ICAART24-3P: Oral Presentations (Online) **Sunday, February 25th 2024**

09:00 - 10:30

Agents

Room Online 2

ICAART24-RP-173: Full Paper **25min**

Q-Defense: When Q-Learning Comes to Help Proof-of-Work Against the Selfish Mining Attack (Online presentation)

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ABSTRACT

The Proof-of-Work (PoW) consensus protocol is widely utilized in various blockchain implementations, including Bitcoin. The security of this protocol relies heavily on the incentive-compatibility of participating miner, who compete against each other to discover new blocks. However, the assumption that competition will naturally evolve into collaboration, ensuring blockchain security, is not always valid. Certain colluding miners, known as ”selfish miners ,” attempt to unfairly obtain rewards by deviating from the prescribed protocol. In this paper, we propose a novel learning-based mechanism to address this challenge and enhance the PoW protocol. Specifically, we apply Q-Learning, a prominent technique in reinforcement learning, to each miner in order to mitigate the impact of selfish collaboration among colluding miners. To best of our knowledge, this is the first defense mechanism based on Q-Learning in the literature. Our comprehensive analysis demonstrates that the proposed modification to the PoW protocol can increase the threshold for successful selfish mining attacks from 25% to 40%. Furthermore, simulation results comparing our defense mechanism with tie-breaking, a well-known defense approach, validate the effectiveness of our proposed mechanism.

KEYWORDS

Blockchain, Proof-of-Work, Selfish Mining, Defense Mechanism, Reinforcement Learning, Q-Learning.

TOPICS

Soft Computing; Multi-Agent Systems; Machine Learning; Distributed Problem Solving; Self Organizing Systems; Intelligence and Cybersecurity; Group Decision Making (with cooperation, coordination, negotiation, interaction protocols); Privacy, Safety, Security, and Ethical Issues; Fairness and Reliability;

AUTHORS

Ali Nikhalat-Jahromi (/node/TechnicalProgram/icaart/2024/personDetails/bd593145-9b63-4976-8350-a005f5a3dfe5)

Department of Computer Engineering, Amirkabir University of Technology, Tehran, Iran

Ali Mohammad Saghiri (/node/TechnicalProgram/icaart/2024/personDetails/b7a2f9f7-bc8b-4d5a-8fa5-dcf2eaa45aa5)

Department of Computer Engineering, Amirkabir University of Technology, Tehran, Iran

Department of Computer Science, William Paterson University, New Jersey, U.S.A.