



Artificial Intelligence in Computer Networks: An Organized Overview of Uses, Methods, Difficulties, and Prospects

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ABSTRACT

Artificial Intelligence (AI) is increasingly becoming an integral part of the modern computer network design, management, and optimisation. Whereas traditional systems rely on rules set by hand, AI based systems can adapt to operational data and make decisions based on changing network conditions. The paper introduces a systematic review of the AI and machine-learning (ML) techniques presented in the networking literature, and primarily based on peer-reviewed journal articles, IEEE survey papers and conference proceedings published between 2015 and 2024. The methods studied are supervised learning, unsupervised learning, reinforcement learning, deep learning, graph-based learning, federated learning and AI-based 5G/6G networking. The review also discusses the key applications such as traffic classification and prediction, adaptive routing, software-defined networking, network security and intrusion detection, resource allocation, edge computing, network slicing, intelligent wireless networking, and quality-of-service management. In all these facets, common challenges are the lack of representative labeled data, limited data interpretability for learned decisions, computational limitations on time-sensitive inferences, susceptibility to adversarial data manipulation, and scalability issues when the network is heterogeneous. The paper specifies the following directions for future research: explainable AI, privacy-preserving federated learning, digital-twin-based network management, and more autonomous network architectures. In summary, the evidence suggests that AI has the potential to enhance network security, flexibility, and efficiency, but there are still challenges to be addressed, particularly in terms of interoperability, trust, standardisation, and the ability to process large quantities of real-time telemetry.

KEYWORDS: 6G Wireless Networks, Reinforcement Learning, Federated Learning, Artificial Intelligence, Machine Learning, Computer Networks, Deep Learning, Software-Defined Networking, Network Security, and Systematic Review.