How Does Data Freshness Affect Real-time Supervised Learning?

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Abstract: The evolution of Artificial Intelligence and Internet technologies has engendered many networked intelligent systems, such as autonomous driving, remote surgery, real-time surveillance, video analytics, and factory automation. Real-time supervised learning is a crucial technique in these applications, where a neural network is trained to infer a time-varying target (e.g., the position of the vehicle in front) based on features (e.g., video frames) observed at a sensing node (e.g., camera or lidar). Due to the communication delay among network nodes, the features delivered to the neural network may not be fresh, impacting both the accuracy of real-time inference and the performance of networked intelligent systems. In this talk, we will discuss (i) how data freshness affects the performance of real-time supervised learning and (ii) how to design scheduling strategies to minimize inference error. The former problem is addressed using an information-theoretic analysis, with illustrations from several supervised learning experiments. To solve the second problem, we explored a connection between the Gittins index theory and Age of Information (AoI) minimization that we discovered. These results lay out a potential path toward contextual and goal-oriented status updating.

Biography: Yin Sun is an Assistant Professor in the Department of Electrical and Computer Engineering at Auburn University, Alabama. He received his B.Eng. and Ph.D. degrees in Electronic Engineering from Tsinghua University, in 2006 and 2011, respectively. He was a Postdoctoral Scholar and Research Associate at the Ohio State University from 2011-2017. His research interests include wireless networks, machine learning, robotic control, age of information, and information theory. He has been an Associate Editor of the IEEE Transactions on Network Science and Engineering, an Editor of the Journal of Communications and Networks, a Guest Editor of the IEEE Journal on Selected Areas in Communications for the special issue on “Age of Information in Real-time Systems and Networks,” a Guest Editor of Entropy for the special issue on “Age of Information: Concept, Metric and Tool for Network Control,” and a Guest Editor of Frontiers in Communications and Networks for the special issue on “Age of Information.” He has served in the organizing committees of ACM MobiHoc 2019, 2021-2023, IEEE INFOCOM 2020-2021, IEEE/IFIP WiOpt 2020, IEEE WCNC 2021, and International Teletraffic Congress 2022 (ITC 34). He co-founded the Annual Age of Information Workshop in 2018, served as the General Chair and TPC Chair of the workshop in 2018-2019, and has been a steering committee member of the workshop since 2020. His articles received the Best Student Paper Award of the IEEE/IFIP WiOpt 2013, Best Paper Award of the IEEE/IFIP WiOpt 2019, runner-up for the Best Paper Award of ACM MobiHoc 2020, and 2021 Journal of Communications and Networks (JCN) Best Paper Award. He co-authored a monograph Age of Information: A New
Metric for Information Freshness, published by Morgan & Claypool Publishers in 2019. He received the Auburn Author Award of 2020. His research group has maintained an online Paper Repository on Age of Information since 2016. He is a Senior Member of the IEEE and a Member of the ACM.