



IoT and Blockchain

**Dr. Phillip G. Bradford (University of
Connecticut, Stamford CT. USA)**

phillip.bradford@uconn.edu,
phillip.g.bradford@gmail.com

Outline

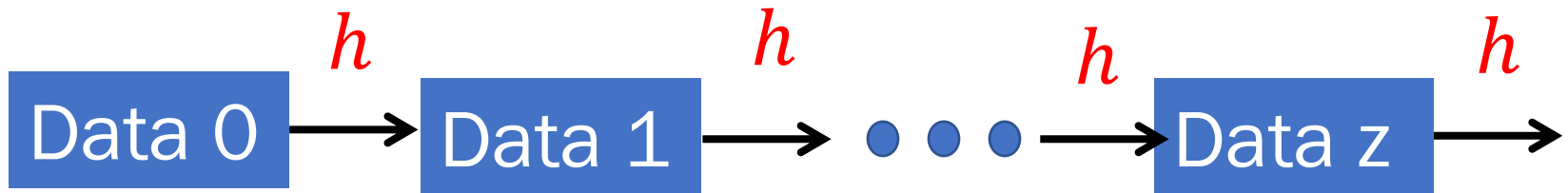
Hash chains

Blocks

Mining

Consensus

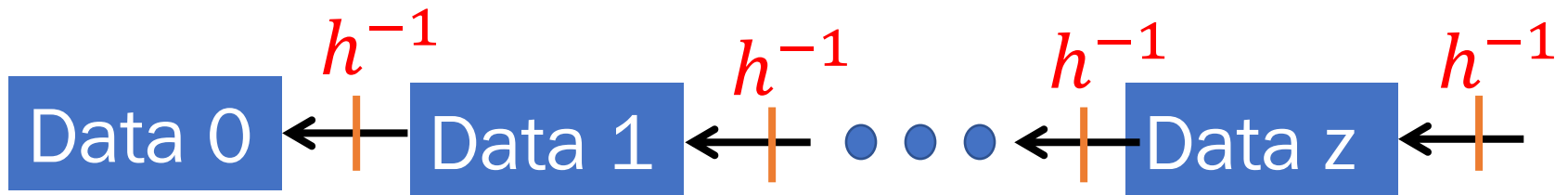
Hash chain



Easy to validate going forward computing h
pseudo unique – collision intractability

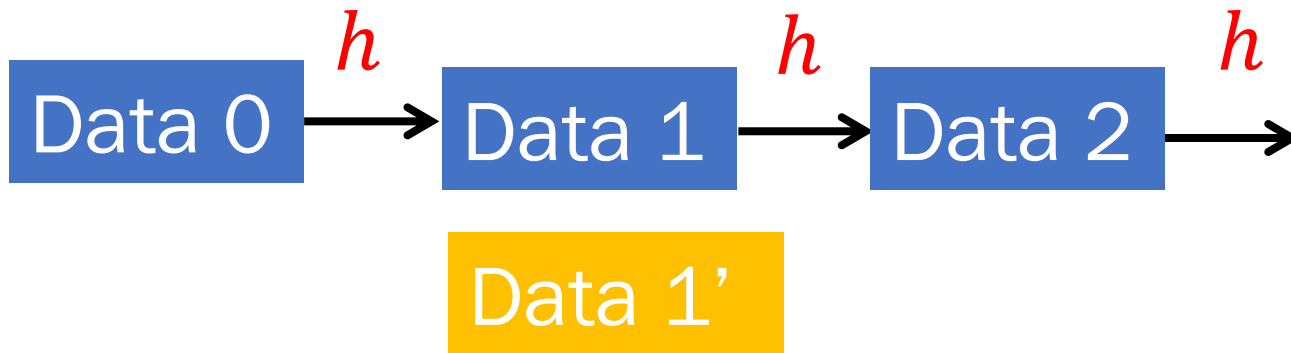
Intractable to go-backwards h^{-1}

Hash chain: intractable backwards



Intractable to any step go-backwards h^{-1}

Hash chain - security



Challenge! Collision intractability

Common assumption **Data 0** is valid

Ingredient of blocks: consensus

Valid Chain

Previous hash

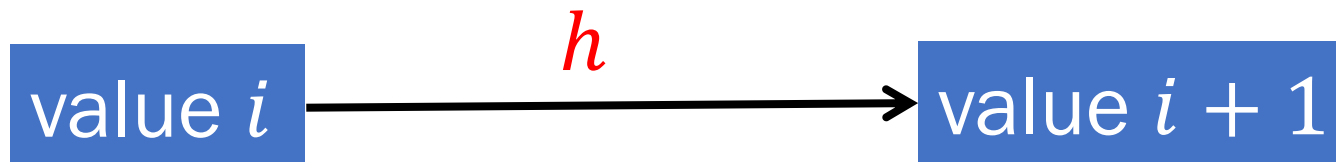
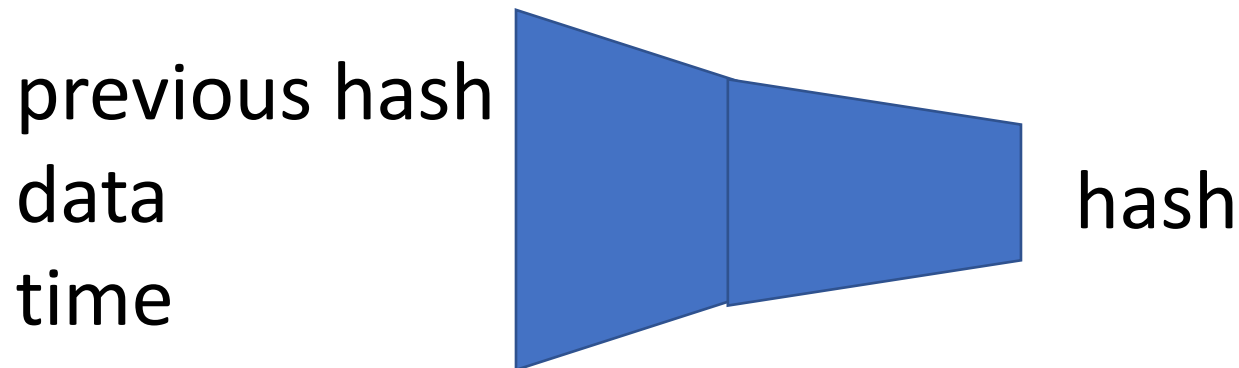
Data

Building a winner by consensus

How?

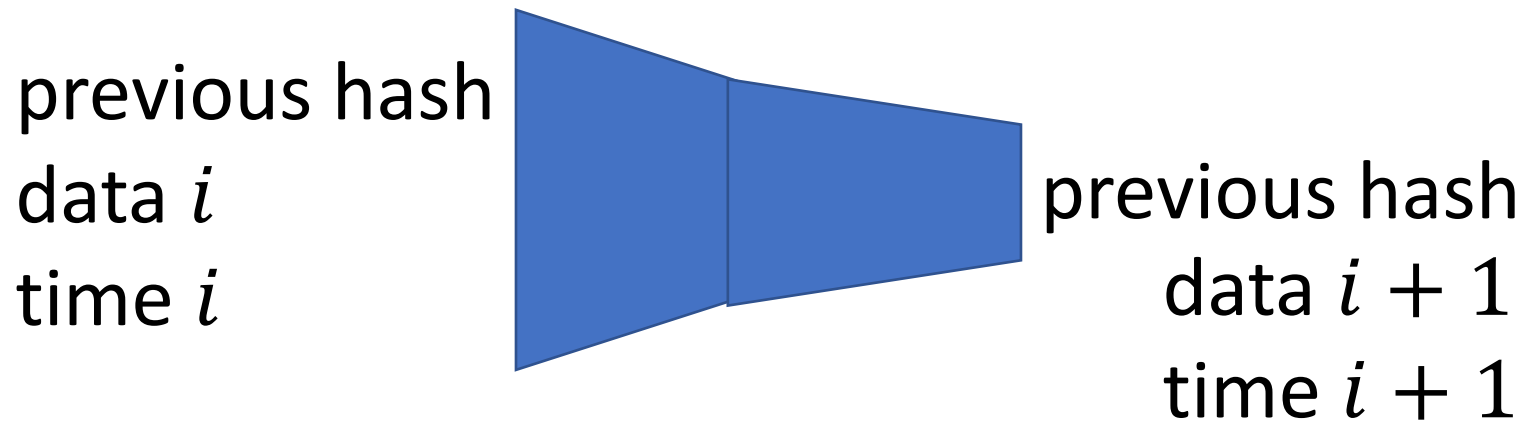
Our simple Blocks

class Block:

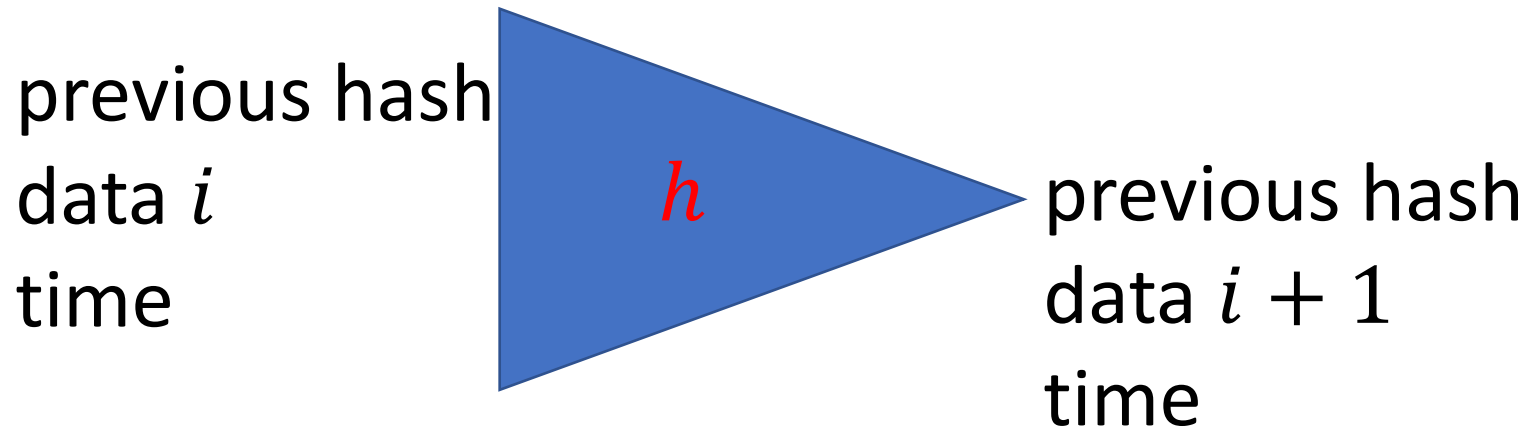


Our simple Blocks

class Block:



Our simple Blocks



Basic blocks

```
RPI_1> git clone \
```

```
https://github.com/wonder-phil/WIoT2021Blocks.git
```

```
Host> git clone \
```

```
https://github.com/wonder-phil/WIoT2021Blocks.git
```

Python compHash

```
def compHash(self):  
    hashFunction = hashlib.new('sha256')  
    myStr = str(self.prevHash)+str(self.data)+str(self.time)  
           +str(self.nonce)  
    myBytes = myStr.encode()  
    hashFunction.update(myBytes)  
    self.bHash = hashFunction.hexdigest()  
    return self.bHash
```

Simple block hashes: base 16

Hash for block 1 :

e28731c23c541c3b682e80a332ee30bda1d5ac8b8acb5f5f206cef25db3529fb

Hash for block 2 :

75154608b0943abefc3494bd9f84a39e9a5df362175a9cbb9903d2e443593b25

Hash for block 3 :

b0a0643f8c7d867e9eae994b72d9acd13f172591ab07fd87b93cd23a33d10191

What is the likelihood of a leading 0 ?

Our simple Blocks

class Block:

difficulty

previous hash

data

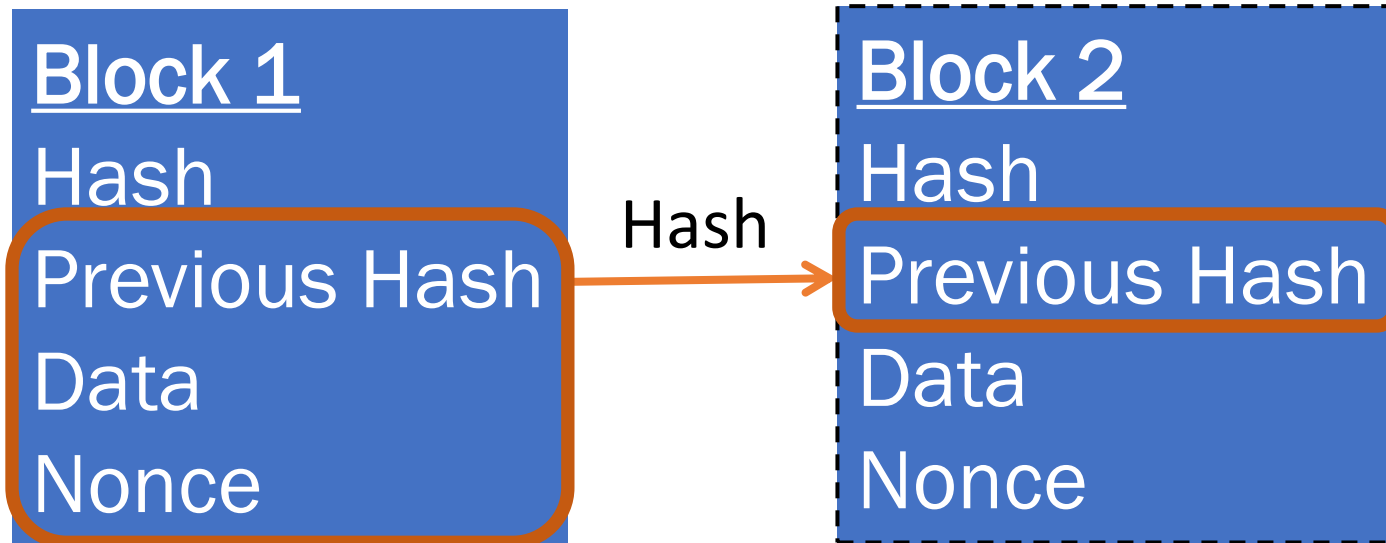
time

nonce

hash



Generating Blocks



Simple block hashes: base 16

Hash for block 1 :

028731c23c541c3b682e80a332ee30bda1d5ac8b8acb5f5f206cef25db3529fb

What input can we change to get a leading 0 ?

Nonce

First to get **difficulty** leading zeros

Who finds the next block?

Key idea: leading zeros

$$P[x \text{ leading zeros}] = \frac{1}{16^x}$$

First generating a block with the given inputs

While varying the **nonce**

Enough leading zeros

Example

```
b=Block("empty","Genesis block")
```

```
b.nonce
```

```
b.bHash
```

```
b.nonce = 436
```

```
b.compHash()
```

```
for i in range(16):
```

```
    b.nonce = b.nonce + 1
```

```
    b.compHash()
```

Block mining

Given a fixed difficulty

Picking up data from a common data block

All miners grab this data

Change nonce & re-hashing to get difficulty
leading zeros

Python Miner

```
def mineBlock(self,diff):  
    self.target = "0"*diff  
    while self.bHash[0:diff] != self.target:  
        self.nonce = self.nonce + 1  
        self.compHash()  
    print("Block mined: ", self.bHash)  
    return self
```

Consensus

Who is the first to get **difficulty** leading 0s?



51% validation of new block

Acceptance of new block