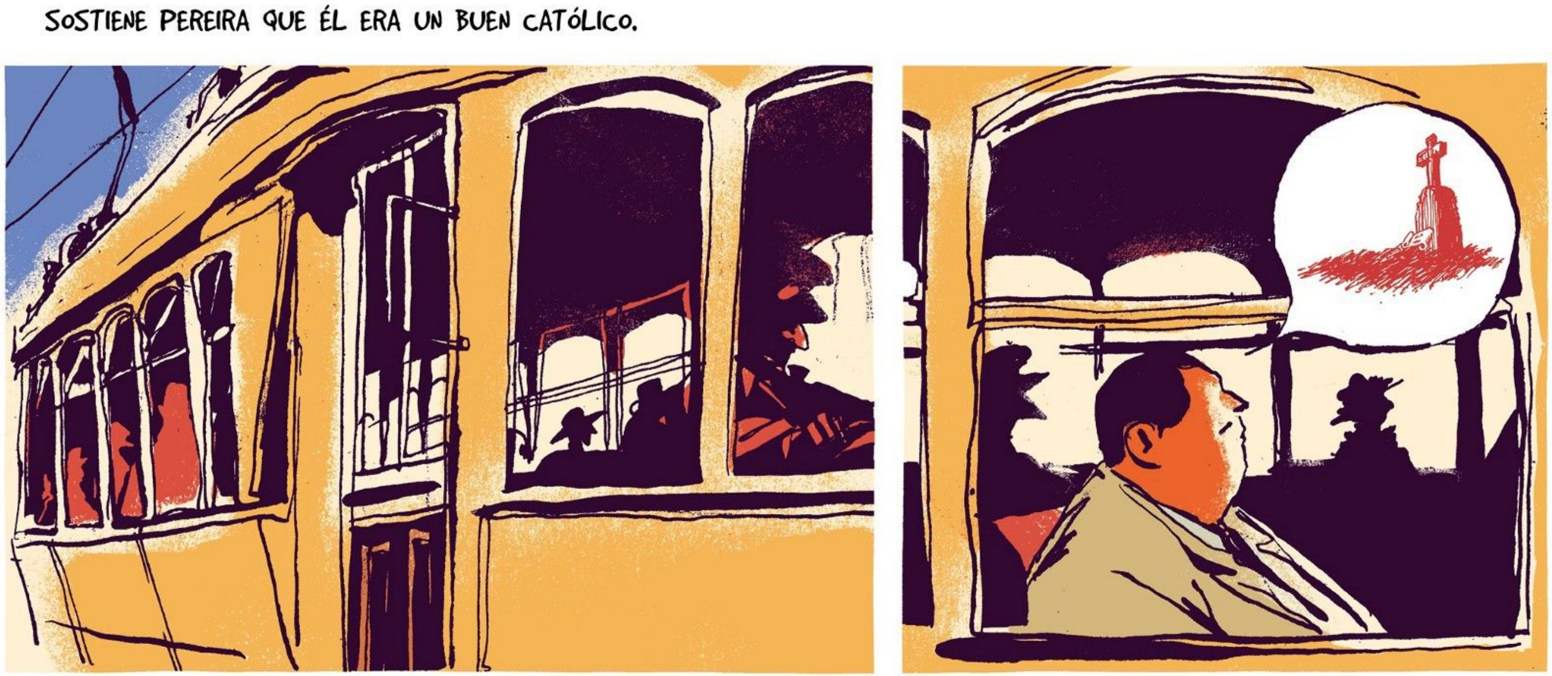
State channels with state assertions

Chris Buckland and Patrick McCorry



State channels

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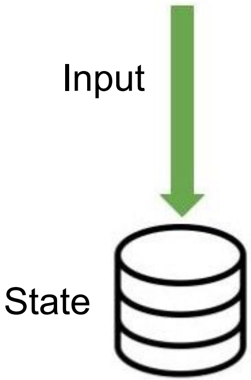
1. Participants commit funds to the channel under some initial conditions
2. Parties sign new states off-chain
3. If parties cannot cooperate off-chain, one party can force the continuation on chain
4. When parties move state back on-chain they are both given an opportunity to present their latest state - “Dispute resolution”

So what’s the problem?

A cooperation break down results in the usual costly **transaction fees**, and high latency

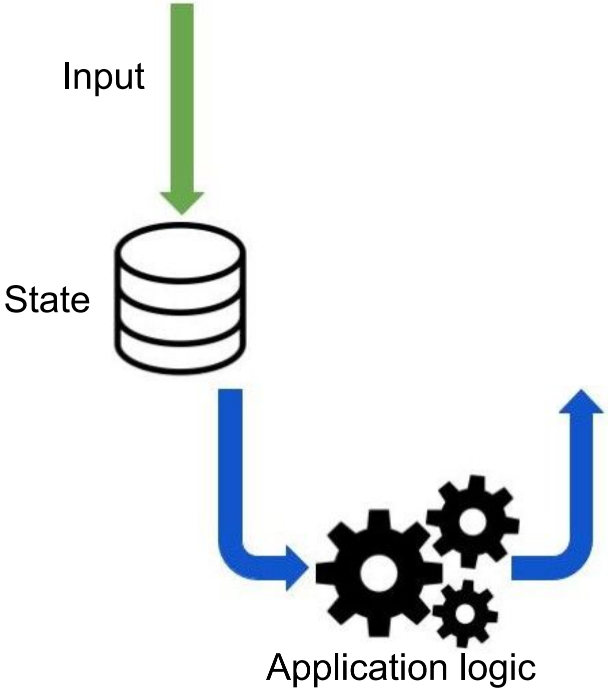
Smart contracts



Input

State

Smart contracts



Input

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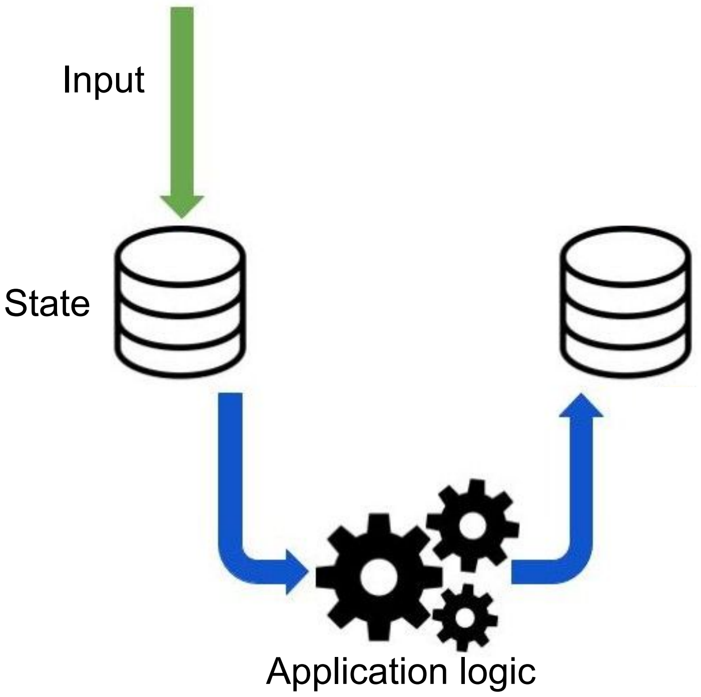

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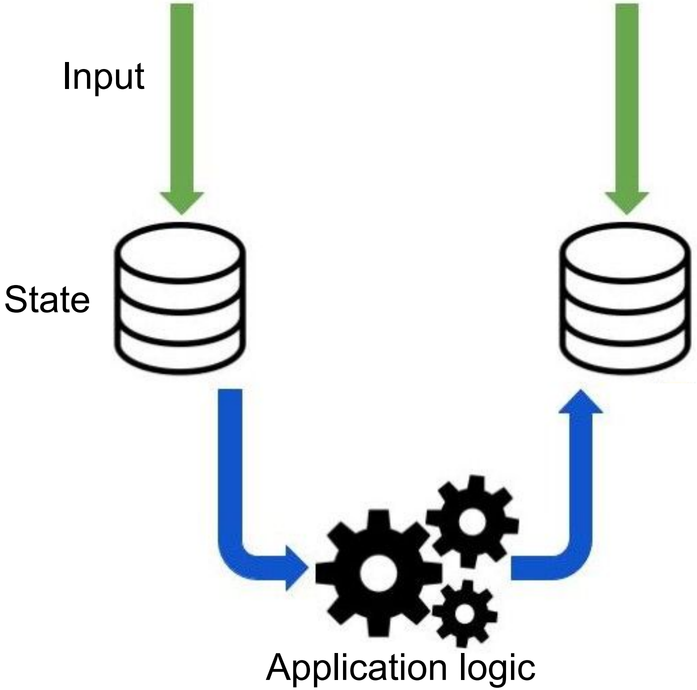

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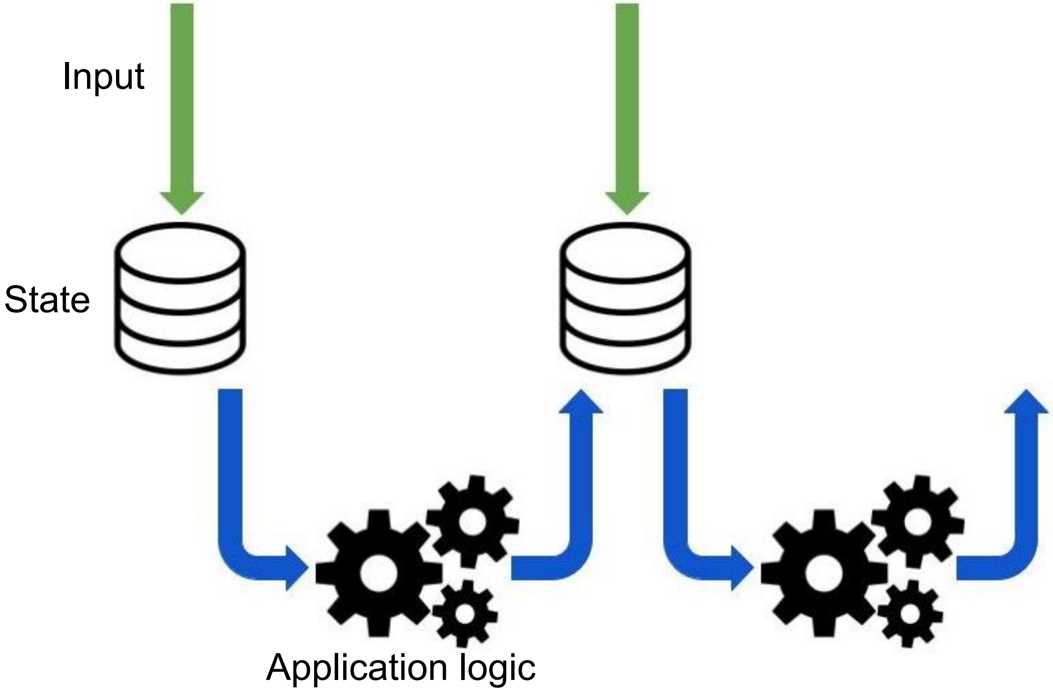

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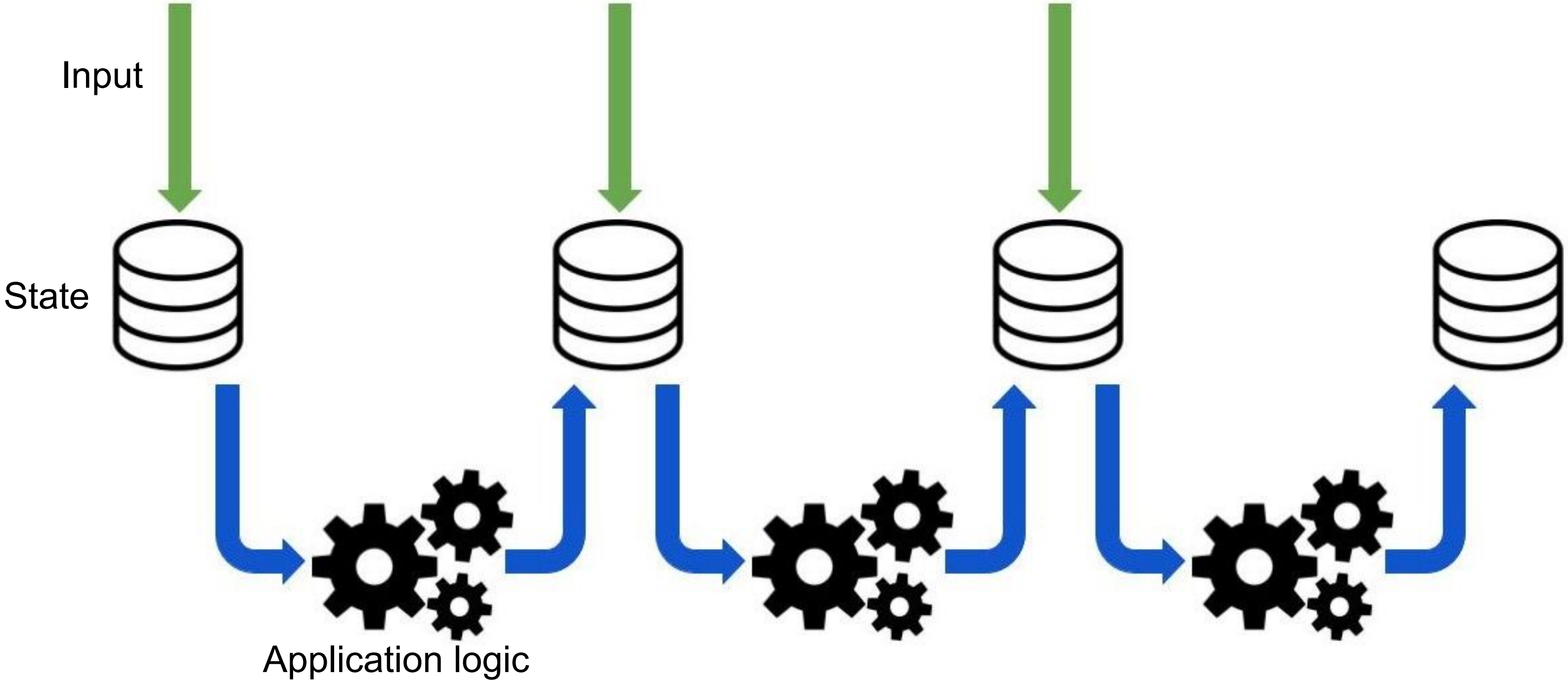

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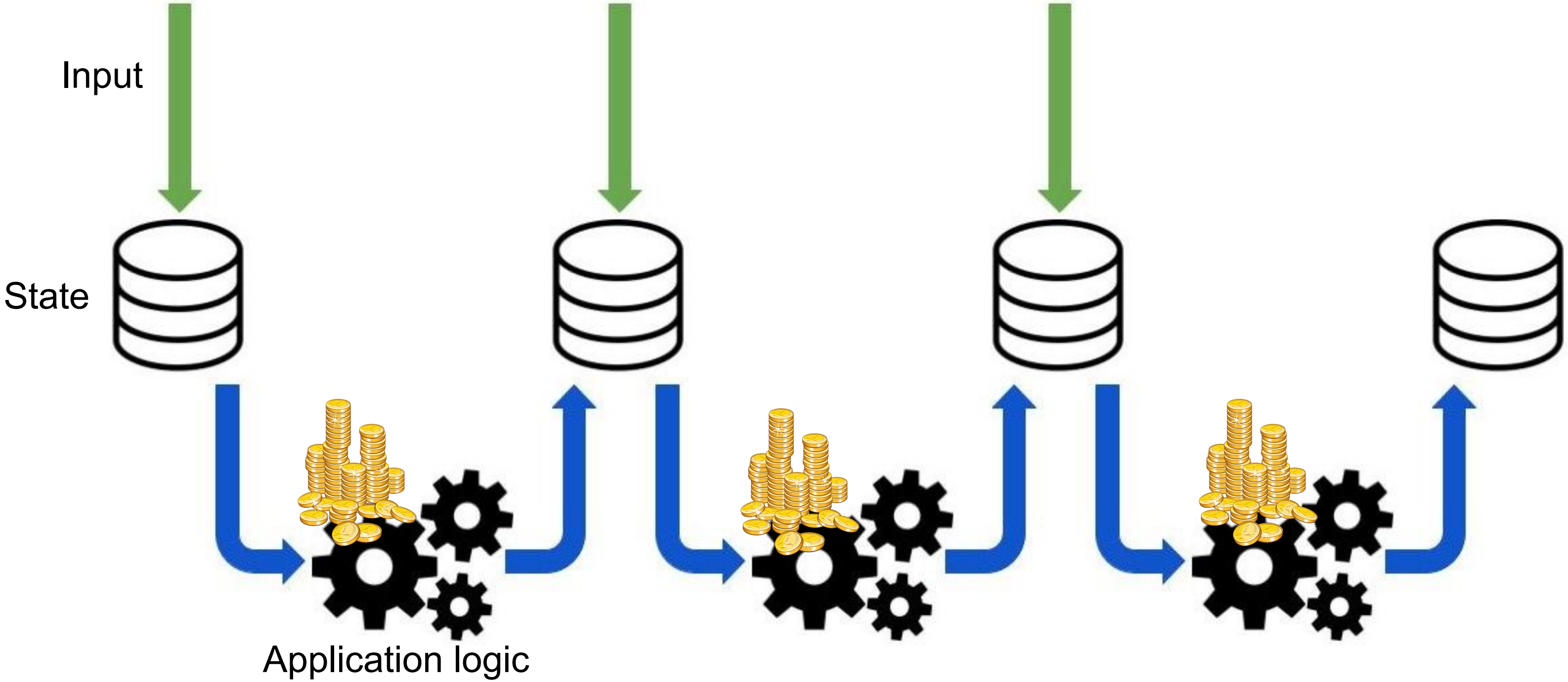

Input

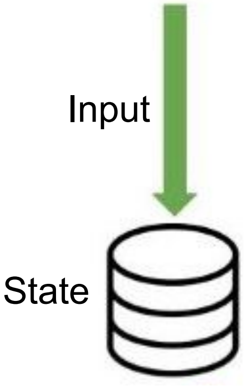
State

Application logic

‘Optimistic’ smart contracts

Accept any state as input, then wait for a fraud proof

Optimistic smart contracts



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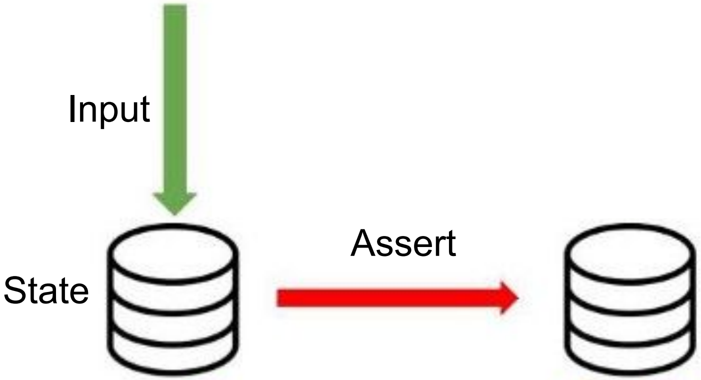

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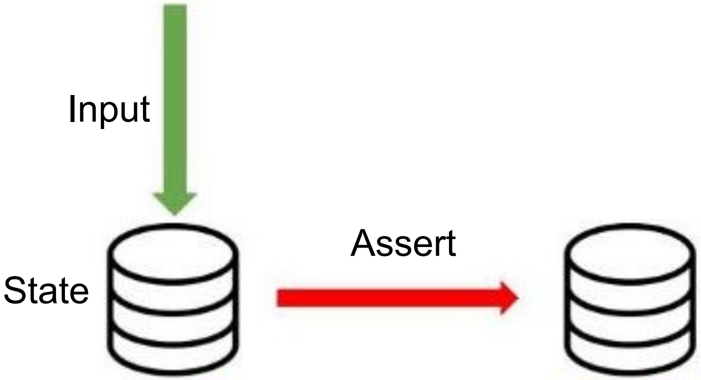

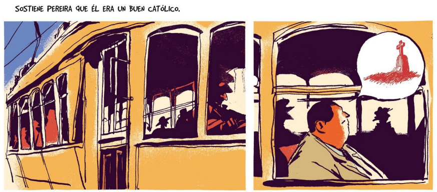

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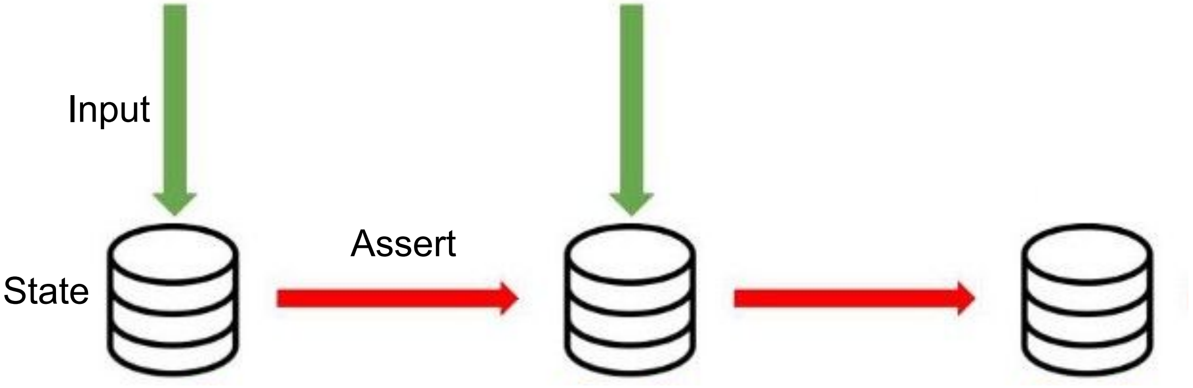

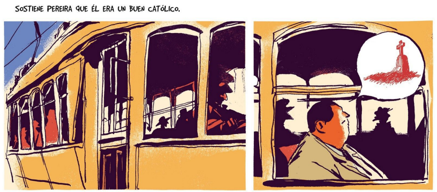

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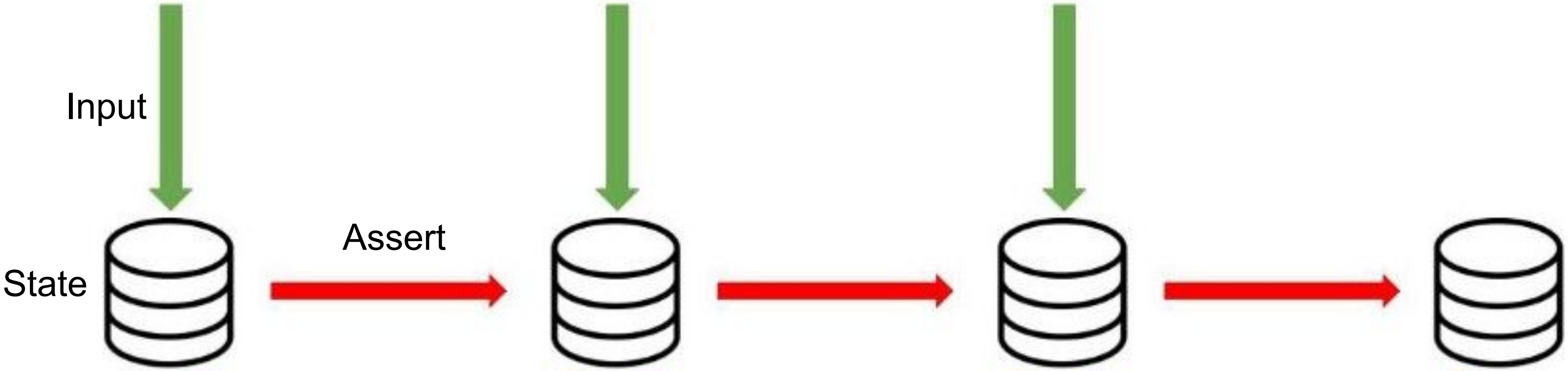

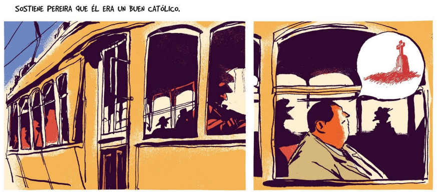

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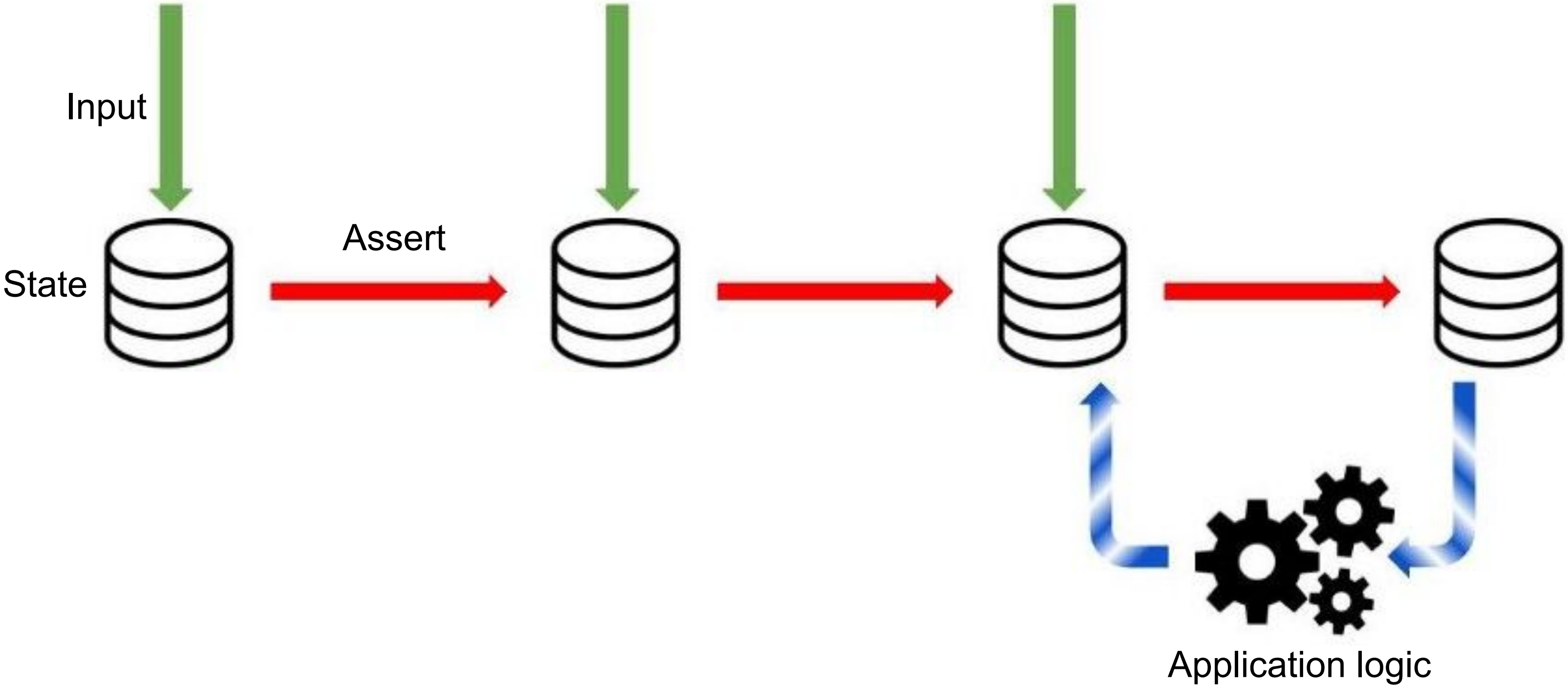

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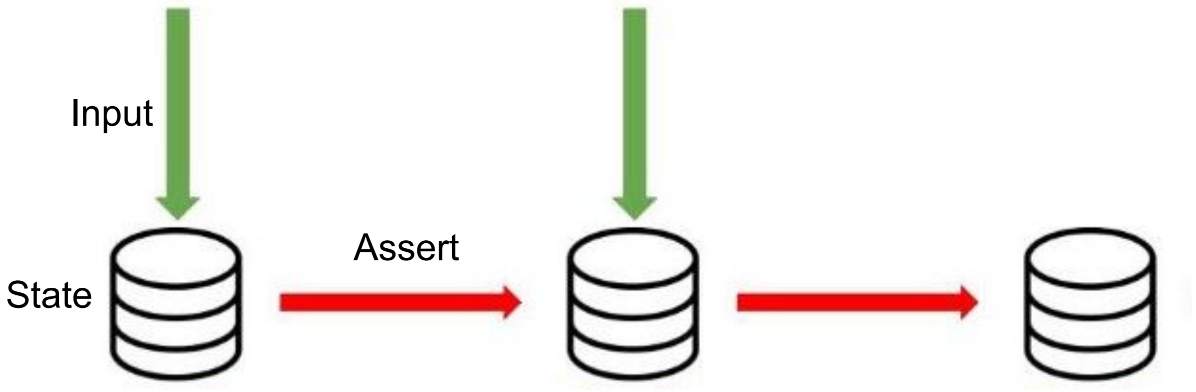
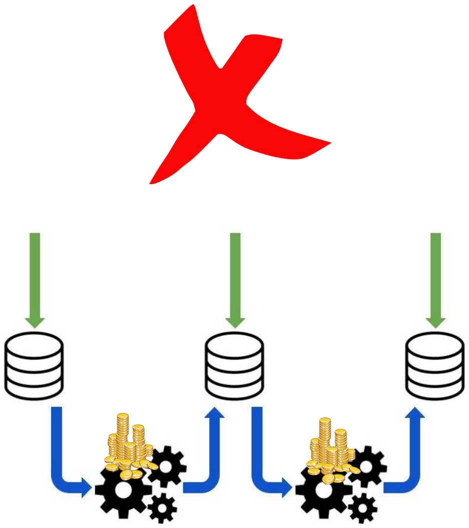


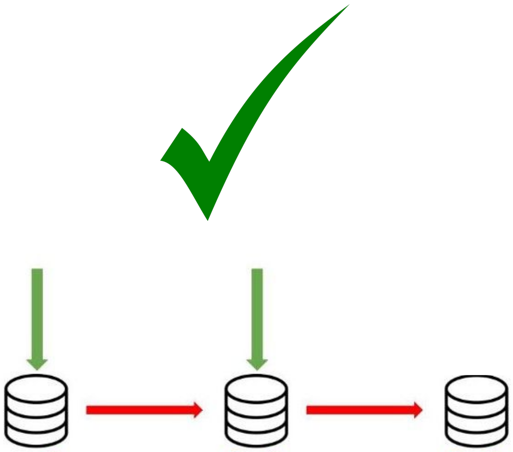
Optimistic contracts trade tx fees for latency

State channels + optimistic contracts = cheaper disputes

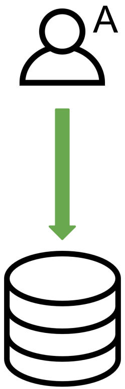
How does it work?

Dispute resolution takes place via assertions instead of being fully computed





Why is this a good match?



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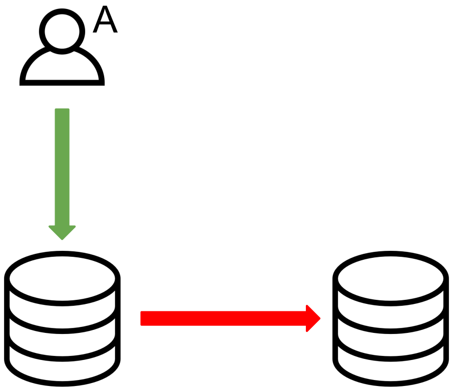

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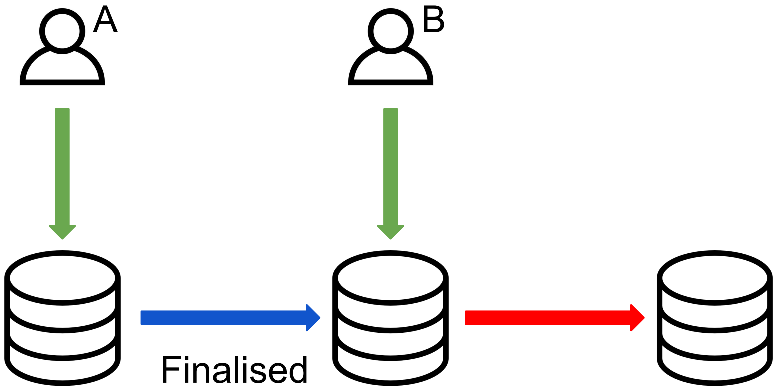

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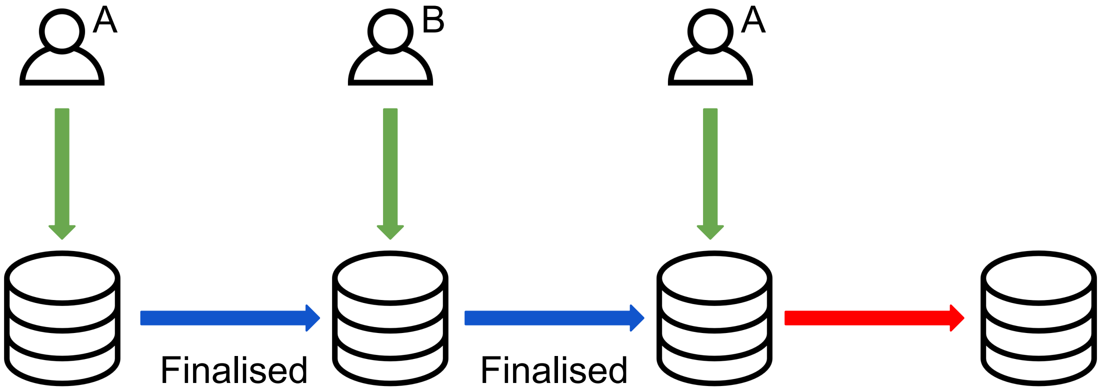

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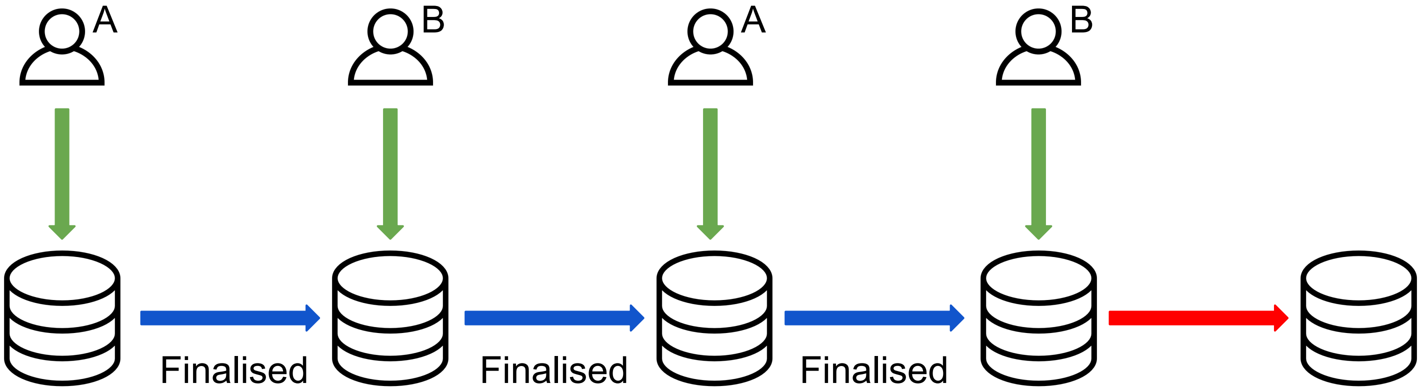

The result

Taking turns as part of the worst case dispute in a state channel is **independent of the computational complexity** of the application

Experiment built on Ethereum:

60,000 + 40n gas per state assertion

*(where **n** is the number of input bytes)*

A cautionary note..

- Malicious counterparty can now transition to any arbitrary state if a party is offline

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Related work

- Optimistic contracts - https://medium.com/@decanus/optimistic-contracts-fb75efa7ca84
- TrueBit - https://people.cs.uchicago.edu/~teutsch/papers/truebit.pdf
- Arbitrum - http://stevengoldfeder.com/papers/Arbitrum-USENIX.pdf
- Battleships - https://nms.kcl.ac.uk/patrick.mccorry/battleship.pdf

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