Ethereum
Module I

Agenda

Module I

Intro

Key Concepts

Module II

Solidity

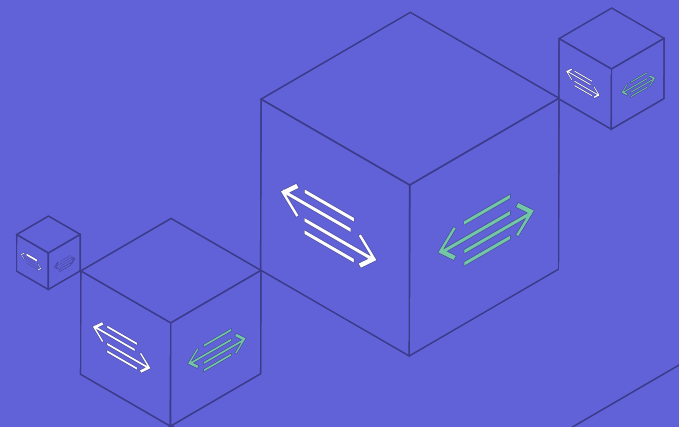
Hands-on

Module III

Web 3

Hands-on

Demo



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Why Ethereum?

Open source

Broad commercial adoption

Community

Lower technical entry barrier

Smart contract development

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History

- Adding Scripting language to expand Bitcoin Blockchain uses

  -> Rejected
- New platform
- 01/2014 Core Ethereum team

  Vitalik Buterin

  Mihai Alisie (Akasha)

  Anthony Di Iorio (Jaxx)

  Charles Hoskinson (Cardano)

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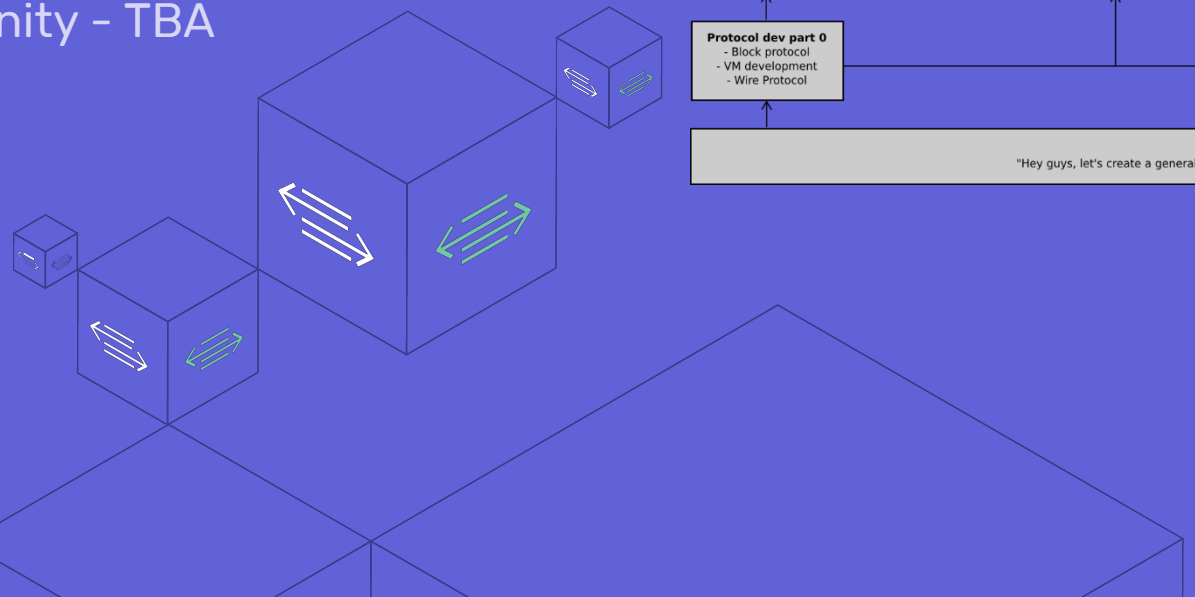
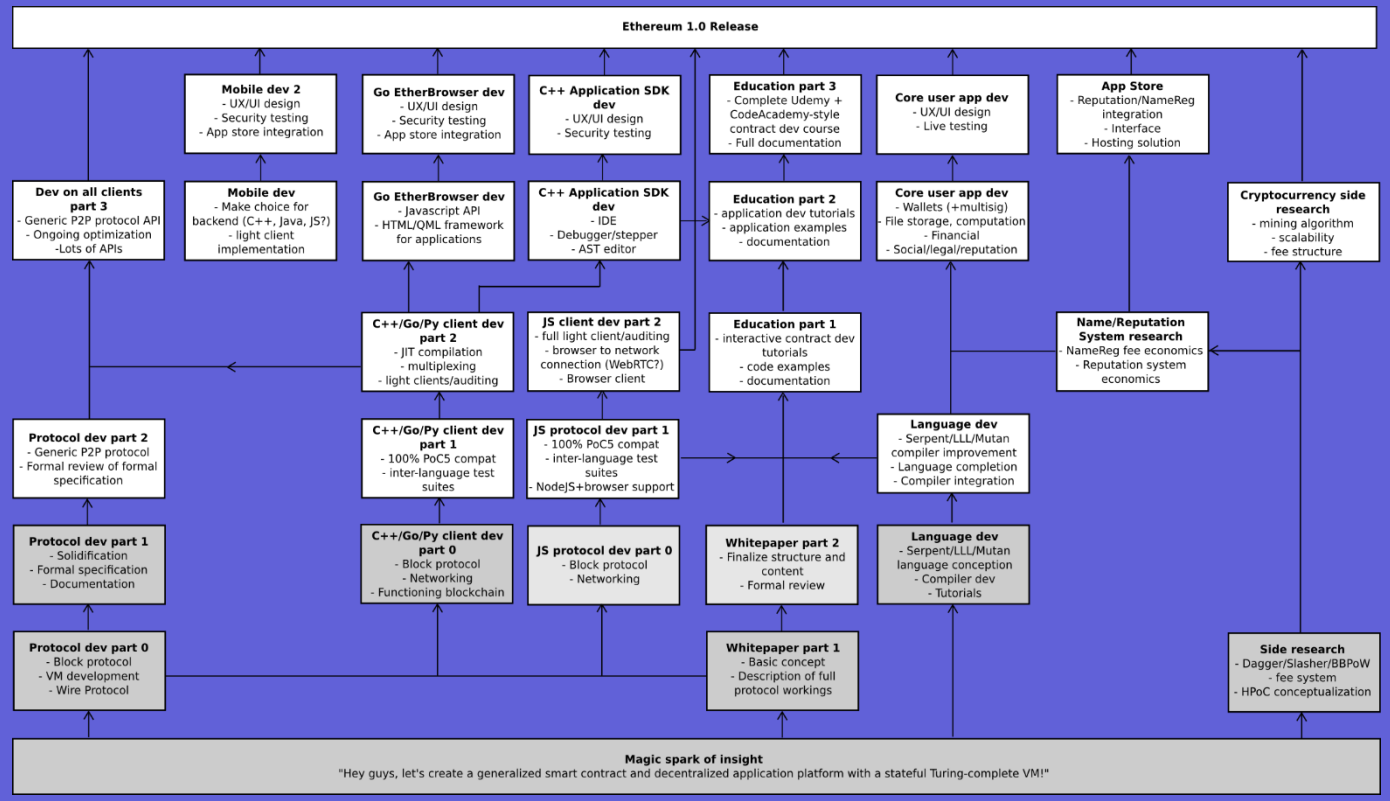
Releases

- Olympic – 05/2015
- Frontier – 06/2015
- Homestead – 03/2016
- Metropolis (vByzantium) – 10/2017
- Metropolis (vConstantinople) - TBA
- Serenity - TBA





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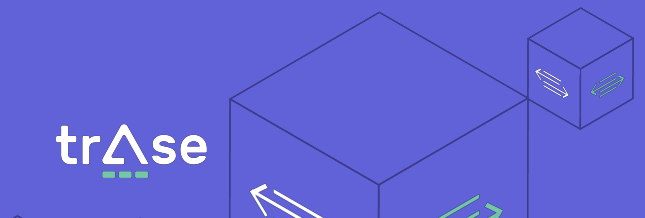
Ether

- Cryptocurrency
- Block time 14-15 seconds
- Balance model vs UTXO
- Replay attack protection in Balance model



Ether Denominations

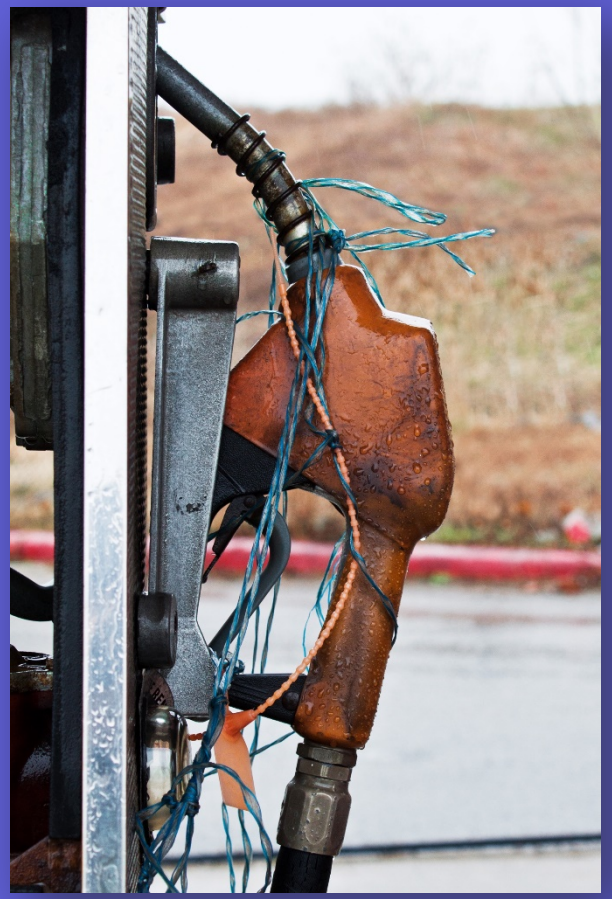
Unit	Wei Value	Wei
wei	1 wei	1
Kwei (babbage)	1e3 wei	1,000
Mwei (lovelace)	1e6 wei	1,000,000
Gwei (shannon)	1e9 wei	1,000,000,000
microether (szabo)	1e12 wei	1,000,000,000,000
milliether (finney)	1e15 wei	1,000,000,000,000,000
ether	1e18 wei	1,000,000,000,000,000,000

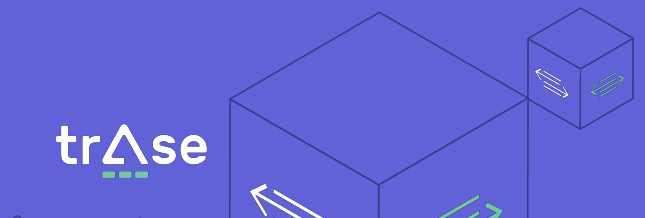
GAS – Payment model

Protect against attacks

Computation Memory Bandwidth Storage

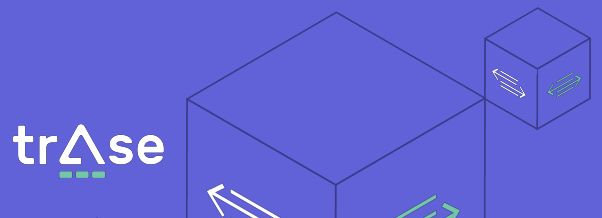
Rollback





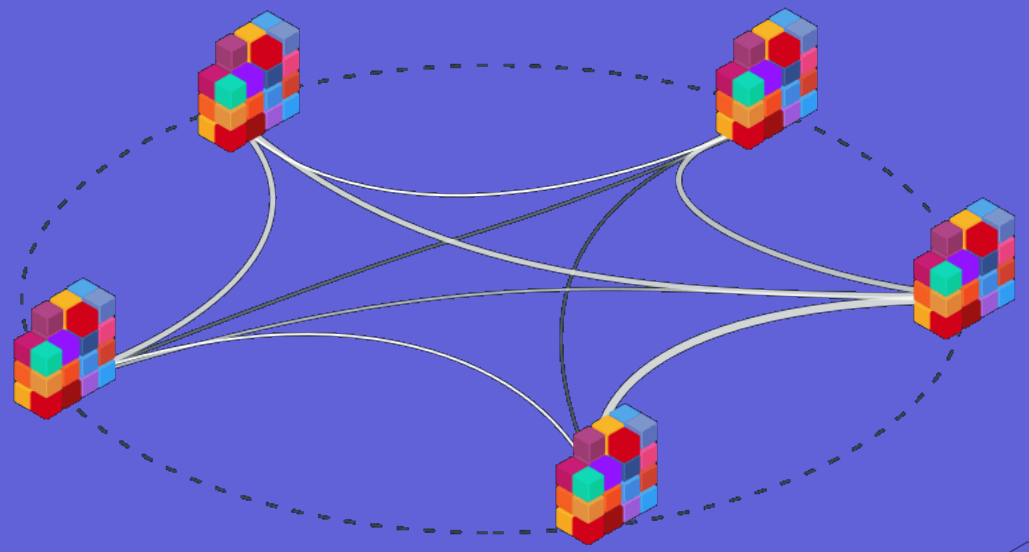
GAS – Calculate fees

Gas price	Startgas	Gasprice
Too low	Not sent to miners	No work done by miners
Low	Out-of-gas error	Mined slower
Medium	Ideal	Ideal
High	Delay in getting mined	Mined faster
Too high	Exceed block gas limit	Not sent to miners if sender is out of funds



Decentralized Applications

Decentralized applications (dApps) are applications that run on a P2P network of computers rather than a single computer.



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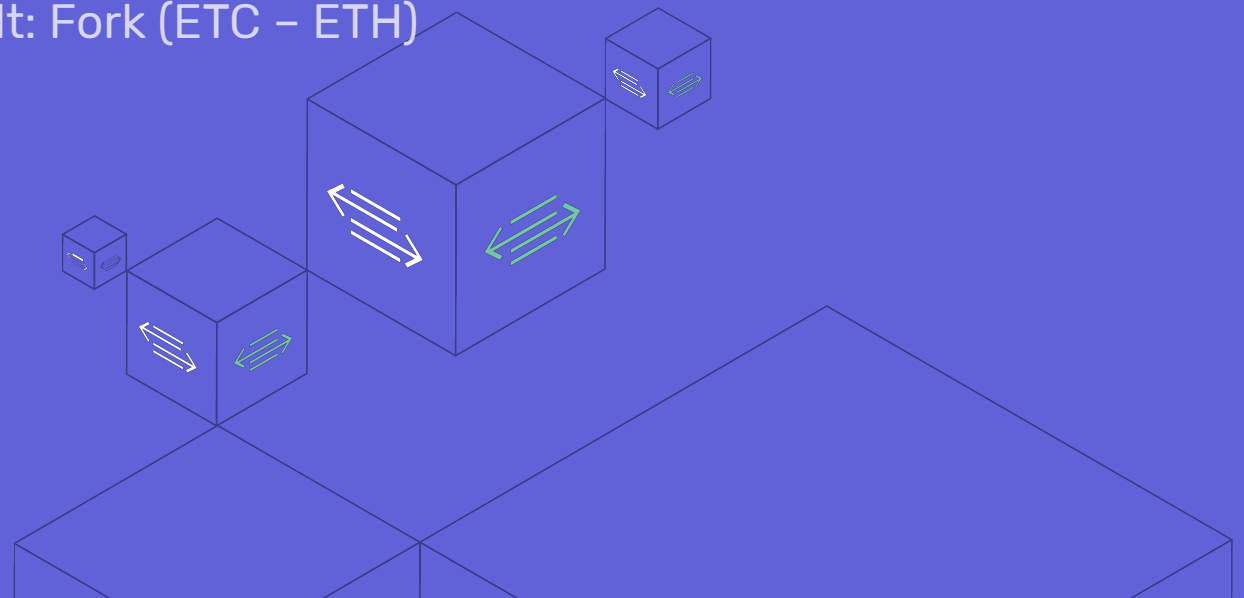
The DAO

- Decentralized Autonomous Organization
- Venture Capital Fund, stateless -> regulation?
- 28 days crowdfunding, $150 million
- Security flaws

  - Recursive Calls

Result: Fork (ETC – ETH)



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Consensus - Proof Of Work

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Consensus - Proof Of Work

- Why?
  - Distributed trustless consensus
  - Remove malicious/faulty transactions
  - Limited supply, monetary benefit

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Consensus - Proof Of Work

- How?

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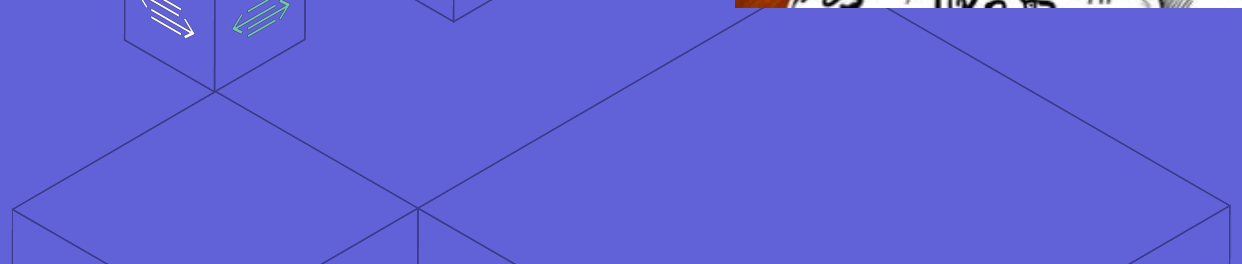
Consensus - Proof Of Stake

- Stake
- Miner – Forger
- More stake = more chance
- Degree of luck
- Incentive: fees vs new currency



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Consensus - Proof Of Stake

Advantages:

- Less Energy
- Security
- Decentralization

Disadvantages:

- Nothing at Stake

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Casper Protocol

Helps achieve decentralization

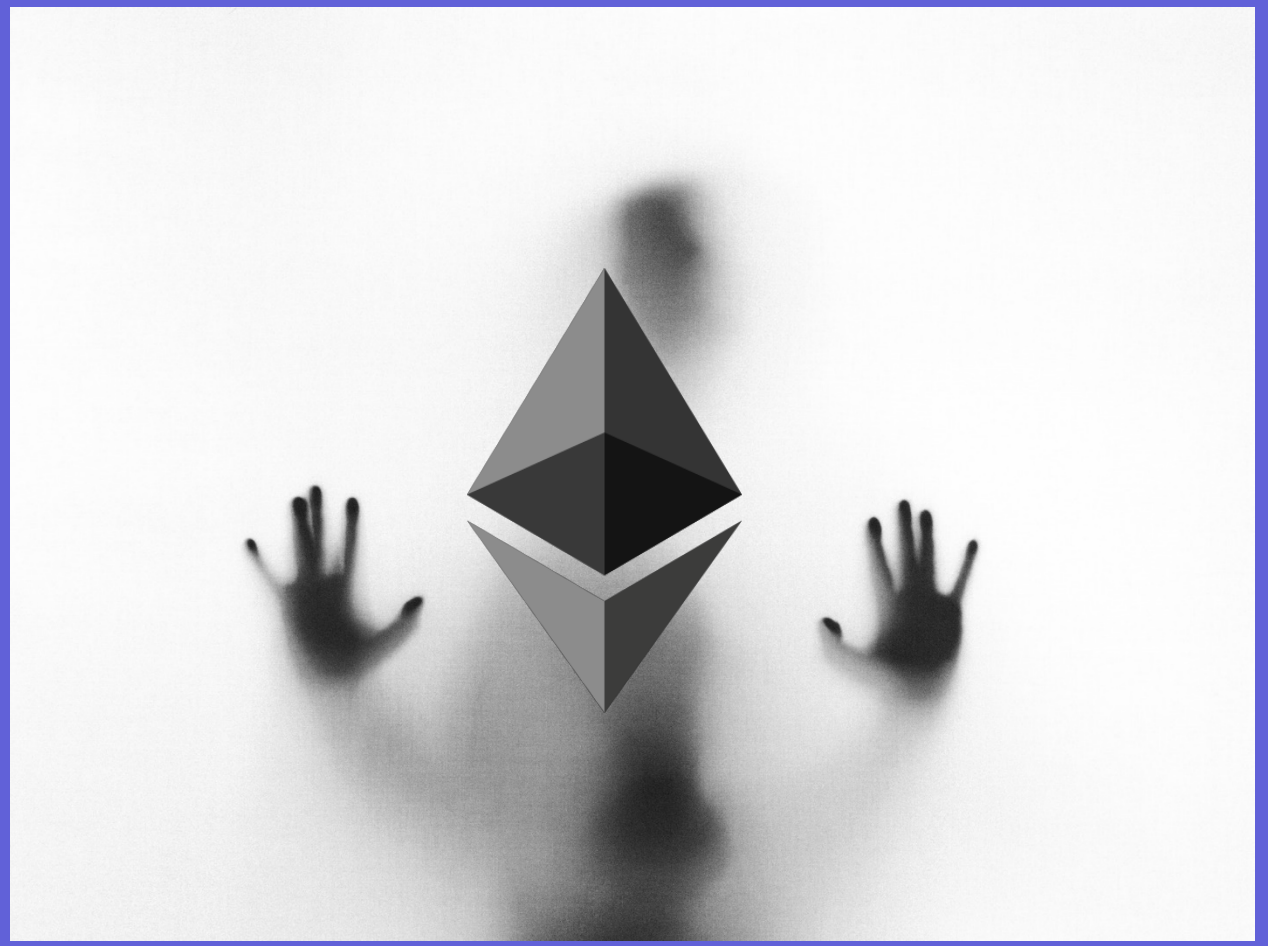
Energy efficiency

Economic security

Scaling

Transition to POS

Sharding



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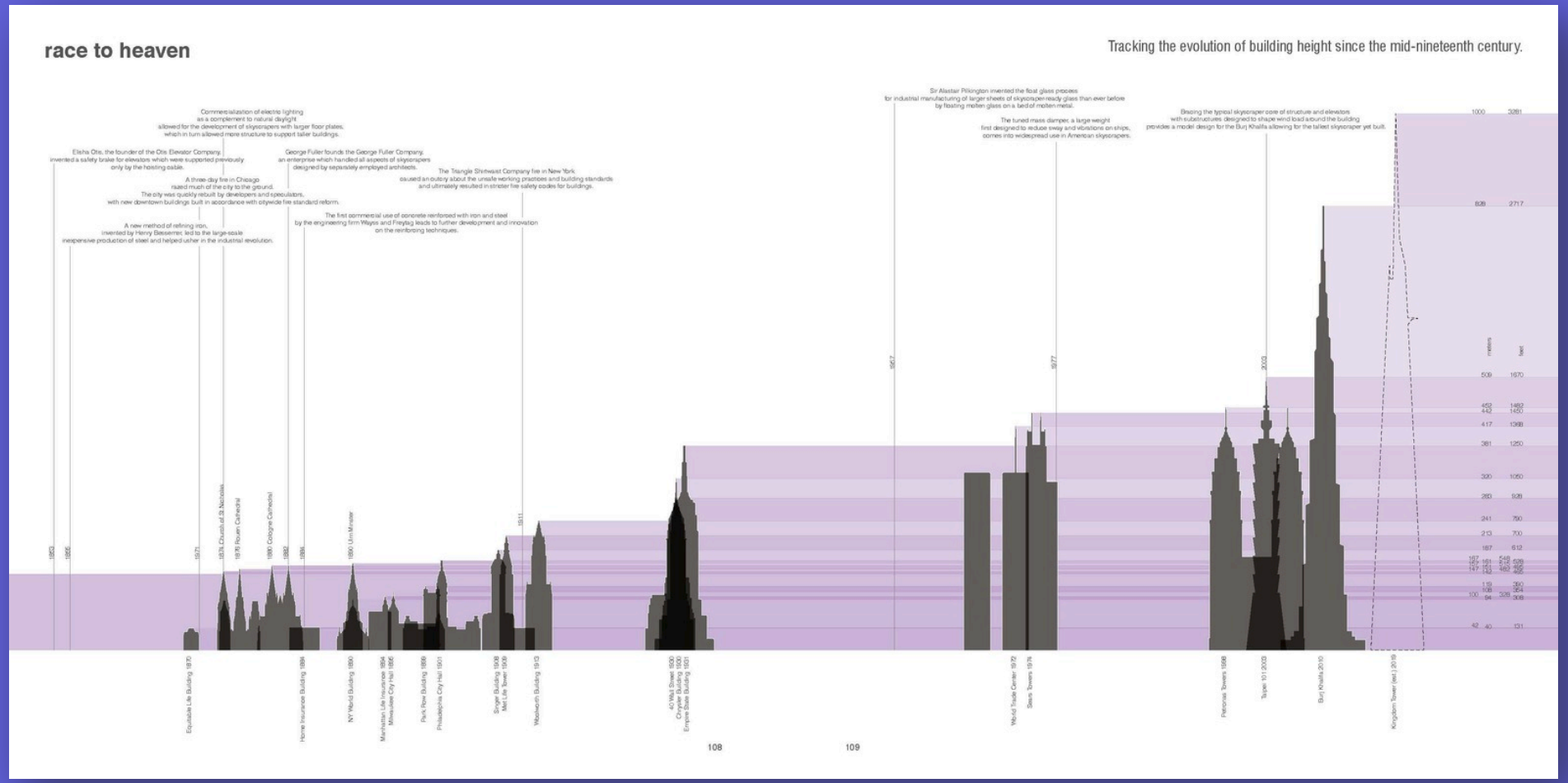
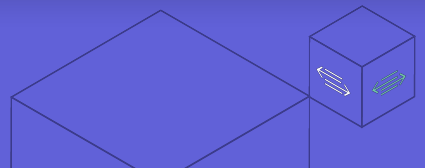
A word on scaling





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Key Concepts

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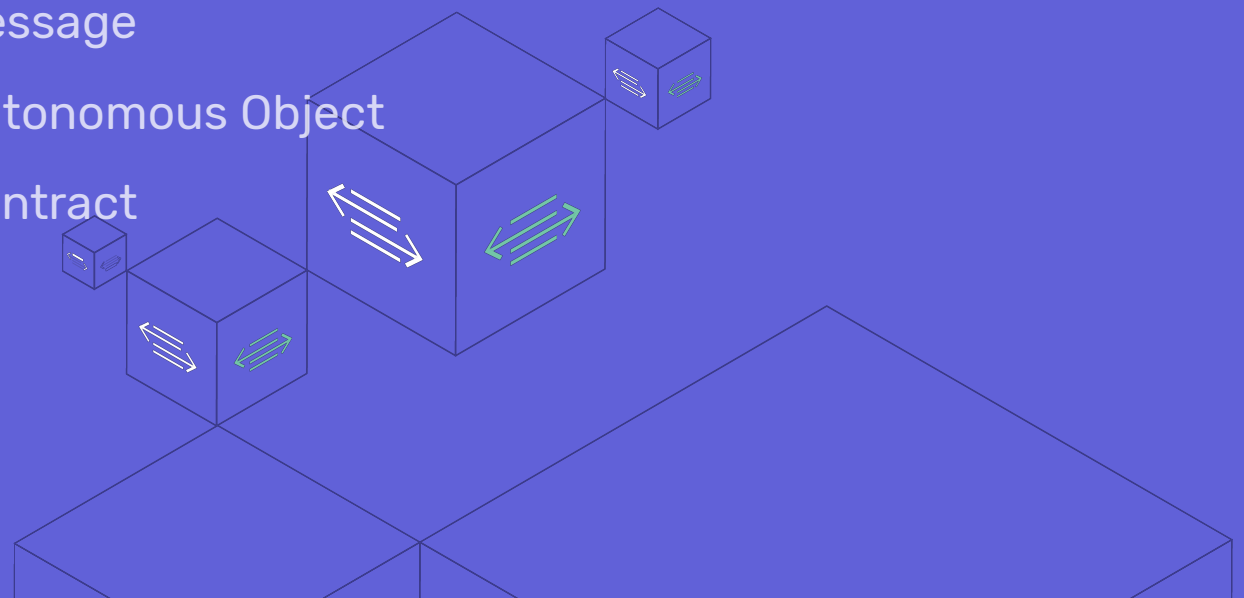
Important Keywords

- Hash
- Tuple (!= C# tuple)
- Account Nonce
- Uncle
- Gas
- Message
- Autonomous Object
- Contract



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Hashes

- Arbitrary input
- Output fixed length
- Small chance of collisions
- In Ethereum: Keccak-256
- 1 small change

  —> Generates new hash

Input	Output
“Vitalik” —>	2b6ab720e1 69042d13b3c d63cc64db9e
“Vitaliik” —>	a323ddd0f65 285828fa774 c78eb3af84

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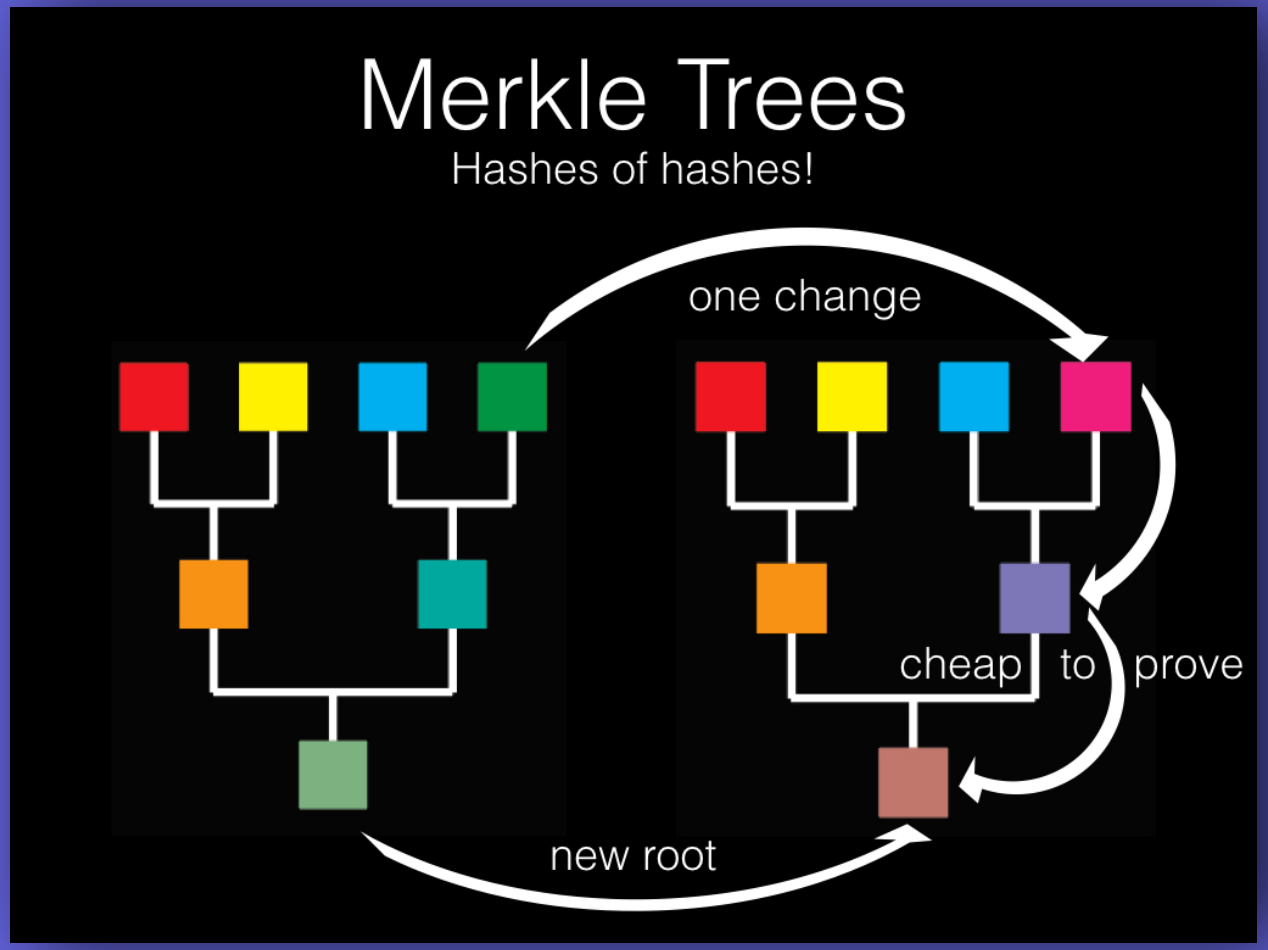
Merkle trees

- Root hash
- Changes are reflected throughout the tree
- Only keep the new part
- Merkle proof
- Ethereum: Patricia tree



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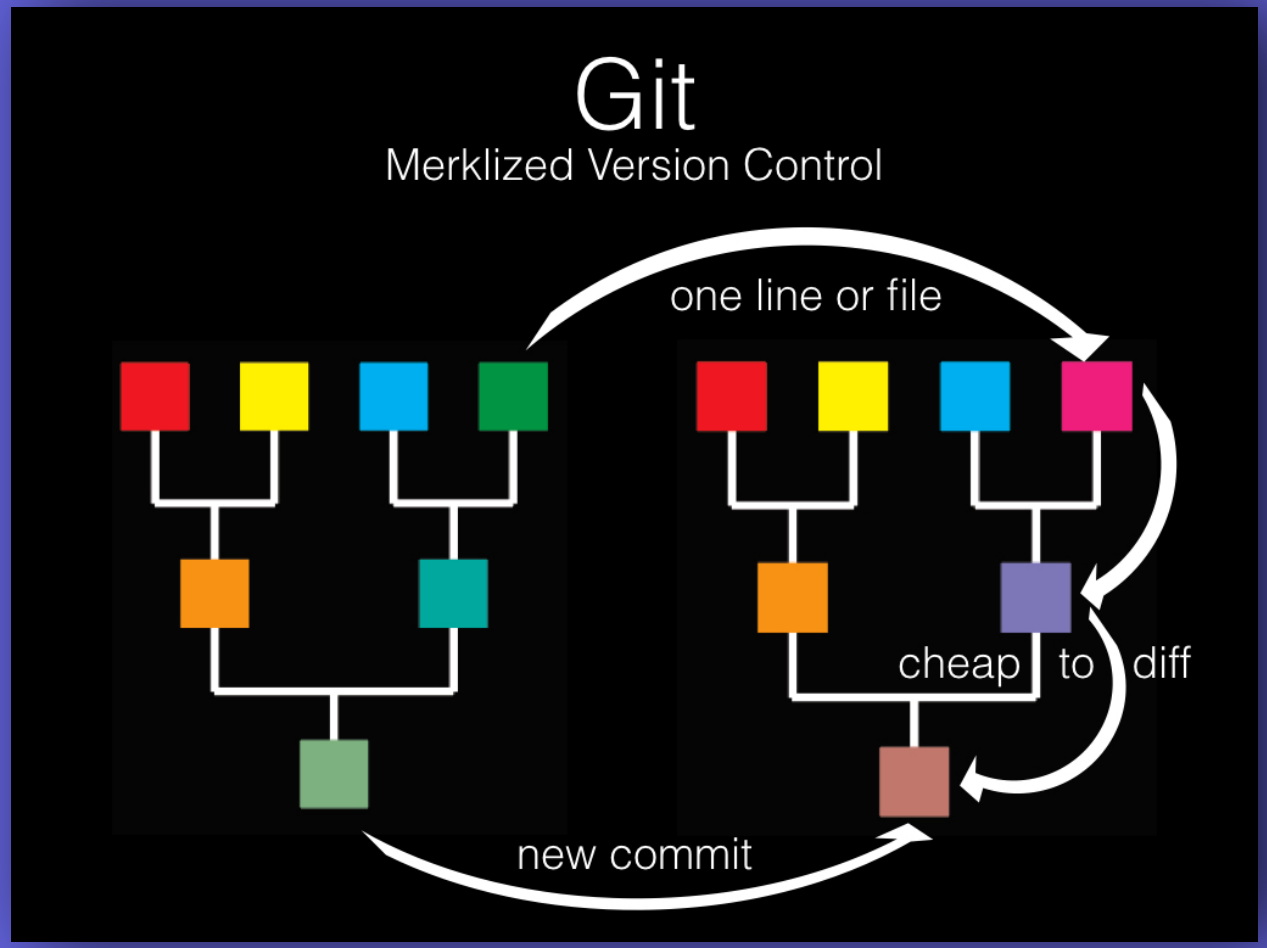
Merkle trees

- Root hash
- Changes are reflected throughout the whole tree
- Merkle proof



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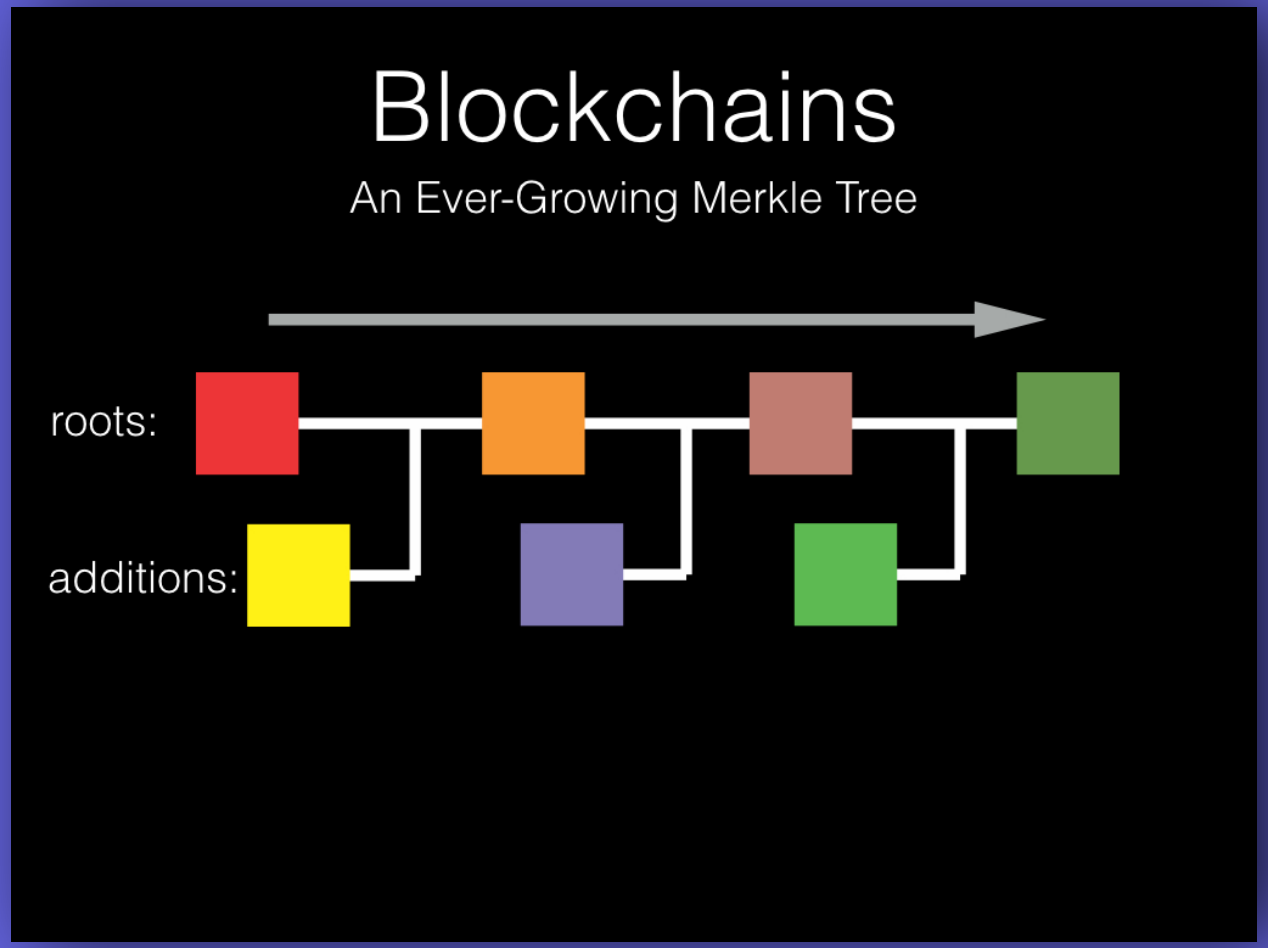
Blockchains

- Hash + hash = new root hash (new block)
- Full history is available
- Synchronized – specific ordering
- No “double spend”



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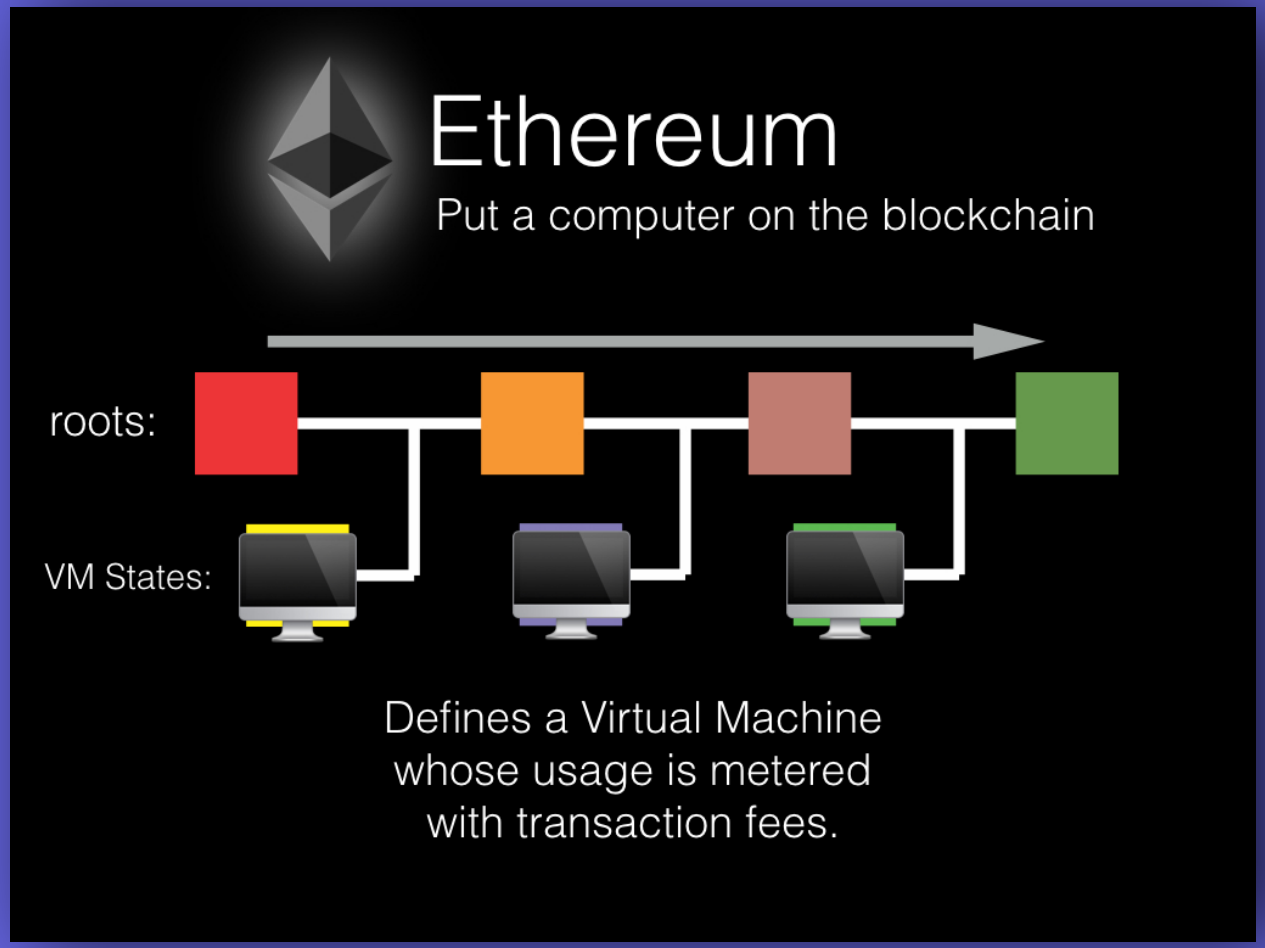
Ethereum

- Bitcoin —> Transactions
- Ethereum —> VM States
  - State updates (Computer operations)



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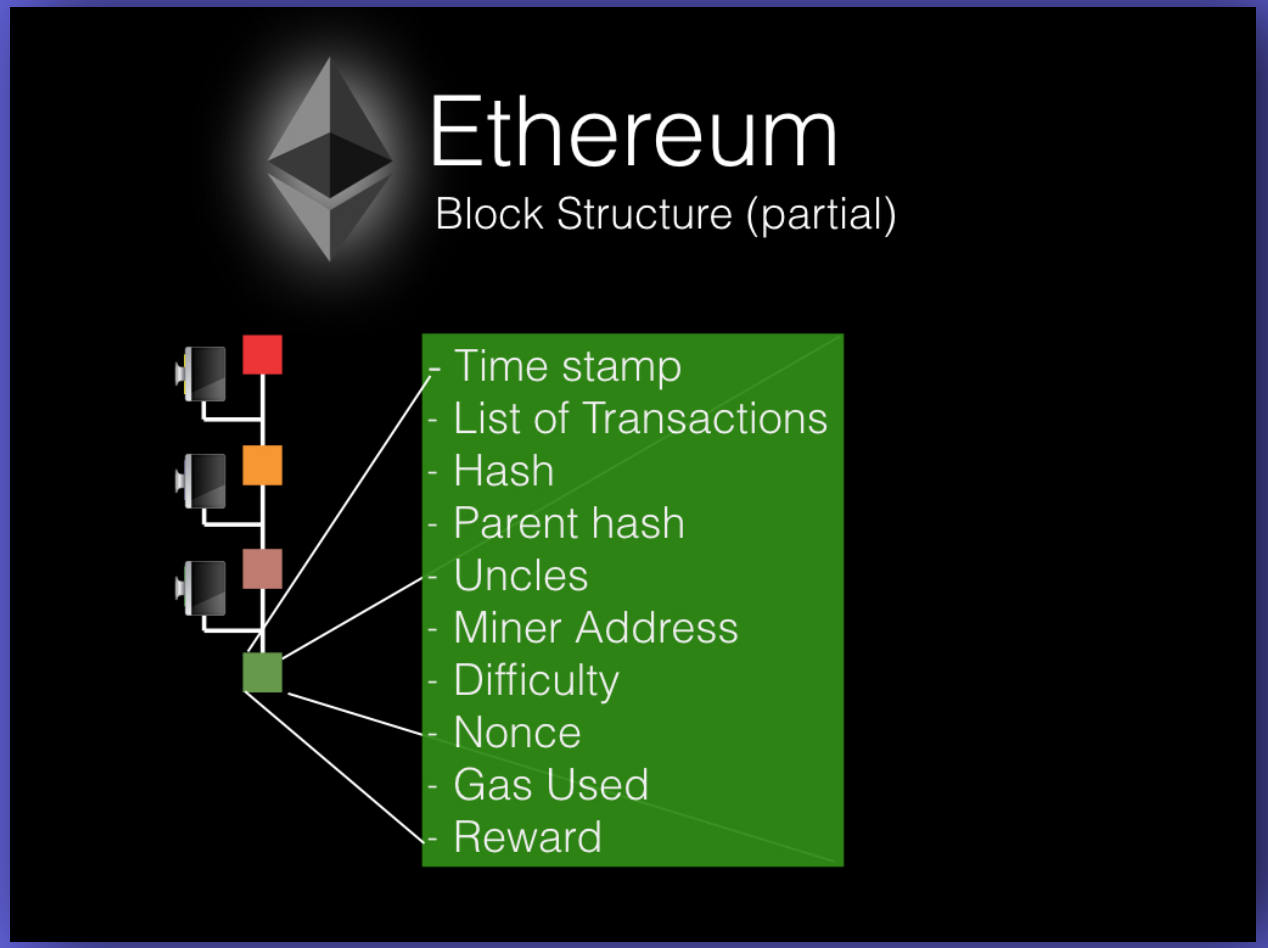
Block overview



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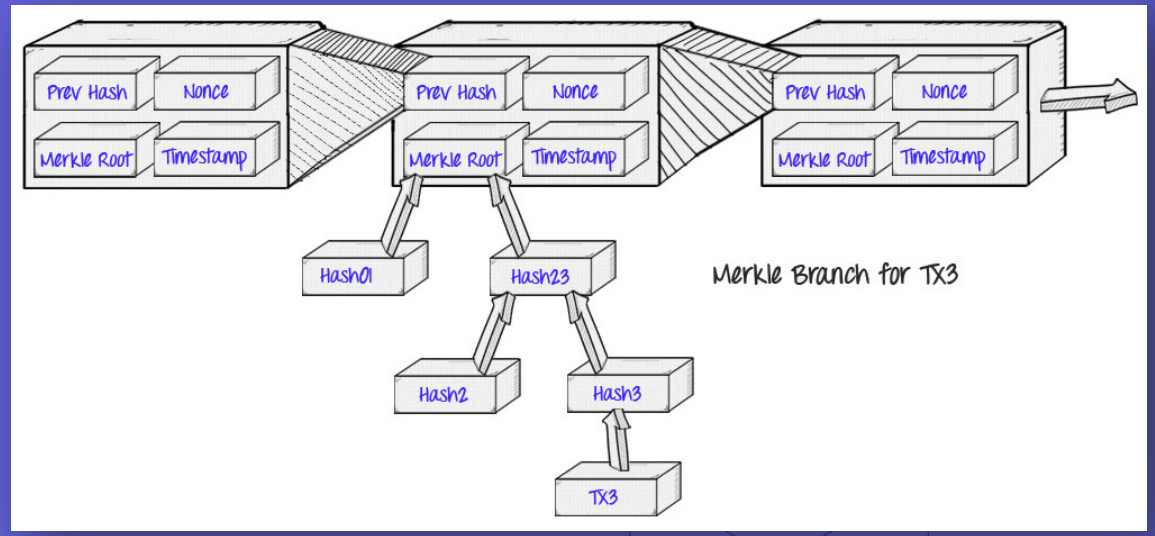
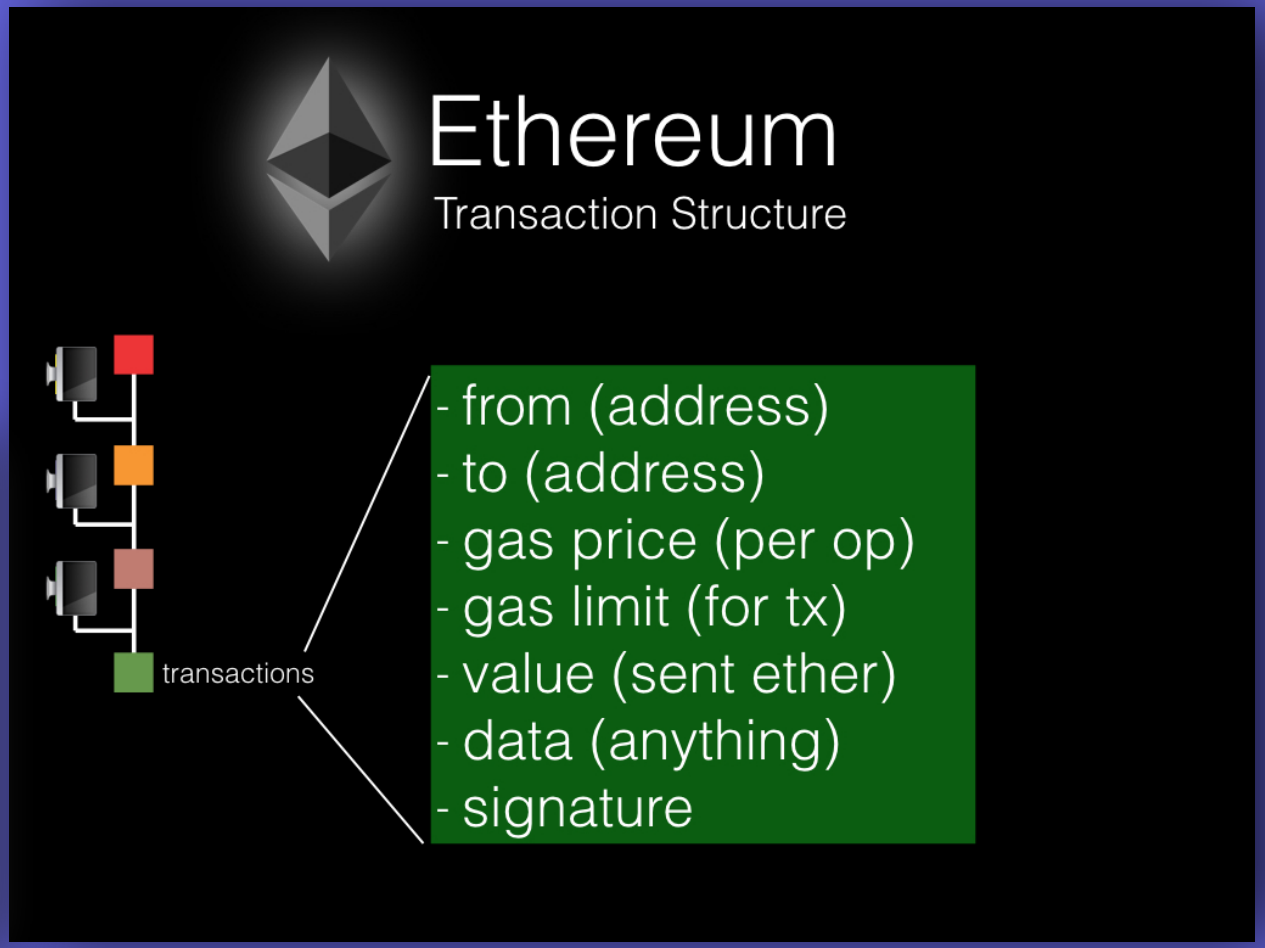
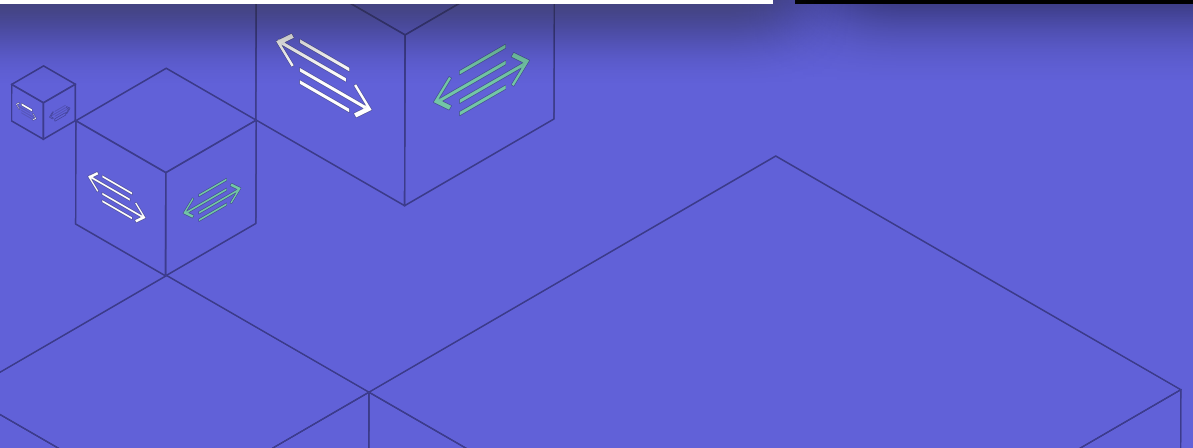
Transaction overview







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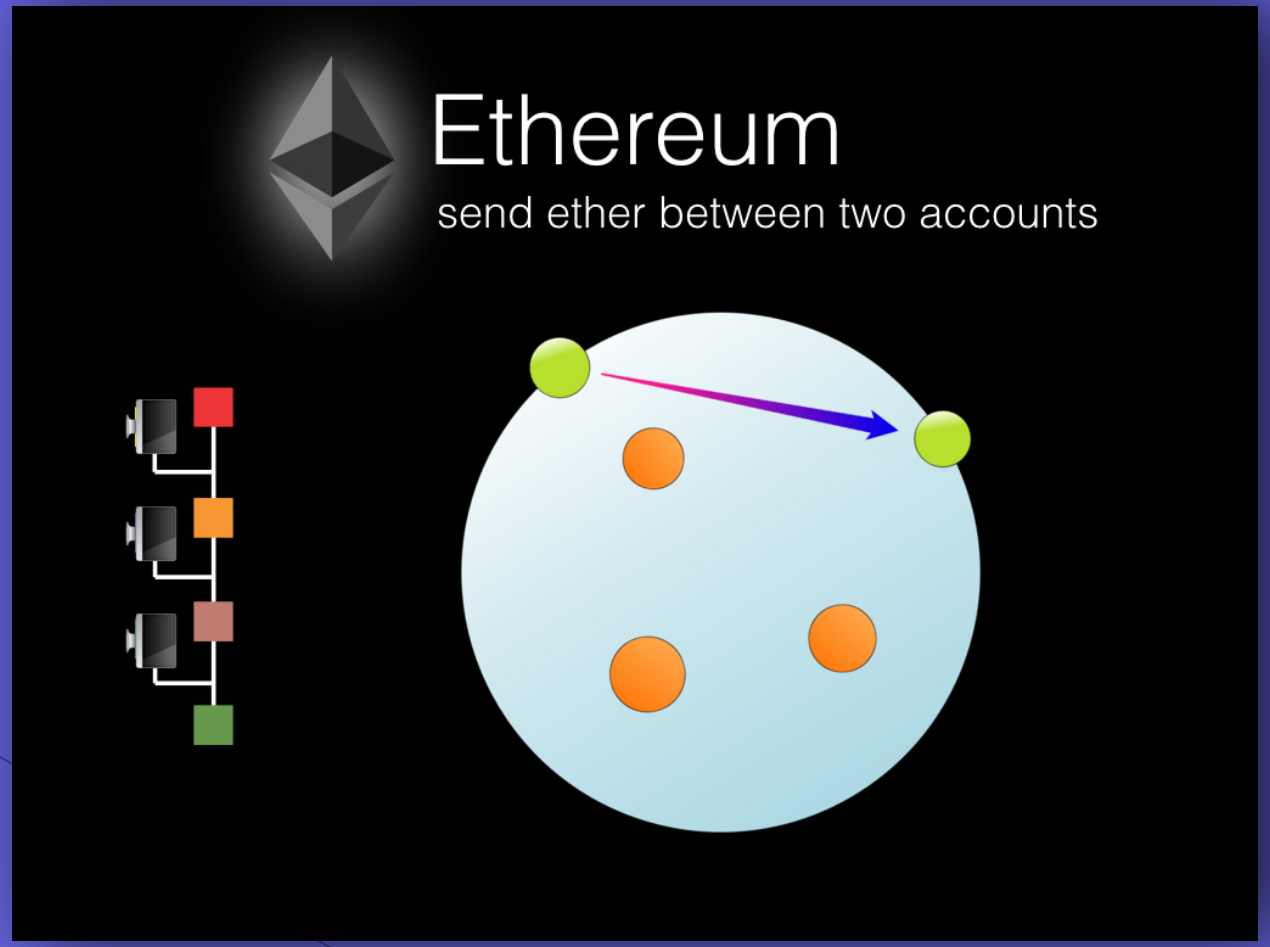
Transactions & Smart Contracts

- Transactions between accounts accounts (ETH)



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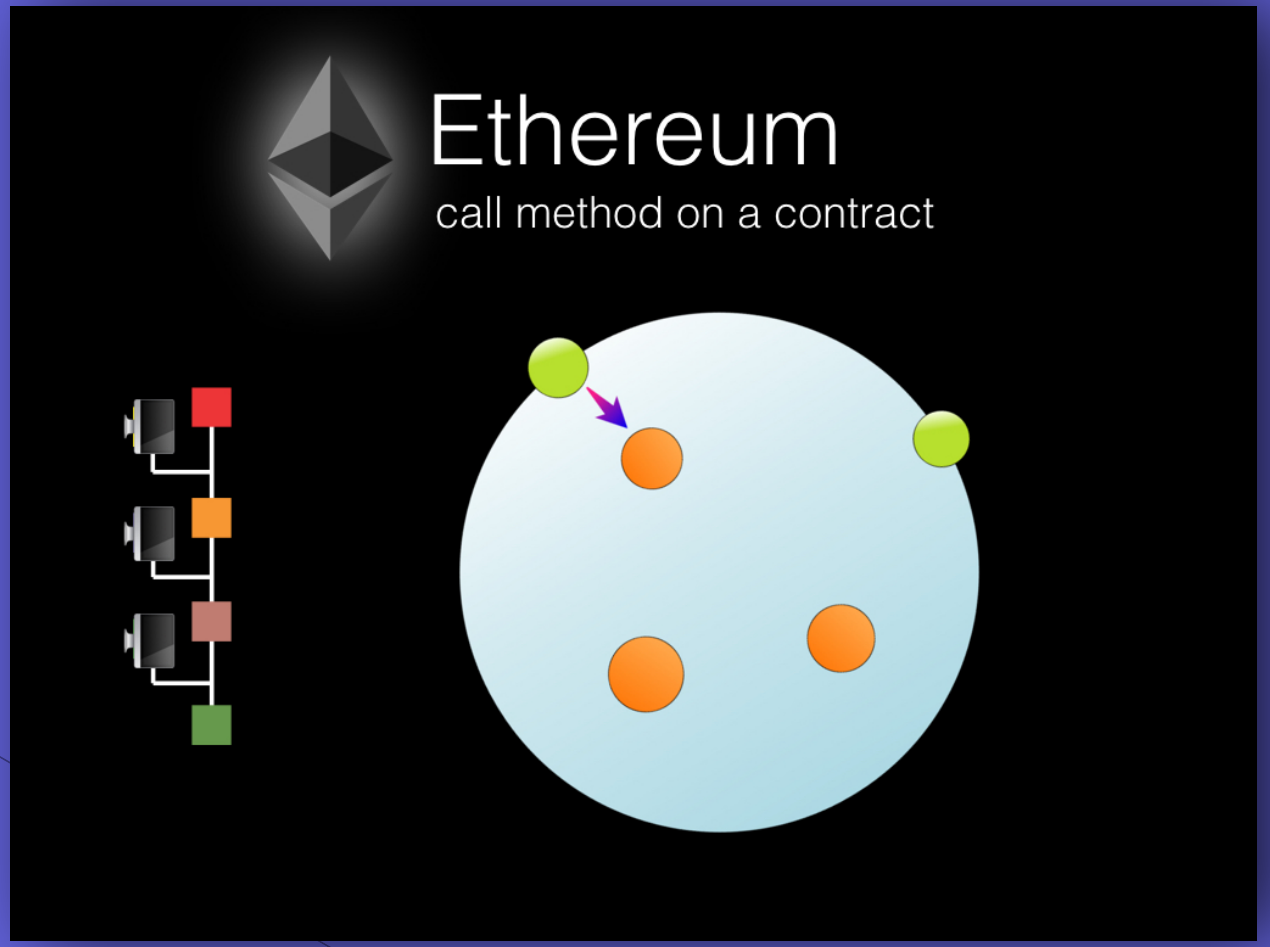
Transactions & Smart Contracts

- Interactions with smart contracts



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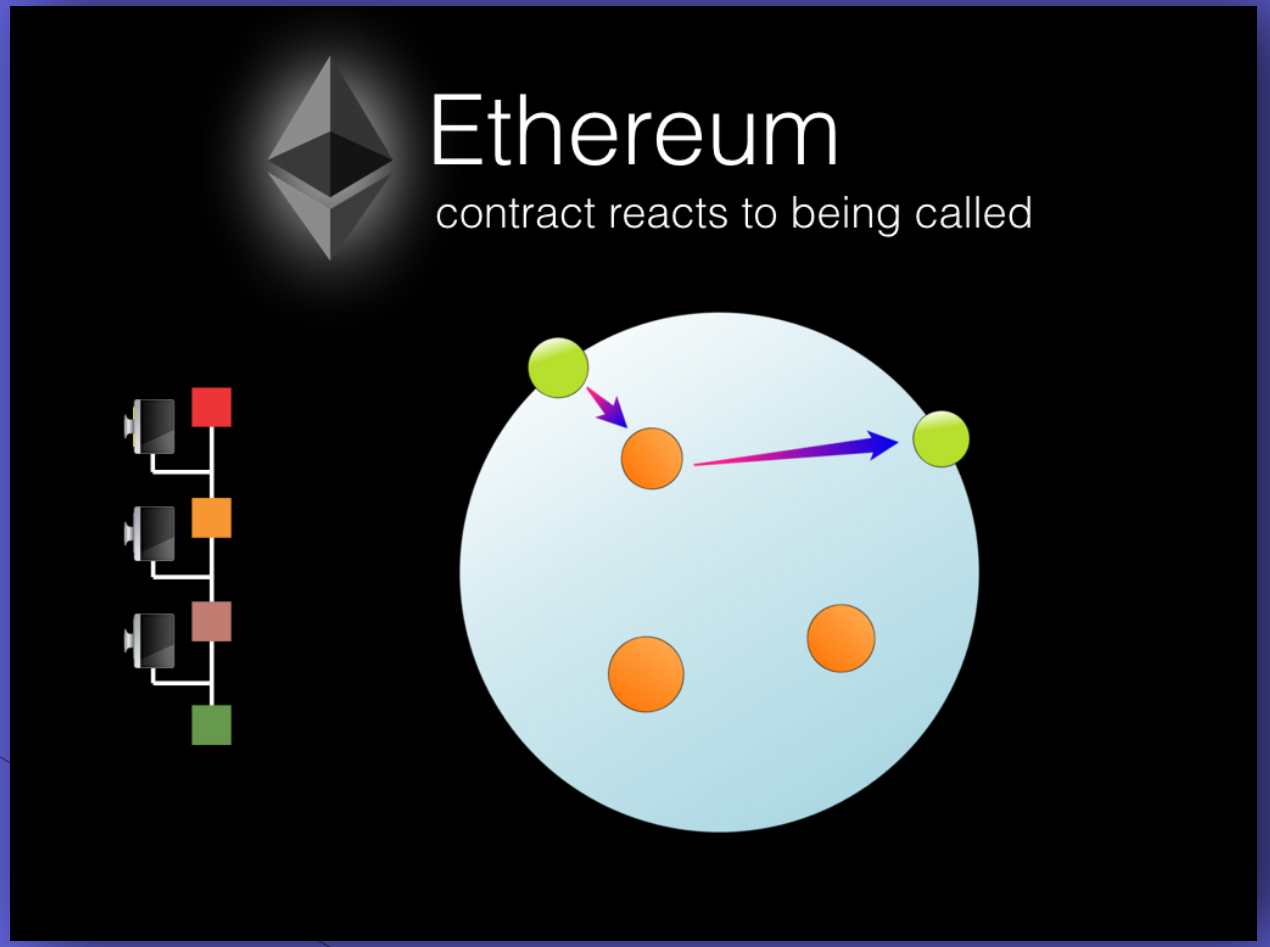
Transacties & Smart Contracts

- Interactions with smart contracts that interact with users



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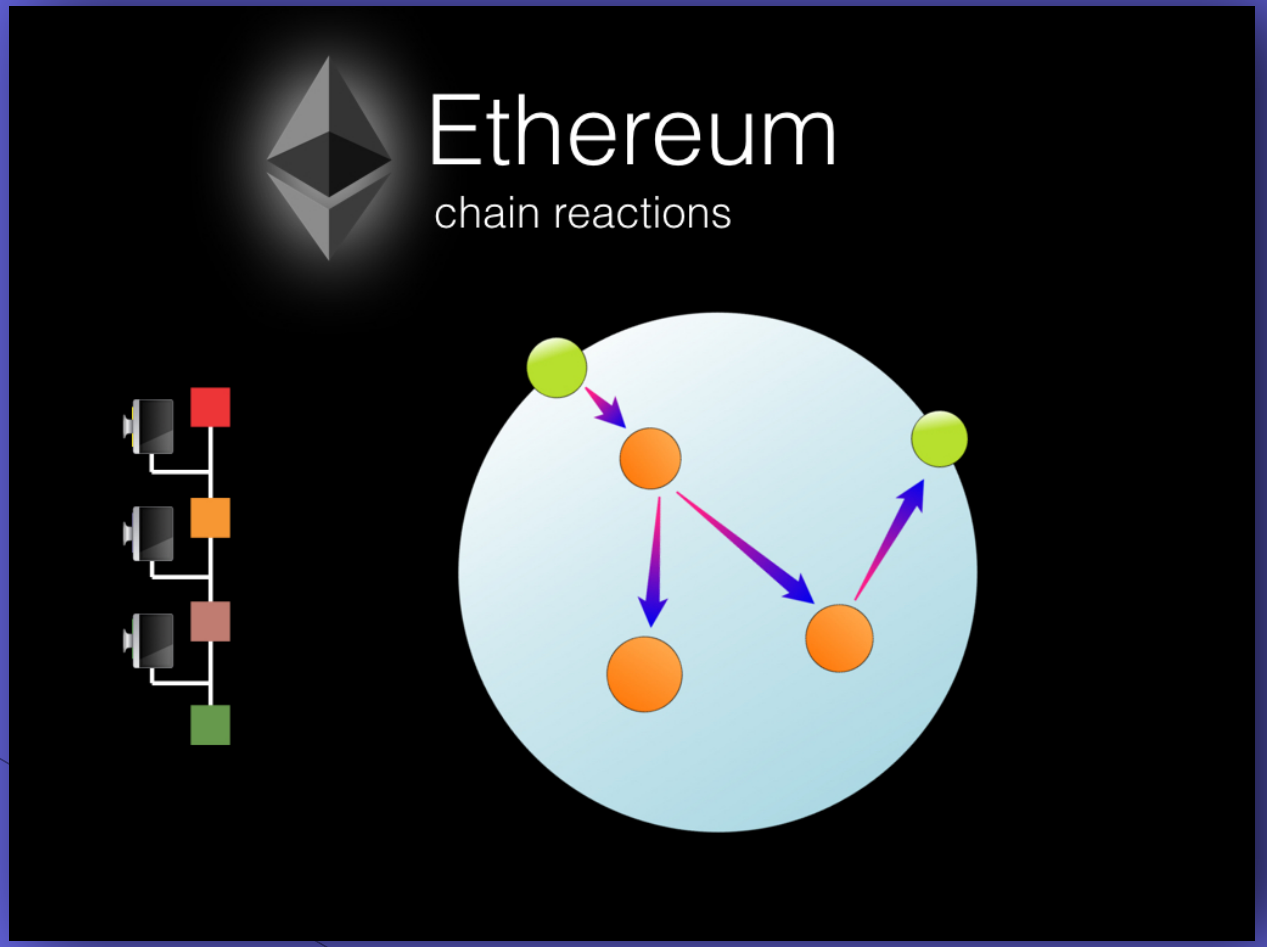
Transactions & Smart Contracts

- Complex chain reactions



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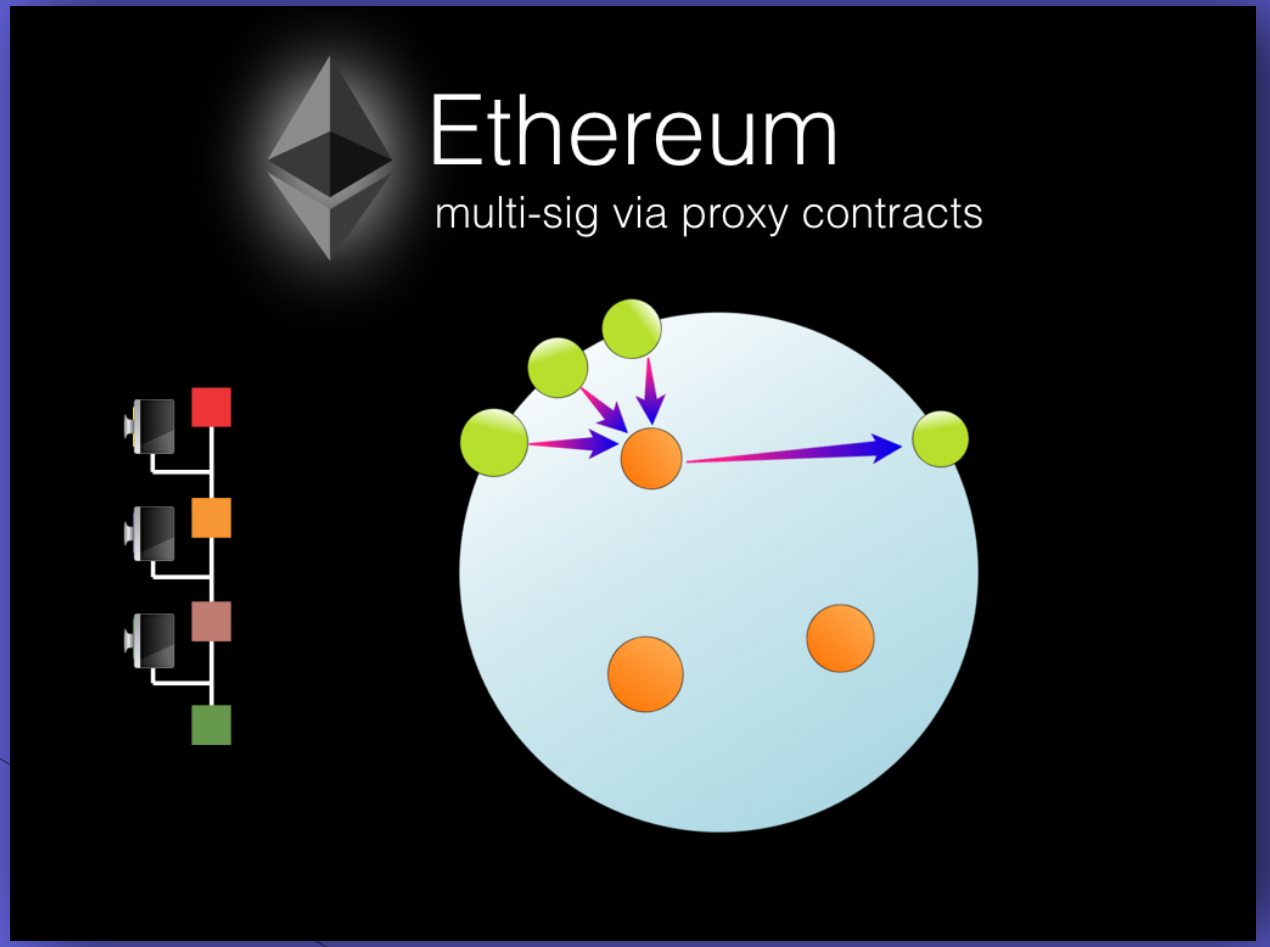
Transactions & Smart Contracts

- Complex chain reactions



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Questions?

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