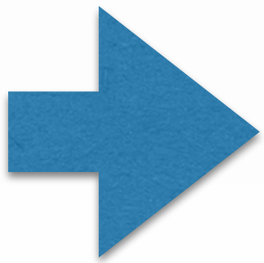
Blockchain

Simple Cryptography

Data Types

- **Cryptographic Hash Functions**
  - SHA256
  - RIPEMD160

Arbitrarily long data



Fixed sized hash/digest

Cryptographic Hash Function

- Cryptographic Hash Functions
  - Takes any byte sequence as input
  - Fixed size output
  - Efficiently computable
- Security Properties:
  - Collision-resistance
  - Second pre-image resistance
  - Pre-image resistance
  - Hiding
  - Puzzle-friendly

Example: https://www.pelock.com/products/hash-calculator

Pre-image Resistance

- For any given h in the output space of the hash function, it is hard to find x, s.t. H(x)=h

Second Pre-image Resistance

- For a given message x, it is hard to find y s.t. $x \neq y$ and $H(x) = H(y)$

Collision Resistance

- It is hard to find a pair of values, $x \neq y$ and $H(x) = H(y)$

Hiding

- A hash function H is hiding when a secret value r is chosen from a high min-entropy probability distribution, then given H(r || x), it is hard to find x.

Puzzle-friendly

- A hash function H is puzzle friendly if for every possible n-bit output value h, if k is chosen from a distribution with high min-entropy, then it is infeasible to find x such that H(k || x) = h in time significantly less than 2^n.

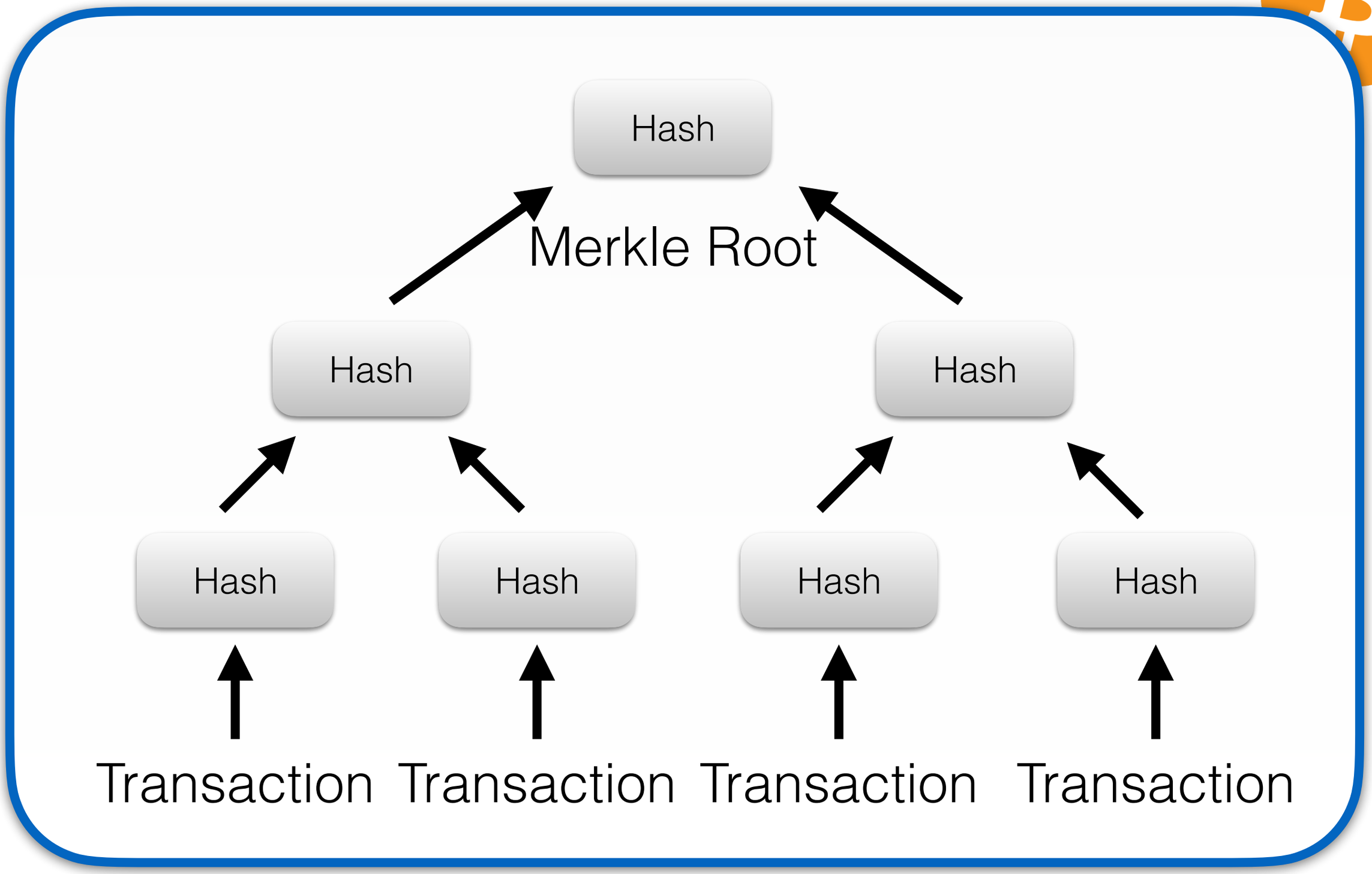
Search puzzle

- A hash function H
- A value, id, chosen from a high min-entropy distribution
- A target set Y

A solution to the puzzle is a value x, s.t.

$$H(id||x) \in Y$$

Data Types


Hash
Merkle Root
Hash
Hash
Hash
Hash
Hash
Hash
Transaction
Transaction
Transaction
Transaction

Data Types

- ECDSA (secp256k1 curve) is used to
  - Sign transactions
  - Verify the signature of transactions
  - Nothing in Bitcoin is encrypted

- **Elliptic Curve Signature Algorithm (ECDSA)**