NPTEL ONLINE CERTIFICATION COURSES

Blockchain and its applications

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Lecture 08: Distributed Systems for Decentralization – The Beginning

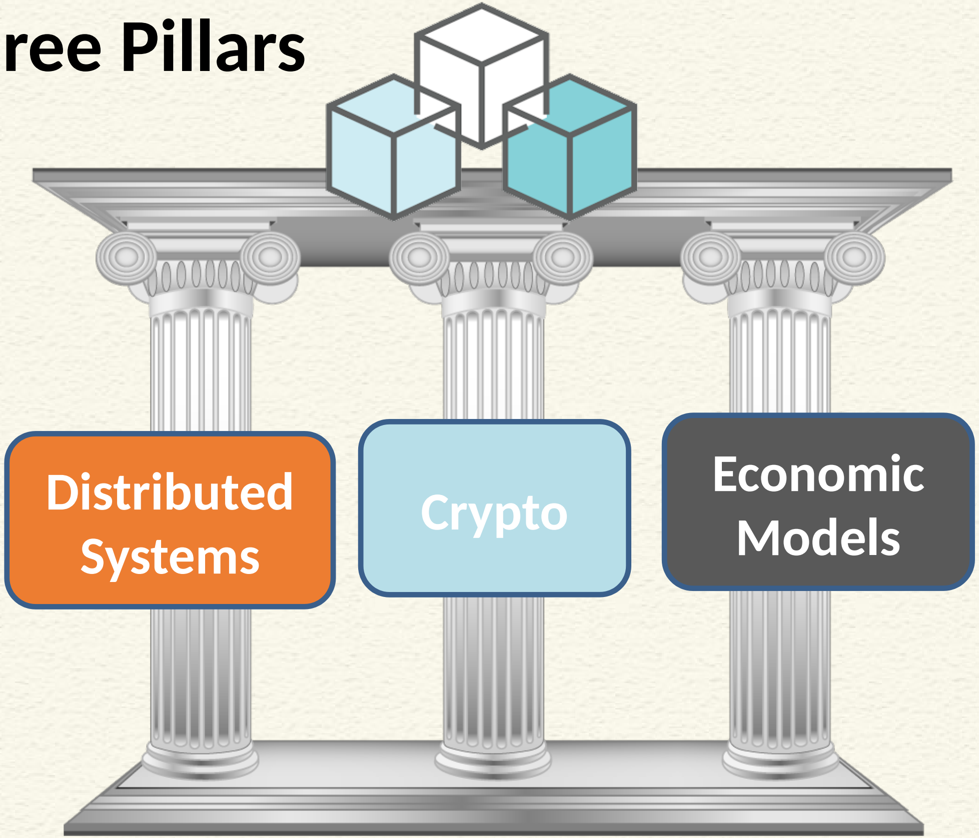
CONCEPTS COVERED

- Distributed Systems
- Blockchain as a Distributed System
- Distributed Consensus – A History

KEYWORDS

- **Distributed System**
- **Consensus**

The Three Pillars

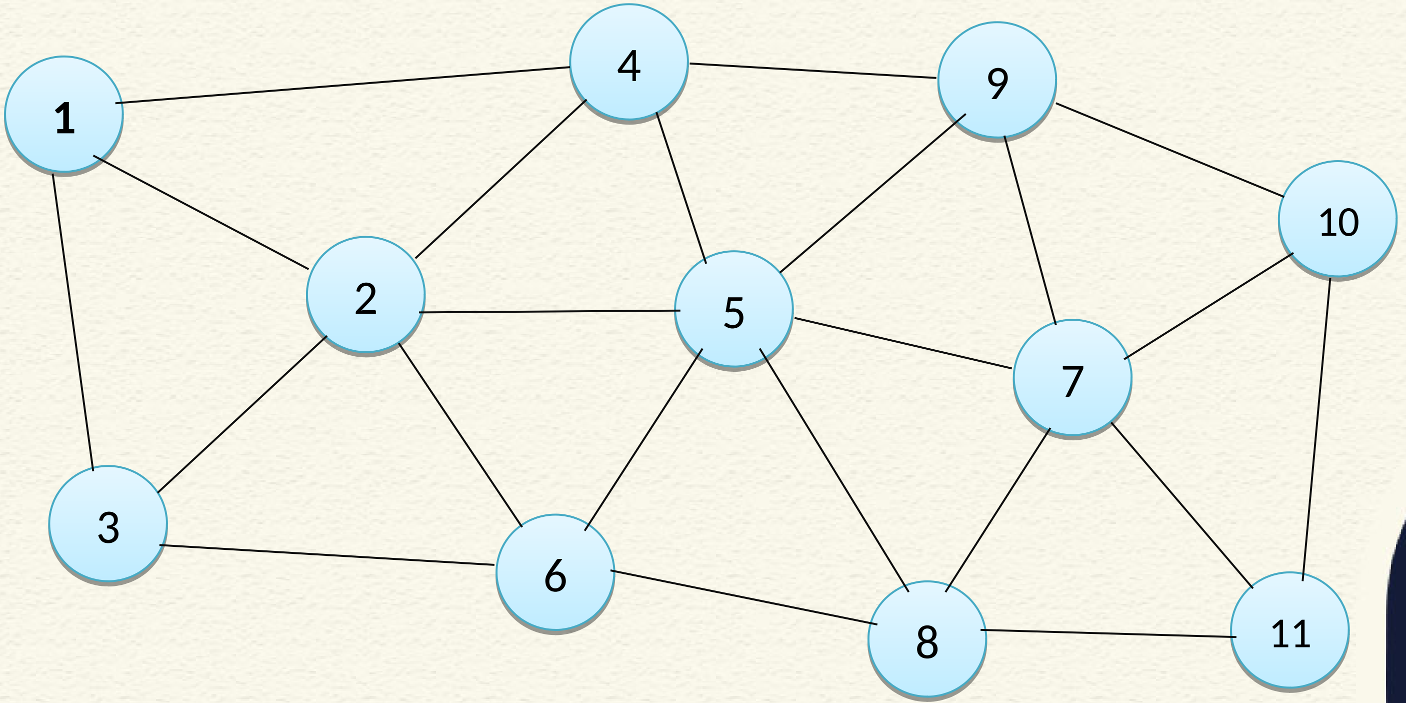


Distributed Systems

Crypto

Economic Models

Our Core Problem



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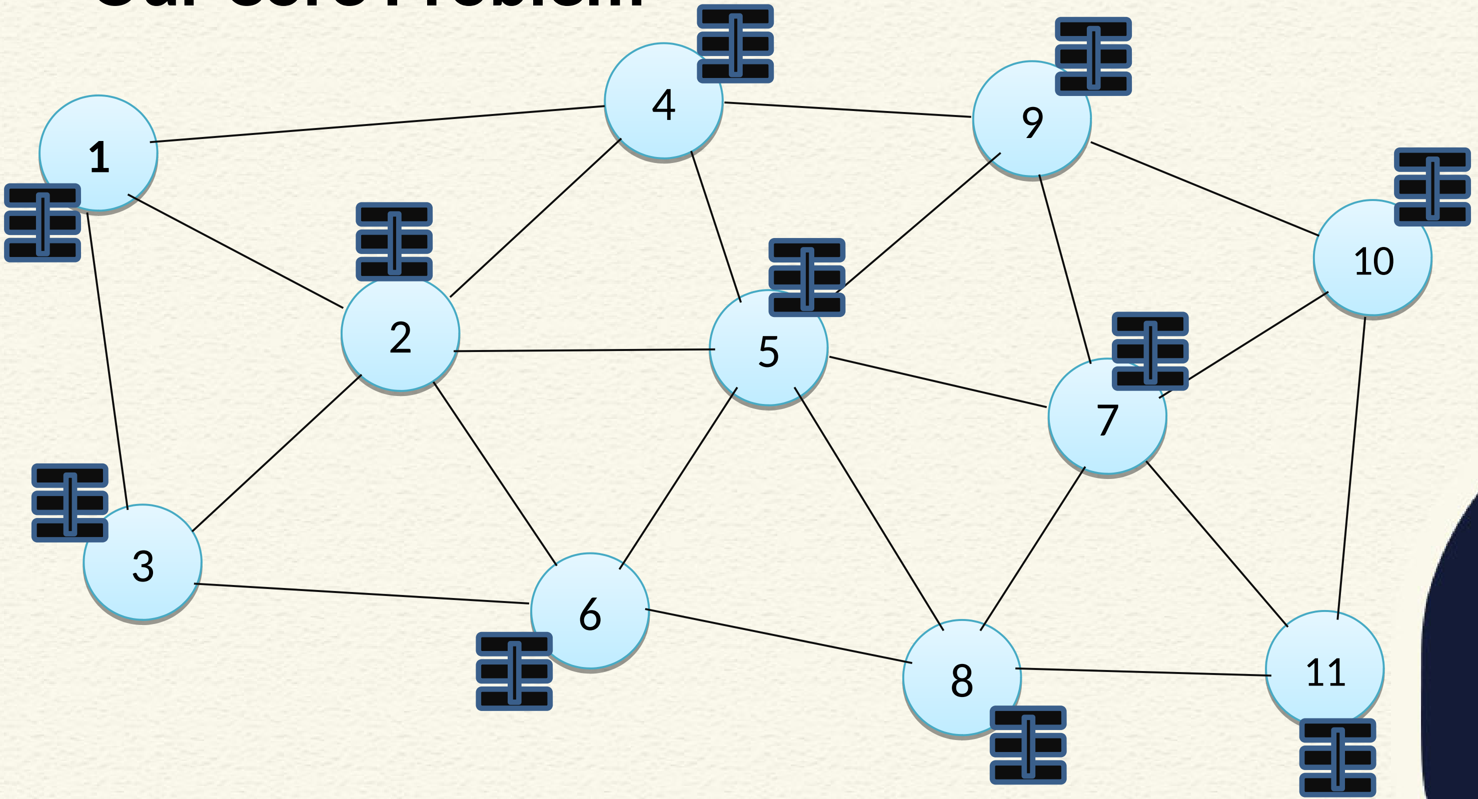

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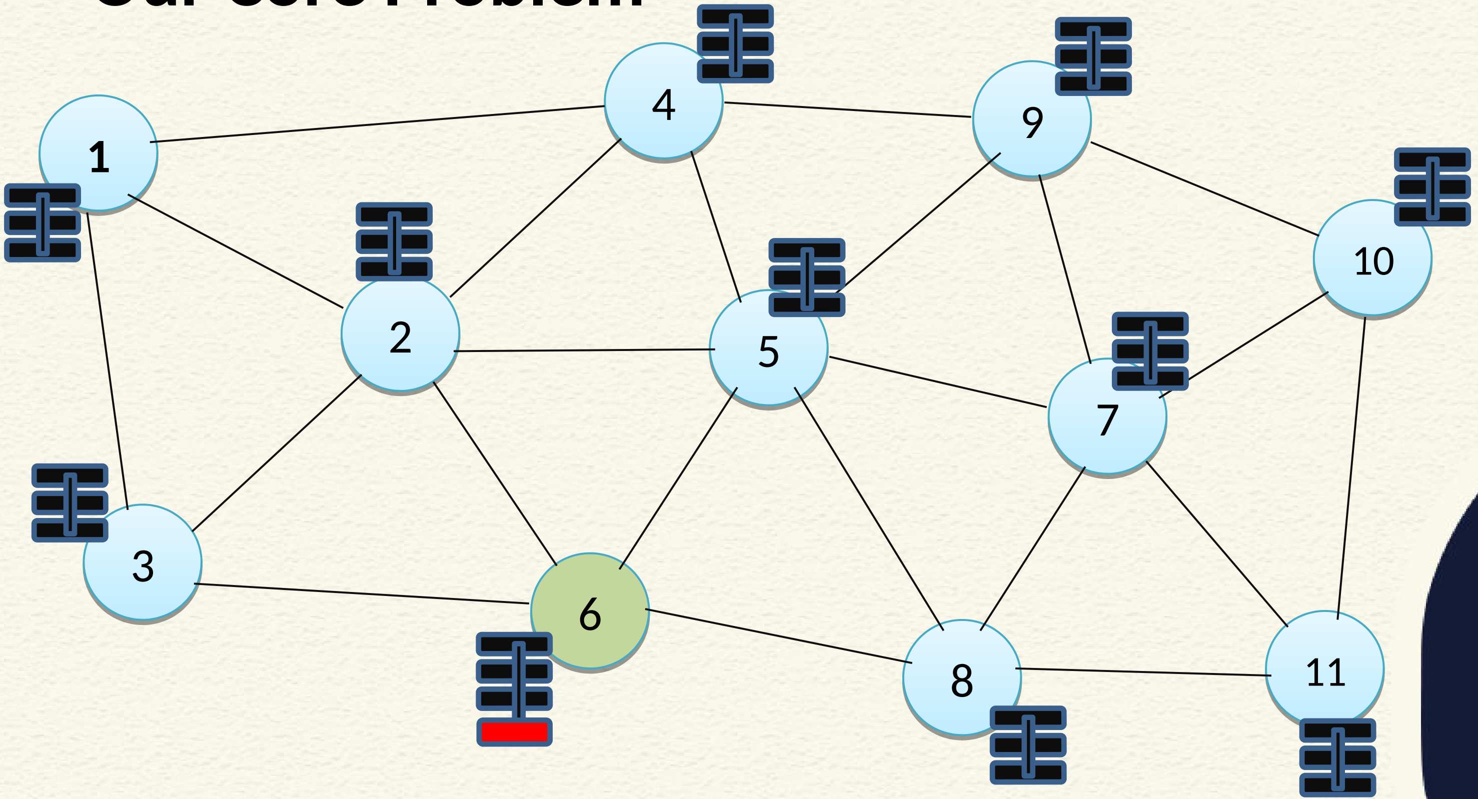

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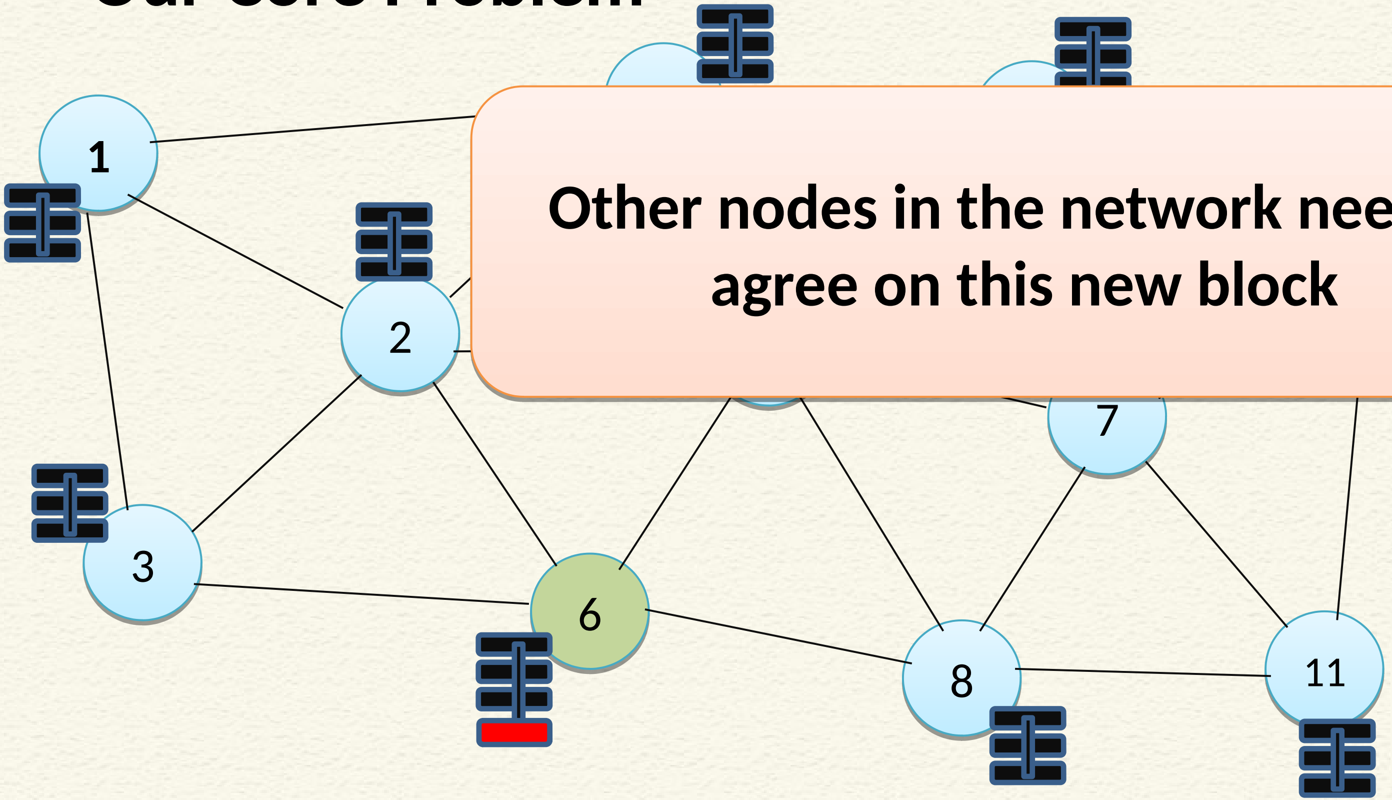
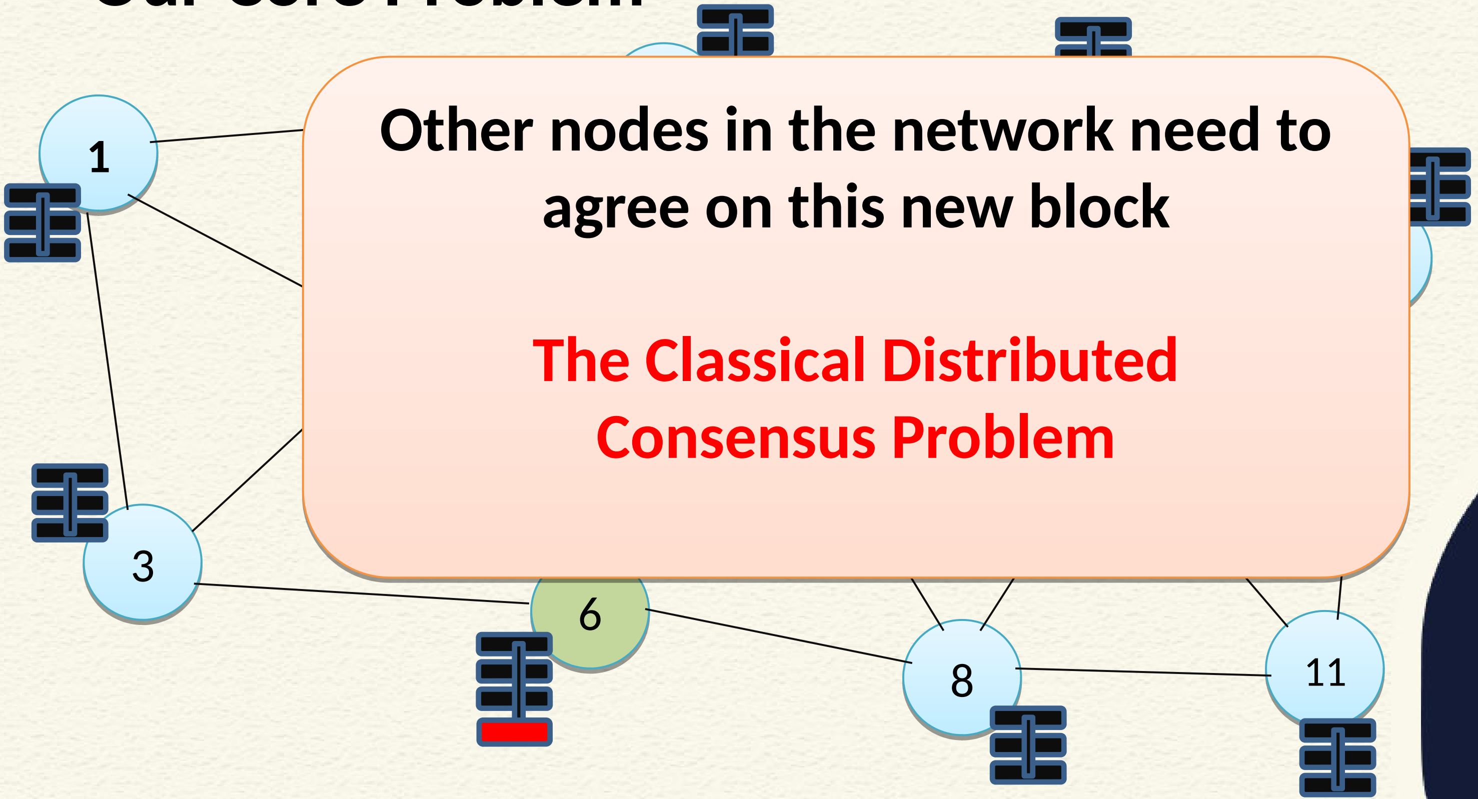


Other nodes in the network need to agree on this new block

Our Core Problem



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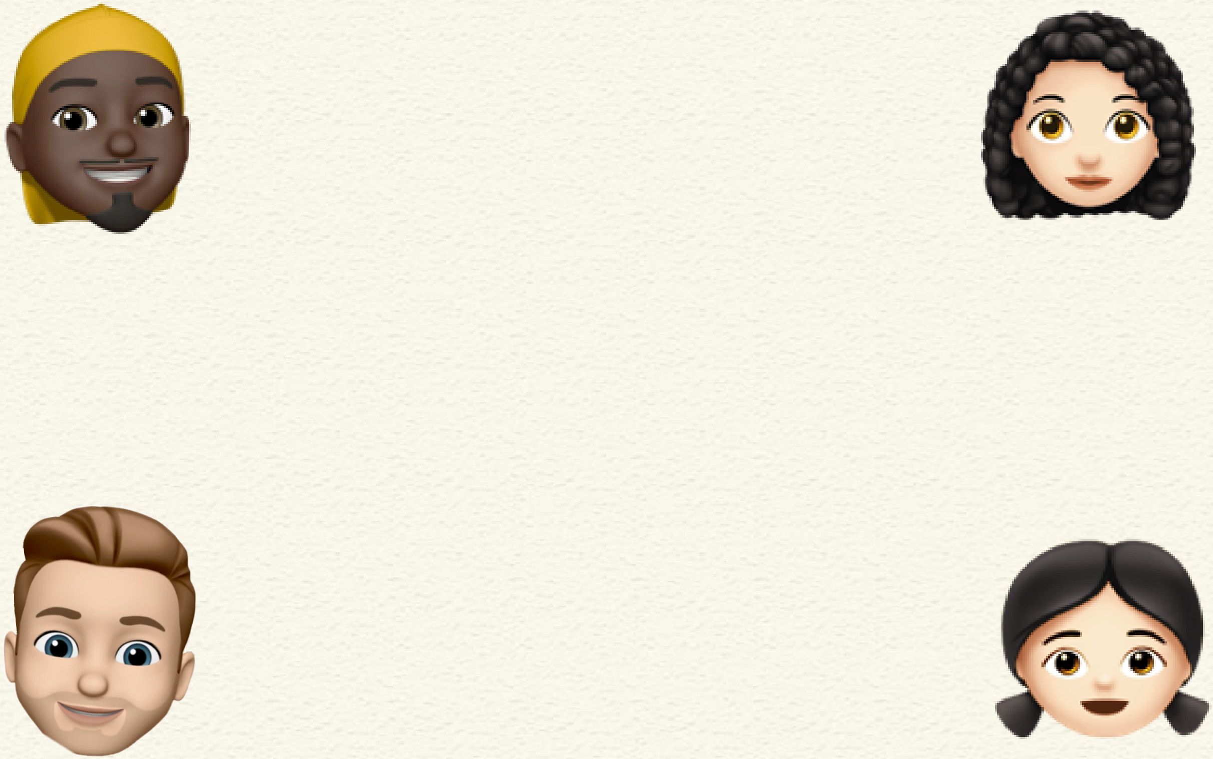
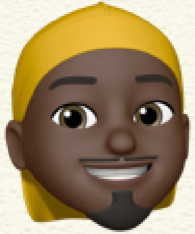
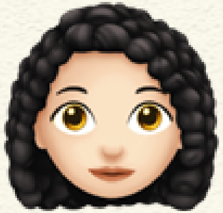
The Classical Distributed Consensus Problem

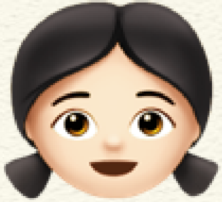
Distributed Consensus



Distributed Consensus





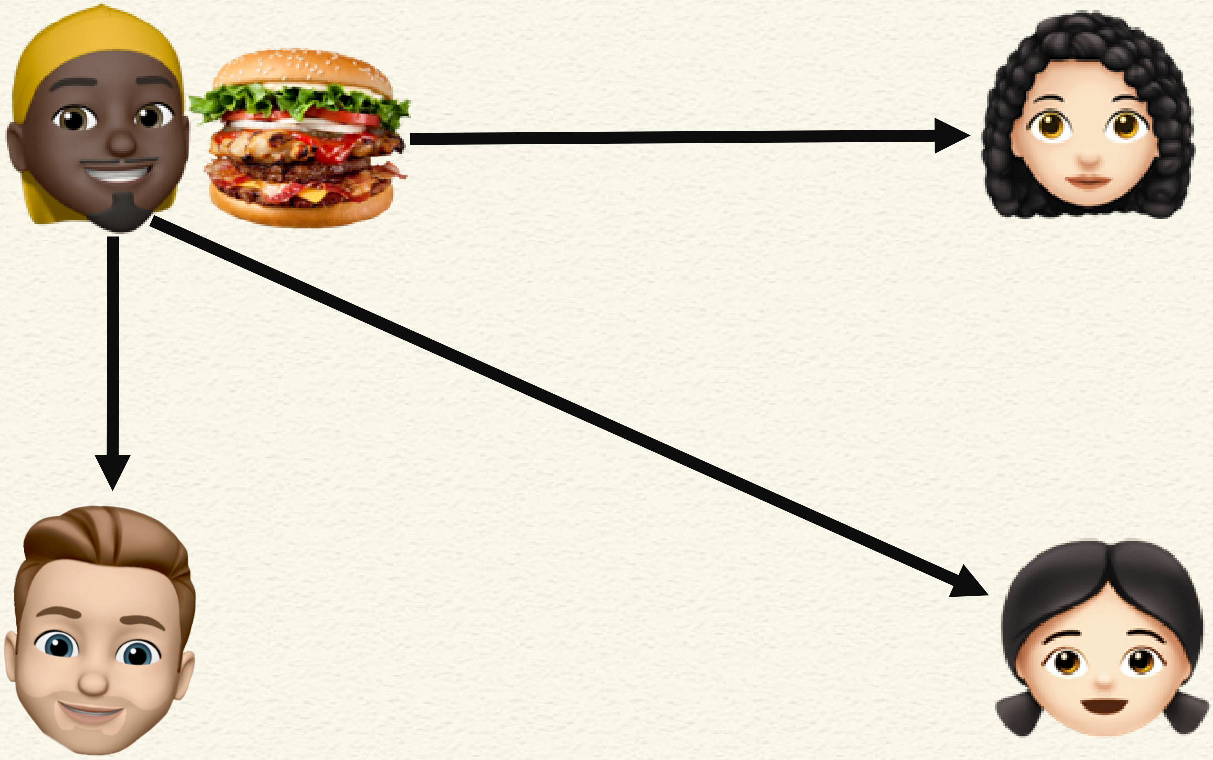


Distributed Consensus

Distributed Consensus

How can we make this decision in a distributed way?

Distributed Consensus



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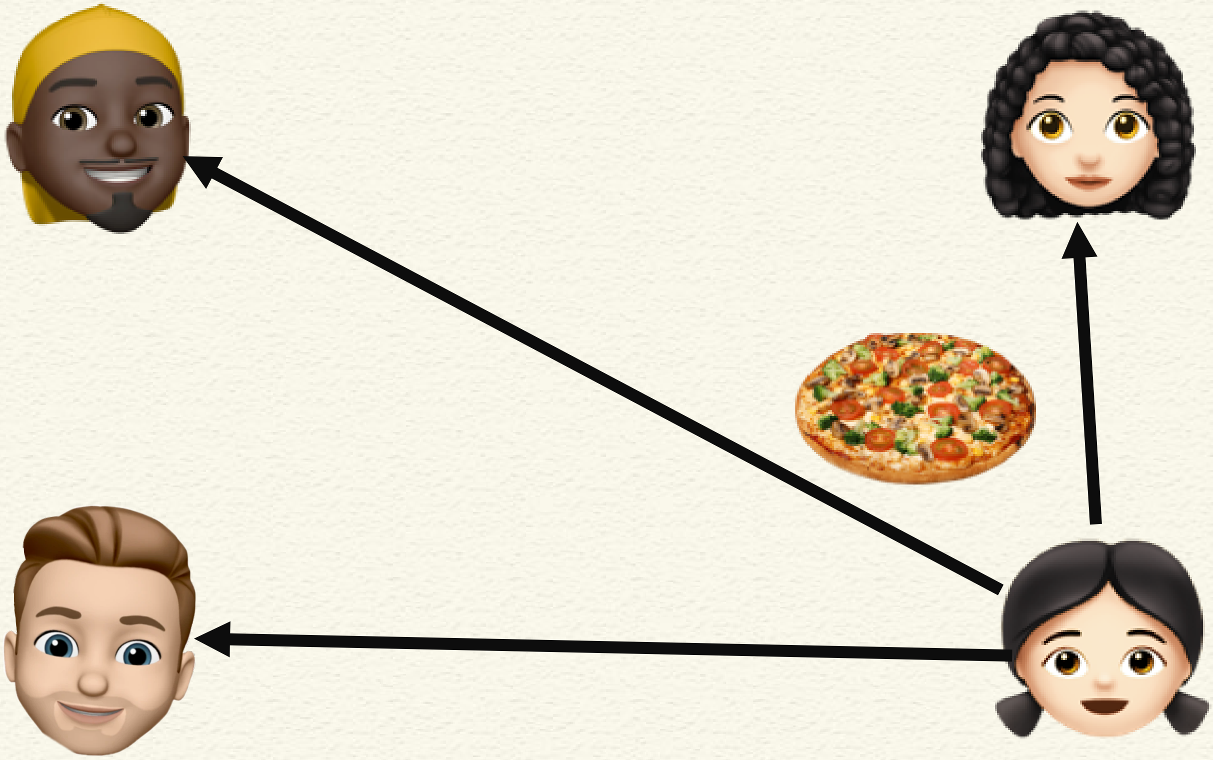

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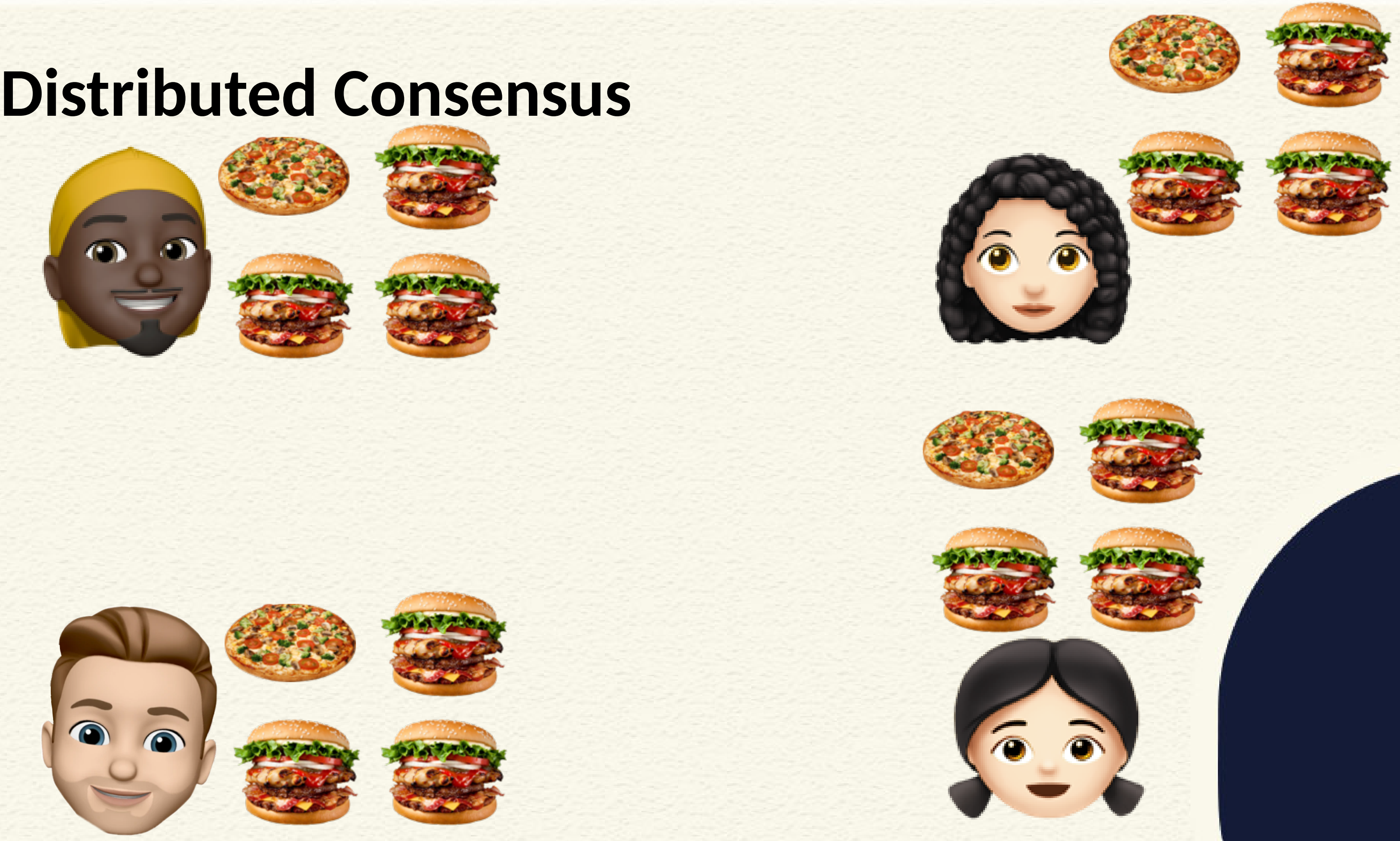
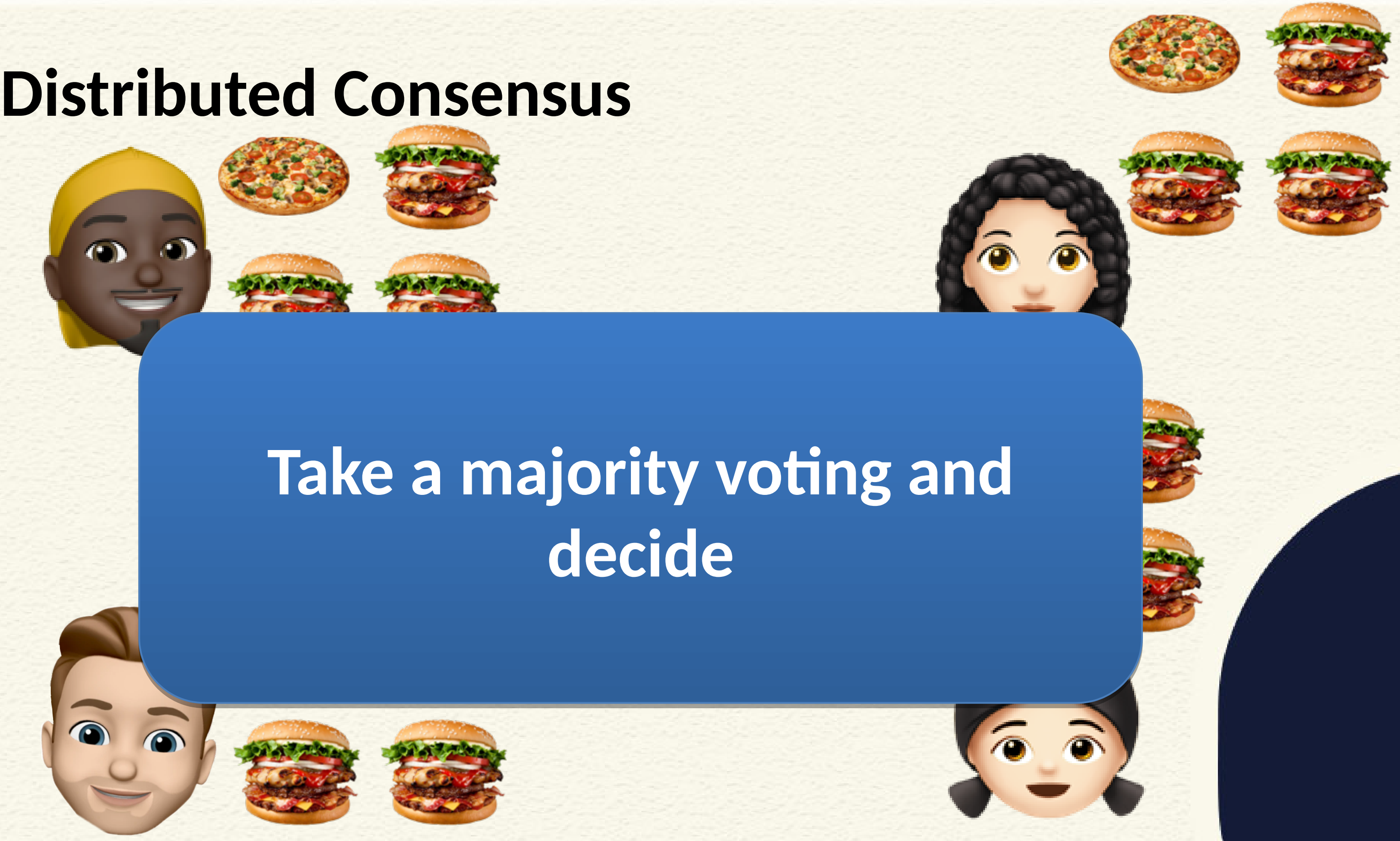
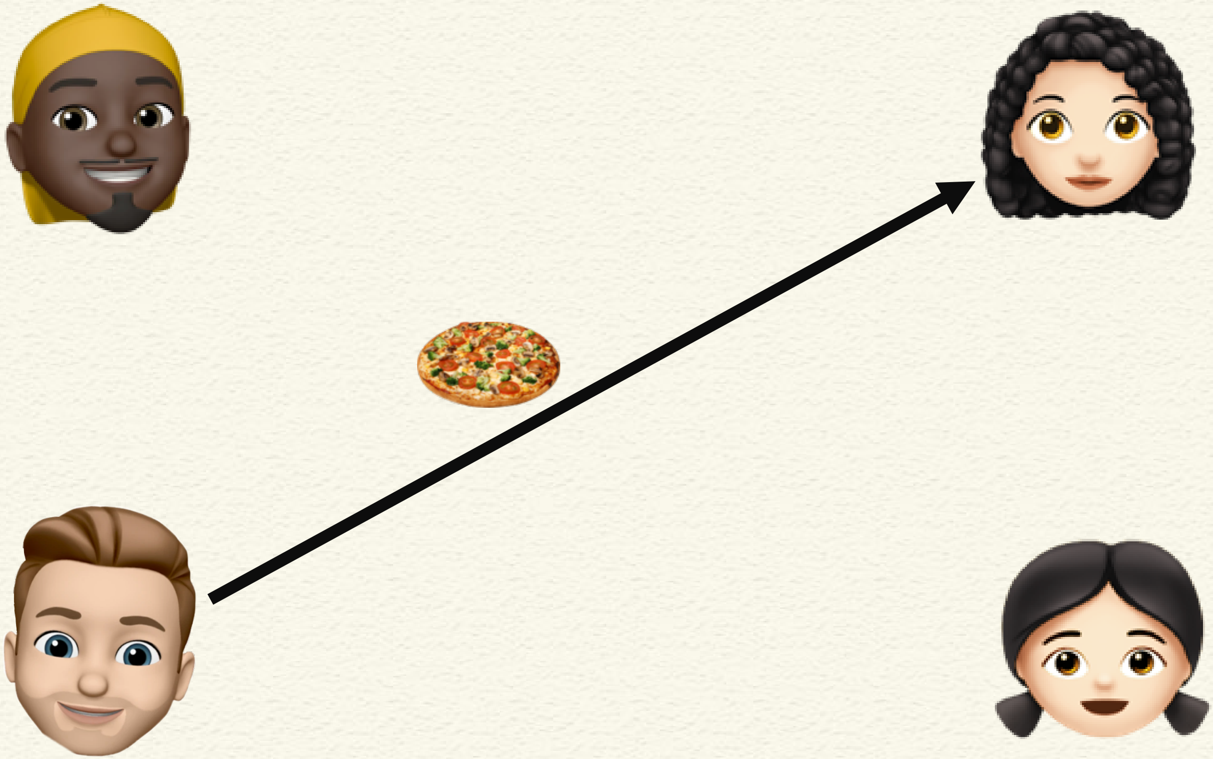


Distributed Consensus



Take a majority voting and decide

Distributed Consensus



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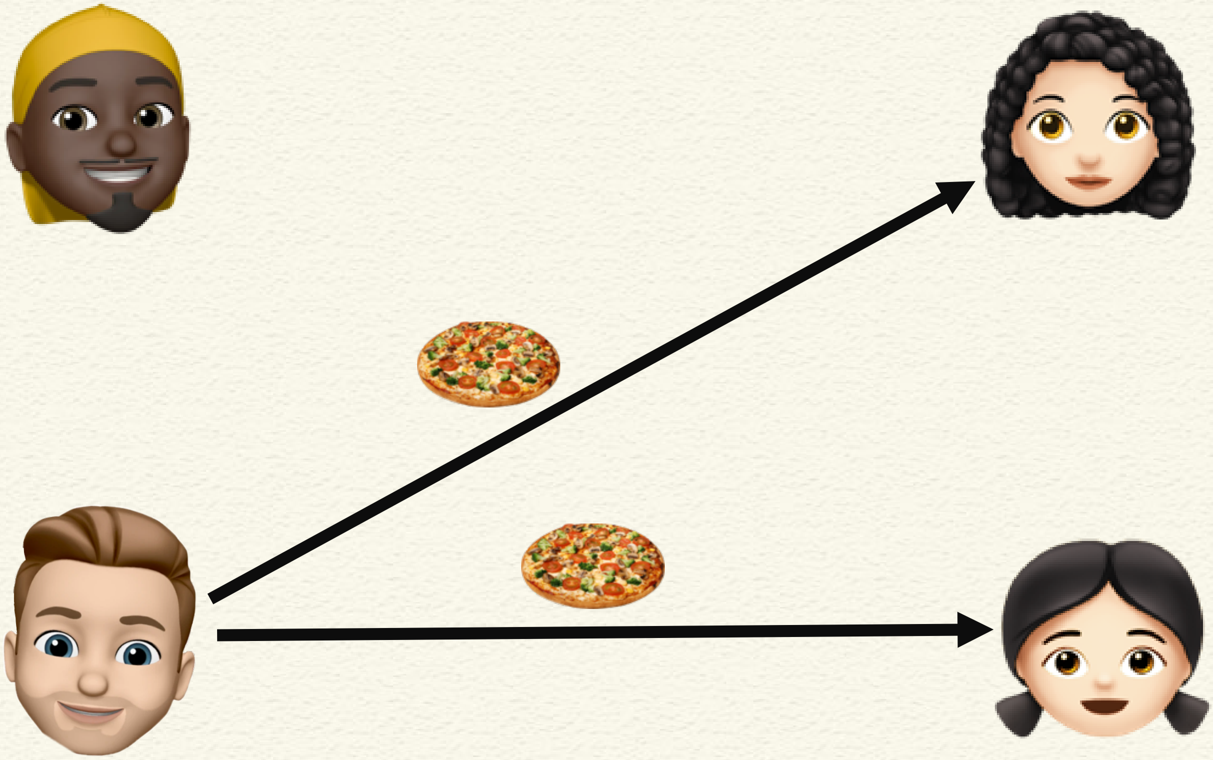

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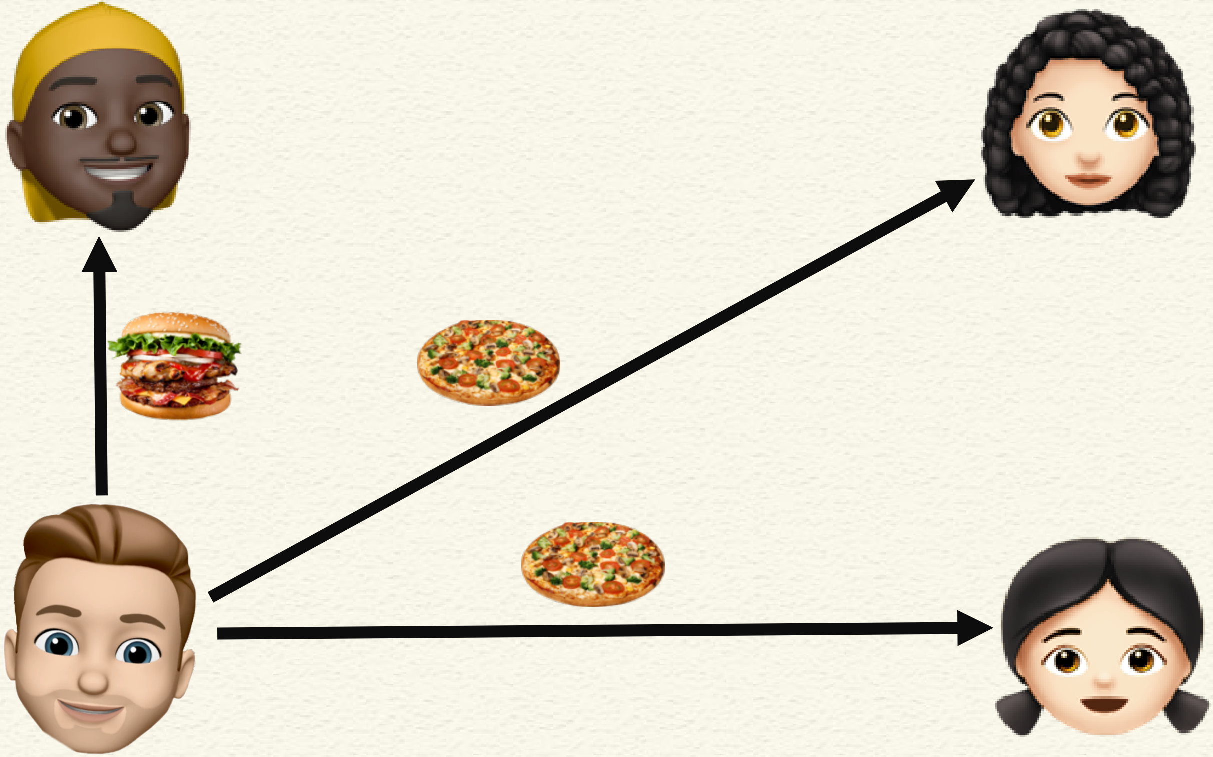

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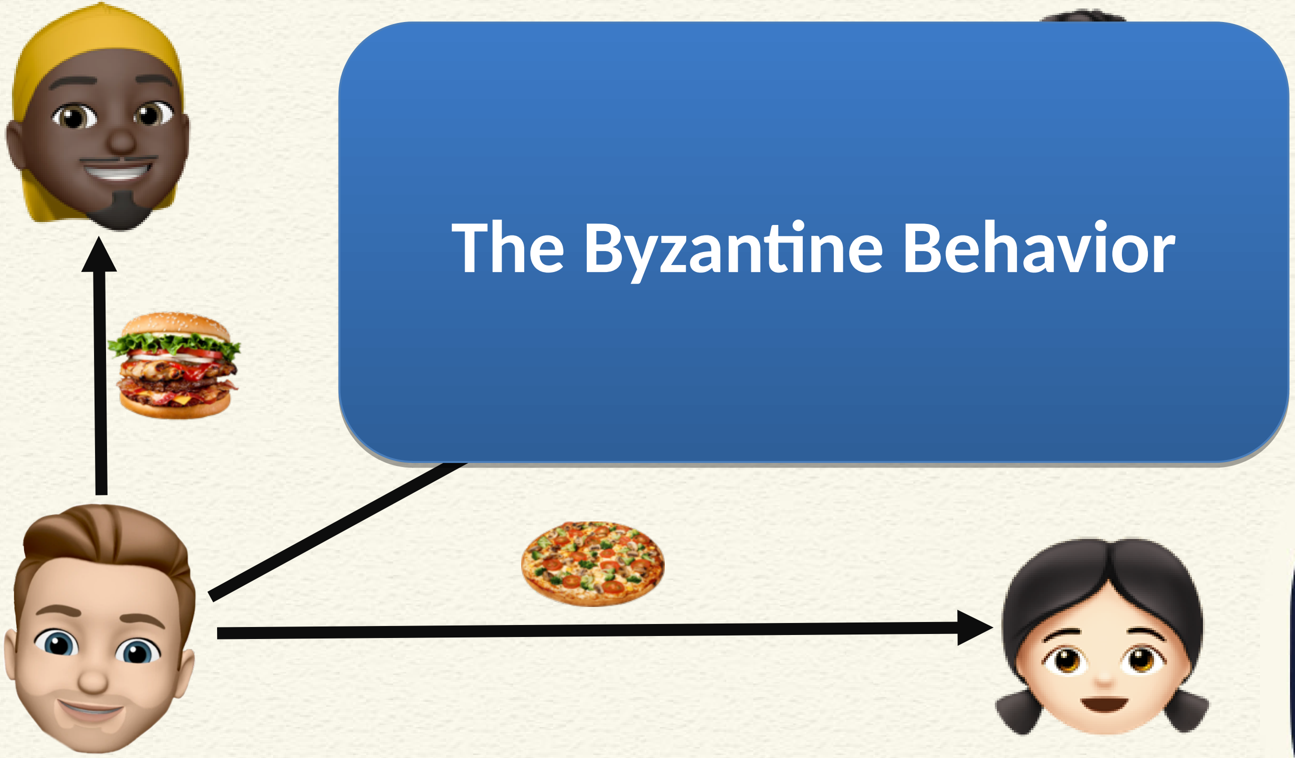

The Byzantine Behavior

Distributed Consensus – The Literature

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  - Consensus is impossible in a fully asynchronous system even with a single crash fault

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Correct processes will yield the correct output

The output will be produced within a finite amount of time (eventual termination)

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  - Supports safety but not the liveness

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- 1989: Lamport started talking about "Paxos"
  - Supports safety but not the liveness
- 1990's: Everyone were confused about the correctness of Paxos

Distributed Consensus – The Literature

- 1998: Paxos got published in ACM Transactions on Computer Systems
- 2001: FLP Impossibility paper wins Dijkstra Prize
  - People starts talking about Distributed Systems
- 2009: Zookeeper released
  - Service for managing distributed applications

Distributed Consensus – The Literature

- 2010's onward: Different types of consensus algorithms released
  - Multi-Paxos
  - Raft
  - Byzantine Fault Tolerance
  - PBFT
  - …

Conclusion

- Blockchain needs consensus at its back
- There is a vast literature on distributed consensus
- Can we use them for blockchain?

Thank you