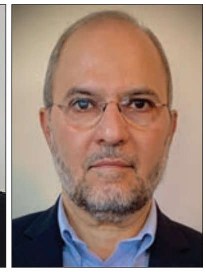
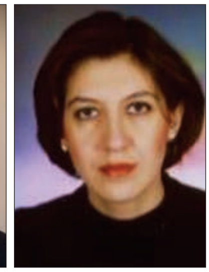
ARTIFICIAL INTELLIGENCE AND DATA SCIENCE FOR COMMUNICATIONS


Yongmin Choi


Ahmed E. Kamal


Malamati Louta

Owing to the unprecedented amount of data and abundant computing resources, artificial intelligence (AI) and machine learning (ML) are widely adopted and used in many disciplines. Since the inaugural issue of this Series in May 2019, we have seen a multitude of studies applying AI and ML techniques to diverse areas of communications. Starting with this issue, we have made a slight change in the title of the series to become "Artificial Intelligence and Data Science for Communications." We considered that most of the submitted manuscripts are related to AI and ML and fewer submissions are related to data science (DS). This is why we moved AI ahead of DS.

This issue of the Series includes three articles that have been reviewed and approved for publication by experts in the respective fields. These articles deal with applying AI and ML techniques to three different areas of communications technologies.

The first article, "From Semantic Communication to Semantic-aware Networking: Model, Architecture, and Open Problems" by G. Shi *et al.*, explores an architectural framework to implement semantic communication. The article surveys the classical semantic communication framework and observes resource-intensive and inefficient semantic communication. By incorporating federated edge intelligence, the authors propose an architectural framework for semantic communication that can alleviate several inefficiencies. In this framework, edge servers, knowledge base, and coordinators in the local cloud and data center cooperate to perform semantic encoding and decoding, identifying knowledge entities, and inferring relations among entities, which requires a large amount of computing resources. This article is a good starting point for research on fundamental theory and practice of semantic communication.

The second article, "Capsule Network Distributed Learning with Multi-Access Edge Computing for the Internet of Vehicles" by J. Xu *et al.*, finds an application of AI to intelligent transportation systems (ITS) in which knowledge required to guide vehicles in motion is often obtained with deep learning (DL) that requires the processing of road images collected by vehicles. Since the vehicles have limited computing capabilities, DL in ITS is performed on clouds at the expense of large transmission times incurred from sending raw images to the clouds. The authors address issues of DL in ITS by employing multi-access edge computing (MEC)-based capsule networks (Caps-MEC). In CapsMEC, distributed learning is carried out on multiple edge servers, and capsule network training is parallelized among geographically grouped edge servers to reduce training time. Since distributed parallel learning requires common datasets, the authors show how to handle data consistency and model consistency in the CapsMEC.

The third article, "Can We Achieve Better Wireless Traffic Prediction Accuracy?" by J. Guo, *et al.*, empirically investigates the performance of traffic prediction models utilizing AI and ML techniques, and deals with an interesting analysis of traffic data and a performance comparison of different AI and ML prediction models. The article starts with entropy and predictability measures indicating the probability that an optimal prediction algorithm predicts future states correctly. The authors review three different types of entropies: random, temporal-uncorrelated, and real entropy, and find that the upper bound of predictability (prediction accuracy) is calculated by the real entropy that can fully explore the traffic patterns of users or base stations in a mobile network. Using two datasets collected from mobile networks in China, the authors compare the performance of five prediction models, and find that the prediction performances of the best prediction models for two datasets still have a gap to the upper bound of predictability.

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BIOGRAPHIES

YONGMIN CHOI [M] (yongminc@hotmail.com) received his B.S. and M.S. degrees in electronic engineering from Seoul National University, Korea, and his Ph.D. degree in electrical engineering from the University of Southern California, Los Angeles, Calif. His professional career spanned diverse fields in the telecommunications industry. His current interests include architecture and technologies for future networks including 6G, inductive analysis and modeling of network traffic, and application of machine learning and artificial intelligence to network analytics. He is with the Network Strategy Business Unit at KT Corporation. He is a member of Phi Kappa Phi and Eta Kappa Nu.

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