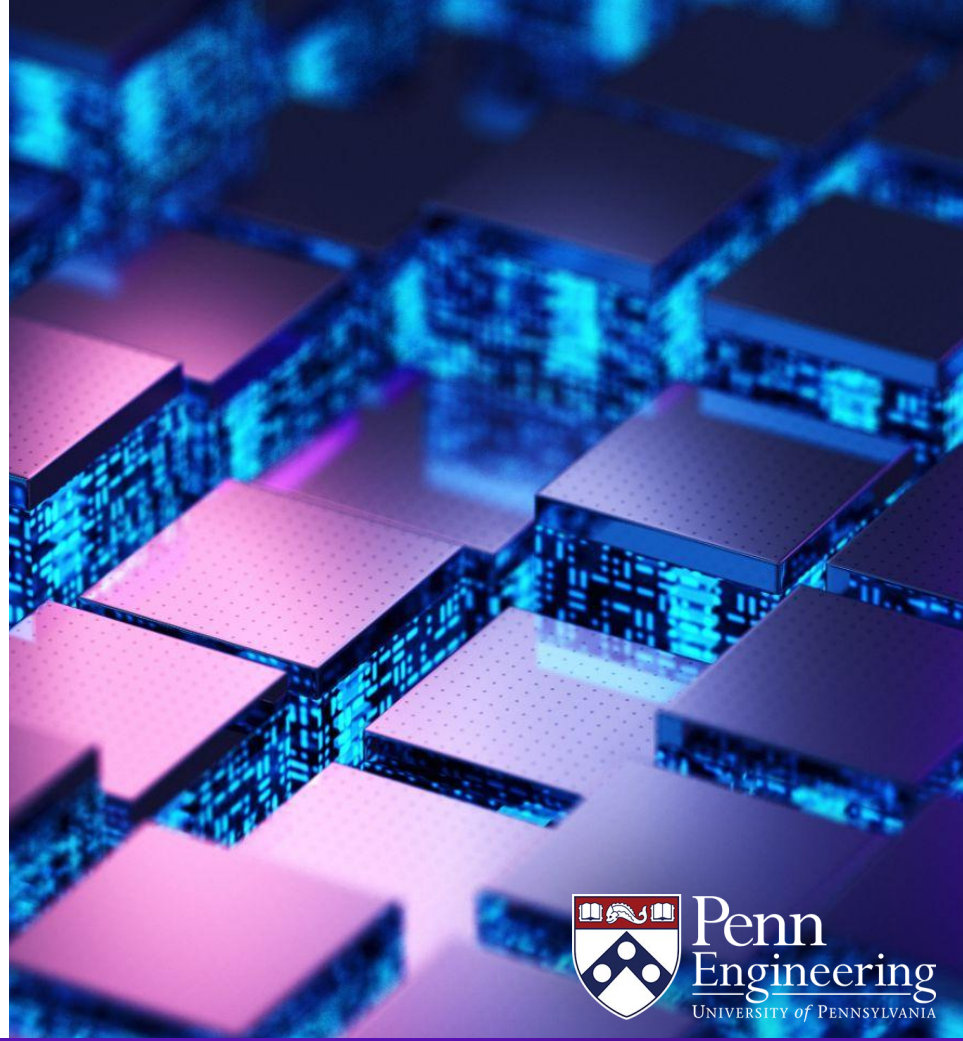
EAS 5830: BLOCKCHAINS

Selfish Mining

Dr. Brett Hemenway Falk



Majority is not Enough: Bitcoin Mining is Vulnerable

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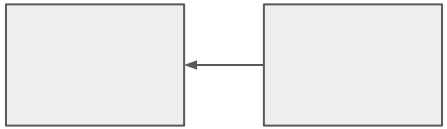
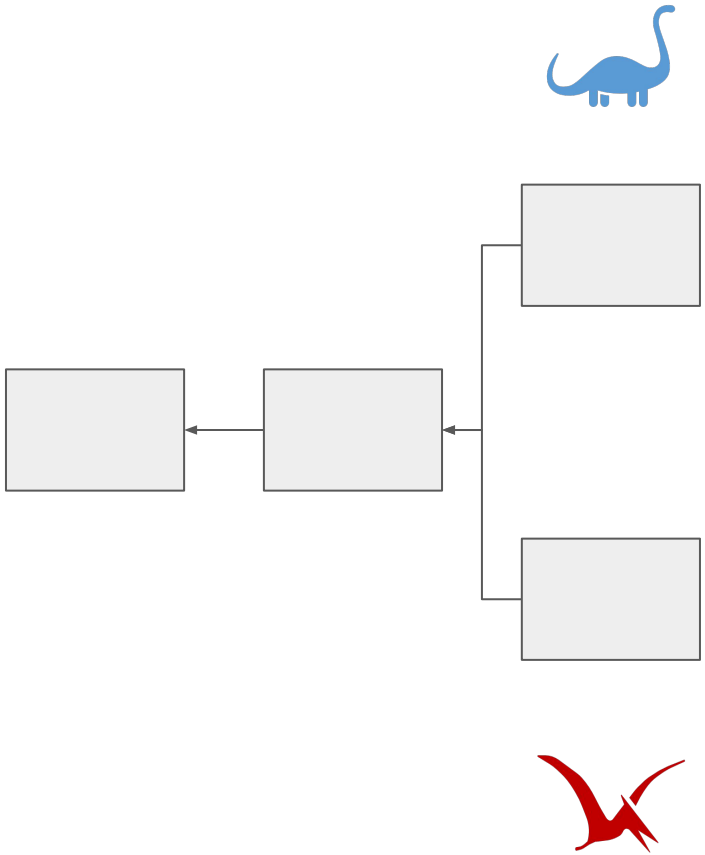
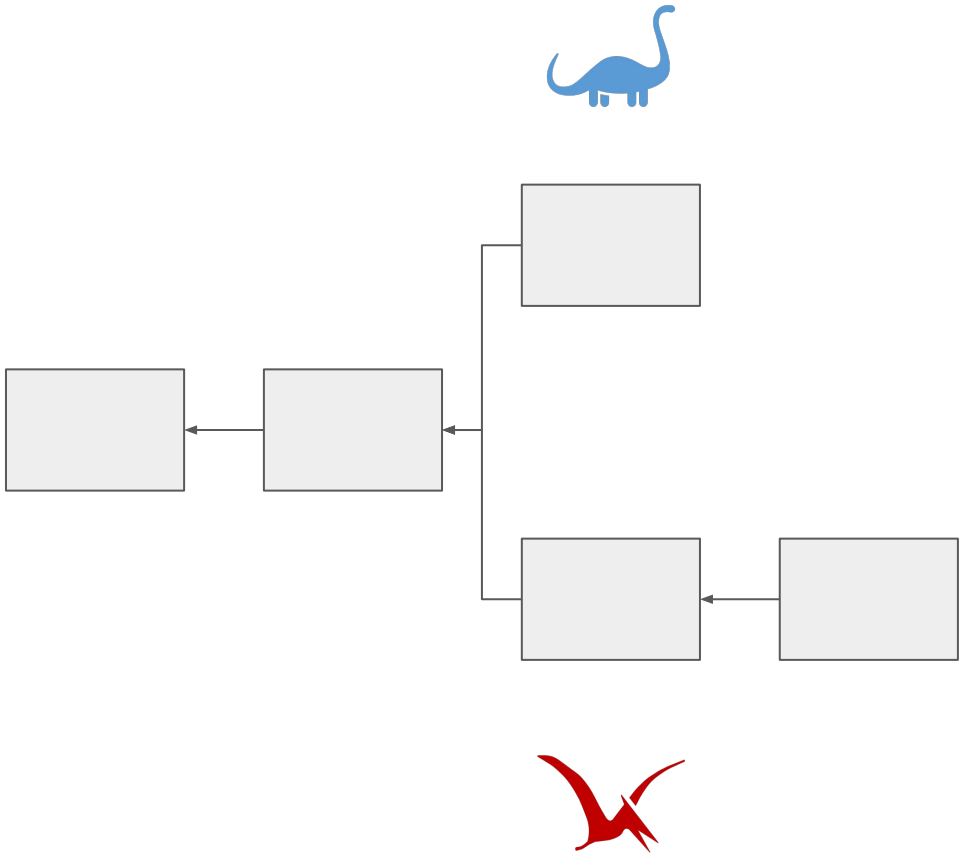
Basic Security Analysis

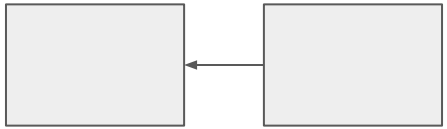
- **Protocol**:
  - Always mine on the longest chain
    - In the event of a tie, mine on the block you saw first
  - Always publish block as soon as you mine it
- **Analysis**:
  - If an attacker ignores the blocks of the honest miners
    - Only mines on their own fork
  - Attack is successful if attacker controls a majority of the stake







Honest miners



Selfish miners

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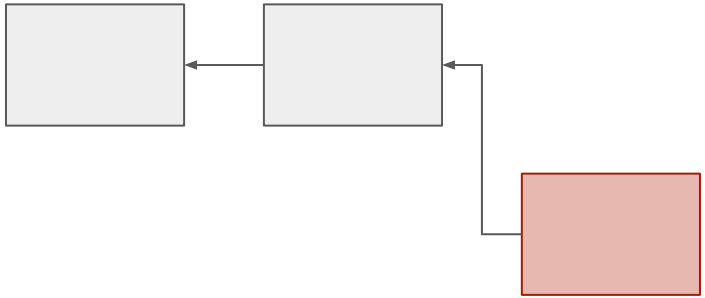
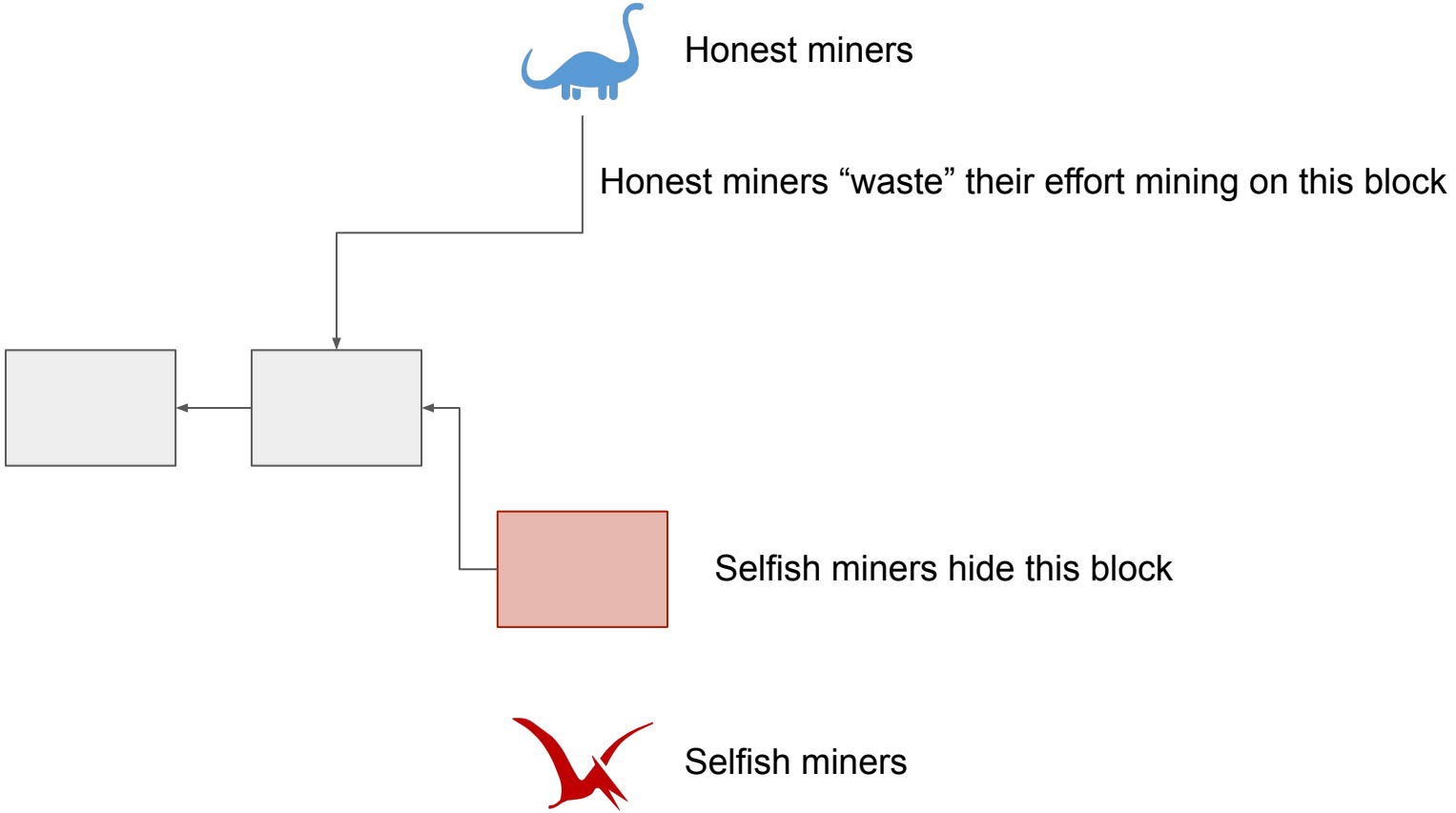


Selfish miners hide this block

Selfish miners


Honest miners
Honest miners “waste” their effort mining on this block
Selfish miners hide this block
Selfish miners

Honest miners

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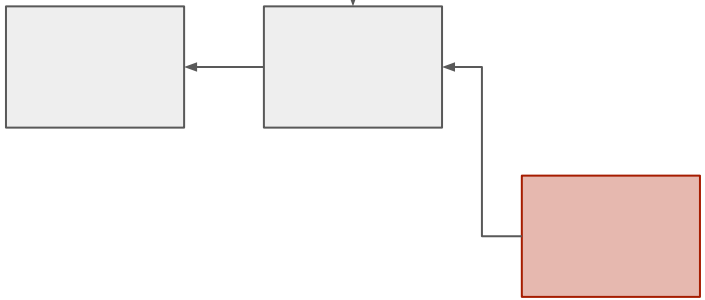


Intuition:
If you can make honest miners “waste” their effort Selfish miner effectively has a larger fraction of the mining power

Selfish miners hide this block

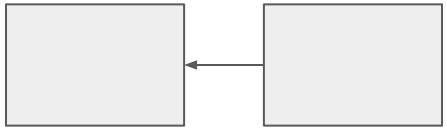
Selfish miners

Warmup

Honest miners

Assume:

- Selfish miners have better connectivity than honest miners
- Selfish miners can propagate blocks faster than honest miners



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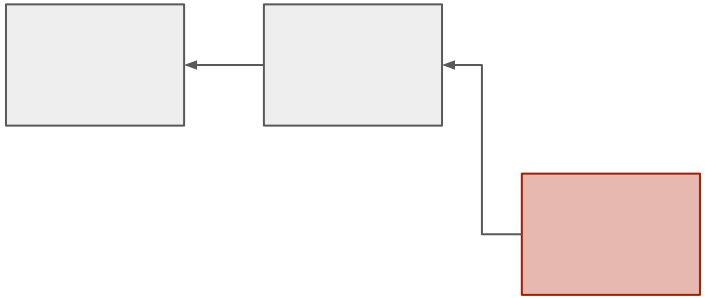
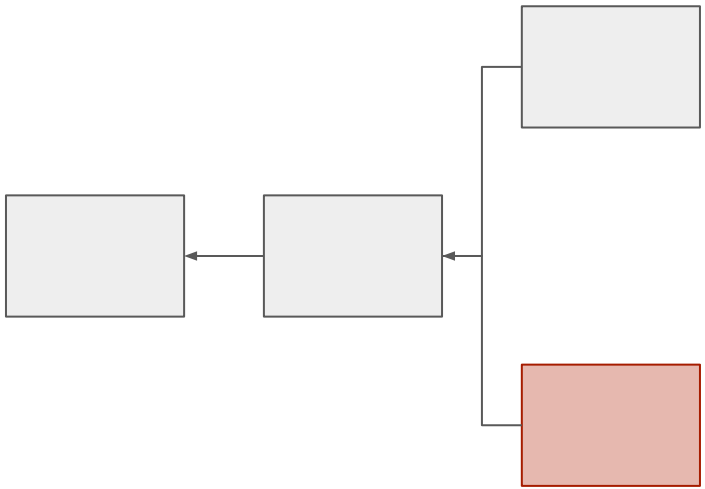


Withhold block

Selfish miners

Warmup



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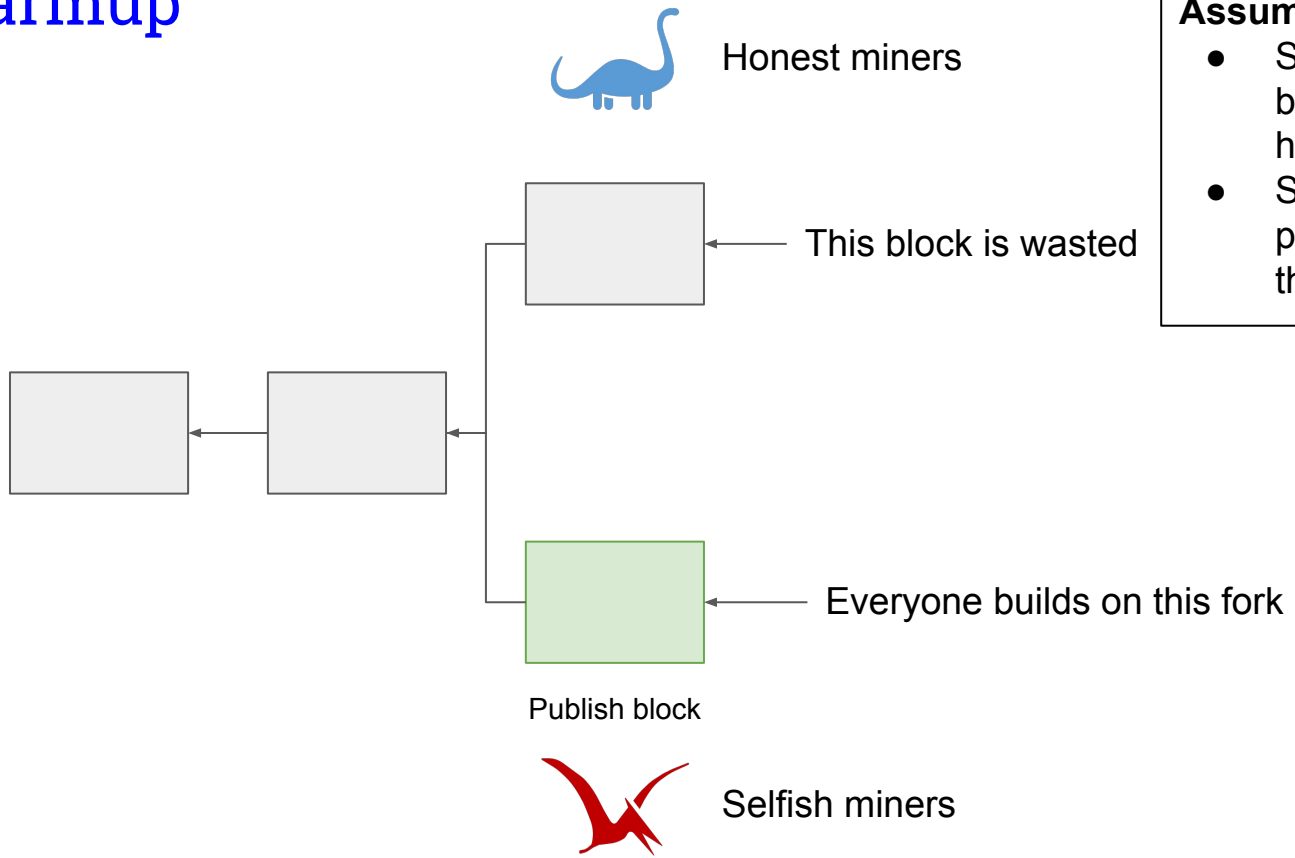

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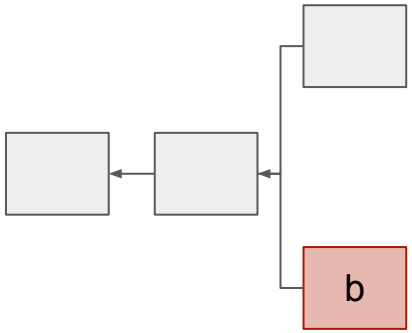
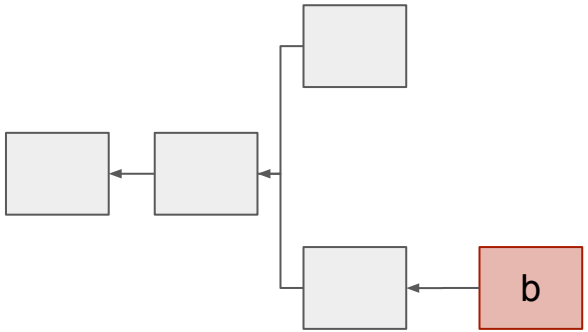
General strategy

- Assume selfish miner controls α-fraction of hash power
- In the case of a tie, a γ-fraction of honest nodes build on selfish-miner's block
  - Warmup was the case $\gamma = 1$
- Strategy
  - If selfish miner has a block b at height h, publish it if:

Case 1: Honest miners catch up



Case 2: Block is "pivotal"



Selfish mining

Theorem:

If $\alpha > ⅓$, following the selfish mining strategy leads to more profit for the selfish miner than following the “honest” strategy

Follow ups

- Majority is not Enough: Bitcoin Mining is Vulnerable
- Optimal Selfish Mining Strategies in Bitcoin
- Undetectable Selfish Mining