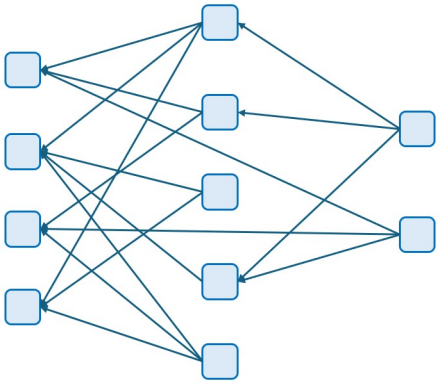
Analysis of Proof-of-Work DAG-Based Blockchains



Proof-of-Work (PoW) Directed Acyclic Graph (DAG)-based blockchains, such as Kaspa, represent a new generation of blockchain protocols designed to overcome the scalability limitations of traditional chain-based systems like Bitcoin. Unlike linear blockchains, where blocks are appended one after another, DAG structures allow multiple blocks to be added concurrently, improving throughput and reducing confirmation times. Kaspa, for example, which employs the GHOSTDAG consensus protocol, achieves roughly 3,000 TPS in test settings, which is orders of magnitude above Bitcoin's 7 TPS in its linear PoW design. The DAG-based approach enables high block rates while preserving security and decentralization under the PoW model.

Despite their innovations, PoW DAG-based blockchains remain vulnerable to classical incentive-driven attacks. In particular, attacks such as selfish mining, where a miner withholds blocks to gain disproportionate rewards, and the 51% attack, where an adversary with majority hash power can reverse transactions, pose significant risks. The impact and severity of these traditional attacks in a DAG setting remain an important research direction that is not yet fully explored by the community. Understanding how these attacks manifest, adapt, or amplify in the context of DAG-based consensus is crucial for evaluating the robustness of such systems.

The student undertaking this project will be expected to: (1) study the existing literature on incentive attacks in PoW systems as well as recent works on DAG-based consensus protocols such as GHOSTDAG; (2) analyze the severity of incentive-driven attacks, including selfish mining, in the context of DAG-based PoW; and (3) develop practical simulations/implementations to measure the effectiveness and feasibility of such attacks. The project aims to provide both fundamental insights and practical evaluation of the security guarantees of PoW DAG-based blockchains.

Practicalities

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Nature of the work:	20% literature, 20% theoretical work, 60% software		
Number of students:	1		

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