Introduction to the Special Section on Learning-Based Modeling, Management, and Control for Computer and Communication Networks

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COMPUTER and communication networks are becoming larger and more complicated, generating a huge amount of runtime statistics data (such as traffic load, resource usages, etc.) every second. Meanwhile, emerging machine learning models and techniques, such as active learning, Deep Neural Networks (DNNs) and Deep Reinforcement Learning (DRL), have been shown to dramatically improve the state-of-the-art of many applications, including video/image processing, natural language processing, game playing, etc. This special issue aims to exploit how these emerging and powerful techniques can be leveraged to grasp the exciting opportunities provided by pervasive availability of voluminous data to model, manage and control computer and communication networks.

We appreciate contributions to this special section and the valuable and extensive efforts of the reviewers.

The topics of this special section range from modeling, analysis, demonstration of various networks with emerging machine learning techniques. A brief review follows:

In "Mitigating bottlenecks in wide area data analytics via machine learning," Wang et al. present a system framework that minimizes query response times by detecting and mitigating bottlenecks at runtime. In "Deep learning meets wireless network optimization: Identify critical links," Liu et al. investigate how to exploit deep learning for significant performance gain in wireless network optimization by identifying the possibility that a smaller-sized problem can be solved while sharing equally optimal solutions with the original problem. For the first time, in "Channel selective activity recognition with WiFi: A deep learning approach exploring wideband information," Wang et al. explore wideband WiFi information with advanced deep learning towards more accurate and robust activity recognition. The key innovation is to actively select available WiFi channels with good quality and seamlessly hop among adjacent channels to form an extended channel. In "Caching for mobile social networks with deep learning: Twitter analysis for 2016 U.S. election," Tsai et al. discuss the problem of context-aware data caching in the heterogeneous small cell networks to reduce the service delay and how the device-to-device and device-to-infrastructure improve the system social welfare. In simulation, such scheme was shown to efficiently reduce the service latency during 2016 U.S. presidential election where mobile users were urgent to request the election information through wireless networks. In "Renewable energy-aware big data analytics in geo-distributed data centers with reinforcement learning," Xu et al. investigate the cost minimization problem of big data analytics on geo-distributed data centers connected to renewable energy sources with unpredictable capacity. Dai et al. propose in "Hierarchical and hybrid: Mobility-compatible database-assisted framework for dynamic spectrum access" a hierarchical framework to enable the hybrid spectrum access scheme. By building relatively reliable clusters, and connecting cluster heads to the spectrum database, nodes with poor or no connections to the database can also benefit from spectrum maps. Finally, "Channel state information prediction for 5G wireless communications: A deep learning approach" by Luo et al. studies one of the most fundamental problems in wireless communication systems, Channel state information (CSI) estimation. The authors propose an efficient online CSI prediction scheme for predicting CSI from historical data in 5G wireless communication systems.

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We believe this special section is timely and important in enhancing and advancing research in the areas of machine learning and computer networking. The collected papers are evidence of the innovative research in the area of network science and a wide range of practical applications in deployed networks. We hope that this special section will impact and contribute to diverse communities in academia and industry interested in applications of machine learning in computer networking.

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