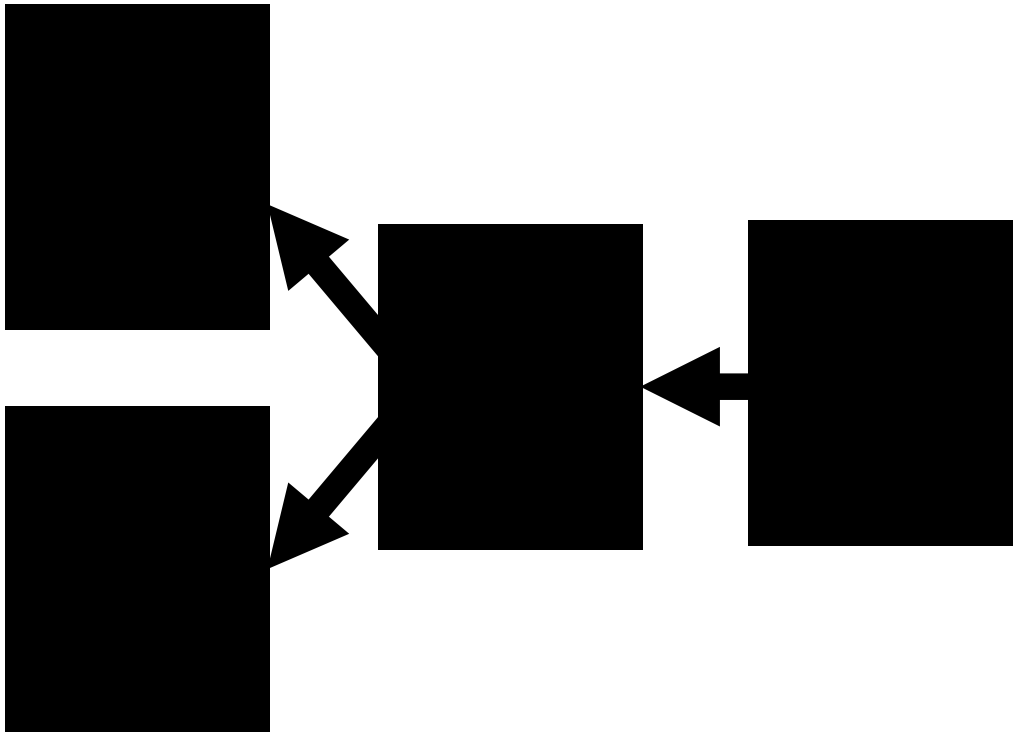
Forks

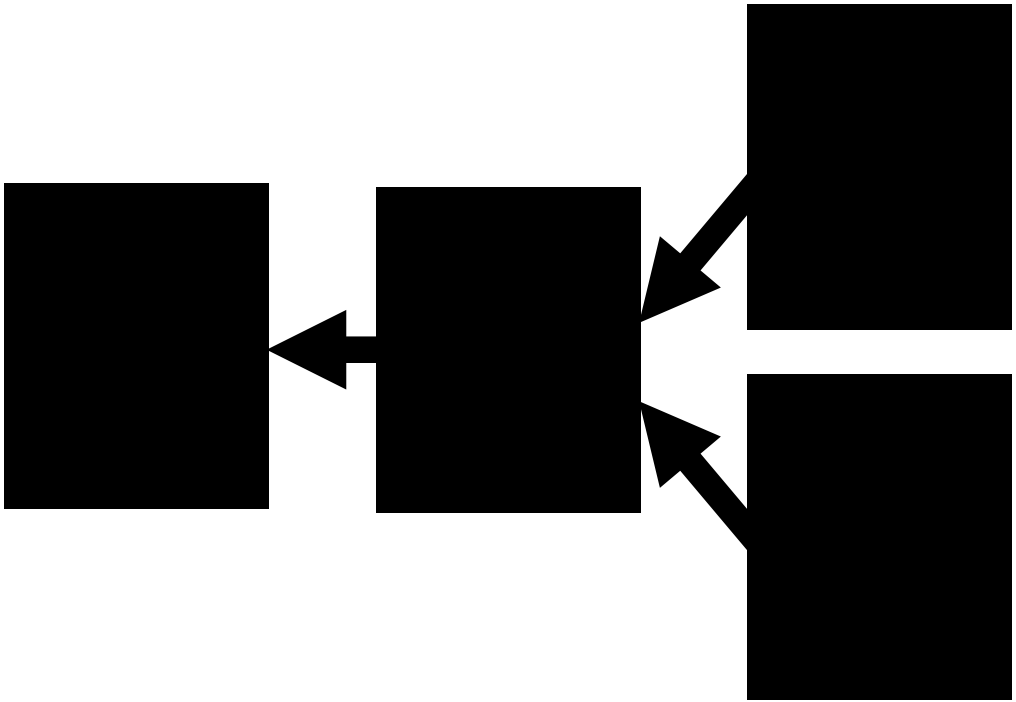
MAS.S62
3/5/2018 Lecture 8
Neha Narula

Can a block point to two prev blocks?



No! Only one spot for prev hash

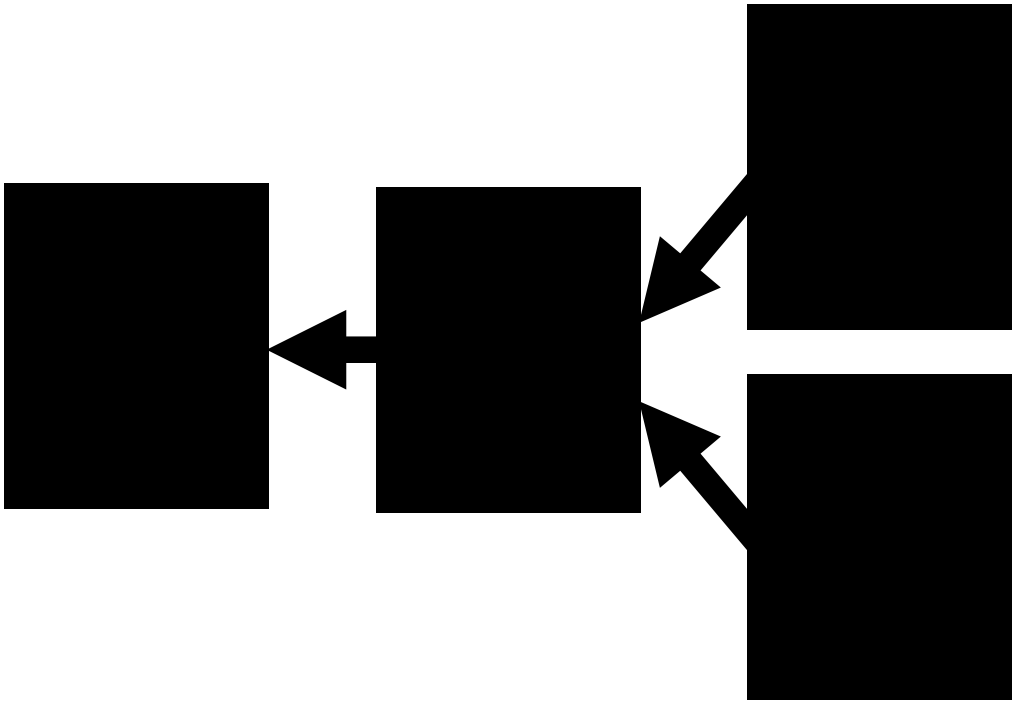
Can two blocks point to one?



Yes! Known as a FORK.

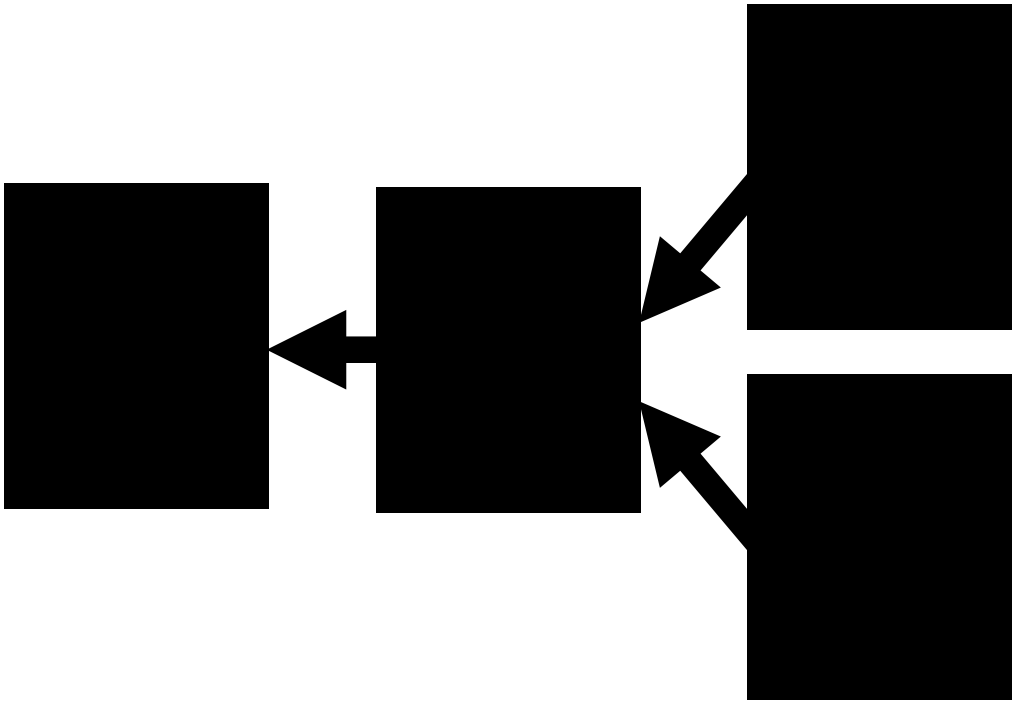
What does this mean?

What does a fork mean?



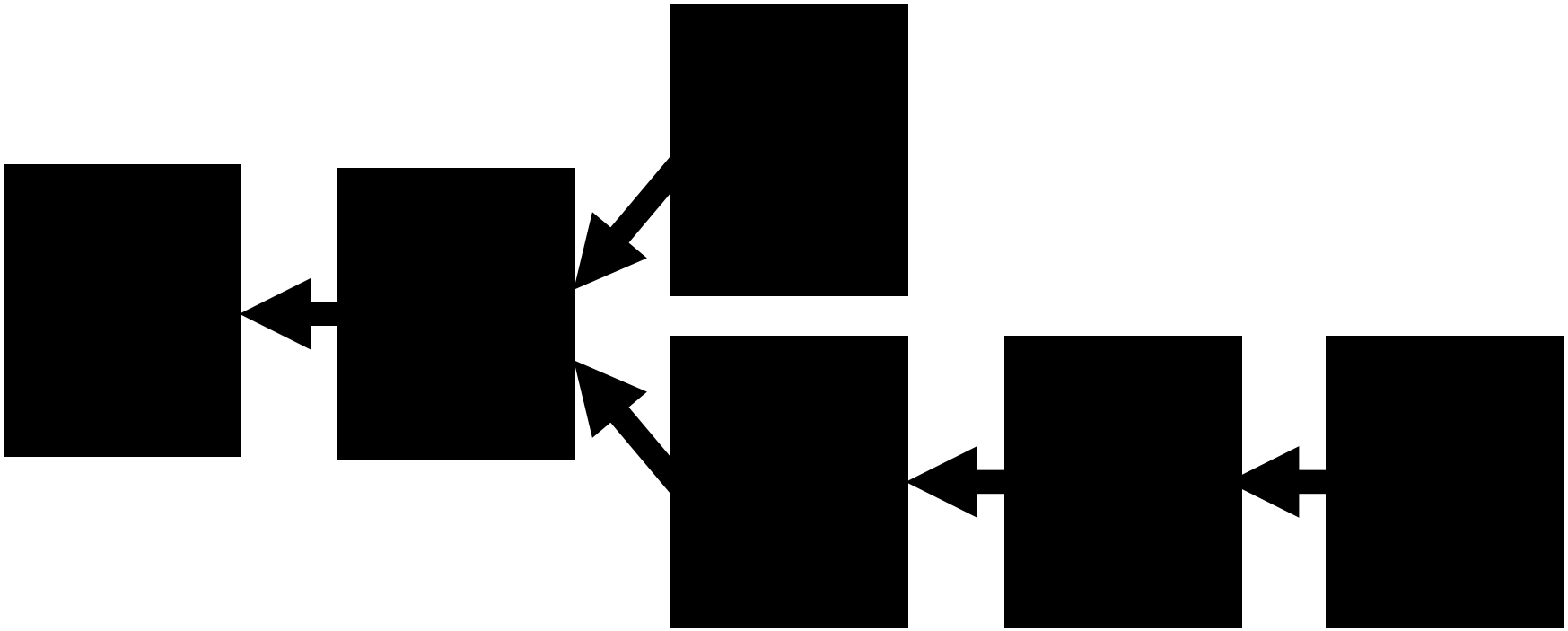
- Two versions of history
- Possible double spends
- Two currencies!

How do we fix it?

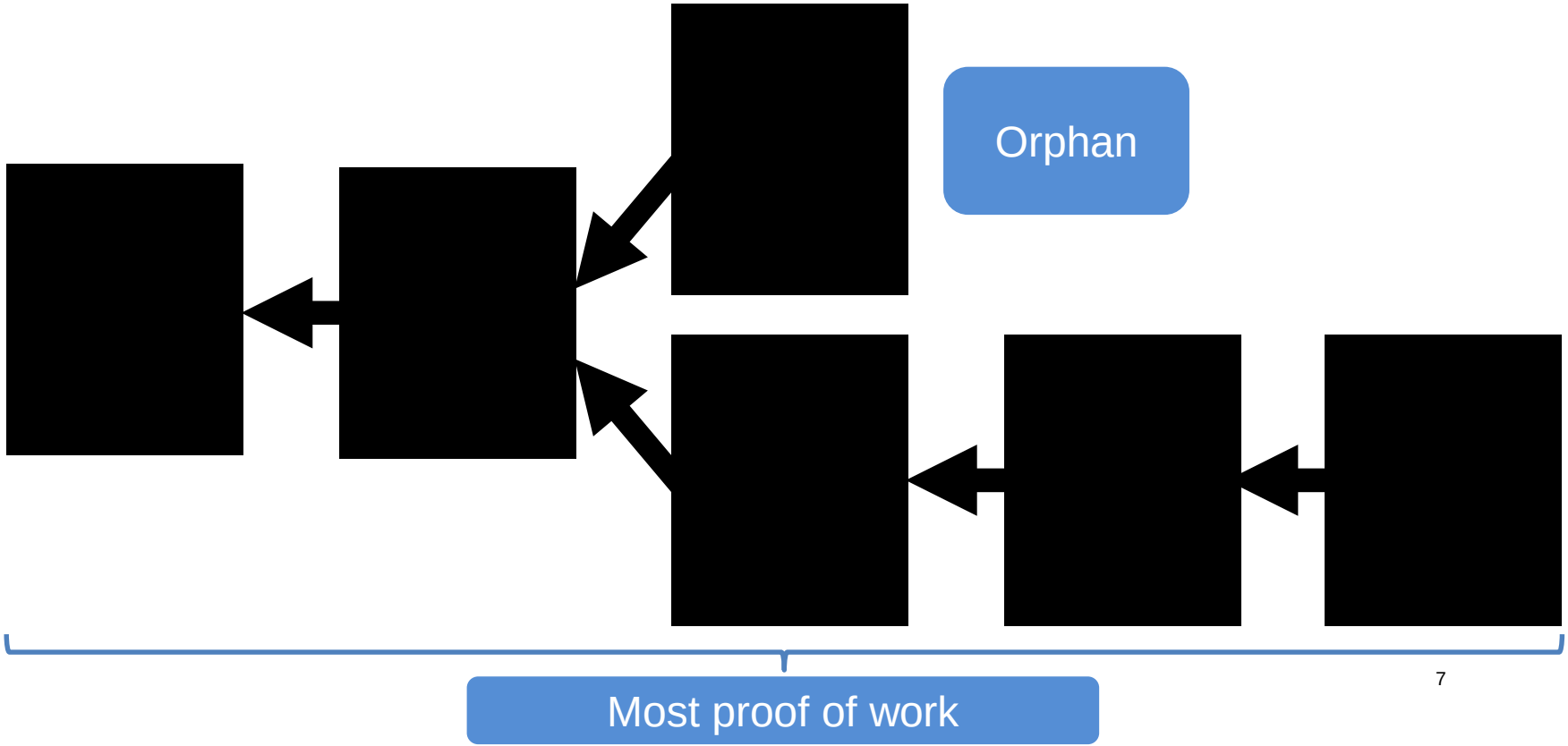


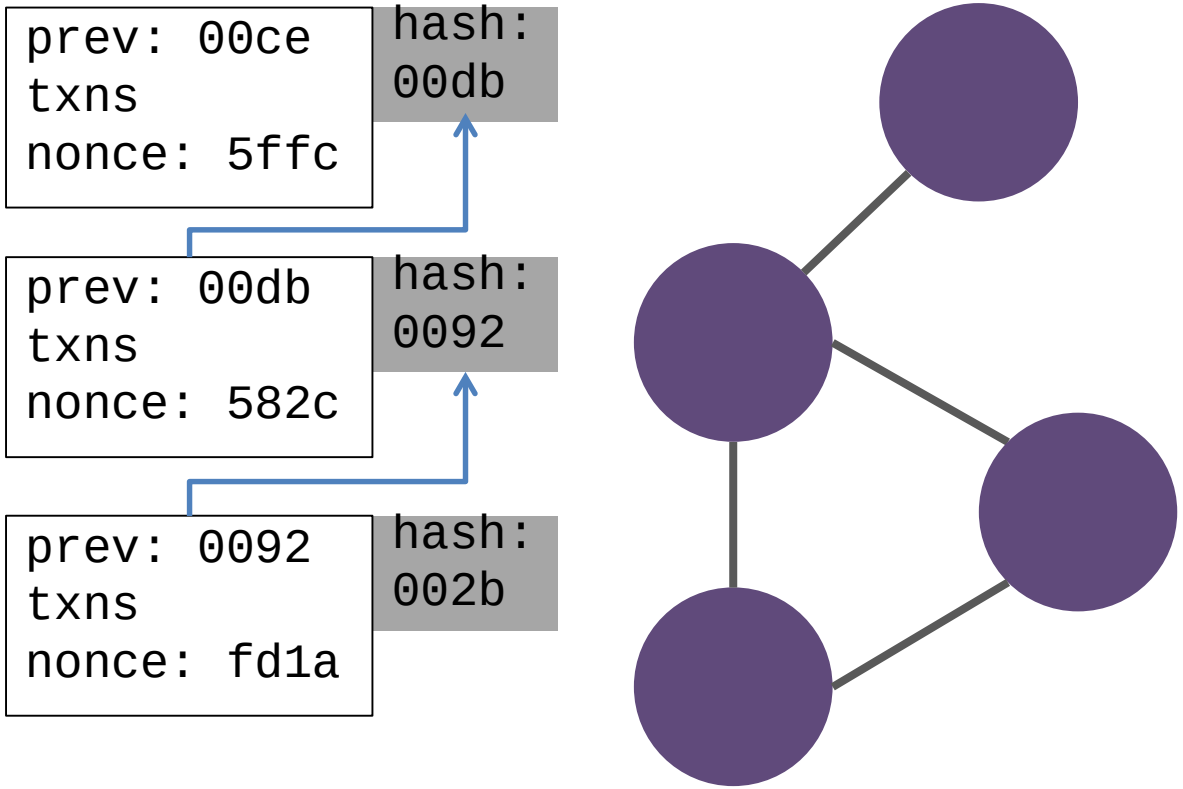
Which is the “right” one?

Over time, one will win



Over time, one will win





?

prev: 002b
txns
nonce: 34a8

hash:
001c

Validation Rules

- < 1 MB blocks
- Valid transactions
  - For each input, scriptPubKey + scriptSig evaluates to true (entire script interpreter)
  - nLockTime
- Proof of work
- No double spends
- Block timestamps
- Prev block hash pointers

Consensus critical

prev: 00ce
txns
nonce: 5ffc

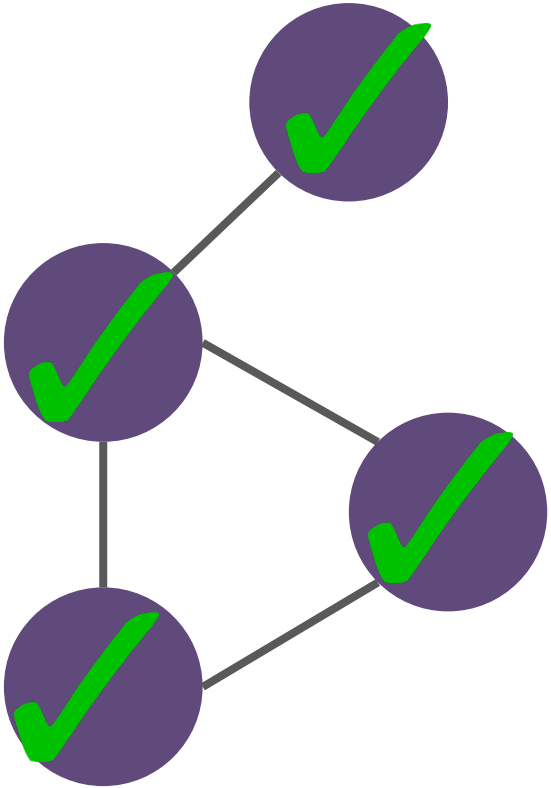
hash:
00db

prev: 00db
txns
nonce: 582c

hash:
0092

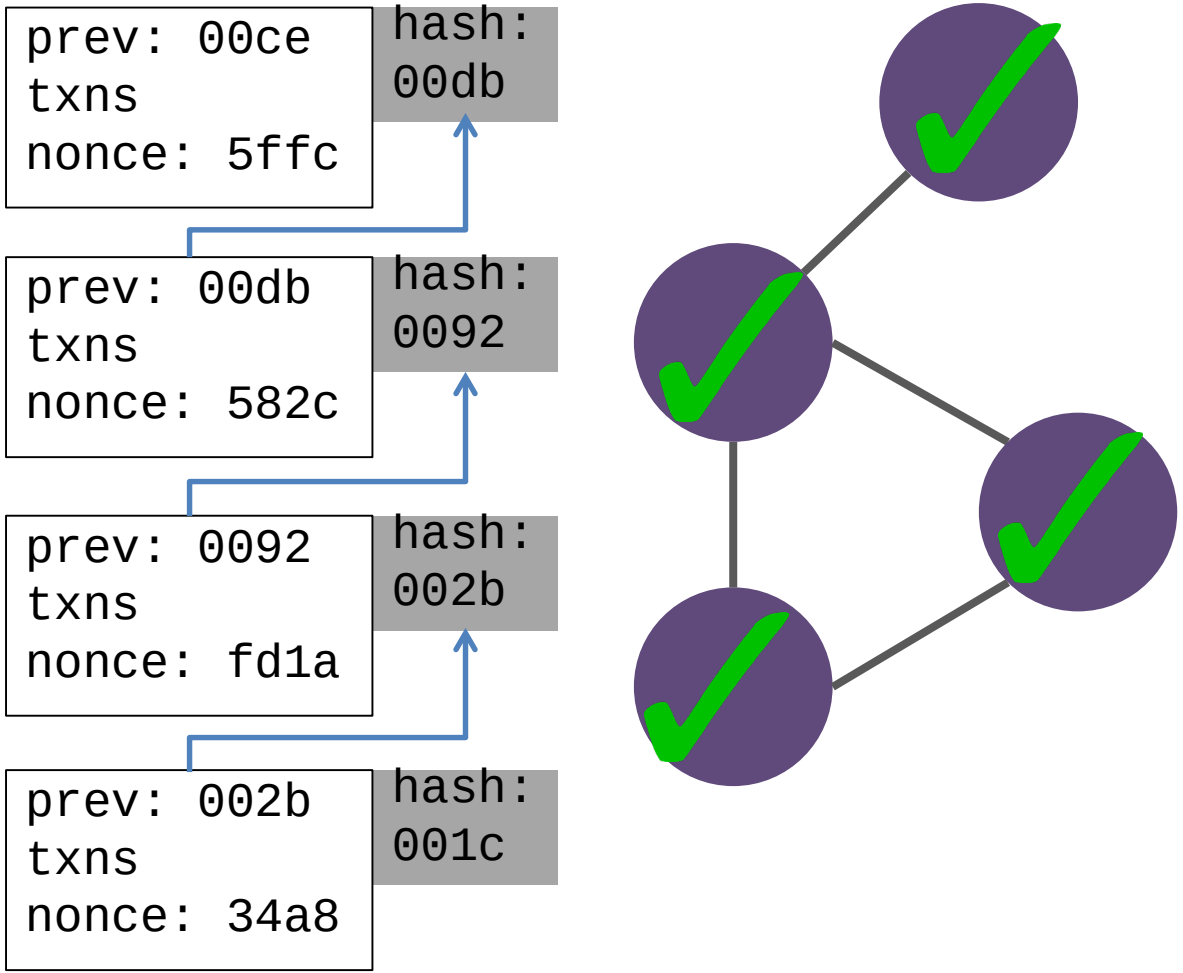
prev: 0092
txns
nonce: fd1a

hash:
002b



prev: 002b
txns
nonce: 34a8

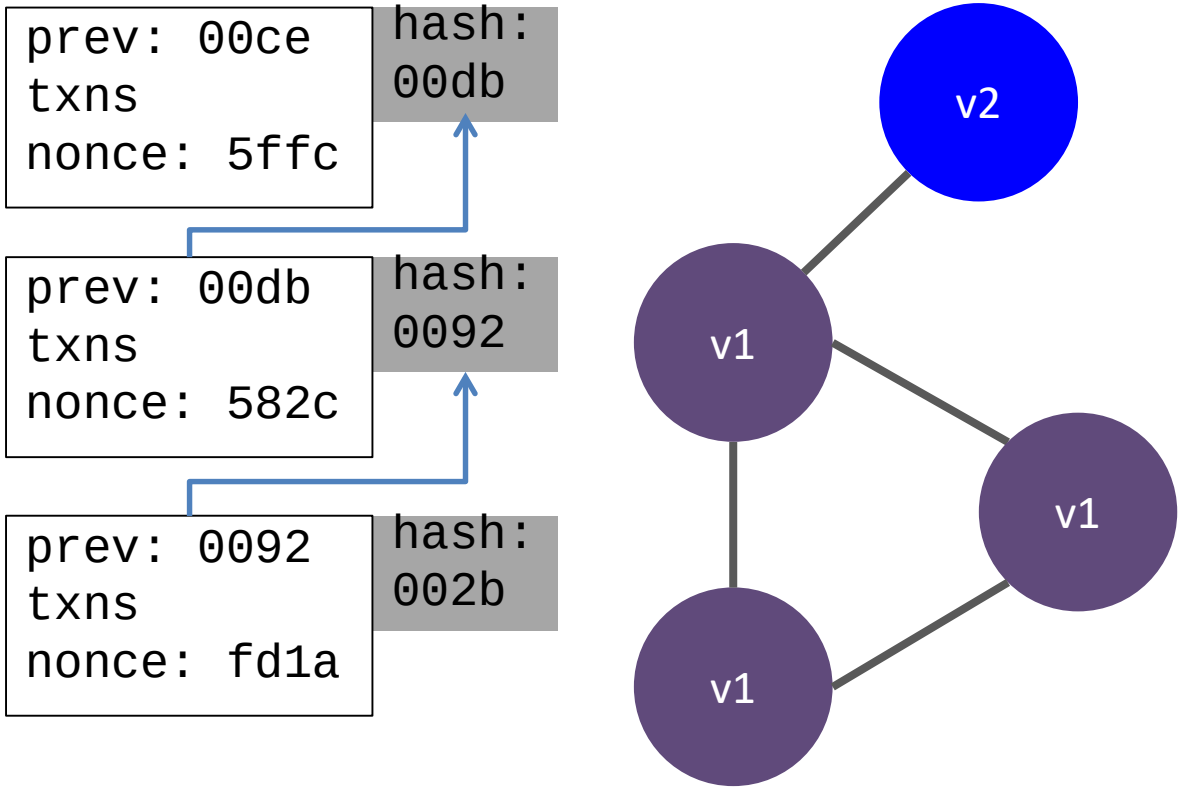
hash:
001c


prev: 00ce
txns
nonce: 5ffc
hash:
00db
prev: 00db
txns
nonce: 582c
hash:
0092
prev: 0092
txns
nonce: fd1a
hash:
002b
prev: 002b
txns
nonce: 34a8
hash:
001c

Changing the validation rules

- Fix bugs
- Major security issues
- New features

Can’t get everyone to upgrade at the same time!



?

prev: 002b
txns v1
nonce: 34a8

hash:
001c

prev: 00ce
txns
nonce: 5ffc

hash:
00db

prev: 00db
txns
nonce: 582c

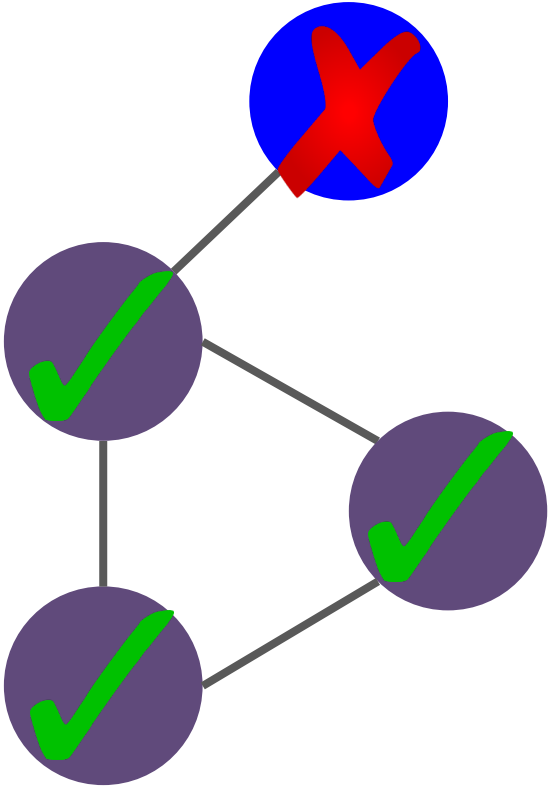
hash:
0092

prev: 0092
txns
nonce: fd1a

hash:
002b

prev: 002b
txns v1
nonce: 34a8

hash:
001c



prev: 00ce
txns
nonce: 5ffc

hash:
00db

prev: 00db
txns
nonce: 582c

hash:
0092

prev: 0092
txns
nonce: fd1a

hash:
002b

prev: 00ce
txns
nonce: 5ffc

hash:
00db

prev: 00db
txns
nonce: 582c

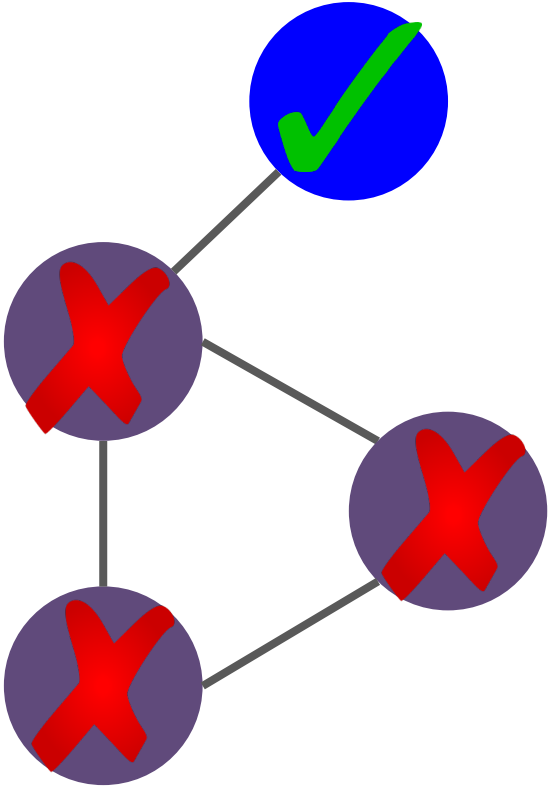
hash:
0092

prev: 0092
txns
nonce: fd1a

hash:
002b

prev: 002b
txns v1
nonce: 34a8

hash:
001c



prev: 00ce
txns
nonce: 5ffc

hash:
00db

prev: 00db
txns
nonce: 582c

hash:
0092

prev: 0092
txns
nonce: fd1a

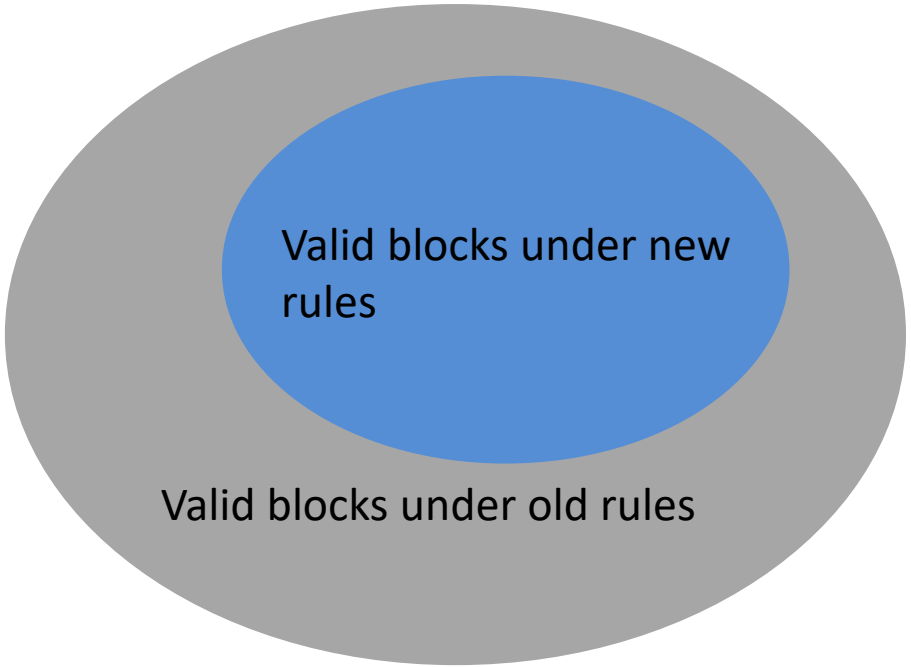
hash:
002b

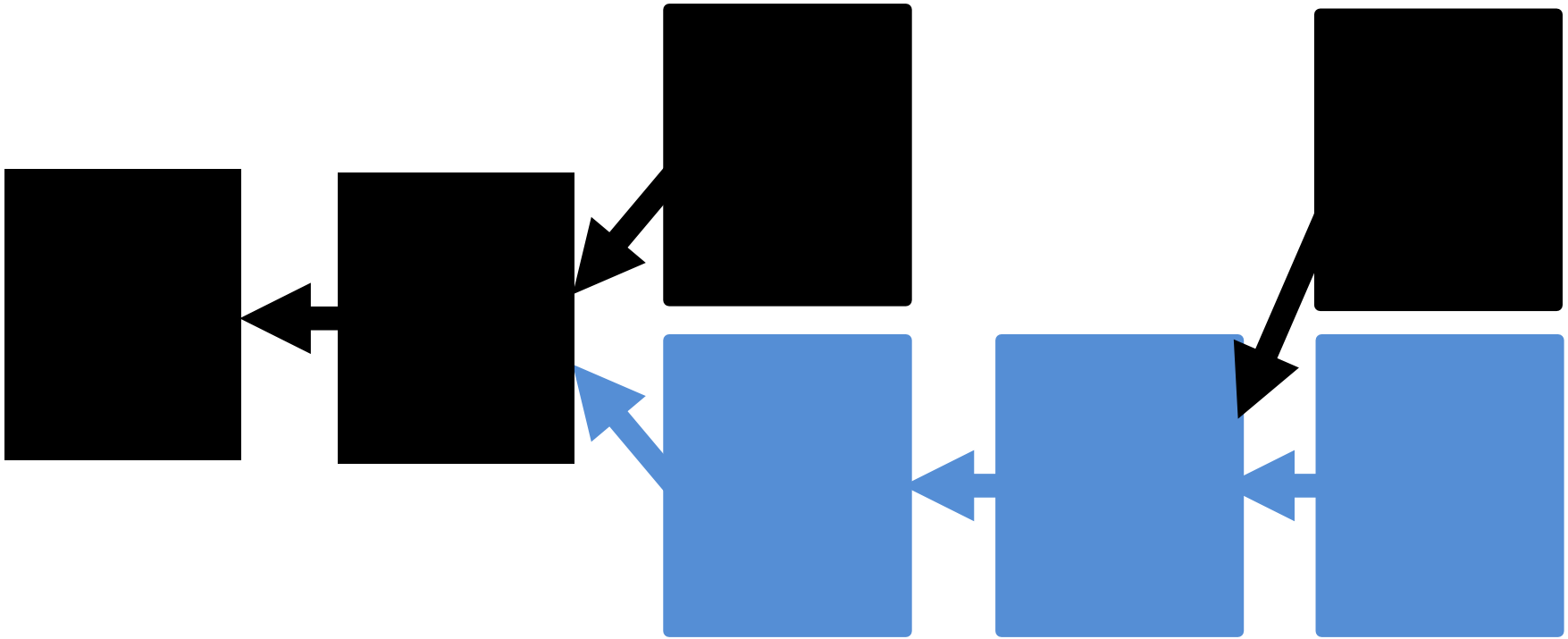
prev: 002b
txns v2
nonce: ce7d

hash:
004d

Soft forks

- Backwards compatible
- Only adding new rules: Old-rule nodes will see new-rule blocks as valid

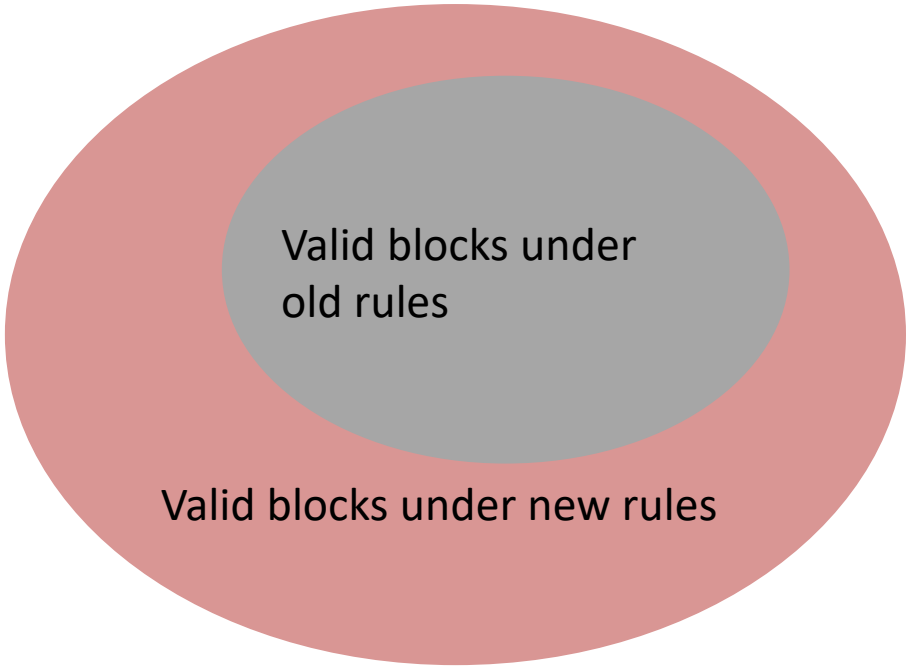


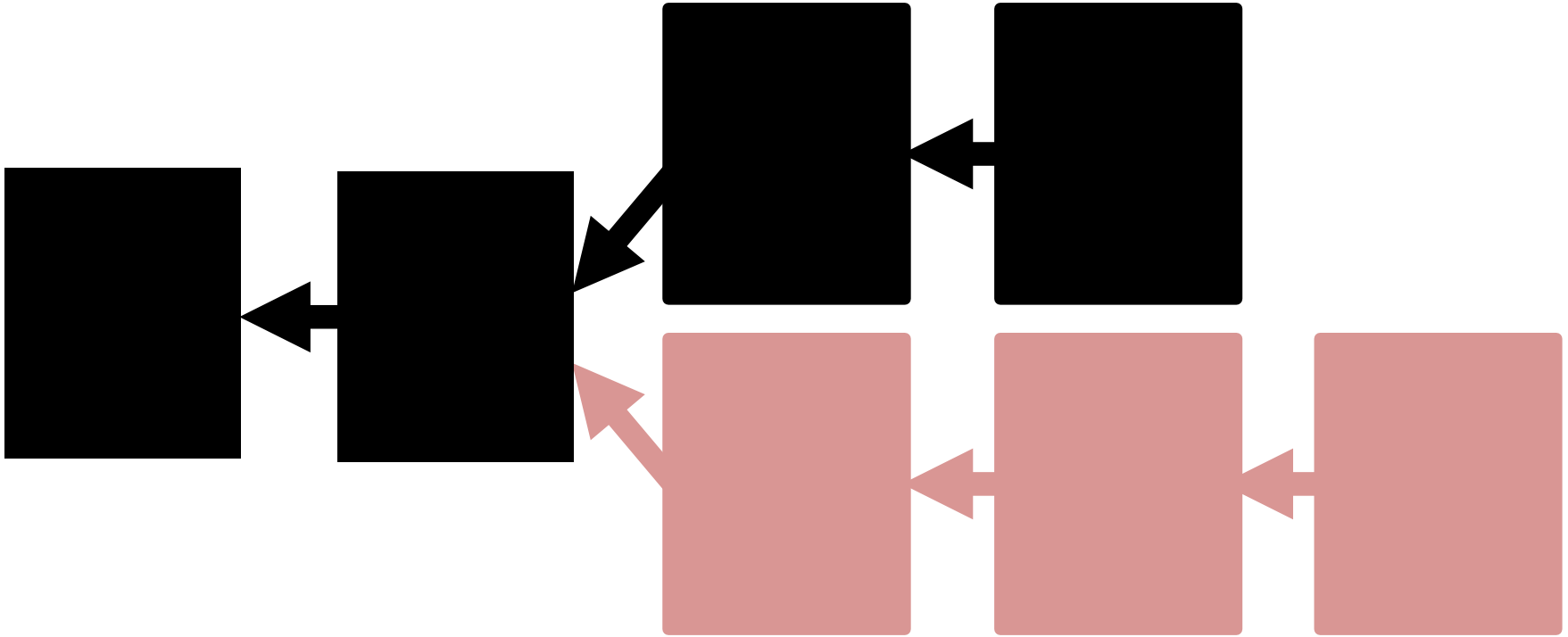


Miners who don’t upgrade might produce invalid blocks, but they will be orphaned

Hard forks

- Not backwards compatible
- Removing rules: Old-rule nodes will NOT see new-rule blocks as valid





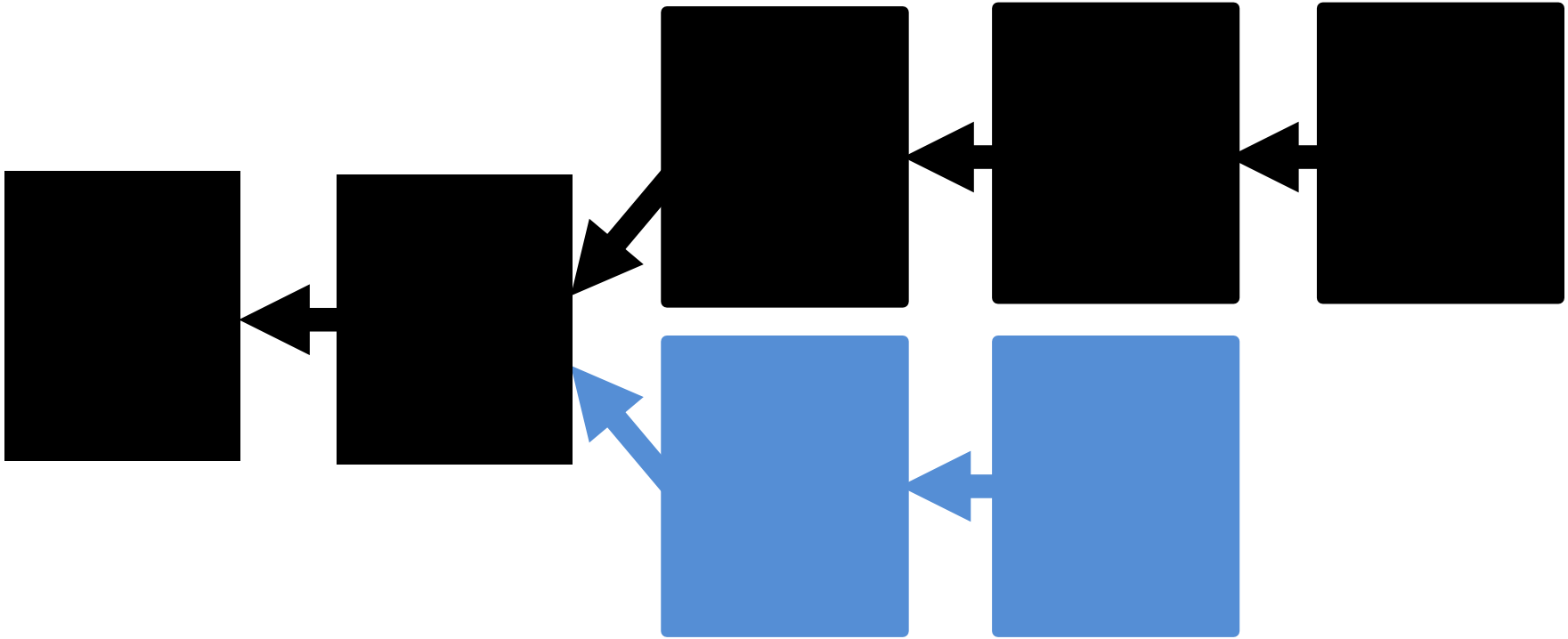
Two chains, possibly forever.

Hard fork vs. Soft fork

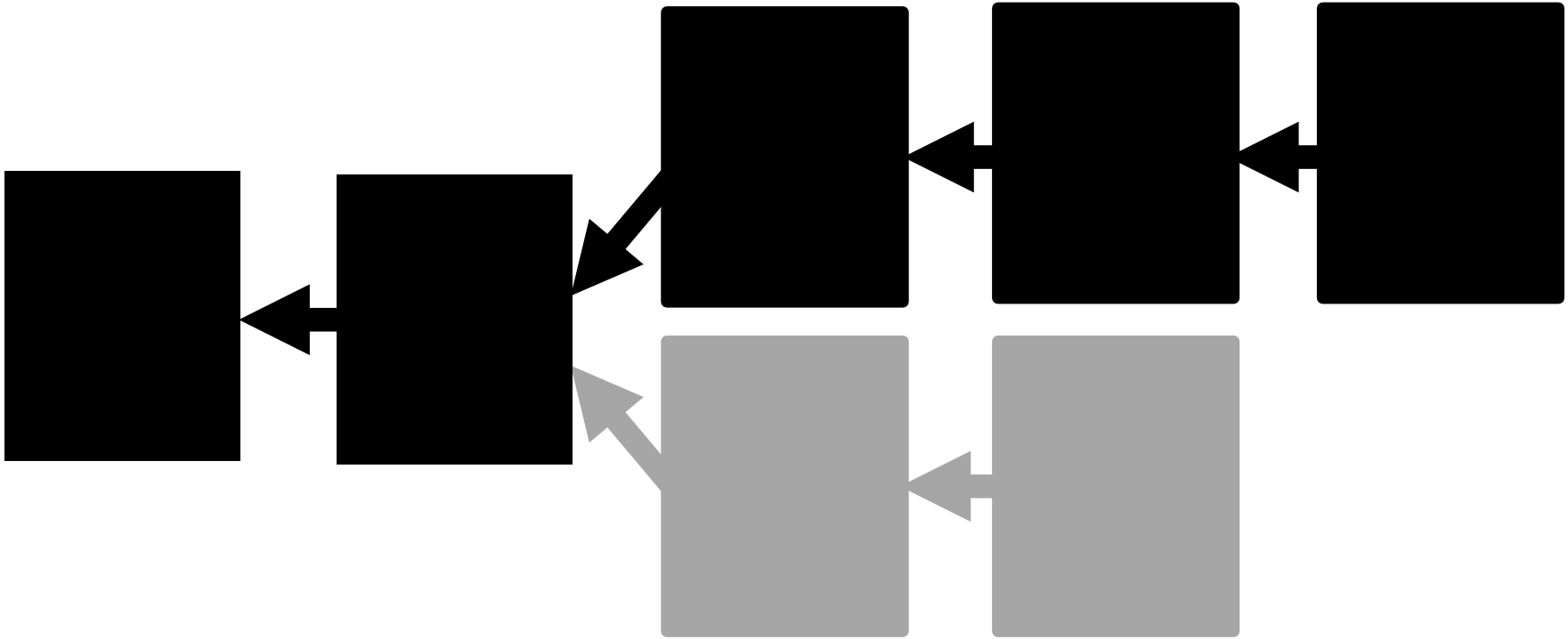
- Hard forks are NOT backwards compatible
- Can do combination hard/soft forks

Who controls forks?

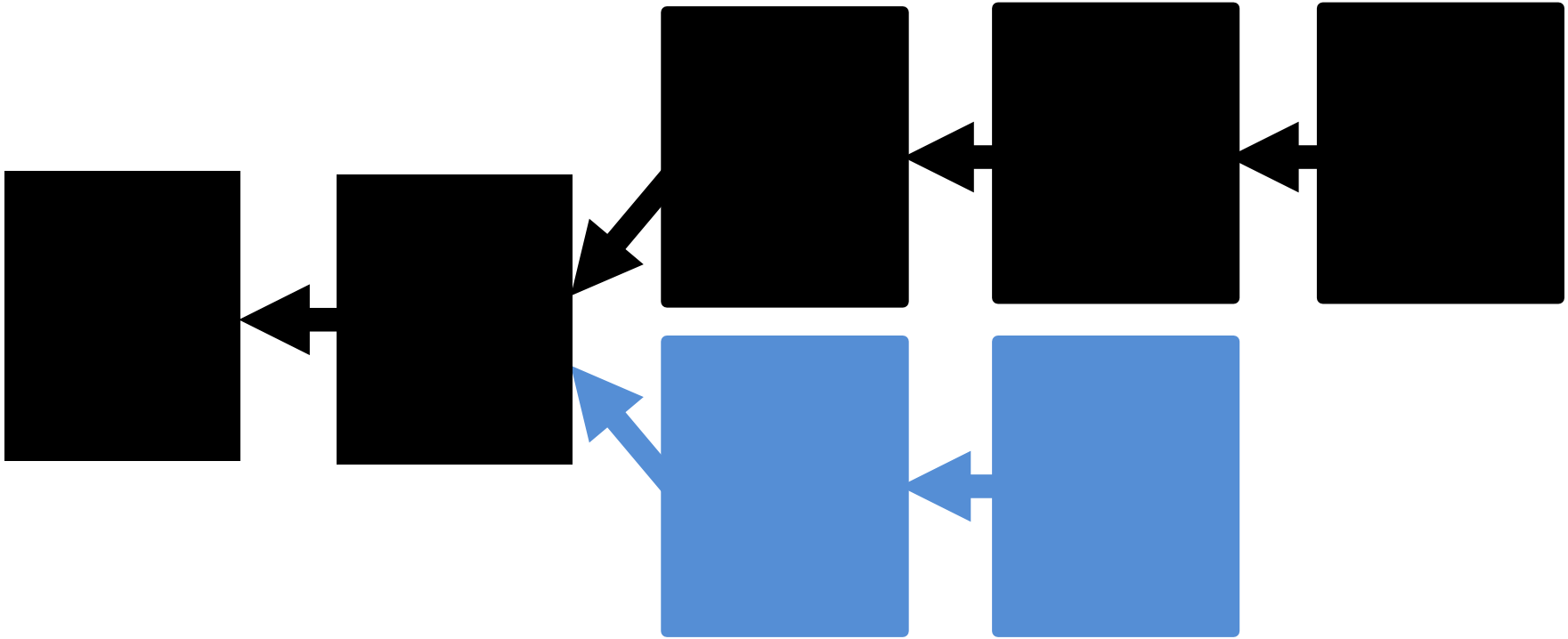
- Miners create blocks
- Nodes validate blocks



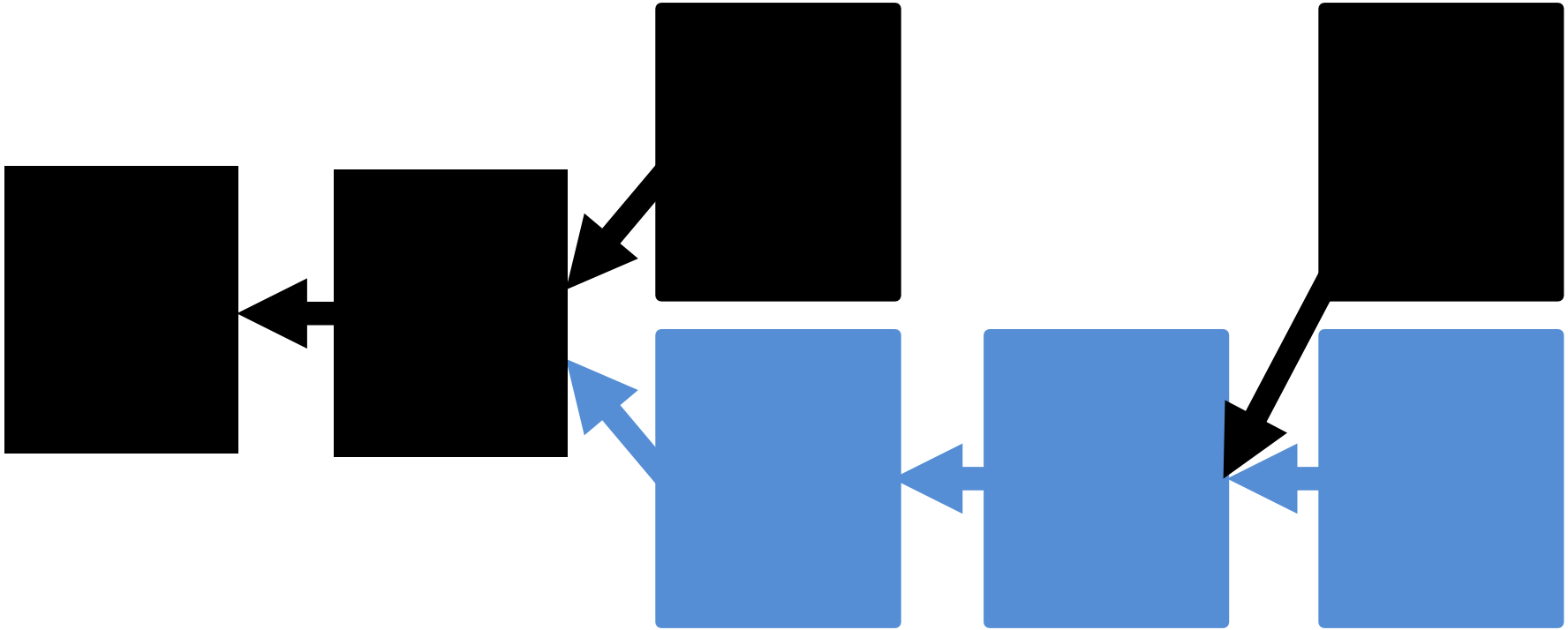
What happens if a soft fork doesn’t obtain > 50% of hash rate?



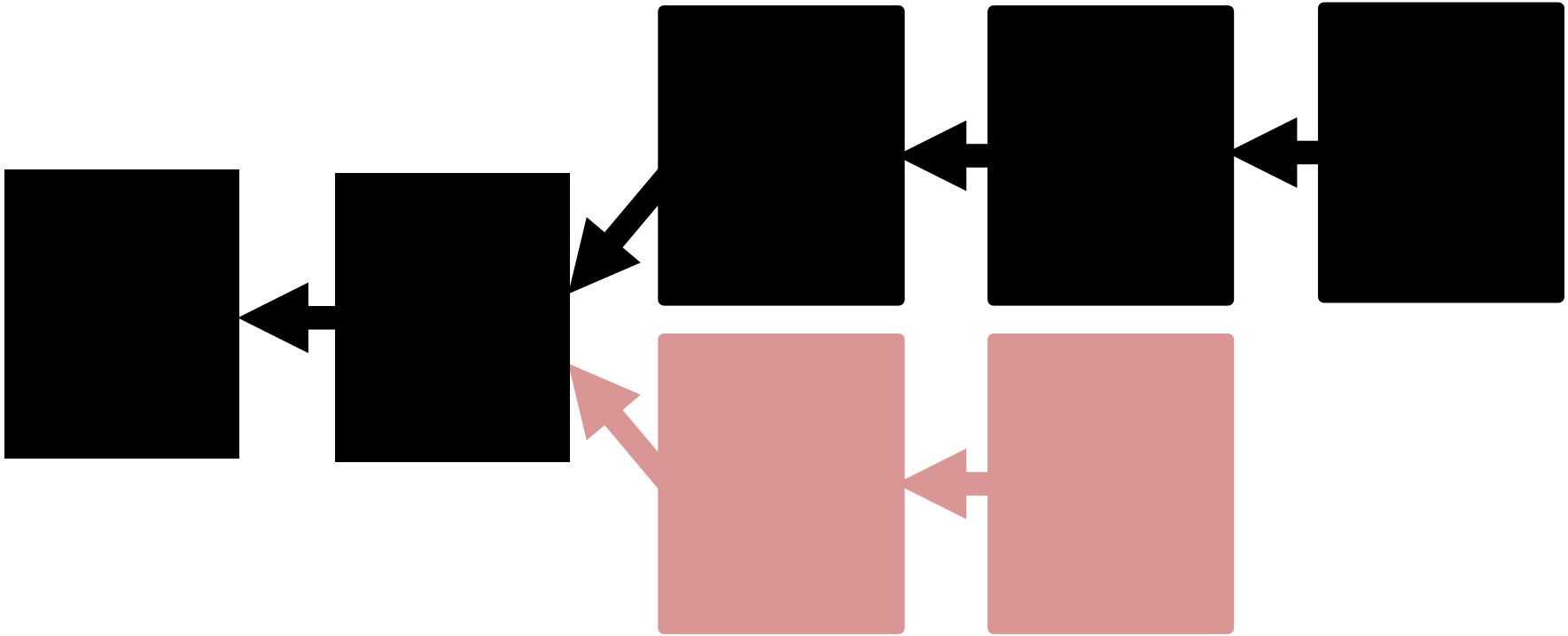
Depends on the soft fork! If old-rule blocks are still valid, soft fork gets reorg'd out



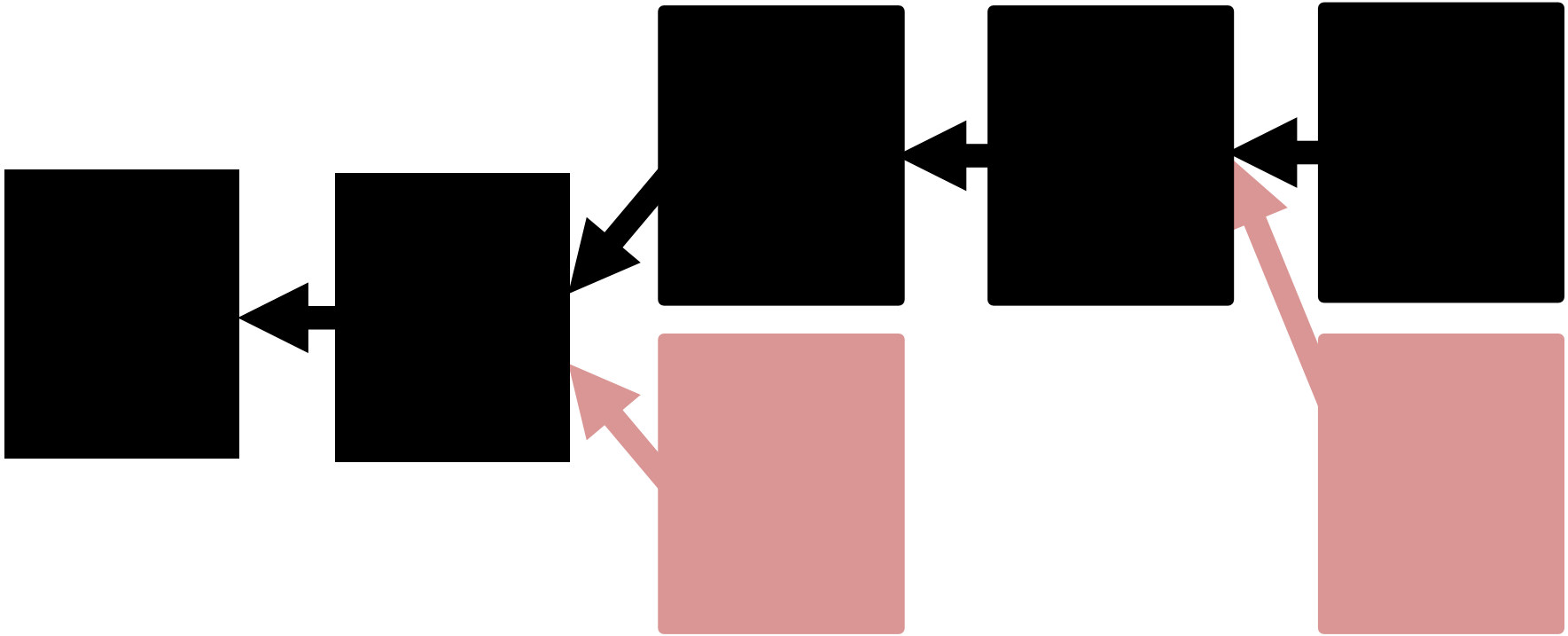
If old-rule blocks are now invalid, fork will persist



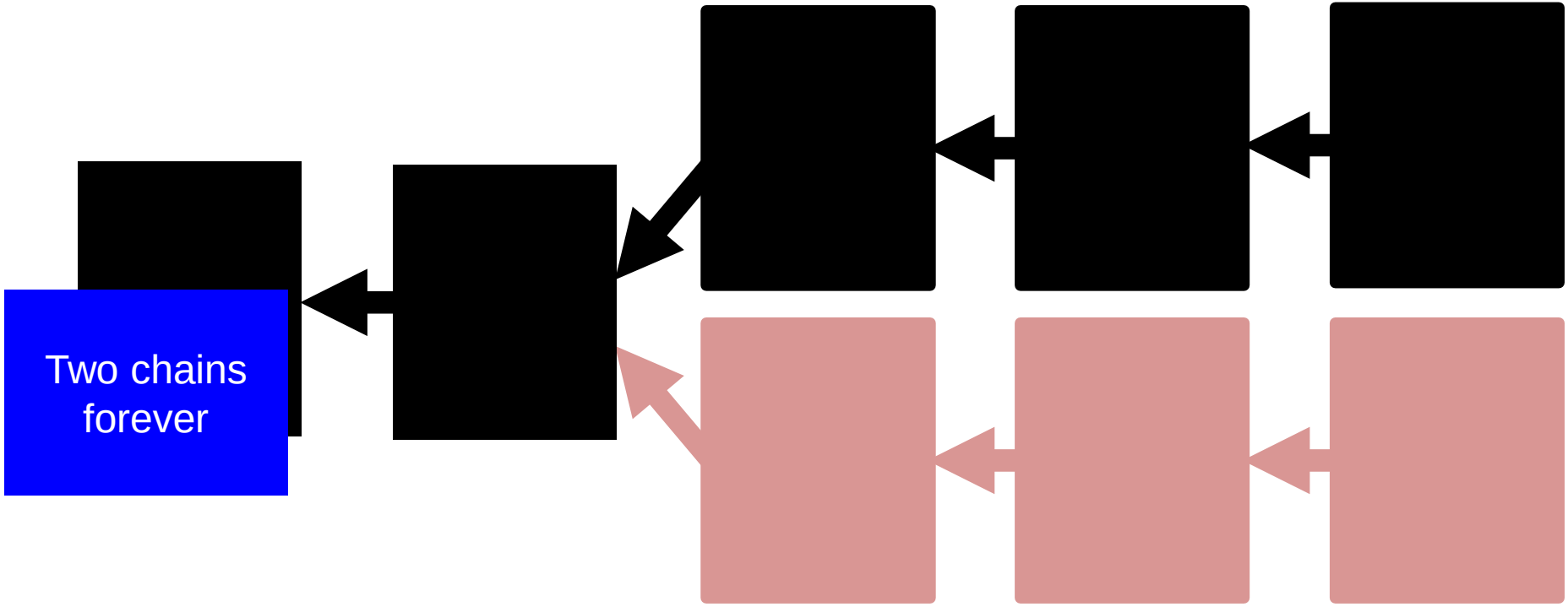
If soft fork > 50%, old-rule blocks will follow new fork automatically



What happens if a hard fork doesn’t obtain > 50% of the hash rate?



Again depends, but if old-rule blocks are still valid, new-rule nodes will follow along



What happens if a hard fork does obtain > 50% of the hash rate?

SPV wallets and forks

- SPV wallets see:
  - Block headers: prev, nonce, merkle root, ts
  - Merkle paths
- What happens during a fork?

Soft forks in practice

- Lots! P2SH, Segwit, OP_CHECKSEQVERIFY

Hard forks in practice

- New Bitcoins (Bitcoin Cash, Bitcoin Gold, Bitcoin Diamond)
- Ethereum DAO hard fork
- Some cryptocurrencies hard fork frequently (Monero, every 6 months)

Ethereum DAO hard fork

- Block 1920000 transferred ~12M ETH from one set of accounts to another for reclamation
- 85% of mining power went along with it
- Two currencies: ETH and ETC (~30:1 today)

Summary

- Forks are extremely challenging
- Quite different than traditional consensus
- Next class: Sharon Goldberg on P2P network

MAS.S62 Cryptocurrency Engineering and Design

Spring 2018