

Paper Title

Edge Learning for B5G Networks with Distributed Signal Processing: Semantic Communication, Edge Computing, and Wireless Sensing

Paper Link

<https://signalprocessingsociety.org/publications-resources/ieee-journal-selected-topics-signal-processing/edge-learning-b5g-networks>

1 Summary

1.1 Motivation

Exploring distributed data communication and learning has become an extensively popular field to process and transfer large amounts of data in emerging wireless services. Apart from the privacy concern, all edge devices cannot transmit the data that they have collected to a data center to execute centralized ML methods for data processing for the shortened wireless communication resource to support extensive data transfer. This has enhanced the utilization of Edge Learning(EL), which is a combination of wireless communications and ML.

1.2 Contribution

The authors presented a concise overview of practical distributed EL techniques and their interaction with advanced communication optimization designs. They specifically addressed performance metrics for dual-functional learning and communication networks. In the context of goal-oriented semantic communication, Xu et al. introduced a mathematical model for goal-oriented source entropy, as an optimization problem.

1.3 Methodology

The authors investigated the relationship between EL techniques and optimizing wireless communication resource allocation. They discussed dual-functional metrics for learning and communication in EL networks, emphasizing wireless resource optimization to enhance learning performance and communication efficiency. They highlighted EL networks for their improved communication compared to cloud data centers and focused on reduced latency and energy consumption. Also, They emphasized federated learning (FL) and mobile edge computing for the importance of managing limited wireless resources for machine learning in EL networks. The role of ML-driven approaches in optimizing wireless resource allocation for edge network communication systems was also showcased.

1.4 Conclusion

The authors provided a thorough exploration of distributed EL techniques, focusing on the interaction between EL and communication optimization design, emphasizing signal processing. They introduced dual-functional performance metrics for both learning and commu-

nication aspects. Additionally, the paper dived into B5G applications, open issues, and challenges in the EL framework. The detailed study on signal processing techniques for EL in wireless communications provided guidance for the seamless integration of machine learning and edge networks.

2 Limitations

2.1 First Limitation

In the learning procedure, ensuring uniform dataset distribution among edge devices is essential for optimal EL performance, but the challenge lies in handling the typical non-i.i.d. datasets found on edge devices.

2.2 Second Limitation

In B5G networks, EL faces security challenges from server attacks and malicious clients. By integrating blockchain's committee consensus mechanism, EL can enhance security.

3 Synthesis

The paper gives an overview of the rapid evolution of wireless networks and ML, highlighting the emergence of metaverse applications that pose heightened demands on 6G networks. To meet these demands, 6G is envisioned as an end-to-end information processing and service network, expanding its core functions to include information collection, computing, and application. The aim is to enhance sensing, communication, and computing capabilities. This study also anticipates that progress in joint sensing, communication, and computing will facilitate the implementation of EL in Beyond B5G networks.