SybilQuorum:
Open Distributed Ledgers through Trust Networks

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Many challenges in blockchains

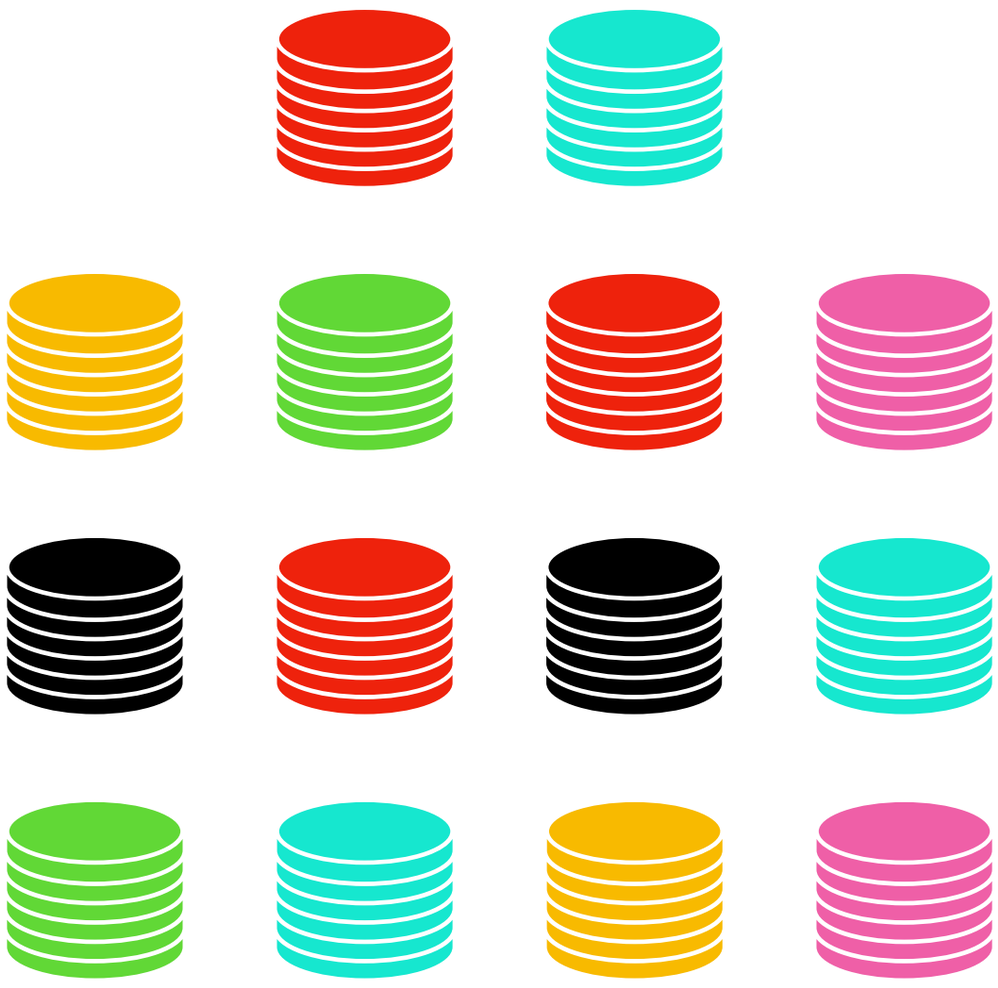
- ✗ Poor privacy
- ✗ Governance
- ✗ Scalability
- ✗ Security

Many challenges in blockchains

- ~~Poor privacy~~
- ~~Scalability~~
- ~~Governance~~
- **Security**

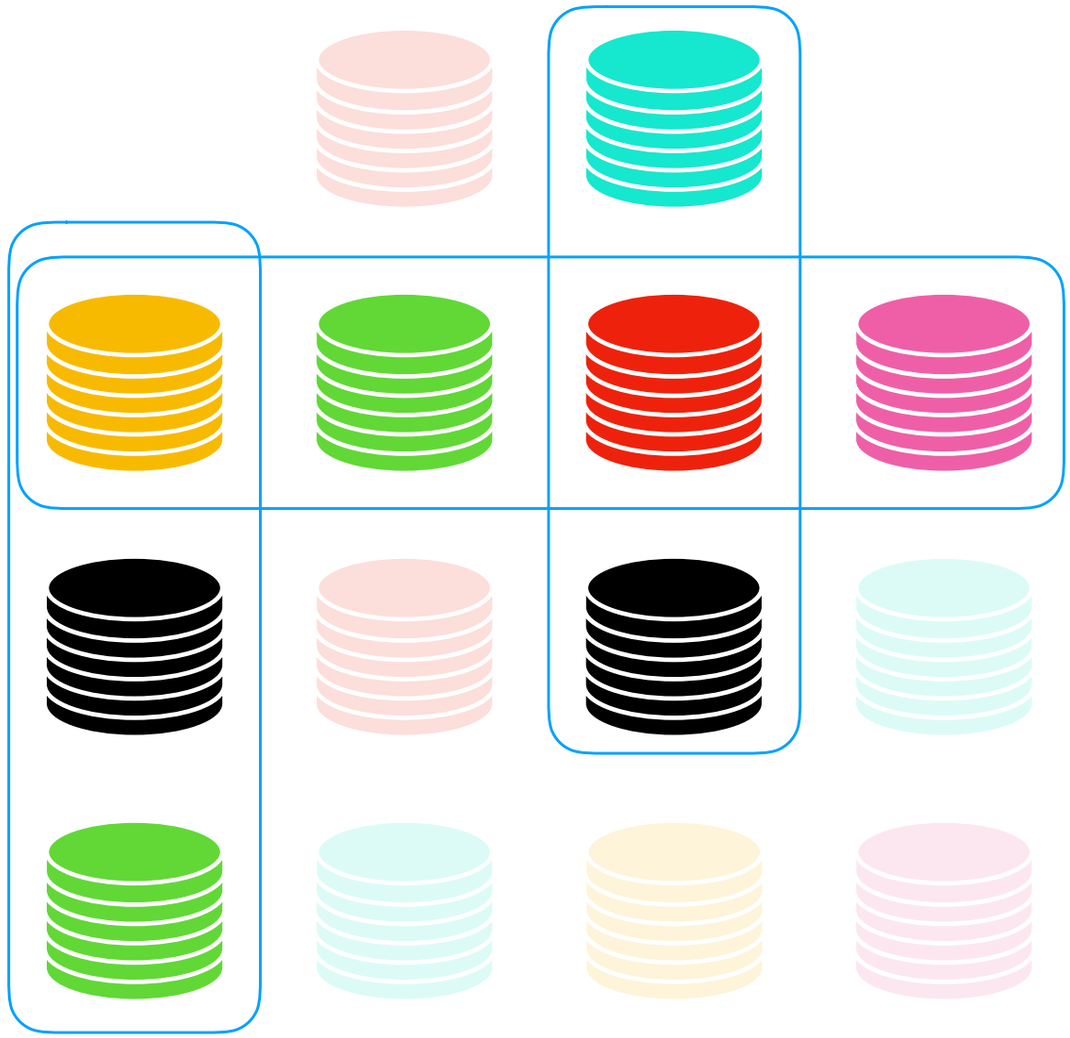
Open systems need strong sybil defences

Our focus: bootstrapping an FBAS



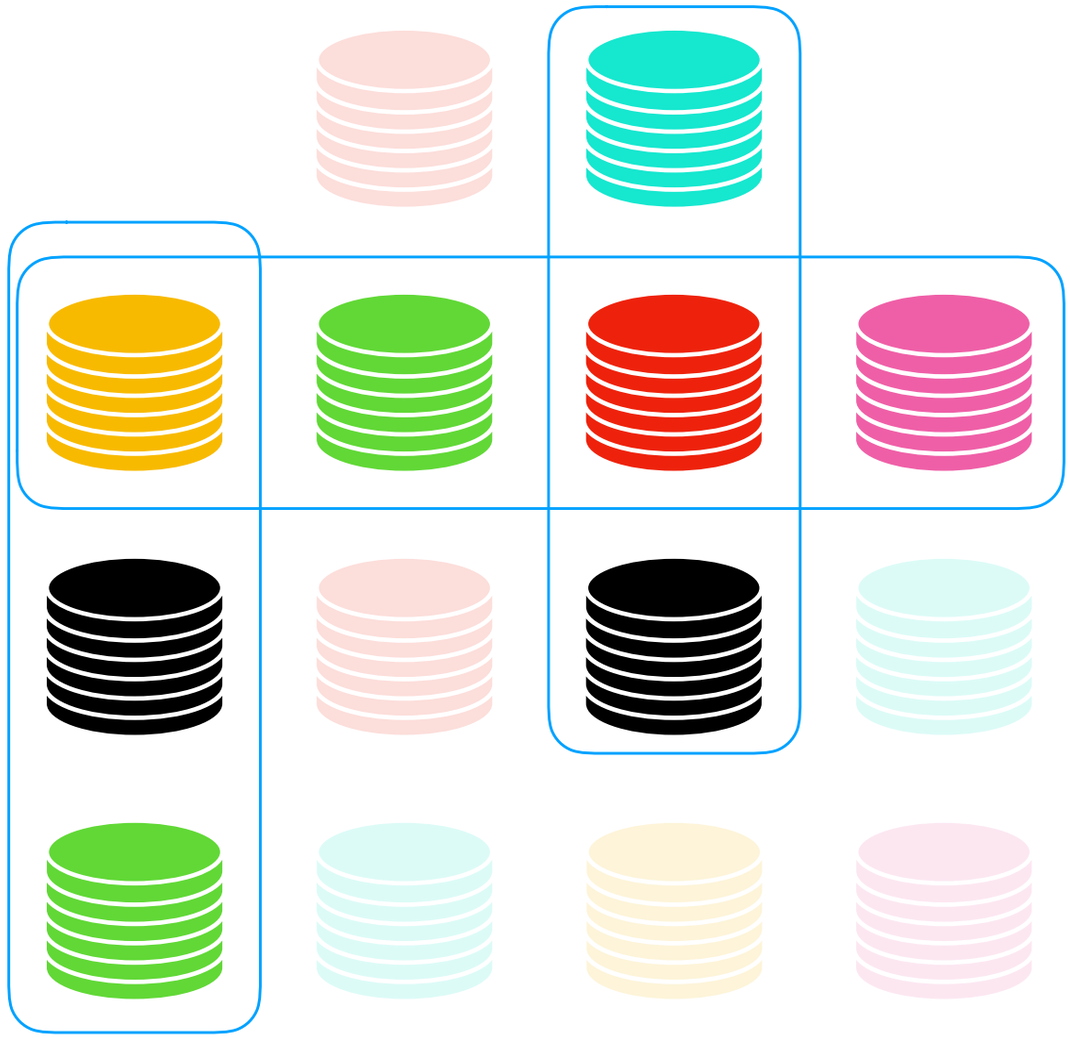
Nodes do not have to be known ahead of time

Our focus: bootstrapping an FBAS



Nodes choose whom they trust

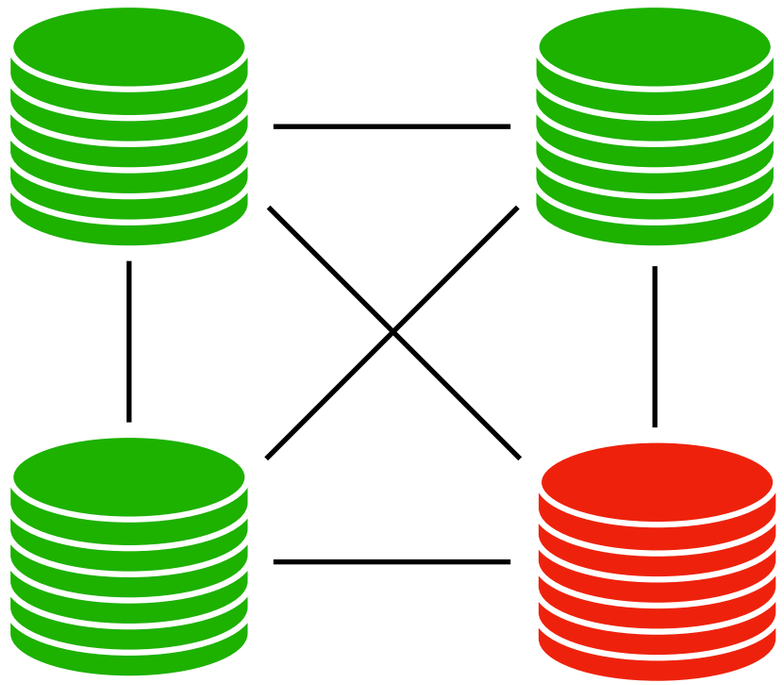
Our focus: bootstrapping an FBAS



How to achieve this with strong sybil resistance?

What are sybil attacks?

- Attacker creates multiple fake identities



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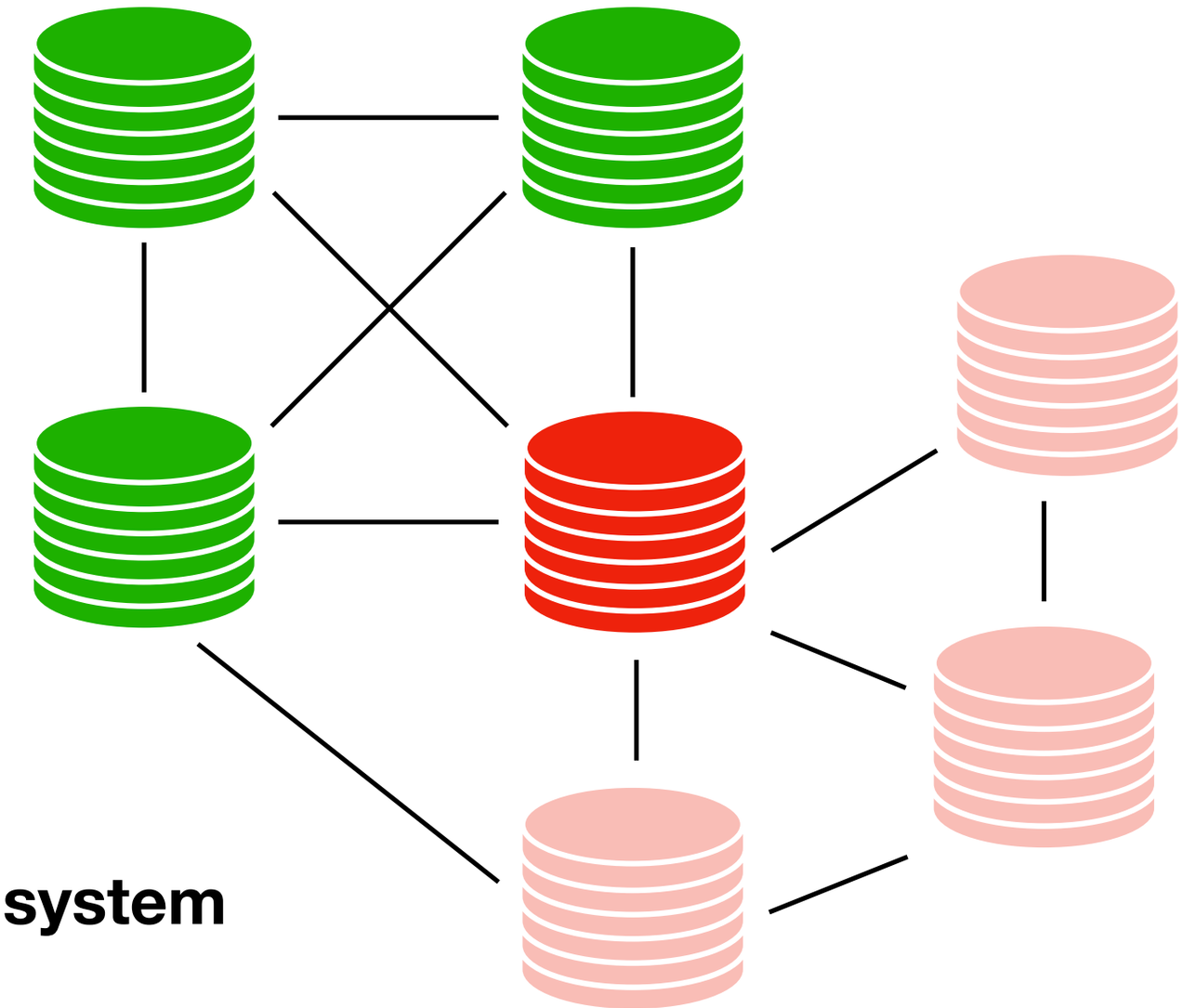


… and takes over the system

What should we do?

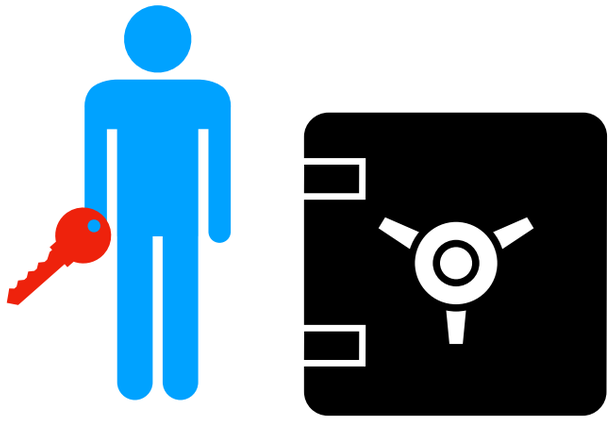
Cap the ability of the adversary to create multiple identities

What are sybil attacks?

- Traditional defences

Proof-of-Work

Proof-of-Stake



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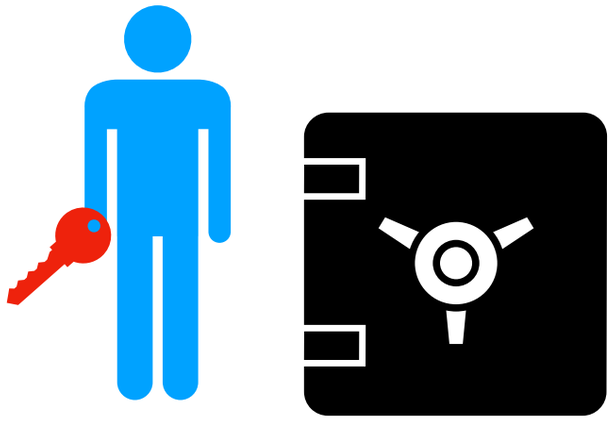
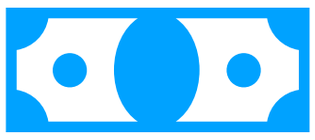
Proof-of-Work

Proof-of-Stake



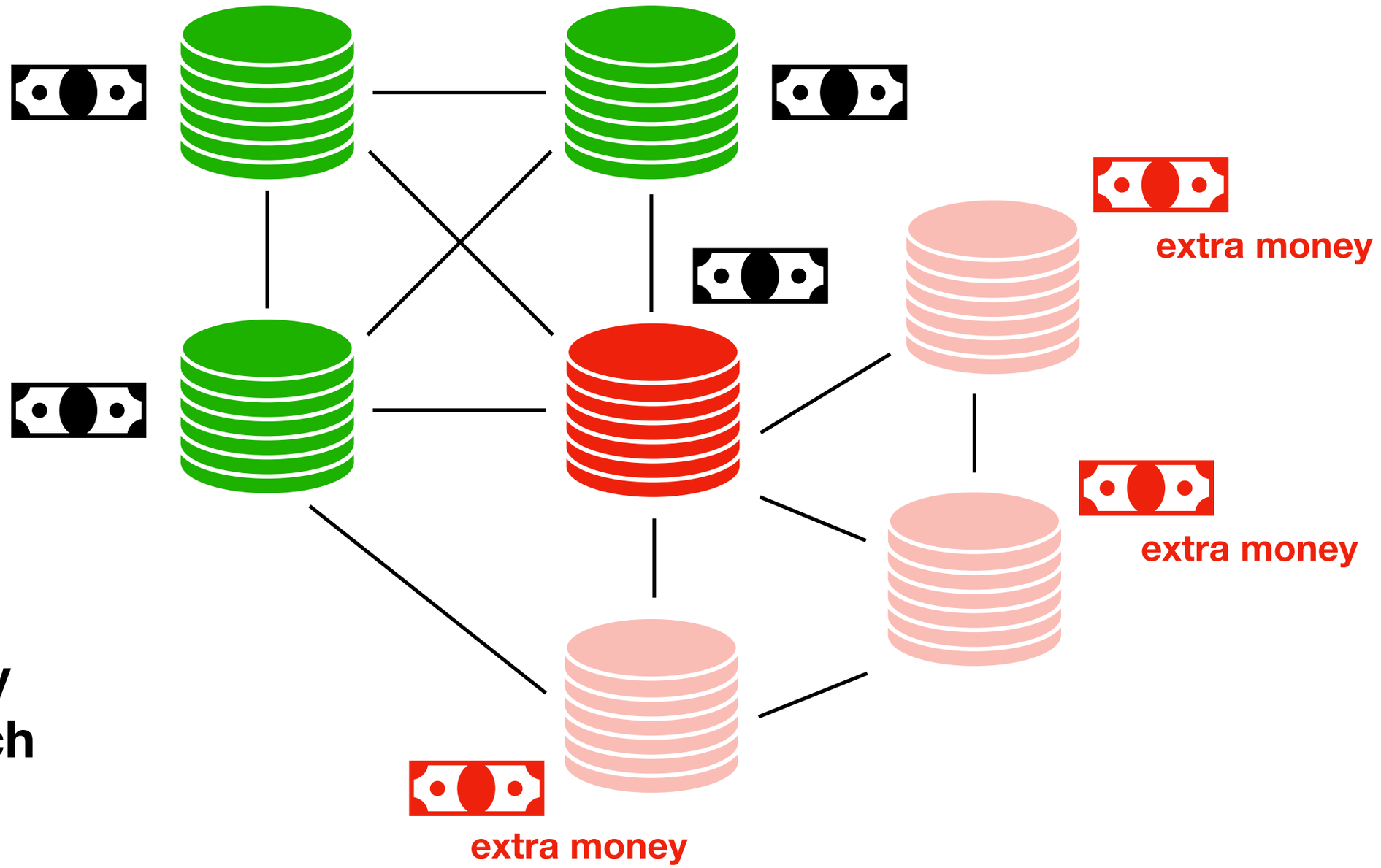
Leverage scarce resources:



Money — by forcing to burn/lock it

What are sybil attacks?

- Traditional defences



The adversary needs to be rich

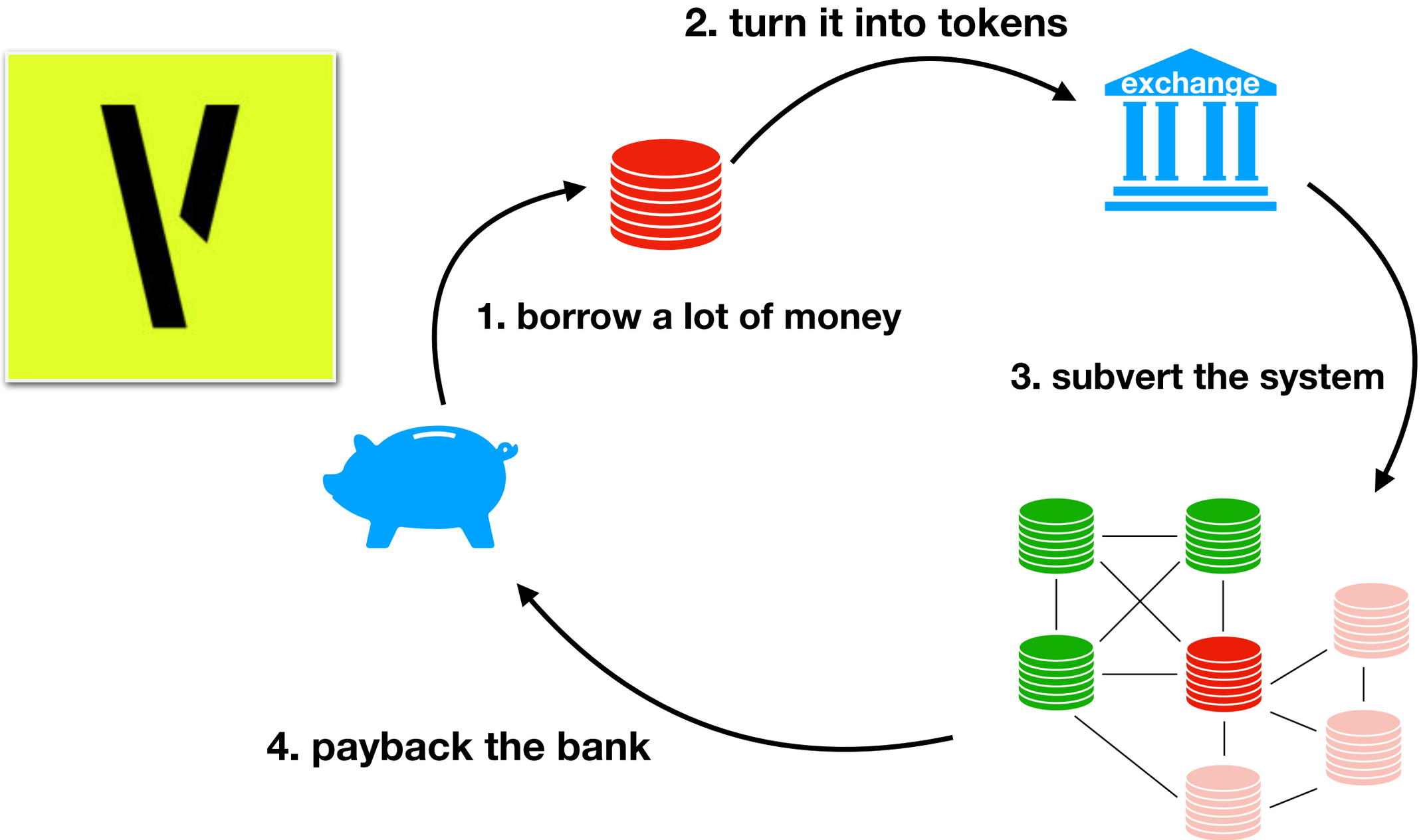
What are sybil attacks?

- Sometimes it is not enough…

Decentralised trading of financial products
(potentially worth $$$)

What are sybil attacks?

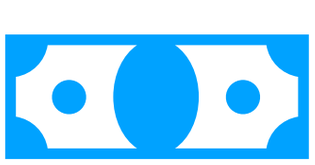
- Sometimes it is not enough…



What are sybil attacks?

- Can we strengthen existing mechanisms?

Leverage scare resources:



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What are sybil attacks?

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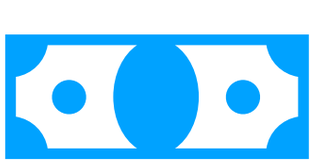

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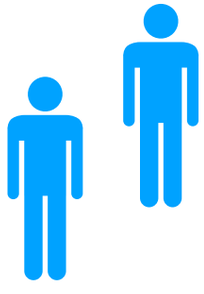
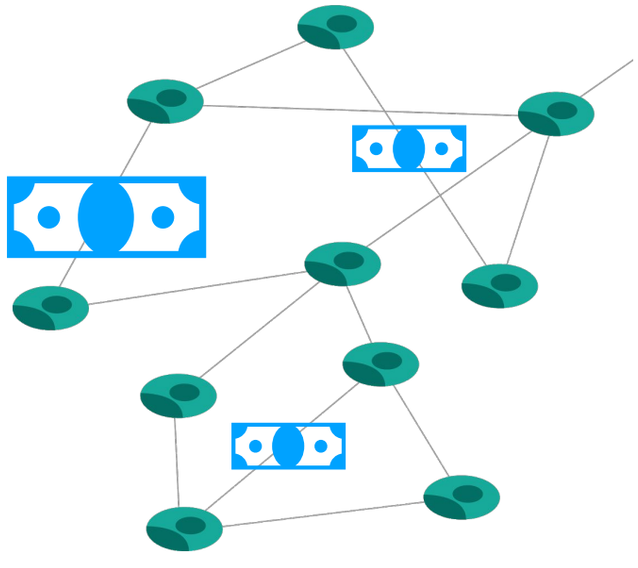


Trust — by penalising poor judgements

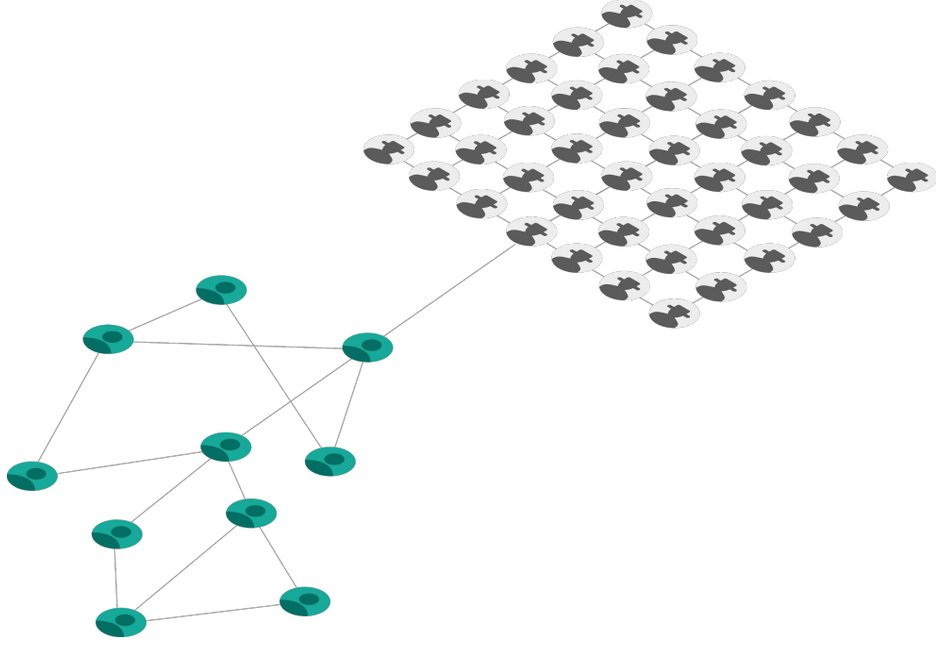
How do we make that happen?

SybilQuorum

Proof of Stake ⊕ **Social network analysis**



Lock stake on particular social links



Statistical analysis of nodes relationships

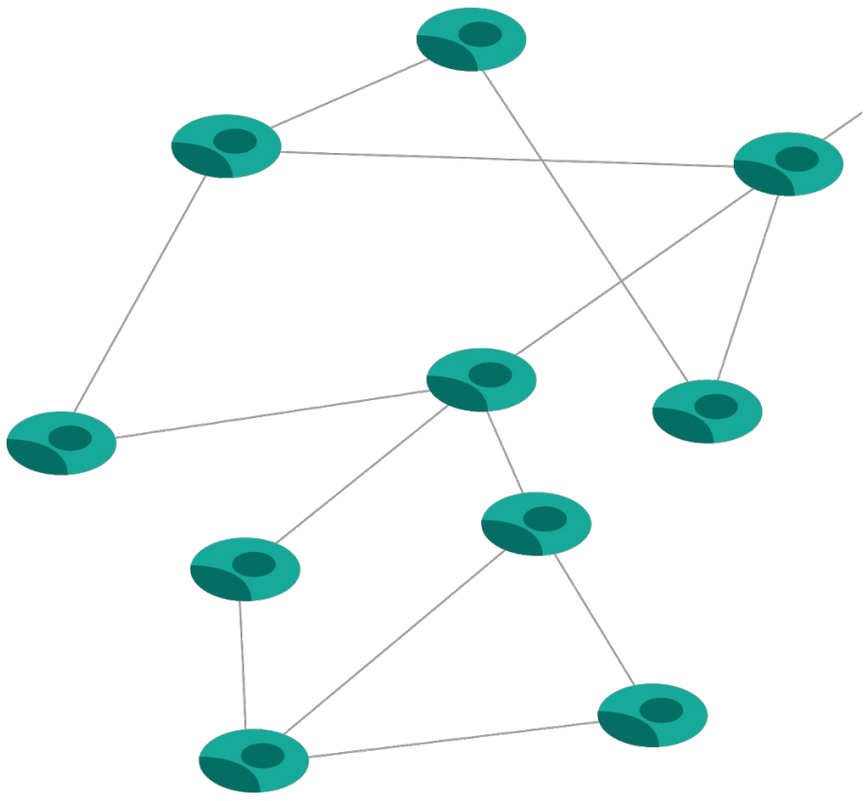
How to bootstrap an FBAS?

Step 1

Attribute weights to people you trust

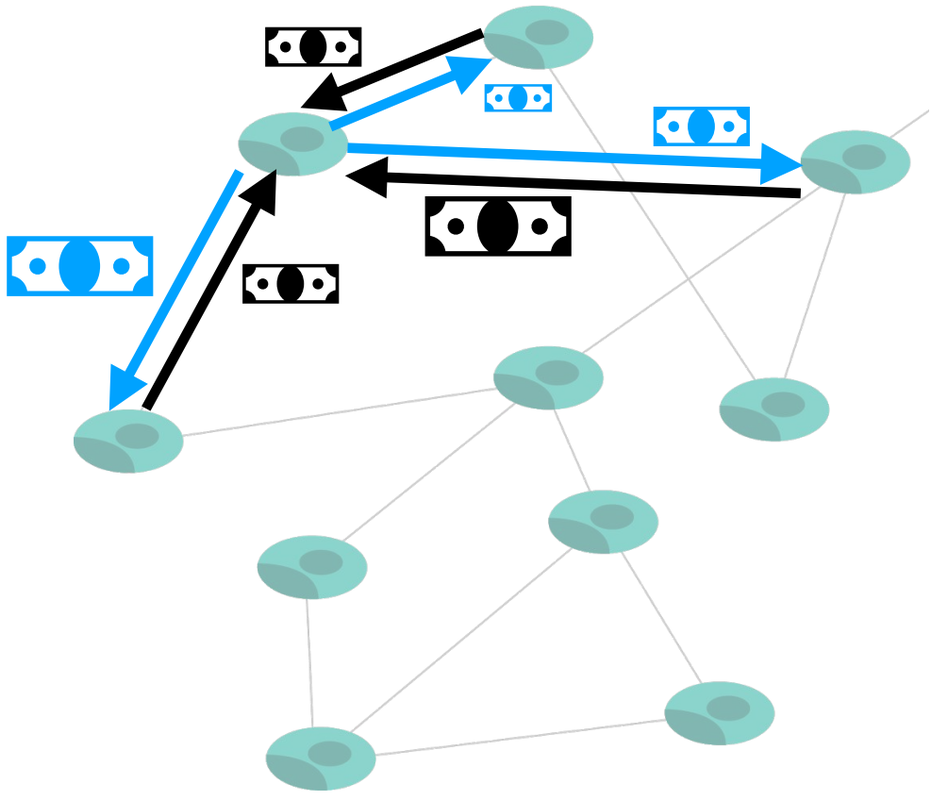
SybilQuorum: Step 1

- Stake-weighted trust relationships



SybilQuorum: Step 1

- Stake-weighted trust relationships

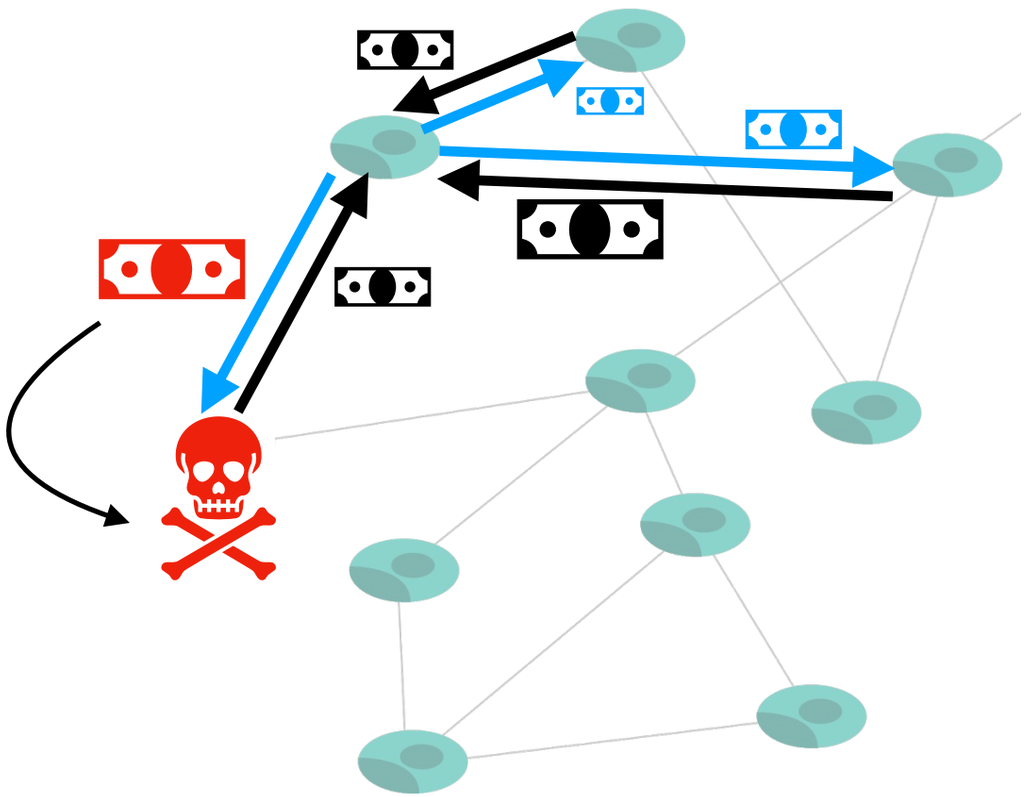


Put money on links!

Both vertices can withdraw the money on the link

SybilQuorum: Step 1

- Stake-weighted trust relationships

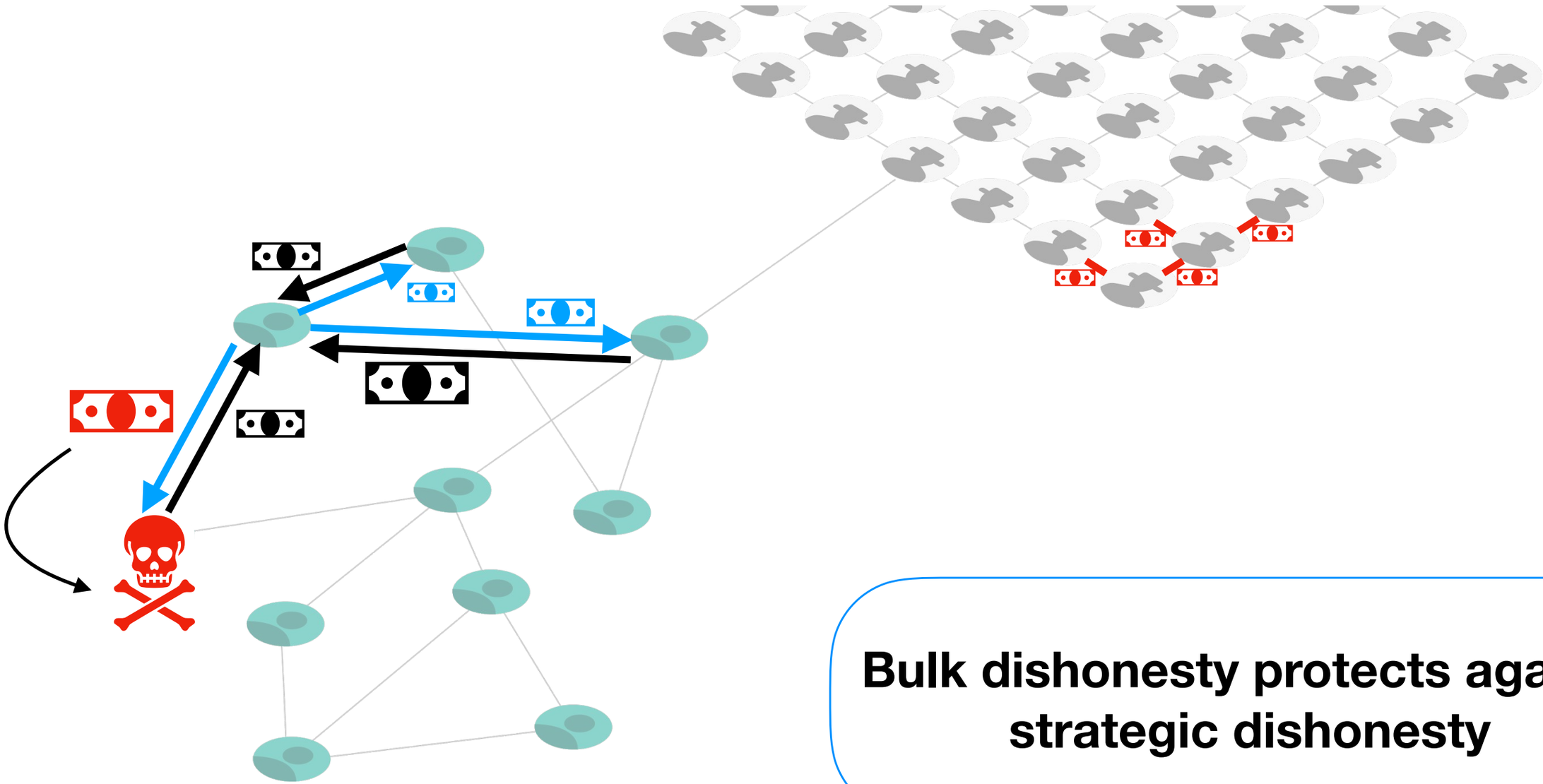


Fraudsters can take the money and disappear

Poor judgement is penalised

SybilQuorum: Step 1

- Stake-weighted trust relationships

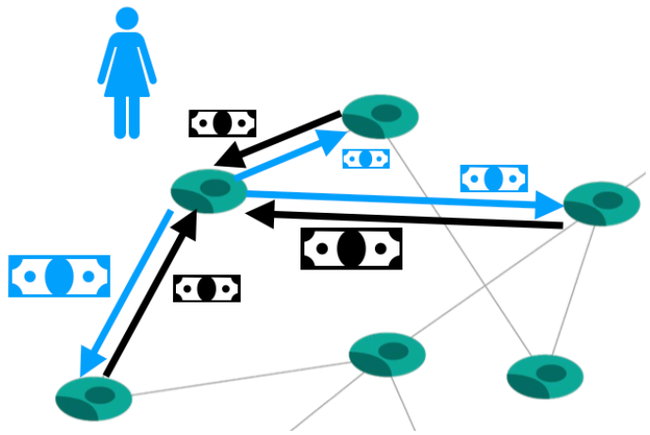


Bulk dishonesty protects against strategic dishonesty

How to bootstrap an FBAS?

Step 1

Attribute weights to people you trust

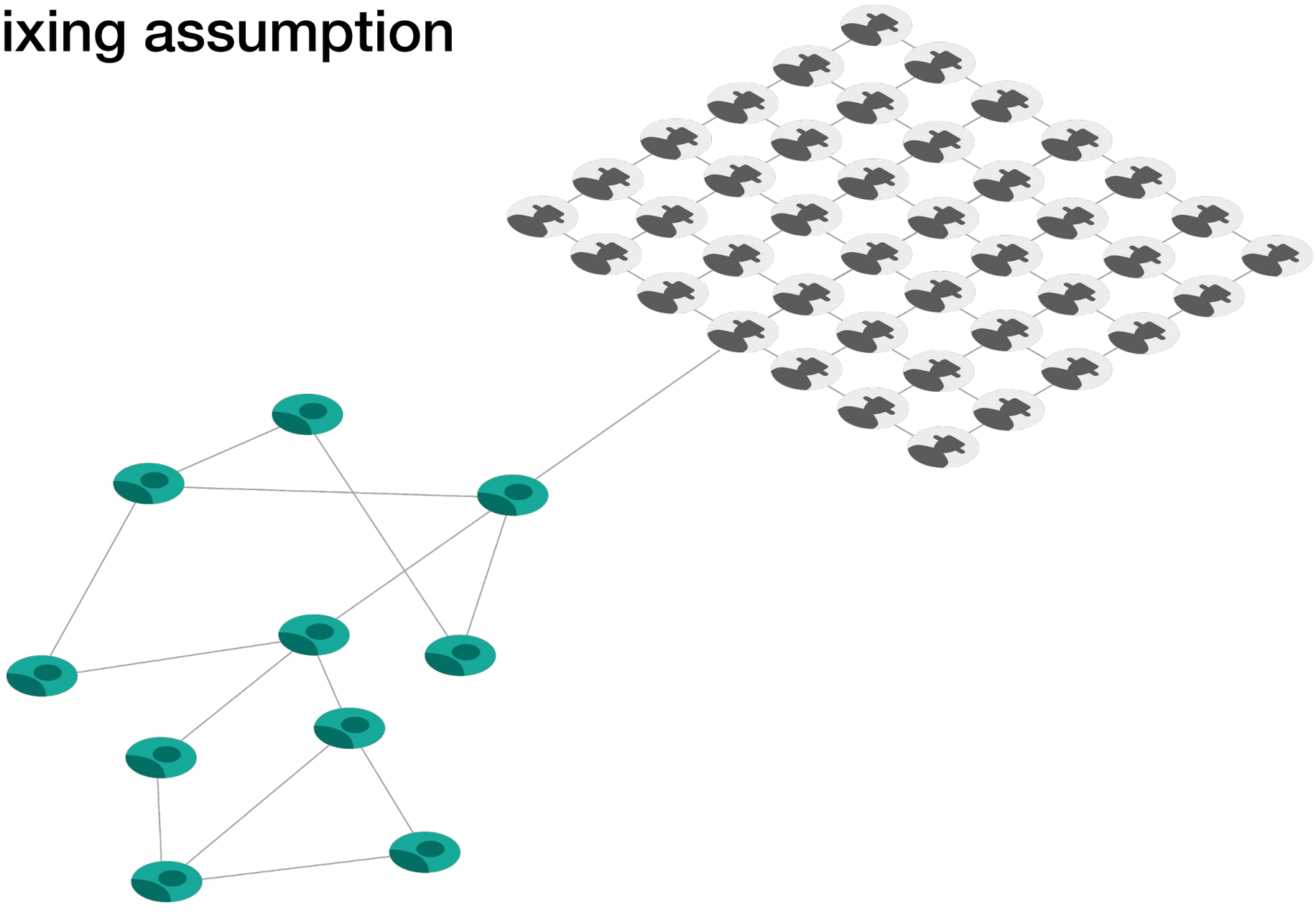


Step 2

Run social network analysis

SybilQuorum: Step 2

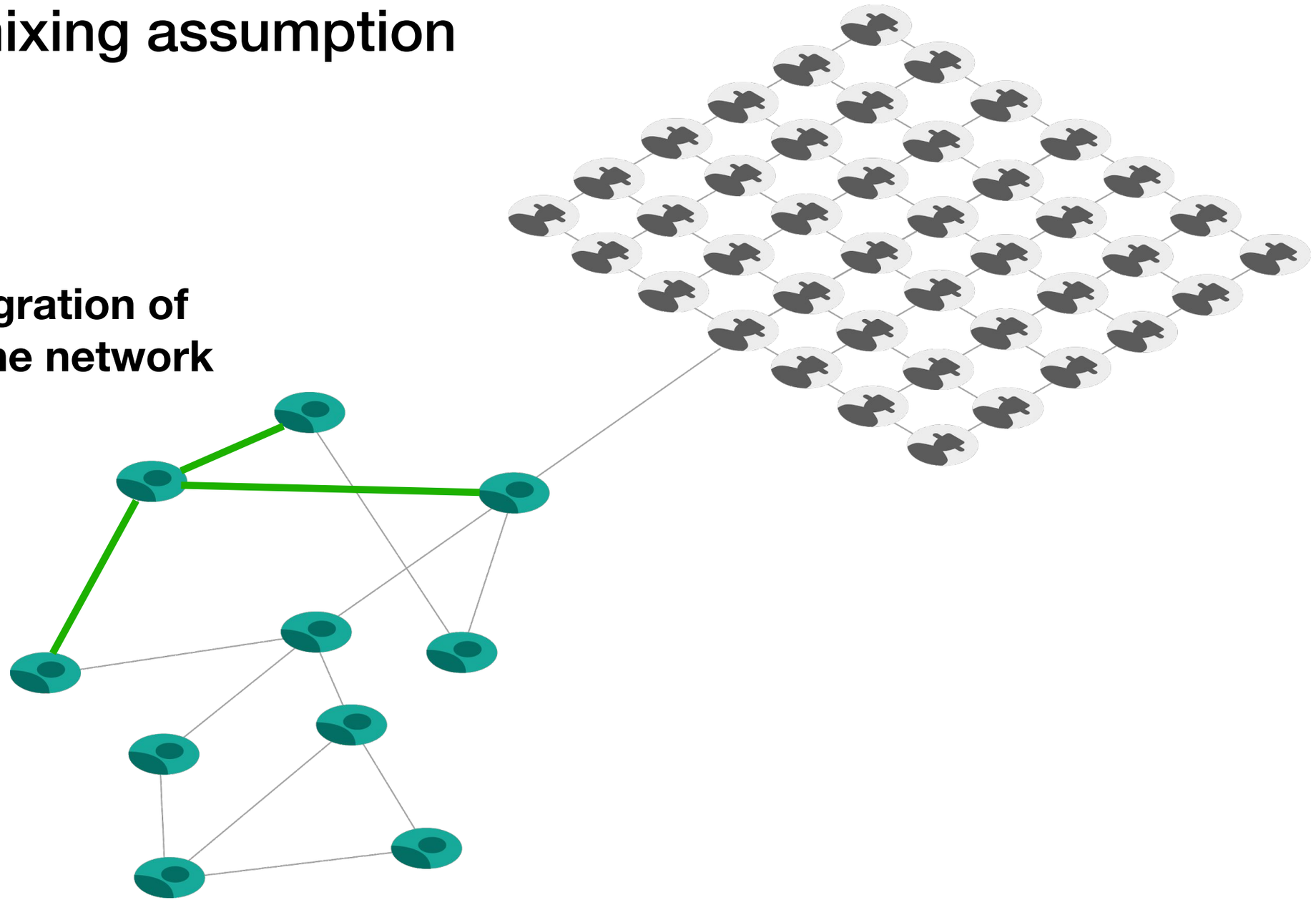
- Fast mixing assumption



SybilQuorum: Step 2

- Fast mixing assumption

1. Fast integration of nodes into the network



SybilQuorum: Step 2

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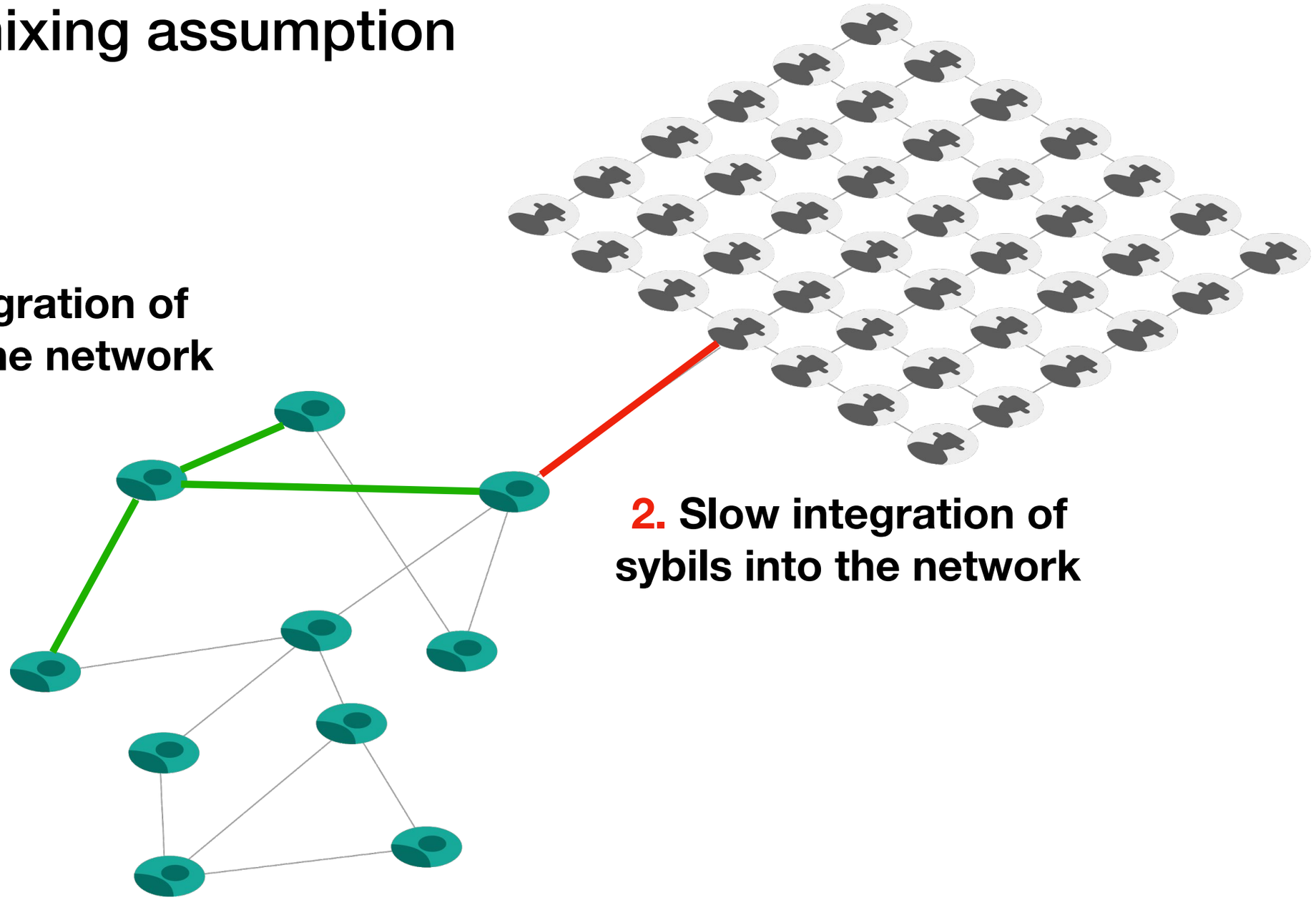


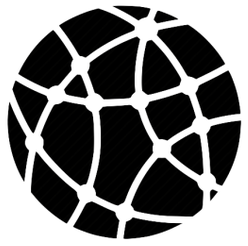
1. Fast integration of nodes into the network

2. Slow integration of sybils into the network

SybilQuorum: Step 2

- Each node performs a local judgement

Node's view of the network



SybilQuorum: Step 2

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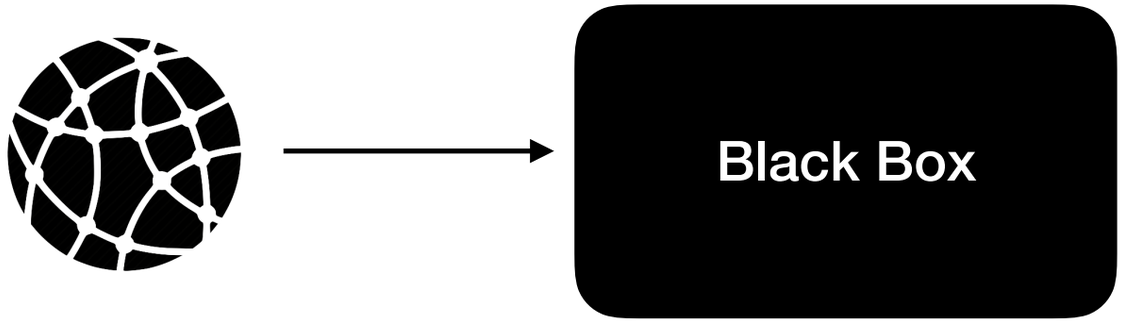

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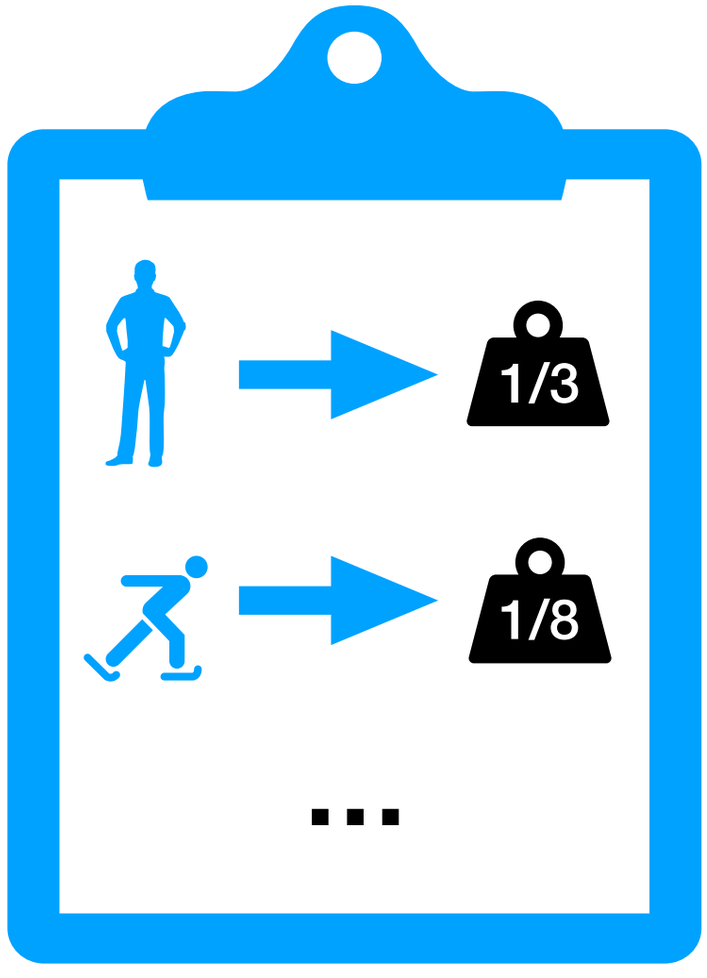
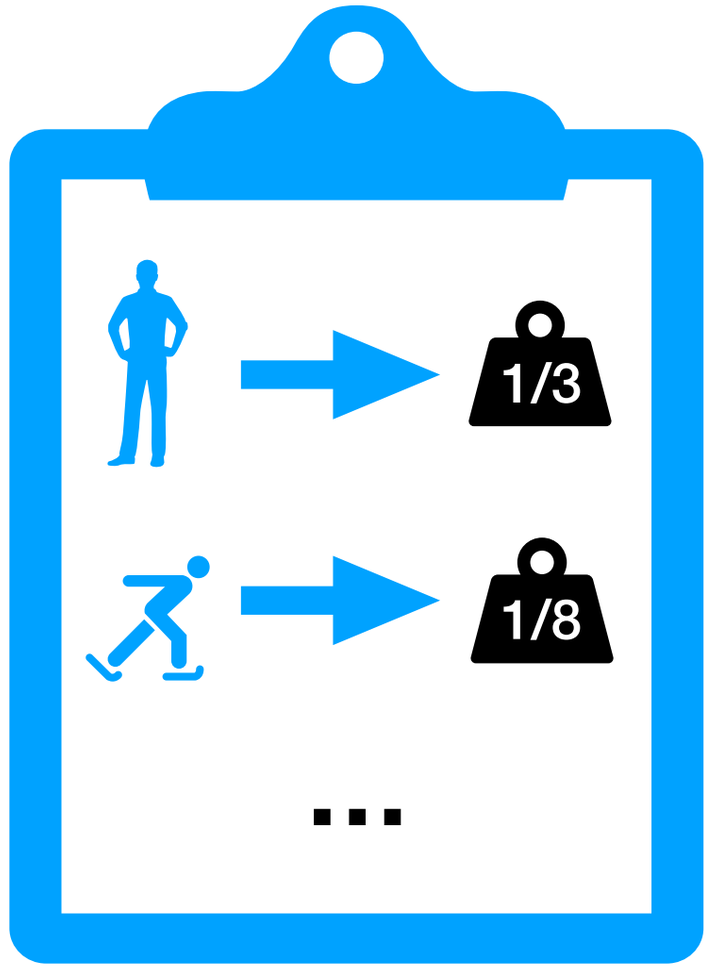


Map nodes to weights

SybilQuorum: Step 2

- Each node performs a local judgement

Node's view of the network



Map pk to weights

Black Box = SybilInfer, SybilGuard, SybilLimit, …

How to bootstrap an FBAS?

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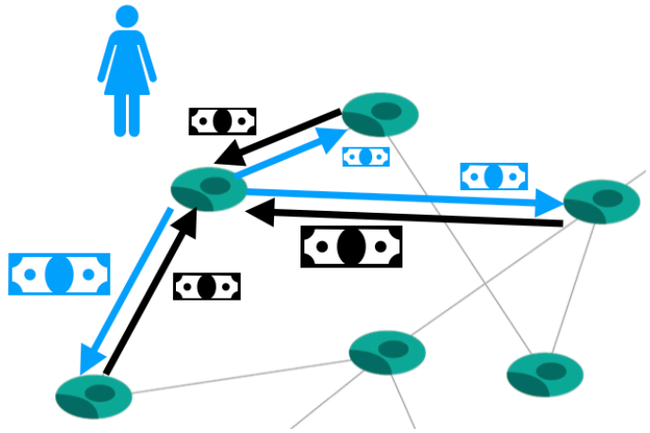
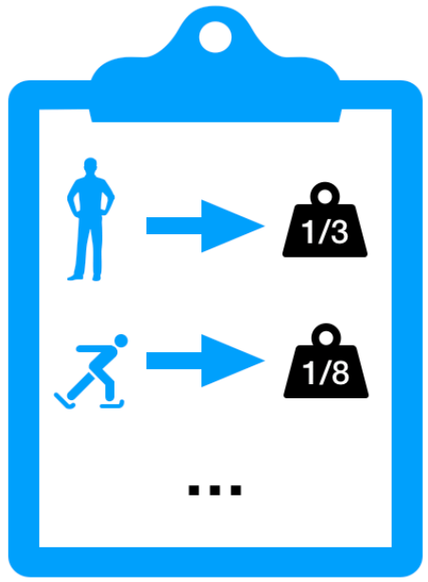


Step 2

Run social network analysis

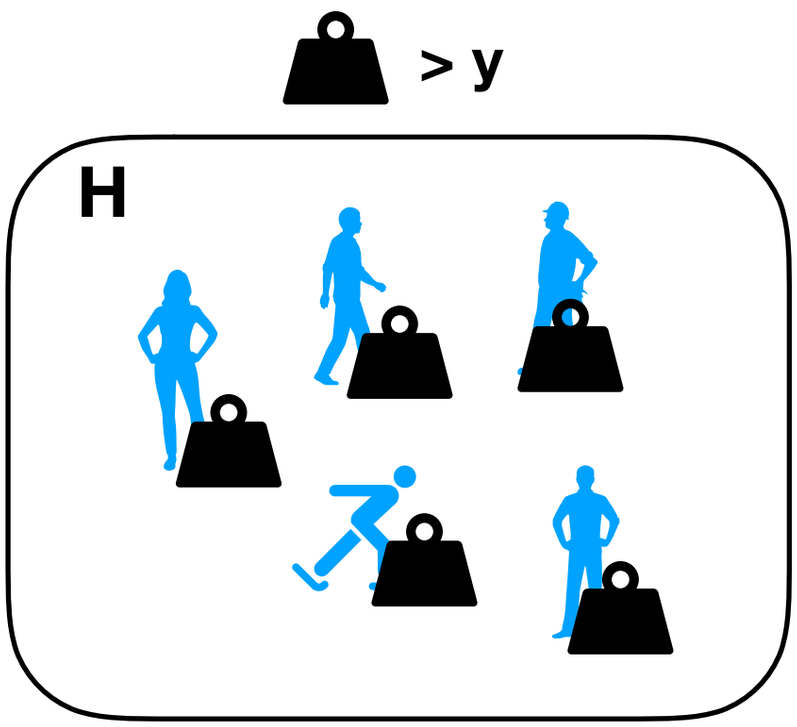


Step 3

Determine the quorum slices

SybilQuorum: Step 3

- Specify quorum slice for each node



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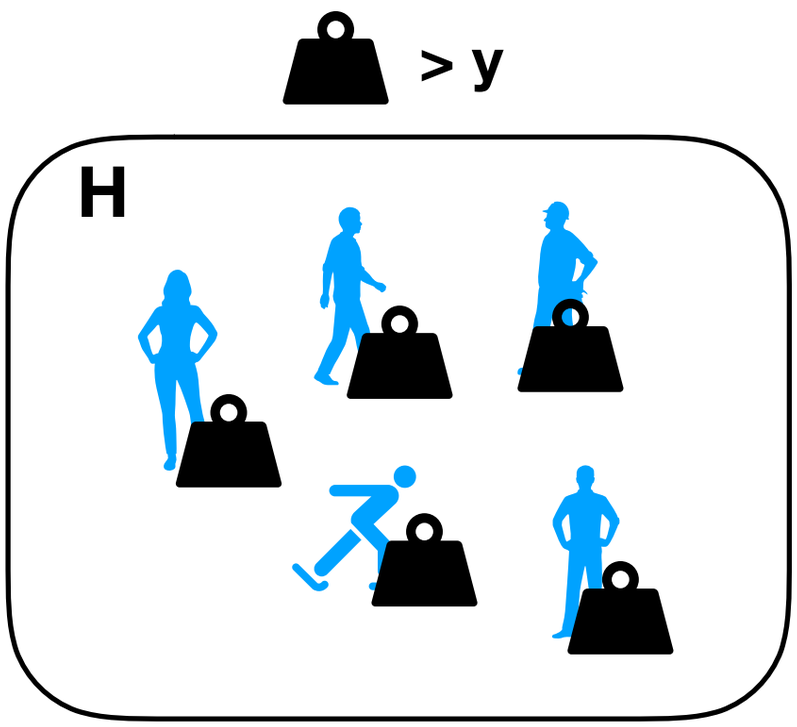

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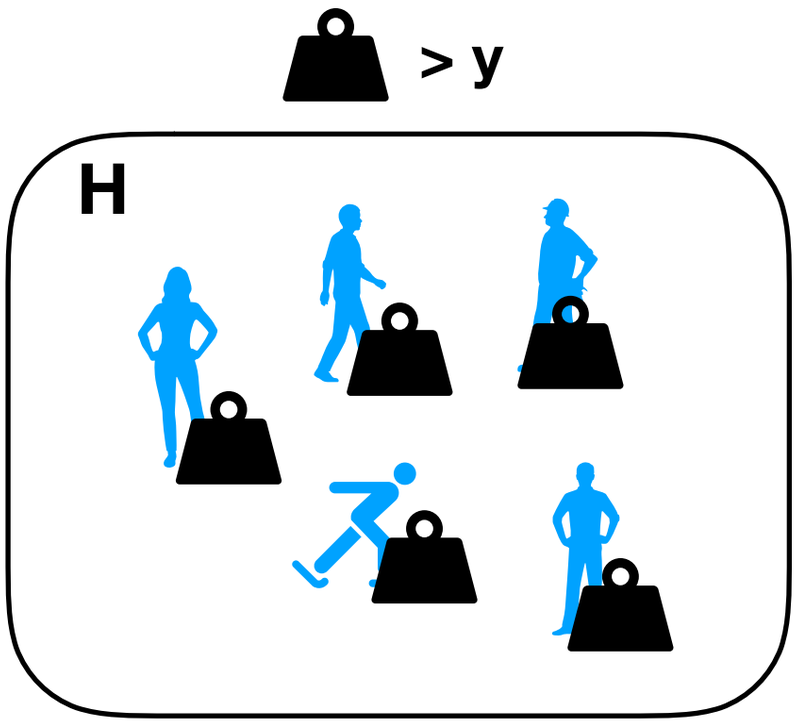
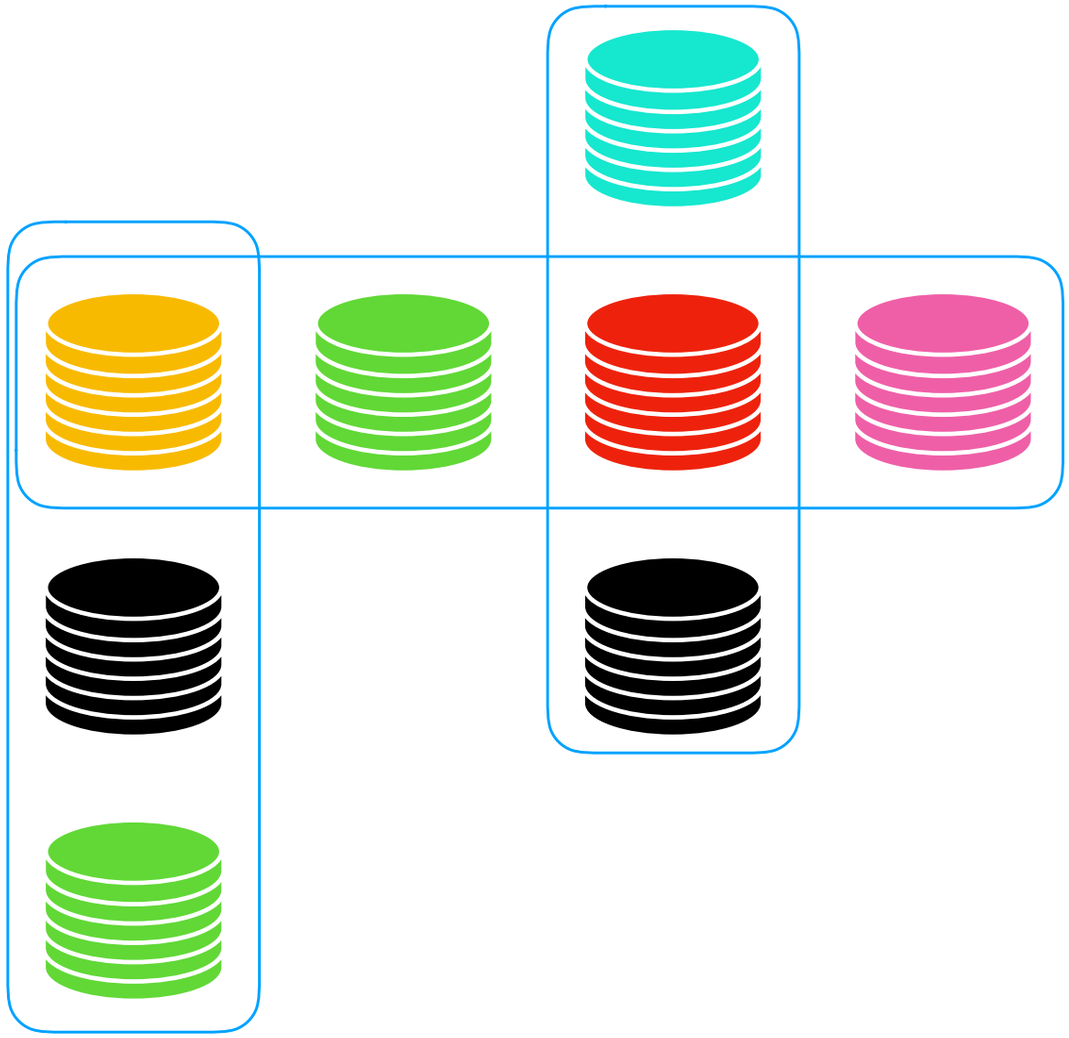


all subsets
> 2/3 |H|



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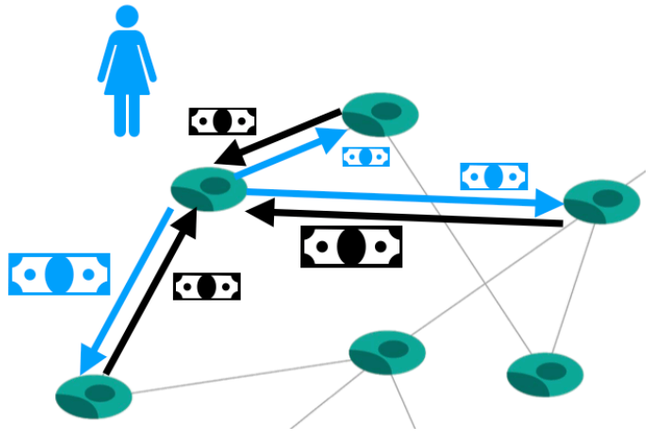

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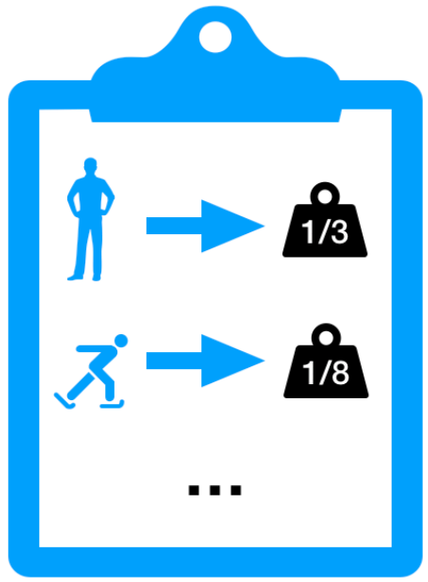

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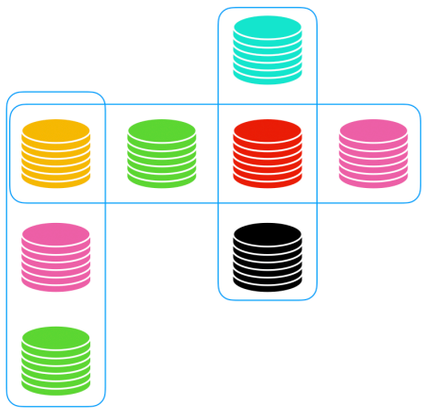
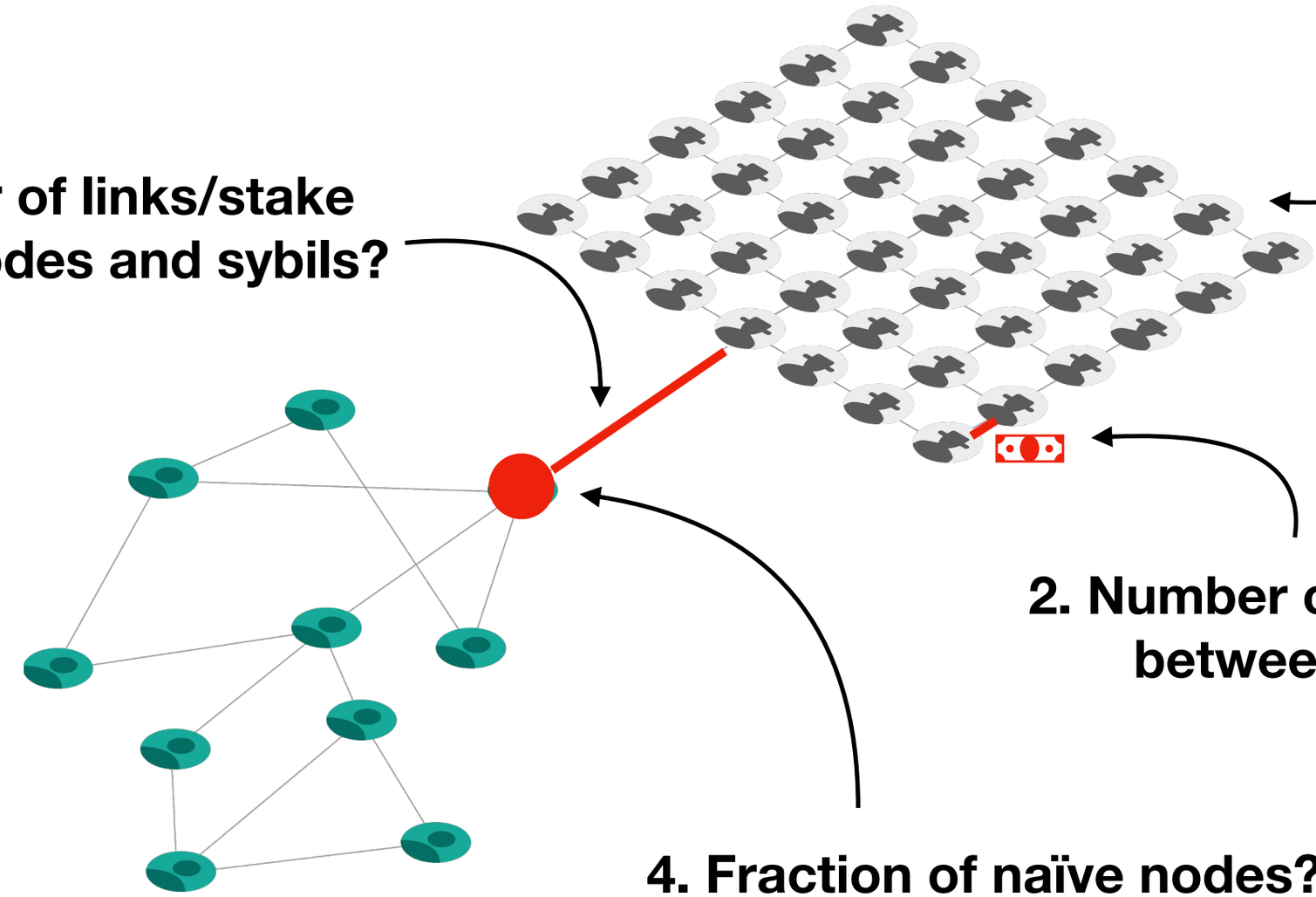


Experimental evaluation

- What to evaluate?

1. Number of sybil nodes?



2. Number of links/stake between sybils?

3. Number of links/stake between nodes and sybils?

4. Fraction of naïve nodes?

Conclusion

SybilQuorum: Sybil resistance mechanism

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- What?

Leverage Money
by forcing to burn/lock it

Leverage Trust
by penalising poor judgement

Conclusion

SybilQuorum: Sybil resistance mechanism

- What?

Leverage Money
by forcing to burn/lock it

Leverage Trust
by penalising poor judgement

- How?

Proof-of-Stake:
build a stake-weighted graph

Social network analysis:
determine sybil regions

Thank you for your attention
Questions?

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http://sonnino.com

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