Blockchain Basics

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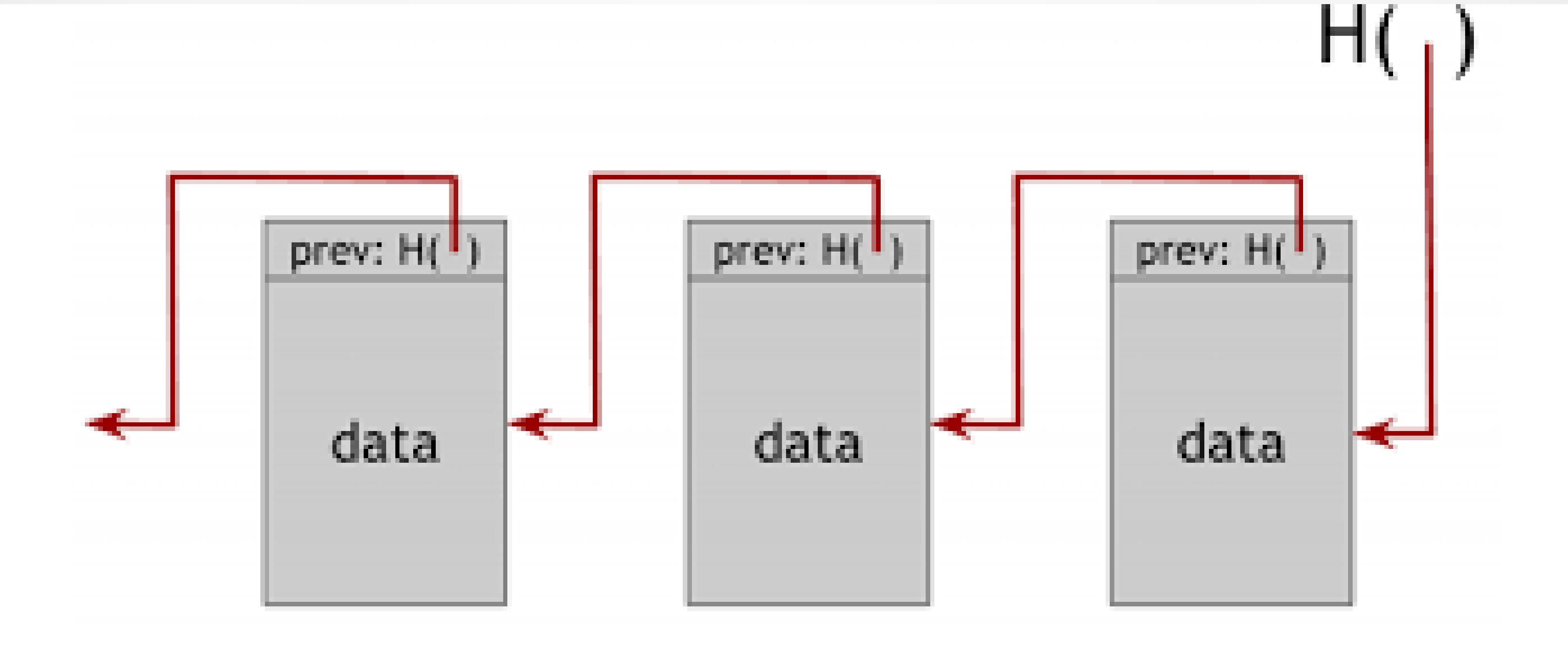
Blockchain: Peer-to-peer distributed ledger that is cryptographically secure,append-only, immutable, and updated by consensus among peer nodes



Blockchain Basics

- Various blockchain based technologies and problem that they solve
  - Bitcoin (decentralized currency)
  - Ethereum (highly decentralized currency, Turing complete scripting language)
    - “Smart Contracts”
- Applications
  - Toll tag logging and payment
  - Smart City sensor data sharing in Singapore
  - Sexual consent logging
  - Walmart – supply chain tracking

Blockchain Basics

- Loose Plan
  - 1st Presentation - Blockchain Basics
    - Mile wide/inch deep
    - At least not wholly conflate Bitcoin and Blockchain
  - 2nd Presentation - Ethereum overview
    - Overview of Ethereum, “Smart Contracts,”
  - 3rd Presentation - Code along
    - Bring laptop and follow along

Blockchain Basics

- What is it?
  - Database (storage)
  - Distributed (across many nodes)
  - Immutable (extremely hard to change)
- What is a blockchain?
  - A series of linked blocks
  - Sequentially updated but not erased
  - Cryptographic hashes assure integrity of data
- What is a block?
  - A block with a (hash) pointer to a prior block
- Blockchain-ish permutations
  - Tangle (IOTA), Hashgraph, others

Blockchain Basics

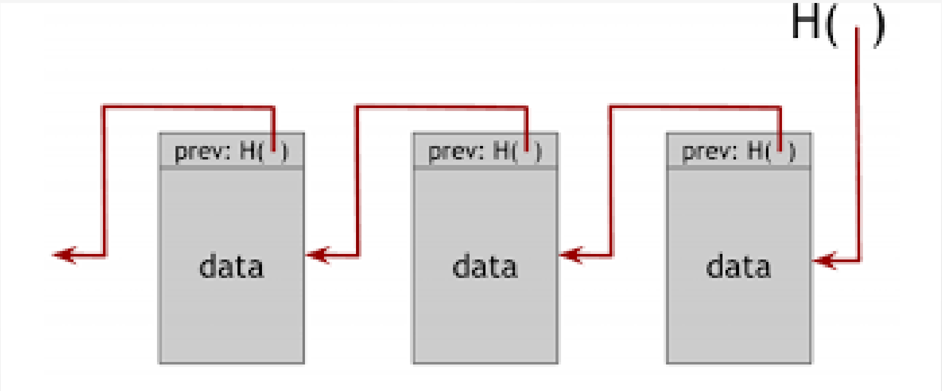
- Various blockchain based technologies alter different aspects of:
  - Data
  - Distribution
  - Immutability
- Platform vs application (or hybrid)
- “Whitepapers” often address key questions:
  - Data
  - Distribution/Actors
  - Level of immutability
  - Interfaces/programming language

Blockchain Basics - Scenarios

- Bitcoin
  - Decentralized cryptocurrency
- Recording and settling toll tag transactions
  - Decreased toll infrastructure
- Smart City sensor array data access/exchange
  - Citizens access, entrepreneurs build upon
- Sexual consent logging/LegalFling
  - Sexual partners log consent to blockchain

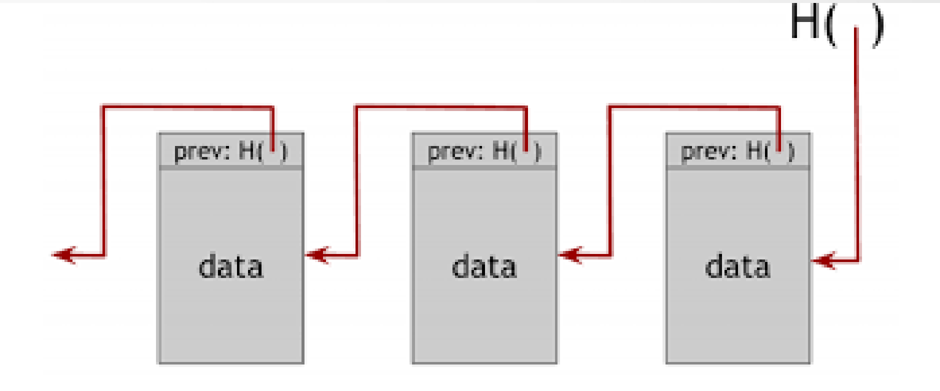
Blockchain Basics - Data

- What is the data?
- It’s “just data” that would be stored in any database
  - Cryptocurrency transactions (signed transaction)
  - Toll tag number, toll gate, timestamp
  - Smart city data – sensor ID, sensor type, value, timestamp
  - Sexual consent – signature, audio/video, ???



Blockchain Basics

- Chain of “blocks”
- Block
  - Block number/index
  - Data
  - Hash/hash as pointer
- Immutability
- Demo (Data -> Hashes, -> Block -> Blockchain)



Blockchain Basics – Distribution & Immutability & Longest Chain

- Distributed/decentralized
  - Who are the actors? What is decentralized?
  - Extent of distribution/decentralization
    - Public vs permissioned
  - Anyone who has computation and/or storage resources?
- “Mining” determines what is the next block in the blockchain
  - Incentive/reward for miners
    - By computing power (proof of work)
    - By rewards are proportional to the size of a user's holdings (proof of stake)
  - Lag in adding the block

Blockchain Basics – Distribution & Immutability & Longest Chain

- Immutability
  - Extent of immutability
  - Do we want 100% immutability?
    - Ethereum vs Ethereum classic
  - “Forks”
    - Who will the ecosystem actors follow?
- Demo (Multiple chains, consensus)

Blockchain Basics – Factors in Selection/Creation of a Blockchain

- Use Case? Simplicity/complexity?
- Who are the actors and what are their roles?
- What is the data? How much? How frequent?
- What interfaces are available?
- Do you need an existing ecosystem?
- What programming languages are available?
- What is the consensus mechanism for conflicts?

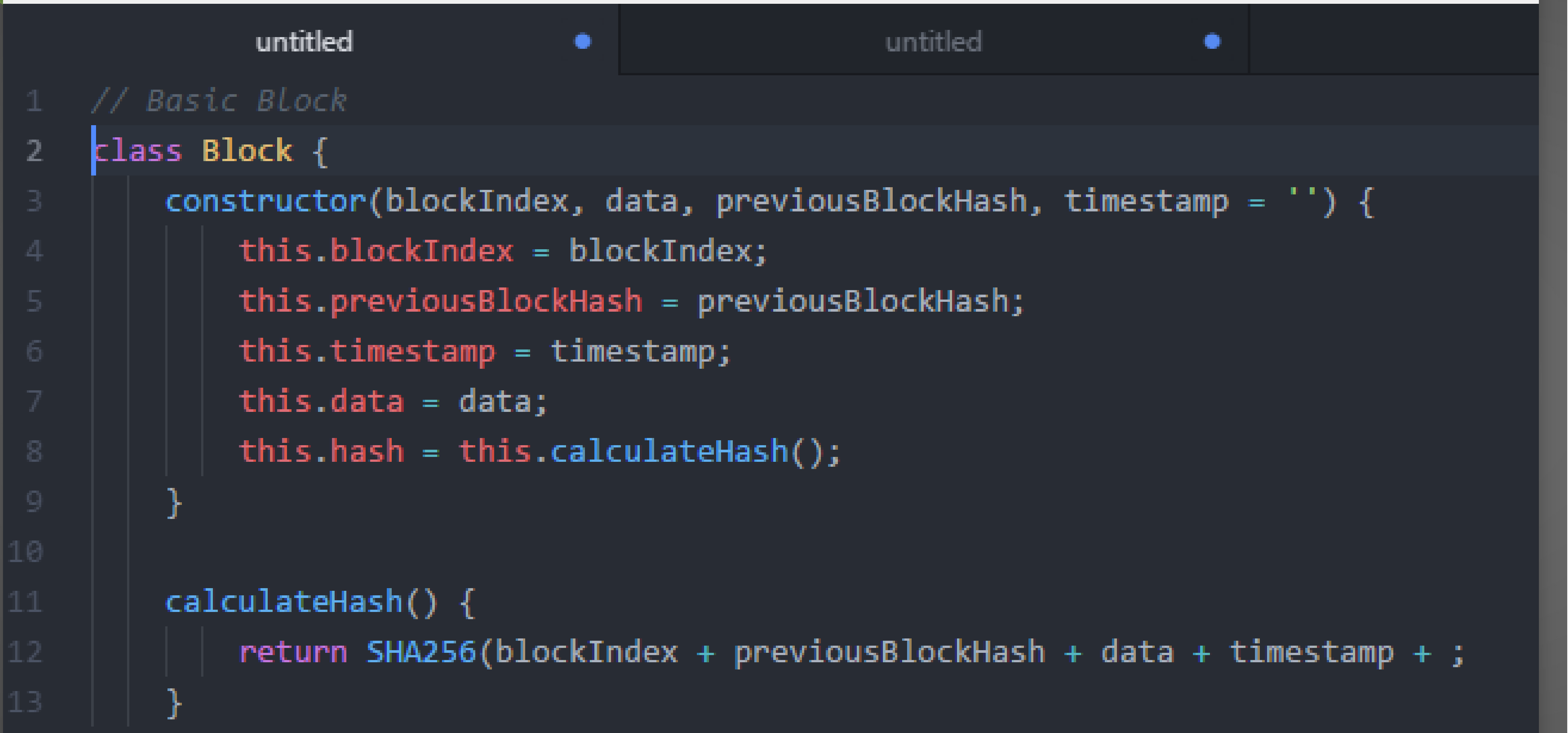
Blockchain Basics - Implementations

- Bitcoin – Use: Decentralized cryptocurrency
  - White papers – “Bitcoin: A Peer-to-Peer Electronic Cash System”
  - Platform vs application (Hybrid)
  - Data (signed bitcoin transactions)
  - Actors (bitcoin holders, miners)
  - Distribution (anyone can mine(*), anyone can own bitcoin)
  - Immutability (highest)
  - Interface (miners, “wallets”, “script”)

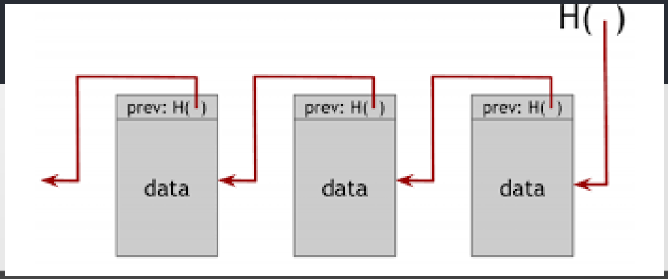
Blockchain Basics - Implementations

- Ethereum – Use: “Smart Contracts”
  - White papers – “A Next-Generation Smart Contract and Decentralized Application Platform”
  - Platform vs application (Platform)
  - Data (signed ethereum transactions, smart contracts, ...)
  - Actors (ethereum holders, parties to contracts,)
  - Distribution (anyone can mine(*), anyone can own bitcoin)
  - Immutability (high)
  - Interface (miners, “wallets”, “Smart Contract”, Solidity)

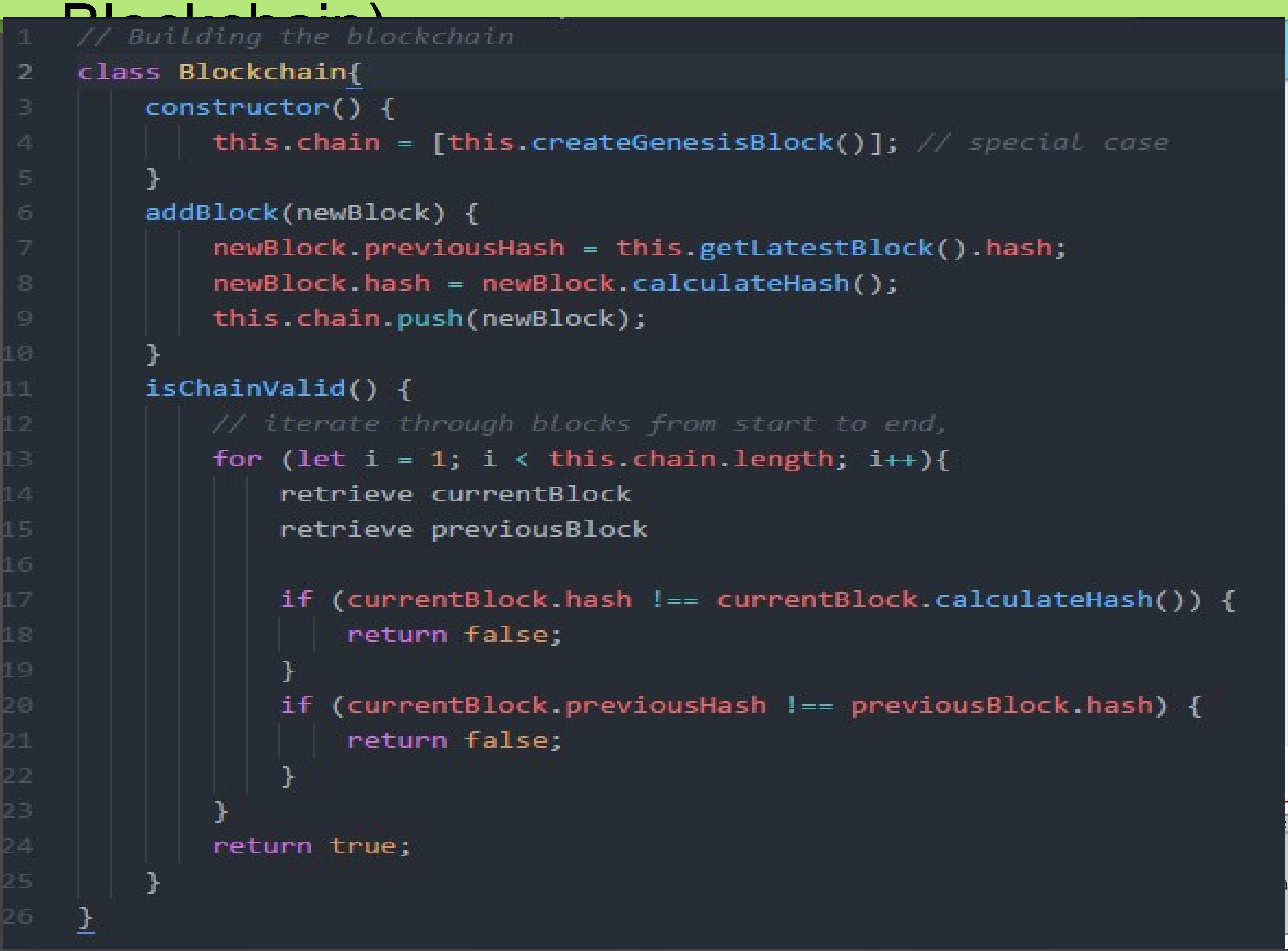
Blockchain Basics –
Pseudocode Walkthrough (a Block)



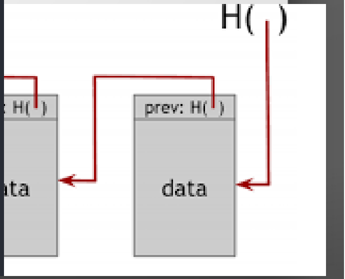
```
// Basic Block
class Block {
    constructor(blockIndex, data, previousBlockHash, timestamp = '') {
        this.blockIndex = blockIndex;
        this.previousBlockHash = previousBlockHash;
        this.timestamp = timestamp;
        this.data = data;
        this.hash = this.calculateHash();
    }

    calculateHash() {
        return SHA256(blockIndex + previousBlockHash + data + timestamp + ;
    }
}
```



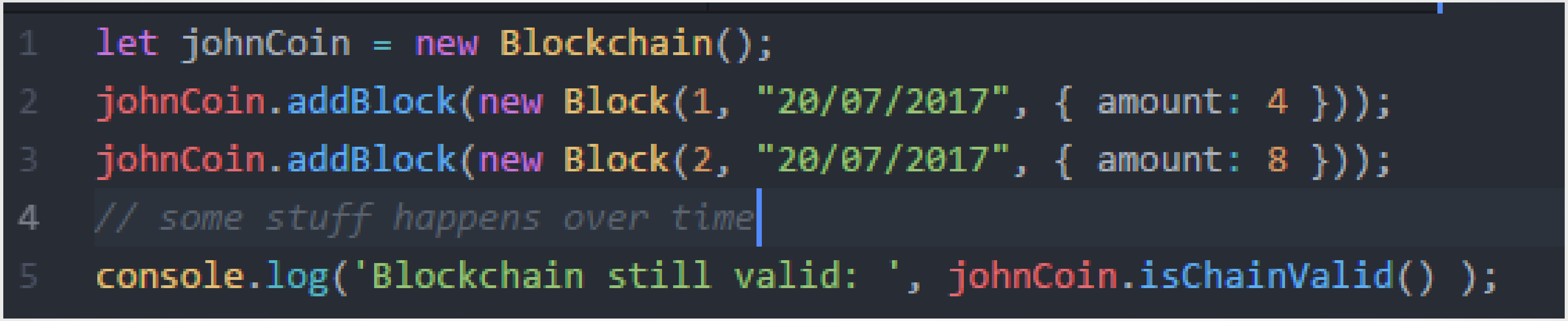
Blockchain Basics – Pseudocode Walkthrough (the Blockchain)



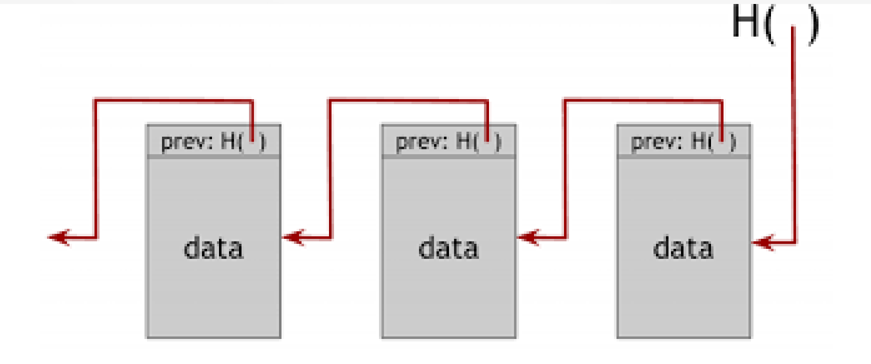
```
// Building the blockchain
class Blockchain{
    constructor() {
        this.chain = [this.createGenesisBlock()]; // special case
    }
    addBlock(newBlock) {
        newBlock.previousHash = this.getLatestBlock().hash;
        newBlock.hash = newBlock.calculateHash();
        this.chain.push(newBlock);
    }
    isChainValid() {
        // iterate through blocks from start to end,
        for (let i = 1; i < this.chain.length; i++){
            retrieve currentBlock
            retrieve previousBlock

            if (currentBlock.hash !== currentBlock.calculateHash()) {
                return false;
            }
            if (currentBlock.previousHash !== previousBlock.hash) {
                return false;
            }
        }
        return true;
    }
}
```



Blockchain Basics –
Pseudocode Walkthrough (Usage)



```
let johnCoin = new Blockchain();
johnCoin.addBlock(new Block(1, "20/07/2017", { amount: 4 }));
johnCoin.addBlock(new Block(2, "20/07/2017", { amount: 8 }));
// some stuff happens over time
console.log('Blockchain still valid: ', johnCoin.isChainValid() );
```



Blockchain Basics

What can you bring to the table where IoT and blockchain truly add to world?

Questions?

John Lindsay
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Coaster, Smooth Driver Application