12/5/19

EE 301

EE 301: Final Report

Presenter: Ayfer Ozgur

Presentation Title: Communication-Efficient Distributed Learning

Describe the topic, the Professor who presented it, the high-level ideas and key takeaways / results:

Professor Ayfer Ozgur is an Associate Professor of Electrical Engineering at Stanford University who studies in information theory and distributed learning. She gave a presentation on learning high-dimensional, structured distributions in a distributed network. In her model, nodes in a network observed independent samples from an underlying distribution. Each node in the network can communicate at most k bits of information to the central processor. The impact of constraining k on the minimax risk under l2 loss was studied.

In her presentation, three different models were examined, though she emphasized the simplest model in her work for the sake of simplicity. In this simplified model, the central processor receives k bits of information from nodes independently, meaning the information received from one node cannot influence the choice of information provided by any other node.

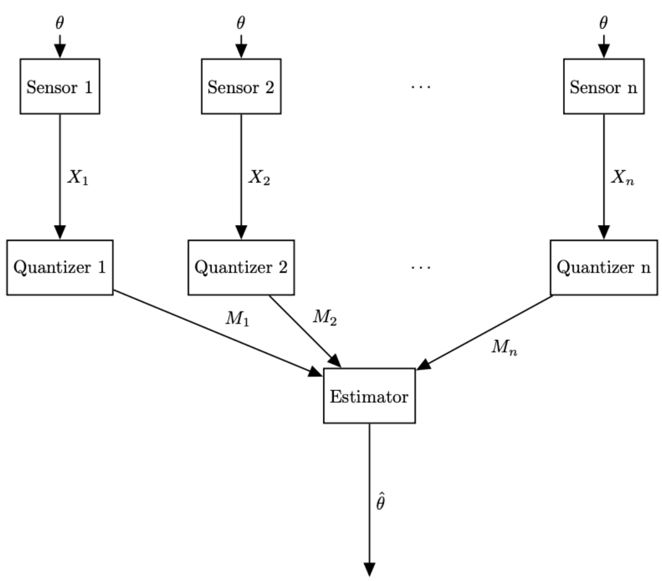

Figure 1 - Simplified Independent Communication Constrained Model

The talk then proceeds to give a communication protocol for each node in the network and analyzed the minimax risk under l2 loss for this protocol. This model was relatively simple and gave an achievability bound for the minimax risk for this scheme. She then proceeded to state, without going into too much detail about her proof techniques, that she proved a matching converse for model. This implies that her simple technique was at least order optimal an only a small constant away from the lower-bound.

Near the end of her talk, she introduced one of the two other communication constrained models. In the first model, messages were transmitted sequentially by each node in the network, allowing each node to use the already transmitted messages to inform their decision on which message to transmit to the central processor. She one again developed a protocol that resulted in an achievability that was slightly improved over that of the simplified model but of the same order of complexity. She also proved a similar converse bound for this model and showed that the converse bound was of the same order as the simplified model. This means that allowing for a more complicated, sequential communication procedure does significantly change the minimax risk under l2 loss.

Conclude by saying what you found exciting and what you think would be next steps you would like to pursue, if you were to work on the topic:

One of the primary assumptions the model considered if Prof. Ozgur's work is a structure on the type of distribution that the nodes are communicating their I.I.D. samples from. If I were to work on this topic, I would loosen the nonparametric, structured constraint of the underlying distribution.

For one, with fewer restrictions on the underlying distribution, the minimax l2 loss may have significantly different bounds than the ones shown in her work. Secondly, one of the main results in her work was to show that even when the result of previous nodes are available to successive nodes, this has little practical effect on achievability and converse bound. Perhaps with less structure in the underlying distribution assumed, the sequential nature of the transmission may allow for the potential for larger benefits to be gleaned from this additional side information.