarcity** – Limited supply prevents excessive devaluation (e.g., Bitcoin's 21 million cap, gold's finite availability).
- **Durability** – Must not degrade over time (e.g., gold vs. perishable goods).
- **Liquidity** – Should be easily tradable for goods and services (e.g., stocks, fiat currency).
- **Stability** – Predictable demand and supply trends maintain long-term value (e.g., real estate).

Bitcoin has been called "digital gold" due to its fixed supply and decentralized nature, though still volatile. Challenges of Bitcoin as SoV include **high volatility**, **regulatory risks**, and **network adoption**.

Is Cryptocurrency Money?

Cryptocurrencies aim to function as money but do not fully meet all criteria of traditional currencies.

Let's look at the example of Bitcoin:

- **Medium of Exchange**: Bitcoin enables transactions without intermediaries. However, high transaction fees and slow processing times limit its everyday use.
- **Unit of Account**: Prices are rarely quoted in Bitcoin due to its volatility. Even in El Salvador (where Bitcoin is legal tender), USD remains the dominant pricing unit.
- **Store of Value**: Bitcoin is often compared to gold due to its fixed supply (21 million BTC). However, price fluctuations make it a high-risk store of value.

Key Takeaway: Bitcoin has monetary properties but is **not widely adopted** as everyday money due to volatility and infrastructure limitations.

Can crypto become mainstream? Key adoption challenges

Regulatory Uncertainty:

- Governments struggle to classify cryptocurrencies as **currency** (unstable for everyday use), **investment assets** (subject to capital gains and other taxes), or **commodities** ("digital gold").
- Regulatory concerns also include Anti-Money Laundering (AML) & Know Your Customer (KYC) compliance, as well as potential **competition** with central bank digital currencies.

Key Takeaway: Governments & financial institutions **influence crypto's future**. Adoption will depend on **regulatory clarity and infrastructure improvements**.

Institutional Adoption:

- **Bitcoin ETFs & Corporate Holdings**: Companies like Tesla, MicroStrategy hold BTC as a **reserve asset**. Further, ETFs now allow traditional investors access to Bitcoin exposure.
- **Ethereum's Role in Financial Infrastructure**: Used in **stablecoins, DeFi, tokenized real-world assets (RWAs)**

Decentralization vs. Compliance Trade-Off:

- Full decentralization = No oversight, risk of illicit use.
- Regulated integration = More institutional trust, but risks centralization.

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3. A short intro to Bitcoin and Ethereum

Where it all started: Bitcoin

Bitcoin's core innovation is **the public blockchain**, a transparent, auditable ledger without a central authority.

How Bitcoin Works:

- Transactions are recorded on a **decentralized ledger** that anyone can verify.
- **Miners** validate transactions and add them to the blockchain using **Proof of Work**.
- No central issuer (e.g., no central bank controlling supply).

Why is This Important?

- Enables **trustless transactions** (no need to trust banks or governments).
- Reduces **counterfeiting risk** (transactions are cryptographically secured).
- Creates an **immutable financial record** (once recorded, transactions cannot be changed).

Key Difference from Traditional Finance:

- In banking, **a central authority (bank) maintains accounts**.
- In Bitcoin, **a decentralized network maintains the ledger**.

Bitcoin's Monetary Policy

Unlike fiat currencies, Bitcoin has a **fixed supply of 21 million coins**.

- New BTC is introduced through **mining rewards**, which are cut in half every ~4 years in an event called the **halving**.

Why Does This Matter?

- **Predictable Supply** – Unlike fiat currencies, Bitcoin's issuance is transparent and algorithmic.
- **Deflationary Tendency** – As supply issuance slows, some argue Bitcoin could increase in value over time.
- **Decentralized Governance** – Monetary policy is enforced by Bitcoin's code, not a central bank.

Comparison to Fiat Currencies:

- Central banks can print more fiat money, leading to inflation.
- Bitcoin supply is **fixed and cannot be increased**, making it resistant to devaluation.

Beyond Bitcoin: The evolution to Ethereum

Bitcoin introduced **decentralized digital money**, enabling trustless transactions.

- However, its **design prioritizes security and decentralization** over speed and scalability.
- The Bitcoin network is **limited to simple transactions** (sending & receiving BTC).

Ethereum expanded blockchain's capabilities, introducing:

- **Smart Contracts** – Programmable agreements that execute automatically.
- **Decentralized Applications (dApps)** – Software running on a blockchain.
- **New Consensus Models** – Transitioning from PoW to PoS for efficiency.

This way, Ethereum moved beyond digital money, creating an **open, programmable financial system**, allowing for **decentralized finance (DeFi), NFTs, and new economic models**.

Ether’s Monetary Policy

Unlike Bitcoin, Ethereum has **no fixed supply limit**.

- Instead, Ethereum introduced **EIP-1559**, which burns a portion of transaction fees to reduce Ether’s (ETH) supply.

How Ethereum’s Supply Works:

- New ETH is issued to **validators** (under **Proof of Stake**).
- **ETH is burned** via transaction fees, reducing overall supply.
- This creates **deflationary pressure**, depending on network activity.

Key Difference from Bitcoin:

- Bitcoin has a **hard supply cap**.
- Ethereum has a **dynamic supply mechanism** (inflationary or deflationary depending on network usage).

Consensus Algorithms: Securing Decentralized Networks

Consensus algorithms enable blockchains to function without central authorities. They determine **how transactions are verified** and **how new blocks are added** to the chain.

Bitcoin and Ethereum initially used Proof of Work (PoW), where **miners** compete to solve cryptographic puzzles, securing the network.

- **Strengths:** High security, decentralization | **Weaknesses:** Energy-intensive, limited scalability.

Ethereum then transitioned to Proof of Stake (PoS) in 2022 (Ethereum 2.0), where **validators** secure the network by staking ETH instead of using mining power.

- **Strengths:** More energy-efficient, faster transaction processing | **Weaknesses:** May favor wealthy participants.

In summary: PoW is more battle-tested but consumes more energy. PoS improves efficiency but may introduce new security concerns. Each consensus model has trade-offs between **security, decentralization, and scalability**.

Proof of Work (PoW) – Securing Bitcoin's blockchain

PoW relies on miners competing to solve complex mathematical puzzles. The first miner to solve the puzzle **adds the next block** and earns Bitcoin rewards.

Why PoW Works:

- **Security:** The cost of attacking Bitcoin is extremely high (requires 51% of mining power).
- **Decentralization:** No single entity controls mining (though large mining pools exist).
- **Immutable Ledger:** Altering past transactions requires re-mining all subsequent blocks, making attacks impractical.

Challenges of PoW:

- **Energy Consumption:** Bitcoin mining uses **more electricity than some countries** (e.g., Argentina).
- **Slow Transactions:** Bitcoin processes **~7 transactions per second (TPS)** (compared to Visa's 24,000 TPS).
- **Centralization Concerns:** Mining is increasingly concentrated in areas with cheap electricity.

Key Takeaway: PoW provides high security but sacrifices efficiency and sustainability.

Proof of Stake (PoS) – How Ethereum achieves consensus

Instead of mining, Ethereum now **selects validators** to propose and confirm blocks:

- Users **stake ETH** (lock funds) to become network validators.
- Validators **earn rewards** for confirming transactions.
- Malicious validators risk **losing their staked ETH (slashing penalty).**

Why PoS is an improvement:

- **Energy Efficiency:** PoS reduces Ethereum's energy use by **99.9%** compared to PoW.
- **Scalability:** PoS can handle thousands of transactions per second.
- **Lower Entry Barrier:** No need for expensive mining hardware—32 ETH is currently needed for solo validation; smaller amounts possible via staking services/pools

Challenges of PoS:

- **Wealth Concentration Risk:** Those with more ETH have **greater influence** over the network.
- **Security Debate:** Some argue PoS is **less secure** than PoW against certain attacks (e.g., long-range attacks).
- **Centralization Concerns:** Large staking providers (e.g., Lido, Coinbase) control significant amounts of staked ETH.

Key Takeaway: PoS is more efficient than PoW but raises questions about decentralization and governance.

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4. The 2024-2026 Landscape

2024 Marked a Turning Point for Institutional Adoption

In January 2024, the U.S. Securities and Exchange Commission (SEC) approved **spot Bitcoin ETFs for the first time**, allowing mainstream investors to gain Bitcoin exposure through traditional brokerage accounts.

Impact of ETF Approval:

- Over $30 billion flowed into Bitcoin ETFs in the first year
- BlackRock's iShares Bitcoin Trust (IBIT) became one of the fastest-growing ETFs in history
- Institutional adoption accelerated as pension funds and asset managers gained compliant access

Regulatory Clarity Is Emerging Globally

EU: Markets in Crypto-Assets (MiCA)

- Became fully applicable on December 30, 2024
- First comprehensive regulatory framework for crypto in a major economy
- Covers licensing, stablecoin requirements, and consumer protection

United States:

- Spot Bitcoin and Ethereum ETFs approved
- Ongoing debate on market structure legislation
- SEC vs. CFTC jurisdiction questions remain

Global Trends:

- Increased focus on stablecoin regulation
- AML requirements tightening
- Growing acceptance of crypto as a legitimate asset class

Current Market Snapshot- February 2026

Metric	Value	Context
Bitcoin Price	~$66,000	Down ~45% from October 2025 ATH of $127,000
Bitcoin Market Cap	~$1.5 trillion	Largest cryptocurrency by market cap
Total Crypto Market Cap	~$2.26 trillion	Down from ~$3.8 trillion peak
Bitcoin Dominance	~58%	> 50%
Active Bitcoin Addresses	~600000 daily	Network remains highly active

Despite recent price volatility, the underlying infrastructure, institutional adoption, and regulatory frameworks continue to mature.

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5. Conclusions

Summary

Centralization vs. Decentralization: Most of today's financial and digital systems are centralized, requiring trust in authorities. Decentralization removes intermediaries but introduces new challenges in governance and efficiency.

The Evolution of the Internet: From **Web1** (static, decentralized, open protocols) to **Web2** (platform-driven, centralized control and Big Tech dominance to **Web3** (blockchain-based, user-controlled digital ecosystems).

The Functions of Money & Cryptocurrency's Role

- **Medium of Exchange**: Bitcoin enables global transactions but faces scalability issues.
- **Unit of Account**: Crypto pricing is rare due to volatility, except in niche cases (e.g., NFTs in ETH).
- **Store of Value**: Bitcoin is seen as "digital gold," but its long-term stability is debated.

Bitcoin vs. Ethereum: Key Differences

- **Bitcoin**: Focuses on security and decentralization, using **Proof of Work (PoW)**.
- **Ethereum**: Supports smart contracts and dApps, now using **Proof of Stake (PoS)** for efficiency.

Concluding Thoughts

As we conclude this first week, we saw how **blockchain technology and cryptocurrencies represent a fundamental shift in how we think about money, trust, and digital interactions**. Traditional financial and information systems have long relied on central authorities—banks, corporations, and governments—to facilitate transactions and verify records. While this centralized model has provided efficiency and stability, it has also introduced significant challenges related to censorship, security vulnerabilities, and single points of failure.

Bitcoin, the first successful implementation of a decentralized currency, emerged as an alternative to traditional financial systems. It enables peer-to-peer transactions without intermediaries, secured by cryptographic proof rather than institutional trust. However, Bitcoin's reliance on Proof of Work (PoW) introduces scalability and energy consumption concerns, prompting the search for alternative consensus mechanisms.

Ethereum extended blockchain's potential beyond digital money, introducing smart contracts and decentralized applications (dApps). With its transition from PoW to Proof of Stake (PoS), Ethereum aims to improve transaction efficiency and reduce environmental impact, though concerns around validator centralization and governance remain.

These two networks—Bitcoin and Ethereum—serve as the foundation of **Web3**, an evolving digital landscape where users have more control over their assets, data, and online interactions. Understanding the trade-offs between centralization and decentralization is crucial. **While decentralized networks promise greater transparency, security, and resistance to control, they also face significant challenges in governance, usability, and regulatory adaptation**. As Web3 technologies develop, we will continue to explore how they shape financial systems, online economies, and the broader internet. This course will dive deeper into these transformations, analyzing their real-world applications, limitations, and future potential.

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6. Further Reading

Further Reading

Foundational Texts:

- **Nakamoto, S. (2008). Bitcoin whitepaper.**
- **Buterin, V. (2013). Ethereum white paper. GitHub repository, 1(22-23), 5-7.**

Other Resources:

- **Nick Szabo : Shelling Out – The Origins of Money**
- **Money in the Modern economy: An Introduction (Bank of England)**
- **Andreas Antonopoulos: "Mastering Bitcoin, Unlocking Digital Crypto-Currencies"**

  (book available for purchase, but also in Github for public feedback and contribution)
- **The Evolution of International Money Transfers – From Barter to Bitcoins**

Questions?

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