Discussing Embedded versus Central Machine Learning in Wireless Sensor Networks

Authors : Anne-Lena Kampen, Øivind Kure

Abstract : Machine learning (ML) can be implemented in Wireless Sensor Networks (WSNs) as a central solution or distributed solution where the ML is embedded in the nodes. Embedding improves privacy and may reduce prediction delay. In addition, the number of transmissions is reduced. However, quality factors such as prediction accuracy, fault detection efficiency and coordinated control of the overall system suffer. Here, we discuss and highlight the trade-offs that should be considered when choosing between embedding and centralized ML, especially for multihop networks. In addition, we present estimations that demonstrate the energy trade-offs between embedded and centralized ML. Although the total network energy consumption is lower with central prediction, it makes the network more prone for partitioning due to the high forwarding load on the one-hop nodes. Moreover, the continuous improvements in the number of operations per joule for embedded devices will move the energy balance toward embedded prediction.