Blockchain and Cryptography: Enhancing Security and Efficiency in Decentralized Systems

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Abstract*: Blockchain technology has emerged as a revolutionary framework for secure and decentralized data management. At its core, cryptography plays a pivotal role in ensuring data integrity, confidentiality, and authenticity within blockchain systems. This paper explores the integration of cryptographic techniques in blockchain to address security challenges and improve operational efficiency. Advanced methods such as hash functions, digital signatures, and elliptic curve cryptography are examined for their contribution to securing transactions, enhancing transparency, and preventing unauthorized access. Additionally, the paper delves into the challenges of scalability and quantum computing threats, proposing potential solutions through innovative cryptographic advancements. By bridging the gap between theoretical frameworks and real-world applications, this study highlights the critical interplay between blockchain and cryptography in shaping the future of secure digital ecosystems.*

Keywords: Blockchain security, Cryptographic algorithms, Hash functions, Digital signatures, Decentralized systems, Data integrity, Privacy, Quantum resistance