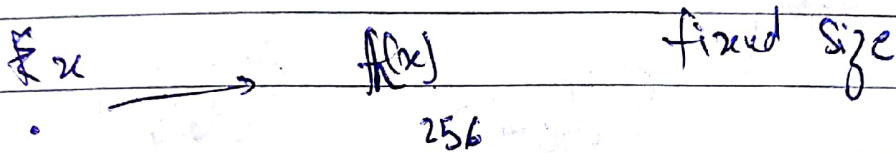


Bitcoin

- Decentralized (No governments) peer-to-peer
- Virtual
- Deflating (limited supply) 21 mil
- Universal

↓ illegality? time lag

Hash



Collision free  $x \neq y \Rightarrow h(x) \neq h(y)$   $x \neq y$

hiding: given  $h(x)$ , can't find  $x$

puzzle friendly

Message digest

$h(r || x)$

Hashing to a range is infeasible (truly random)

App: Commitment

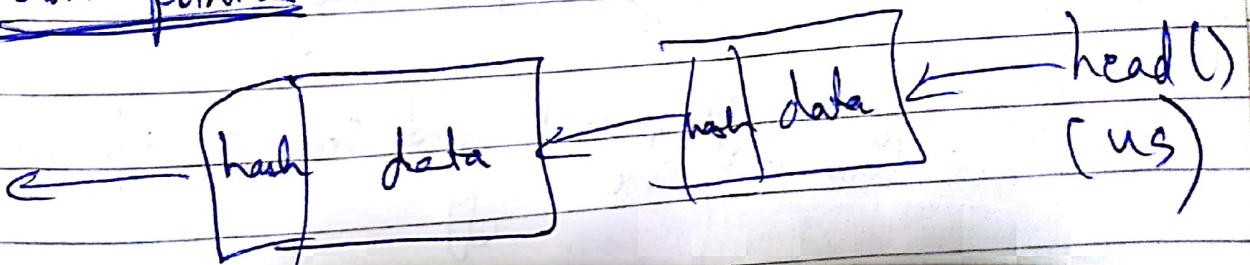
Seal  $h(\text{msg} || \text{key})$

give msg, seal with key in env

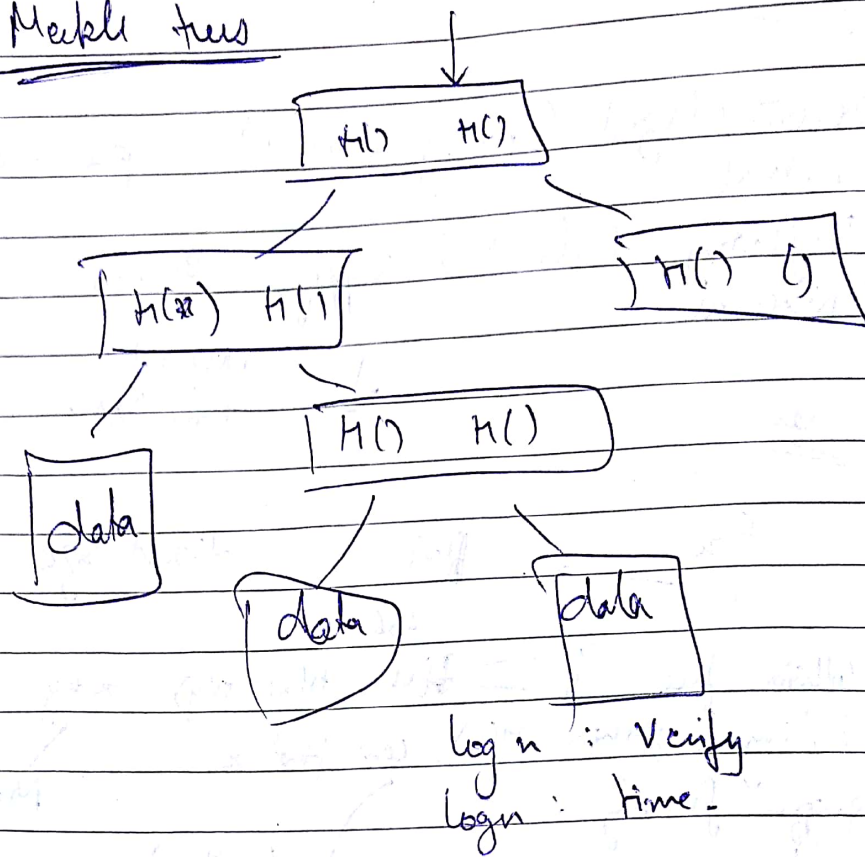
given form  $(H)$ , can't find msg || key = hide

no 2 msgs. : Commit/Bid

Hash pointers



Message trees



Signatures

RSA, DSS

gen : (sk, pk)

secret /

→ public key (identity)

Signing key

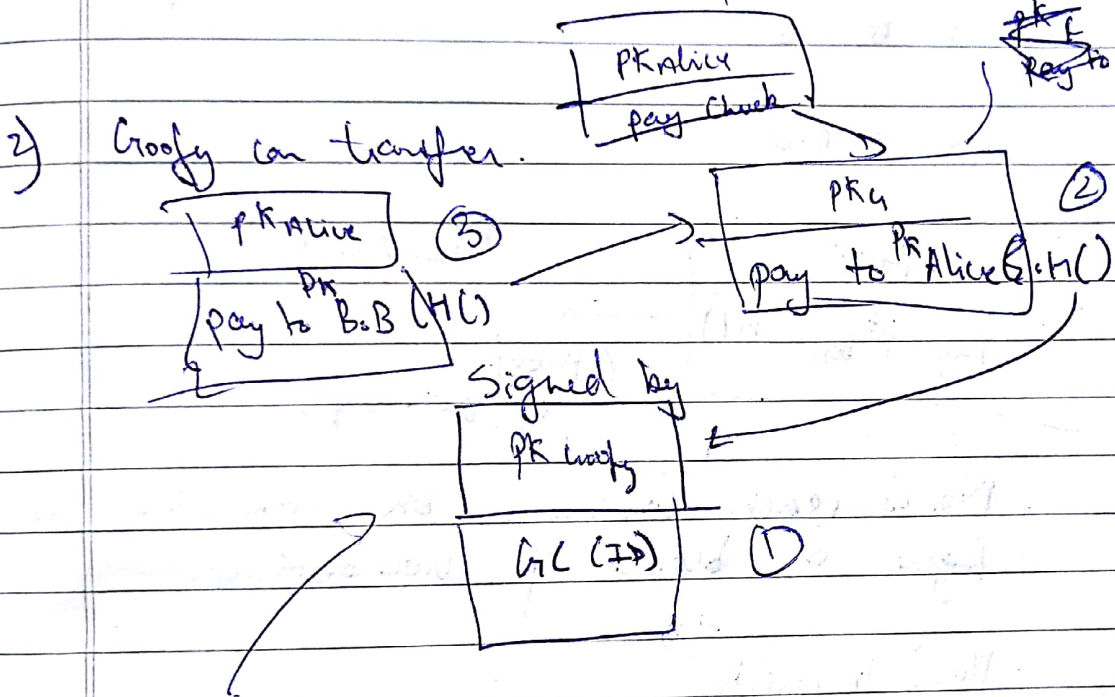
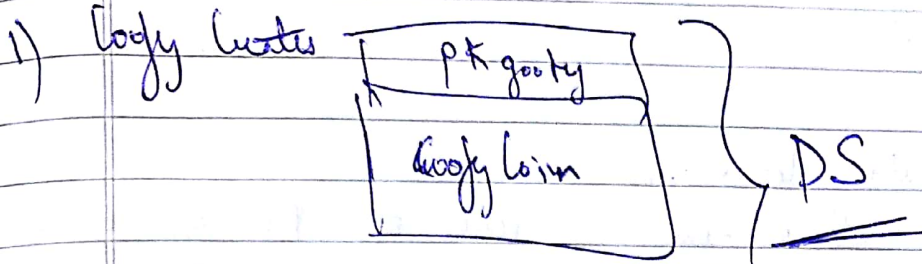
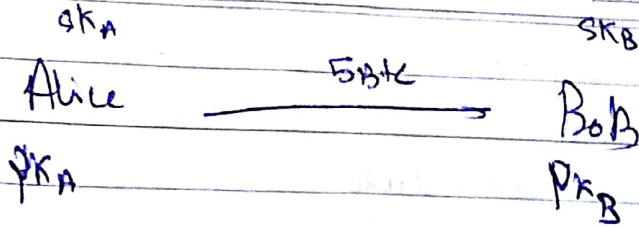
sig : sign(sk, msg)

isvalid = verify(pk, msg, sig)

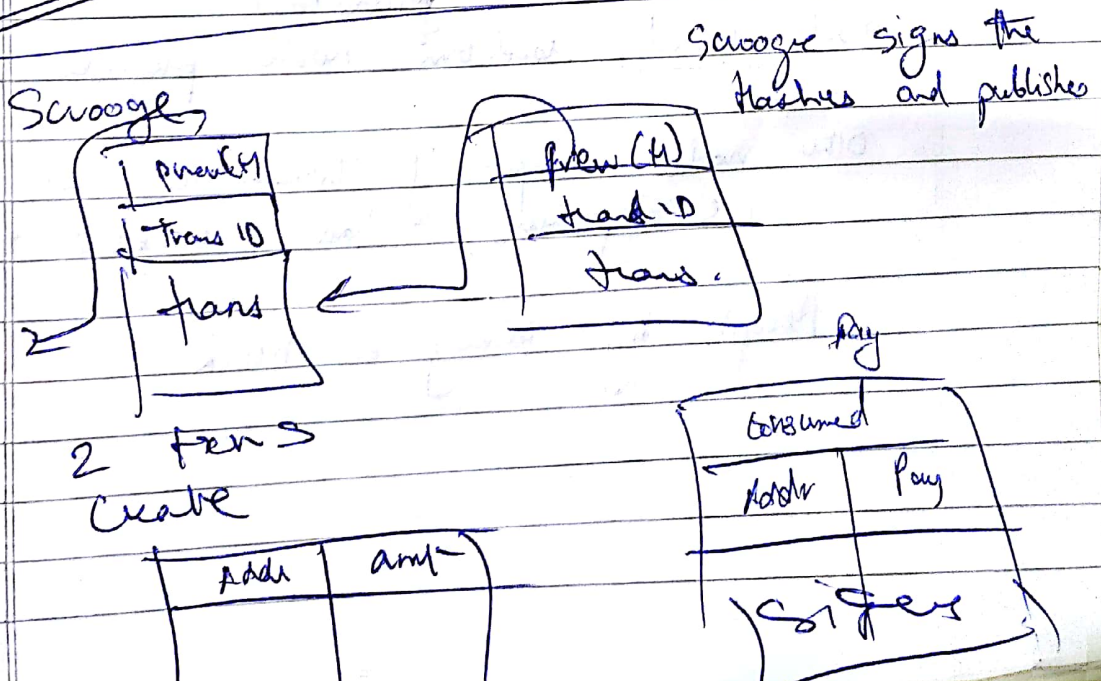
- given pk, cant find sk = unforgeability
- consistent i.e. verify

you are making statements on behalf of pk through sk.

$$\text{Verify}(pk, msg, \text{sign}(sk, msg)) = \text{true}$$



Double Spend



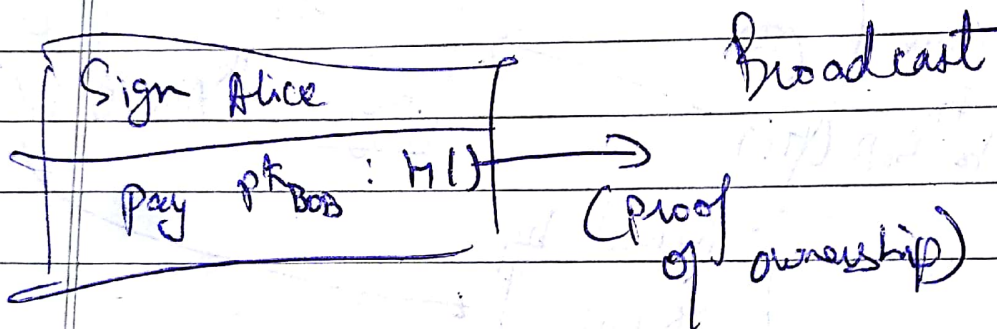
# Decentralization

- Maintaining the ledger.
- validity
- location

Distributed consensus.

Record all or none : Posts on FB going to 30 users

peer to peer.



Nodes reach consensus on transactions and agree on blocks of transactions.

How? Implicit

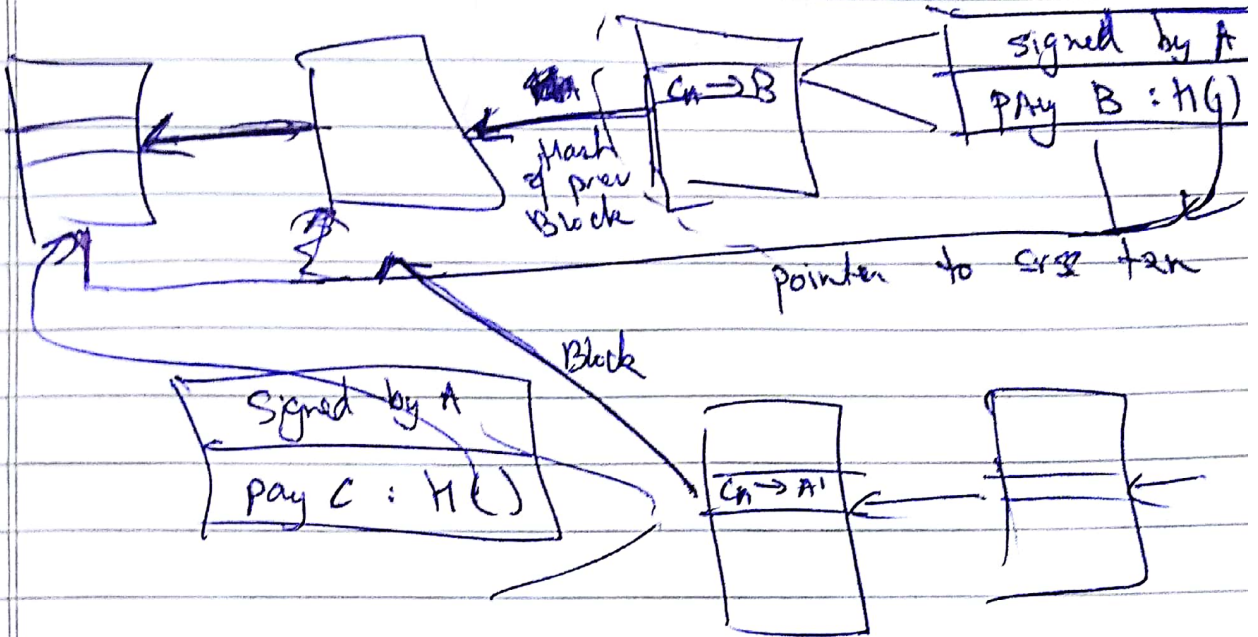
Each node collects broadcasts  
Each round, random node proposes block.

Other nodes accept if transactions are valid.  
i.e. signatures, hash, unique txns.

Accept by mining on block

why does it work?

- Stealing : transfer requires signatures (unforgeable)
- DDoS : wait till next block.



How to extend longest chain

Rounds : Mining

~~block~~ coin waste to yourself.  
Incentive for honesty? Block has to end up on long term chain.

transaction fee

Rounds : who proposes? Voting based on computing power (PoW) / competing.

