Digital Signatures

Public & Private Key pairs

↳ needed to sign a message

↳ used to verify a message & signature

3 protocols:

→ secret signing key

→ (public) verif. key

1. KeyGen() → s, v
2. Sign(m, s) → t
3. Verif(v, t, m) → pass or fail

What are wallet ids?

- Public (verif) keys
  1. Pubkey of block miner
  2. Recipients of transactions

What do we sign?

Whoever's paying signs a transaction.

Ed25519 Signatures
(nacl.signing)   Pynacl

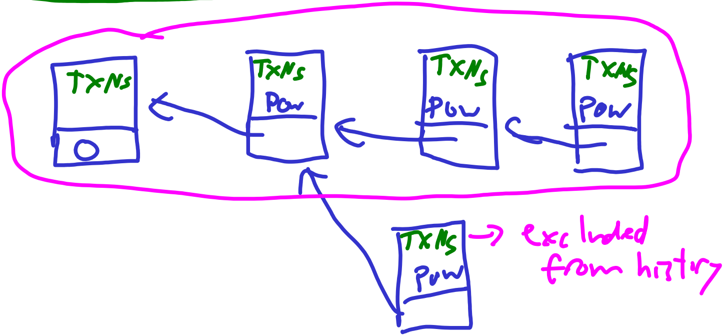
Private, pub keys: 32 bytes each

Signature: 64 bytes

ECDSA, RSA

- ↳ works both ways
- ↳ huge key sizes

Transactions



Longest chain: send-chat (arbitrary)

server /push

(prefer current head)

Bitcoin solved:

① Consensus (distributed)

- Previous block hash
  linear history)
- Longest chain rule
- Proof of work
  (~10 mins per block)

Bitcoin Paper solves:

2 "Double spend problem"

- Prevent a valid, signed transaction from being duplicated.

Transaction contents

- Signature of payer
- Acct no. of payer → (pub key)
- Pub key of recipient
- Amount
- Unique id, avoid cashing twice
- Date (we won't focus on)
  ↳ earliest that txn may be included

Validity checks

- Hasn't been spent in same chain
- Date not in future
- Signature is valid
- Amount $\leq$ amount available

Bitcoin Transaction

Version num. (features & improvements)

Inputs (list) –
- UTXO → unspent transaction output
- Signature

Outputs (list) –
- Public Key (who gets paid)
- Amount

* Single transaction has multiple ins & outs.

Date (locktime)

Why multiple inputs?

May have multiple smaller amounts to combine

Why multiple outputs?

→ Pay yourself the "change"

Fees

Must have

$\sum$ input amts $\geq$ $\sum$ output amts

↓

difference is a "fee" paid to block miner

Coinbase transaction

- first txn in a block
- No inputs
  (Implicitly: Block reward + all fees)
- Outputs as usual

How to refer to transaction?

txid : Hash of entire transaction

index: which output

~~block id~~ (can't know in advance)

→ UTXO