Perspectives on Blockchain

Prof R. Guerraoui, EPFL

Have you heard about?

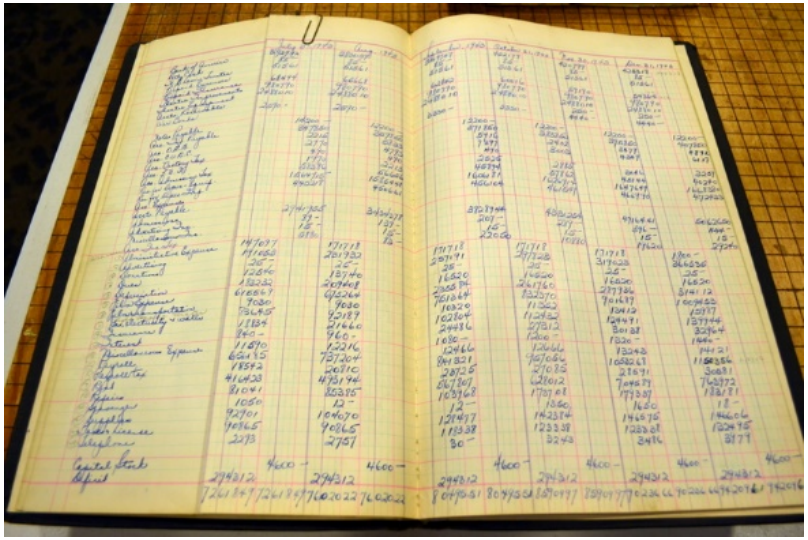
- Bitcoin
- Blockchain
- Ethereum
- Signatures
- Proof of work
- Smart contracts
- Turing Completeness
- NP vs P
- Consensus

Perspectives

- (1) The journalist
- (2) The user
- (3) The participant
- (4) The engineer
- (5) The scientist

(1) The Journalist

- 2008: Financial crisis – Nakamoto (1/21m)
  - From 1c to 8000$ through 20000$
- From trading hardware to general trading
- 2014: Ethereum (CH) - Now 800 $



5	3			7				
6			1	9	5			
	9	8					6	
8				6				3
4			8		3			1
7				2				6
	6					2	8	
			4	1	9			5
				8			7	9

Perspectives

- (1) The journalist
- (2) The user
- (3) The participant
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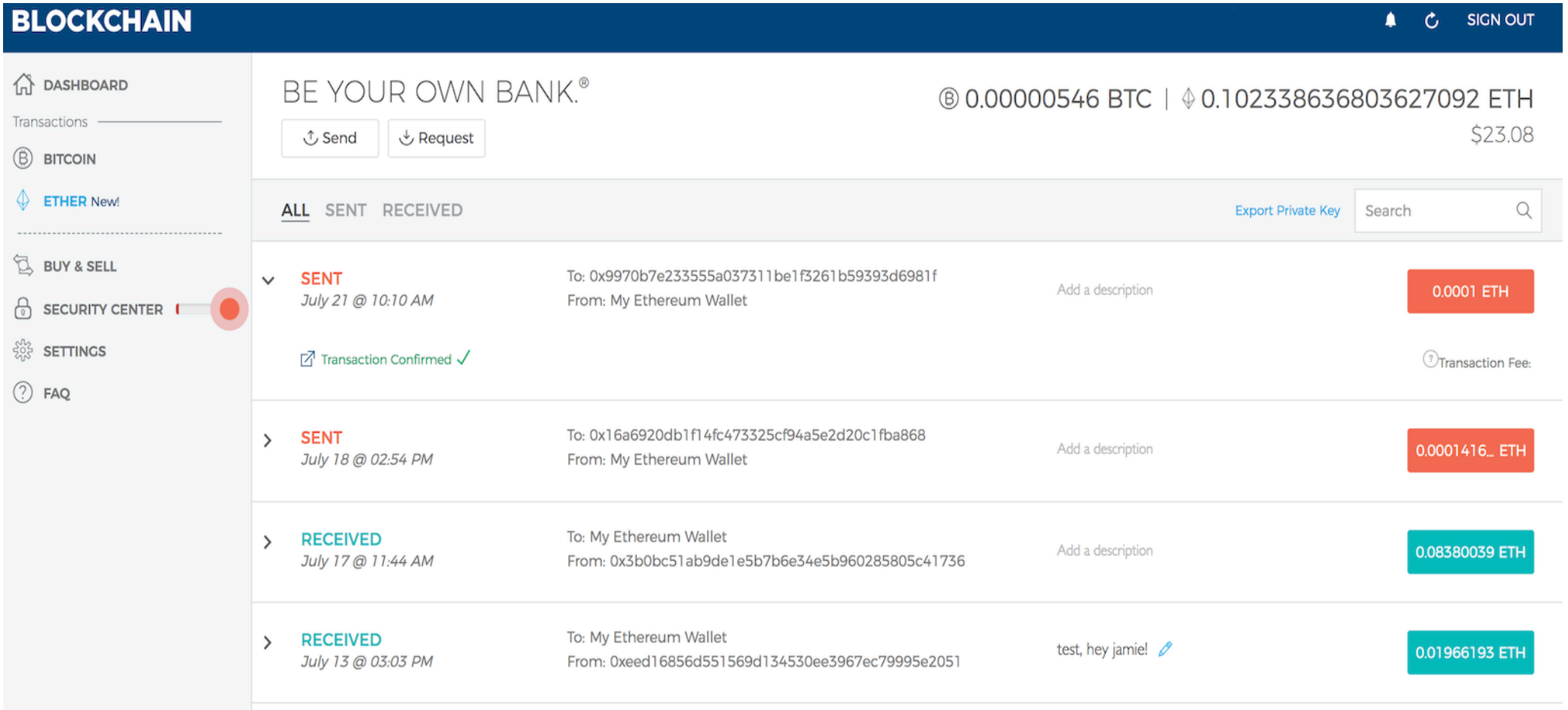
(2) The User


BLOCKCHAIN
SIGN OUT
DASHBOARD
Transactions
BITCOIN
ETHER New!
BUY & SELL
SECURITY CENTER
SETTINGS
FAQ
BE YOUR OWN BANK.®
Send
Request
0.00000546 BTC | 0.102338636803627092 ETH
$23.08
ALL SENT RECEIVED
Export Private Key
Search
SENT
July 21 @ 10:10 AM
To: 0x9970b7e233555a037311be1f3261b59393d6981f
From: My Ethereum Wallet
Add a description
0.0001 ETH
Transaction Confirmed
Transaction Fee:
SENT
July 18 @ 02:54 PM
To: 0x16a6920db1f14fc473325cf94a5e2d20c1fba868
From: My Ethereum Wallet
Add a description
0.0001416... ETH
RECEIVED
July 17 @ 11:44 AM
To: My Ethereum Wallet
From: 0x3b0bc51ab9de1e5b7b6e34e5b960285805c41736
Add a description
0.08380039 ETH
RECEIVED
July 13 @ 03:03 PM
To: My Ethereum Wallet
From: 0xeed16856d551569d134530ee3967ec79995e2051
test, hey jamie!
0.01966193 ETH

(2) The User

- The wallet: 1 private key + several public keys
- Transaction validation
  - signing + gossiping + mining + chaining
- Transaction commitment
  - After time t: thousands of users have seen it
- From transactions to contracts (Ethereum)

(3) The Participant

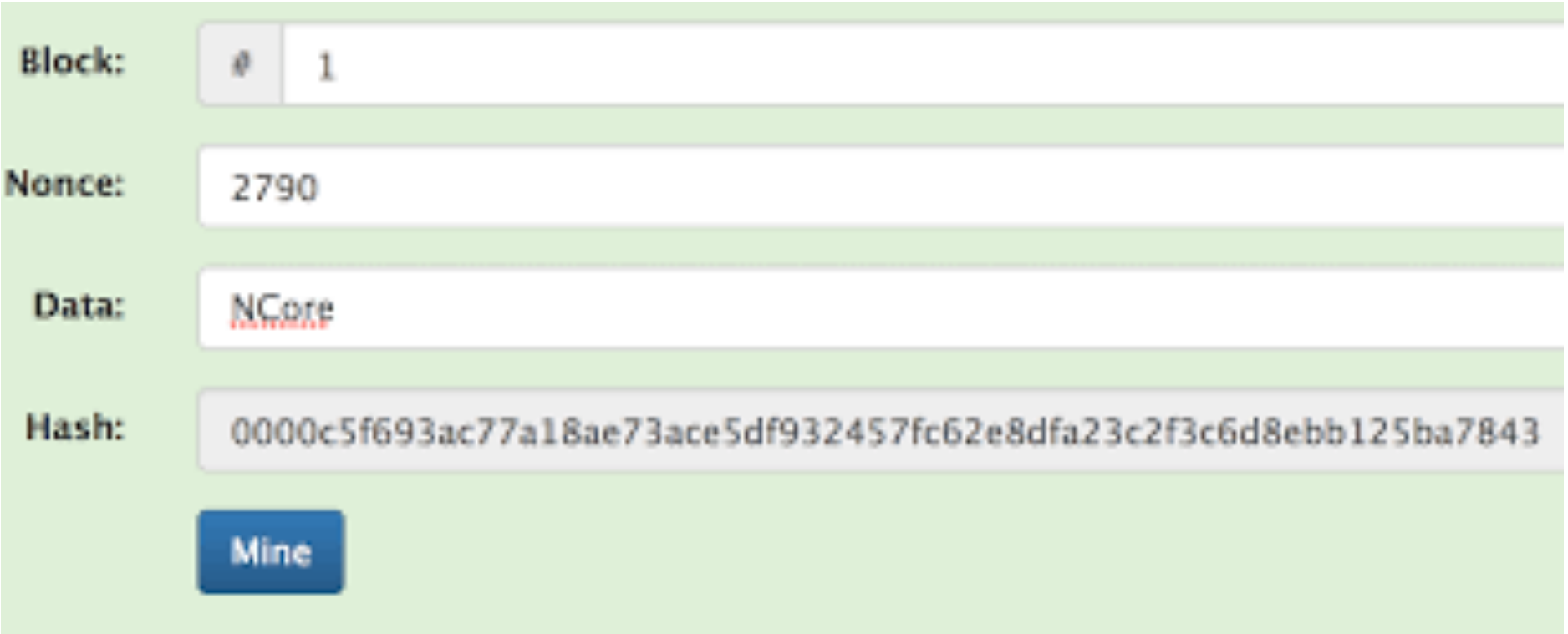
Honey, I'm home!

I found a block today!

5	3			7				
6			1	9	5			
	9	8					6	
8				6				3
4			8		3			1
7				2				6
	6					2	8	
			4	1	9			5
				8			7	9

Miner Jack

(3) The Participant



(3) The Participant

- To validate a transaction, a miner has to solve a puzzle including it
  - Fairness and cooperation
- Incentive: 12 bitcoins / puzzle
  - 50 bitcoins 3 years ago
- Total: 21 millions bitcoins
  - Now: 17 millions

(4) The Engineer

- Joinning (a P2P network)
  - Signing (a transaction)
    - Gossiping (the transaction)
      - Gathering (a block)
        - Mining (proof of work - nonce)
          - Chaining (hash)
            - Gossiping (the block)
              - Committing/Aborting

TECHNOLOGIES OF A BLOCKCHAIN

Asymmetric Encryption

Transaction signing

Hash Functions

Transaction/block hashing as well as obfuscating public keys

Merkle Trees

Efficient way to package transactions into blocks

Key-Value Database

Lookups of previous transactions (prevent double-spends)

P2P Communication Protocol

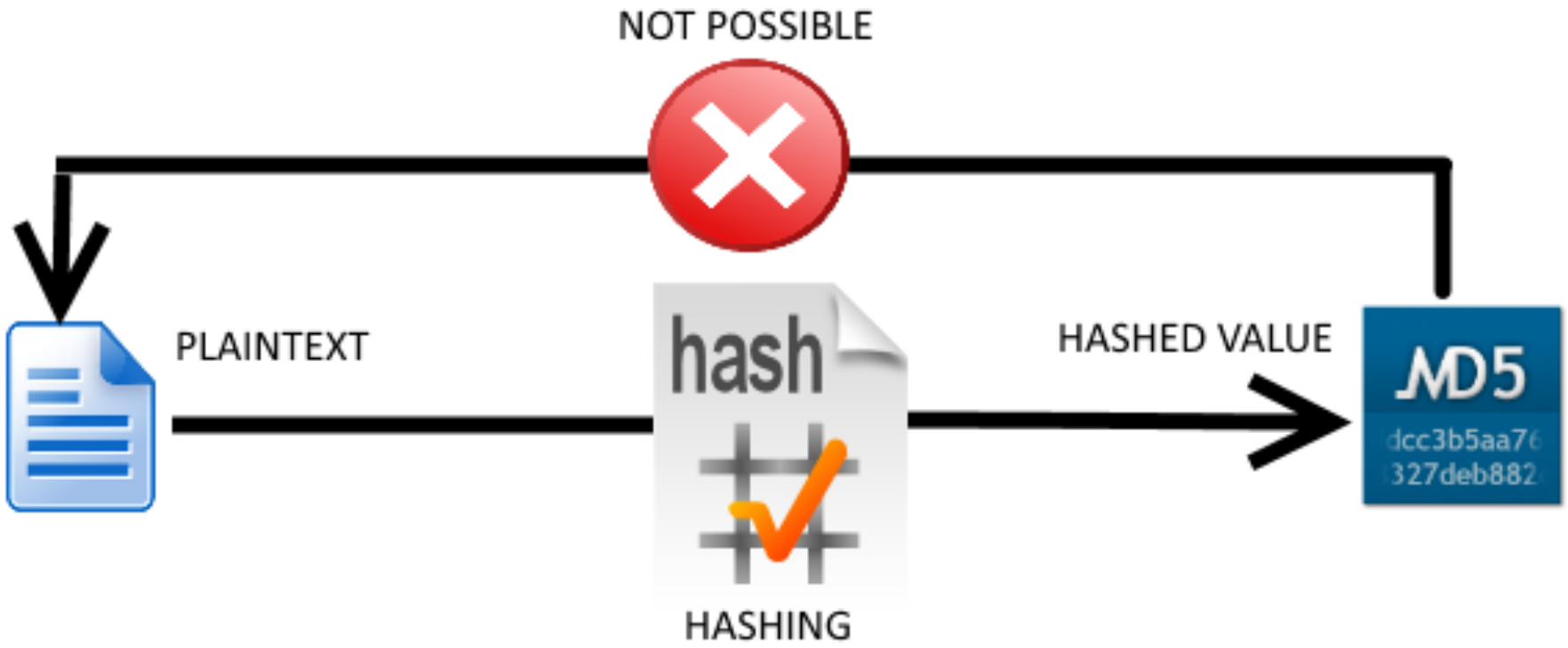
Sharing transactions and blocks

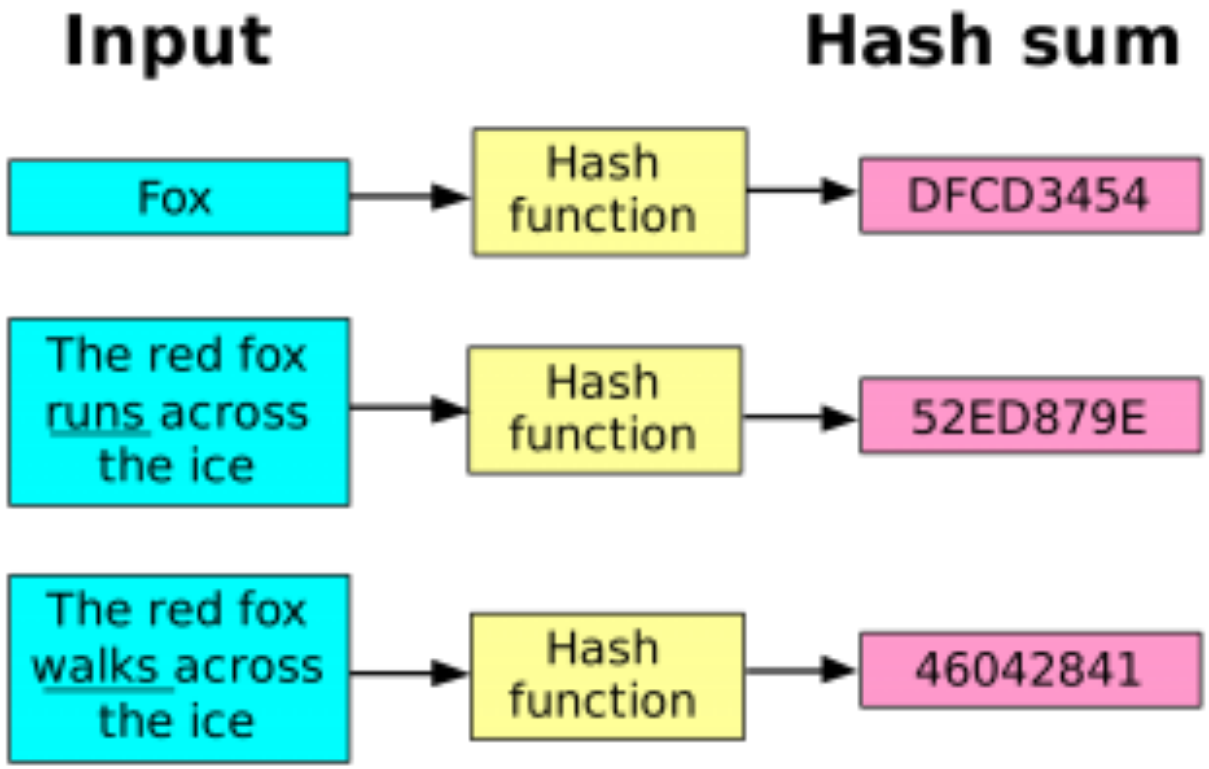
Proof of Work

Method to achieve consensus

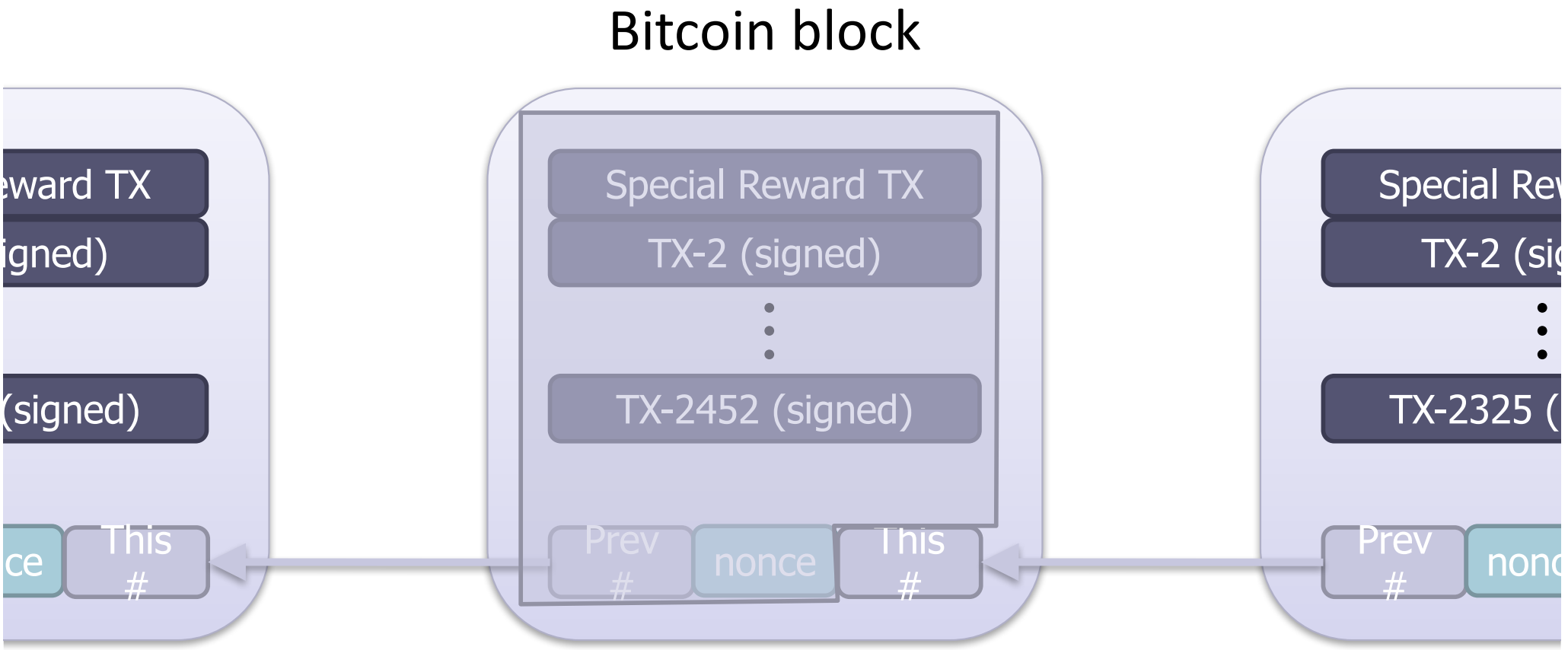
Hashing

Blockgeeks


NOT POSSIBLE
PLAINTEXT
hash
HASHING
HASHED VALUE
MD5
dcc3b5aa7
327deb882


Input
Hash sum
Fox
Hash function
DFCD3454
The red fox runs across the ice
Hash function
52ED879E
The red fox walks across the ice
Hash function
46042841

The Big Picture



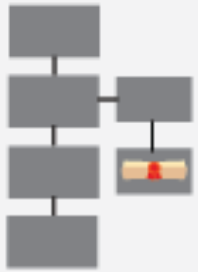
Mining: find nonce such that This # $< d$

How? By trying different nonces (brute force)


Block:
#
1
Nonce:
2790
Data:
NCore
Hash:
0000c5f693ac77a18ae73ace5df932457fc62e8dfa23c2f3c6d8ebb125ba7843
Mine

Smart Contracts

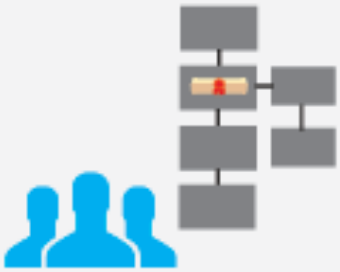
Option contract written as code into a blockchain.



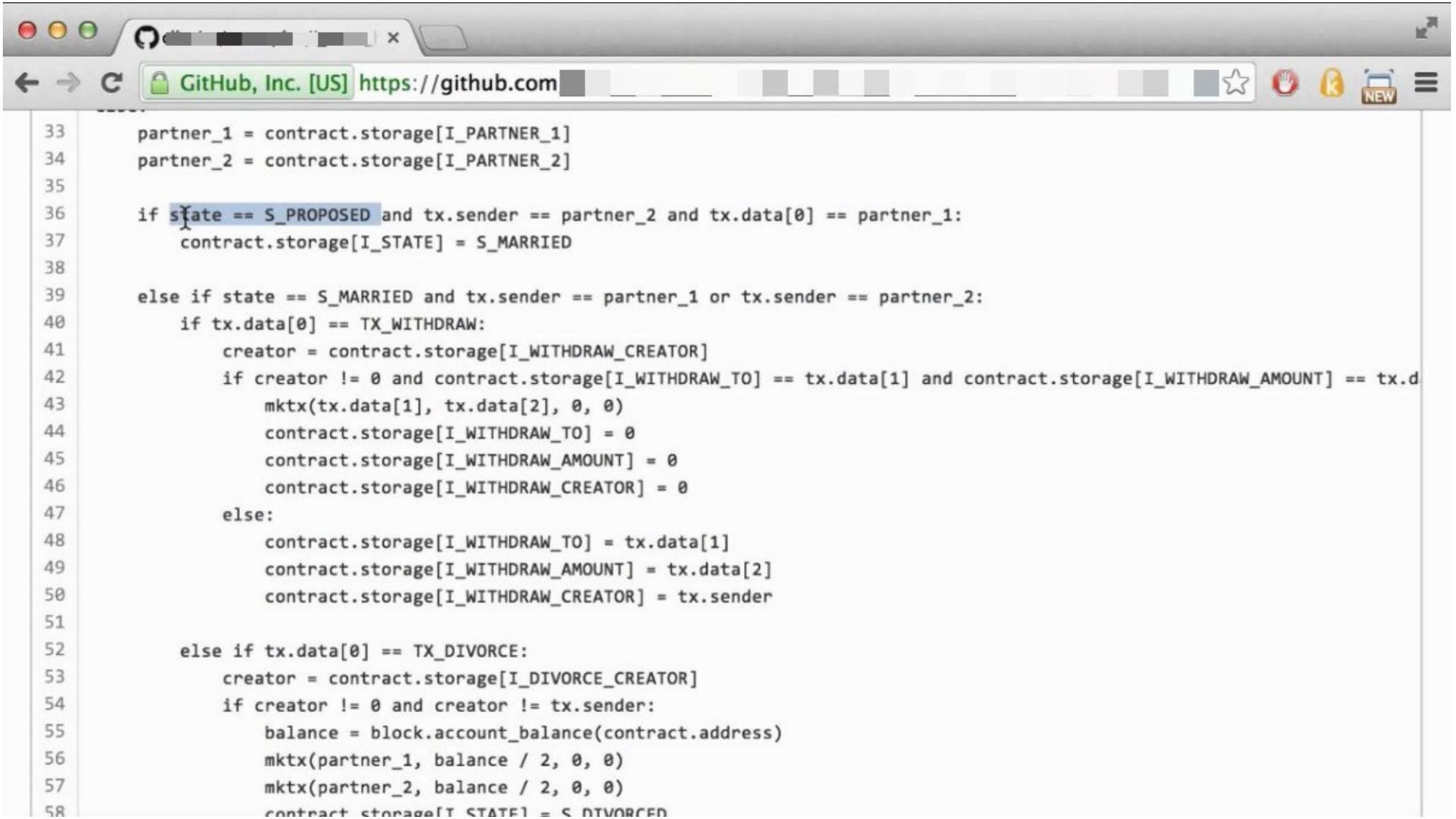
Contract is part of the public blockchain.

Parties involved in the contract are anonymous.

Contract executes itself when the conditions are met.



Regulators use blockchain to keep an eye on contracts.




```
    partner_1 = contract.storage[I_PARTNER_1]
    partner_2 = contract.storage[I_PARTNER_2]

    if state == S_PROPOSED and tx.sender == partner_2 and tx.data[0] == partner_1:
        contract.storage[I_STATE] = S_MARRIED

    else if state == S_MARRIED and tx.sender == partner_1 or tx.sender == partner_2:
        if tx.data[0] == TX_WITHDRAW:
            creator = contract.storage[I_WITHDRAW_CREATOR]
            if creator != 0 and contract.storage[I_WITHDRAW_TO] == tx.data[1] and contract.storage[I_WITHDRAW_AMOUNT] == tx.d
                mktx(tx.data[1], tx.data[2], 0, 0)
                contract.storage[I_WITHDRAW_TO] = 0
                contract.storage[I_WITHDRAW_AMOUNT] = 0
                contract.storage[I_WITHDRAW_CREATOR] = 0
            else:
                contract.storage[I_WITHDRAW_TO] = tx.data[1]
                contract.storage[I_WITHDRAW_AMOUNT] = tx.data[2]
                contract.storage[I_WITHDRAW_CREATOR] = tx.sender

        else if tx.data[0] == TX_DIVORCE:
            creator = contract.storage[I_DIVORCE_CREATOR]
            if creator != 0 and creator != tx.sender:
                balance = block.account_balance(contract.address)
                mktx(partner_1, balance / 2, 0, 0)
                mktx(partner_2, balance / 2, 0, 0)
                contract.storage[I_STATE] = S_DIVORCED
```

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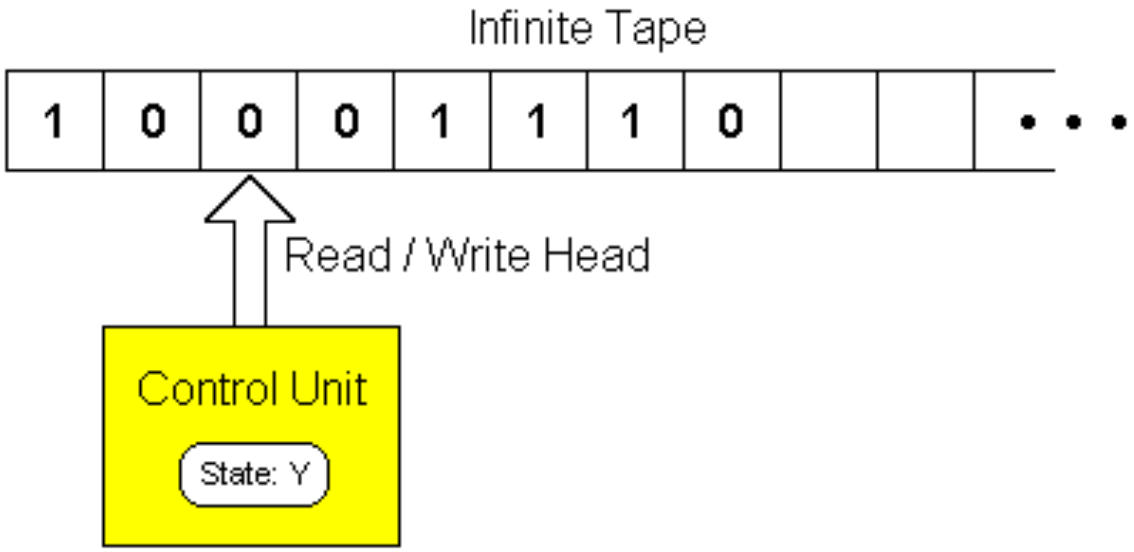
(5) The Scientist

- Conjecture 1: Turing Universality
  - Conjecture 2: P is not NP
  - Theorem 1: Lamport (Consensus) Universality
    - Theorem 2: Consensus Impossibility
      - Theorem 3: Universal Data <=> Code

Turing Universality (1936)



(5) The Scientist

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  - Conjecture 2: P is not NP
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P vs NP (Nash/GV 50 – Ford 70)

$? * ? = 91$

$7 * 13 = ?$

5	3			7				
6			1	9	5			
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(5) The Scientist

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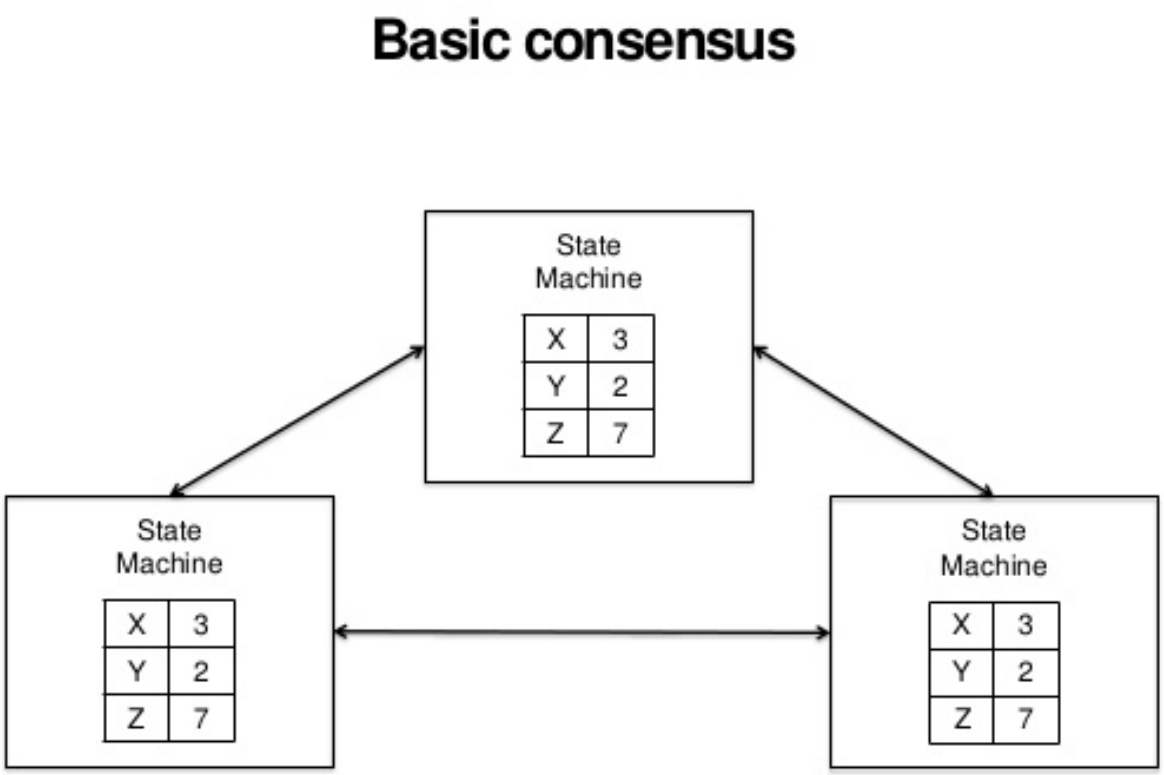
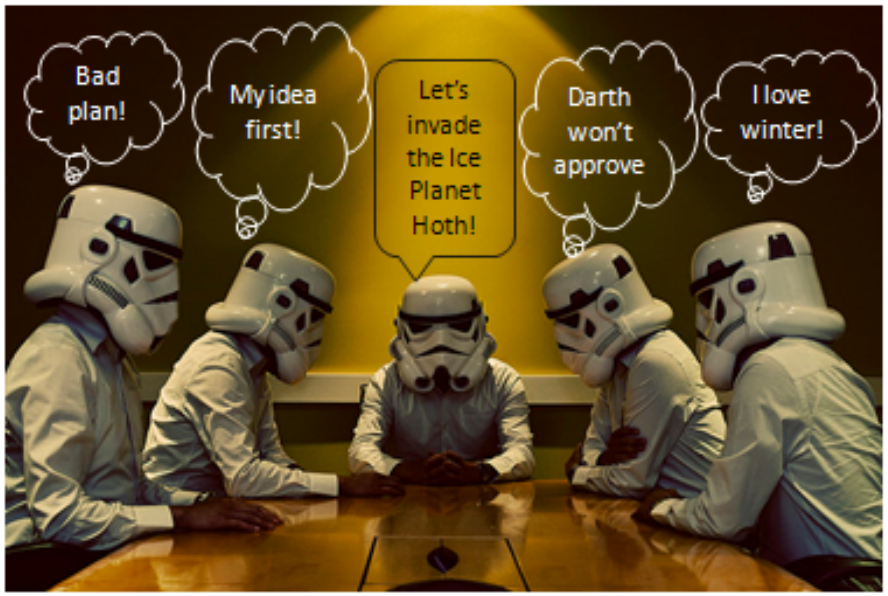
Lamport Universality (76)



Consensus Impossibility (84)



Agreement on a single value among multiple nodes

Safety: No two nodes must choose different values.

The chosen value must have been proposed by a node.

Liveness: Each node must eventually choose a value.

Universal Code⇔
Universal Data (DFG 2010)