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Integrating Edge Intelligence and Blockchain

What, Why, and How

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Preface

Along with the wave of informatization technology, an unprecedented booming era of artificial intelligence (AI) has emerged. Meanwhile, with the proliferation of wireless communication, immense volumes of data are generated by mega-scale terminals instead of traditional cloud datacenters. Driving by these trends, edge intelligence (EI) has elicited escalating attention. Instead of entirely relying on the cloud, EI makes the most of the widespread edge resources to gain AI insight. It is yet facing critical challenges in its decentralized management and security, limiting its capabilities to support services with numerous requirements.

In this monograph, the blockchain (BC) has been seen as a promising solution to tackle the above issues, further support EI. Based on the number of citations or the relevance of an emerging method, this monograph presents the results of a literature survey on the integration of EI and BC. Accordingly, we conduct a summarization of the recent research efforts on the existing works for EI and BC. We then paint a comprehensive picture of the limitation of EI and why BC could benefit EI. From there, we explore how BC benefits EI in terms of computing power management, data administration, and model optimization. To narrow the gap between immature BC and EI-amicable BC, we also probe into how to tailor BC to EI from four perspectives, including flexible consensus protocol, effective incentive, intellectuality smart contract, and scalability. Finally, some research challenges and future directions are addressed.

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Contents

Acronyms

2Ts-DRL	Two-timescale deep reinforcement learning
ACK	Acknowledge character
ADMM	Alternate direction method of multipliers
AI	Artificial intelligence
AIE	Artificial intelligence on edge
API	Application programming interface
BaaS	Blockchain-as-a-service
BC	Blockchain
CD	Computing-power device
CLI	Command Line Interface
CNN	Convolutional neural network
CNN	Convolutional neural network
CNN	Proof of work
CSP	Computing service provider
DAO	Decentralized automatic organization
DApp	Decentralized applications
DL	Deep learning
DLT	Distributed ledger technology
DNN	Deep neural networks
DQL	Deep Q-learning
DQN	Deep Q-network
DRGO	Deep reinforcement learning combined with genetic algorithm
DRL	Deep reinforcement learning
DSIC	Dominant-strategy incentive compatibility
EC	Edge computing
ECSP	Edge computing service provider
EI	Edge intelligence
ePoW	Enhanced proof of work
FL	Federated learning
HRL	Hierarchical reinforcement learning
IC	Incentive compatibility

IDC	International data corporation
IIoT	Industrial internet of things
IoT	Internet of things
IoV	Internet of vehicles
IR	Individual rationality
ITS	Intelligent telehealth system
LM	Learning markets
LSTM	Long short-term memory
MARL	Multi-agent reinforcement learning
MDP	Markov decision process
ML	Machine learning
NFV-MANO	Network function virtualization management and orchestration
P2P	Peer-to-peer
PBFT	Practical byzantine fault tolerance
PoDL	Proof of deep learning
PoET	Proof of elapsed time
PoK	Proof of knowledge
POMDP	Partially observable markov decision process
PoQ	Proof of training quality
PoS	Proof of stake
PoT	Proof of trading
PoW	Proof of utility
QoS	Quality of service
RBFT	Redundant byzantine fault tolerance
UDEC	Ultra-dense edge computing
VANET	Vehicle ad hoc network
WAN	Wide area network
ZB	zettabytes