Robust Asynchronous and Network-Independent Cooperative Learning

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Abstract

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Abstract:
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Abstract:
We consider the model of cooperative learning via distributed non-Bayesian learning, where a network of agents tries to jointly agree on a hypothesis that best described a sequence of locally available observations. Building upon recently proposed weak communication network models, we propose a robust cooperative learning rule that allows asynchronous communications, message delays, unpredictable message losses, and directed communication among nodes. We show that our proposed learning dynamics guarantee that all agents in the network will have an asymptotic exponential decay of their beliefs on the wrong hypothesis, indicating that the beliefs of all agents will concentrate on the optimal hypotheses. Numerical experiments provide evidence on a number of network setups.

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I. Introduction
Distributed inference has gained increasing attention in recent years due to the numerous applications in machine learning, sensor networks, decentralized control, and distributed signal processing. Among distributed inference models, non-Bayesian social learning has emerged as an essential approach to deal with decentralized heterogeneous learning over networks [1], [2]. Non-Bayesian learning exhibits strong theoretical performance and allows large classes of sensing modalities and communication constraints. The non-Bayesian learning model assumes that the network of agents tries to agree on a set of beliefs about the state of the world that best describes a sequence of local observations from a finite set of possible states [1]–[4]. Agents cooperate by exchanging and updating beliefs with their neighbors (in the network). Updating happens by aggregating information via some fusion rule. Moreover, the interaction between the agents over the network is usually modeled as a graph that defines and mediates such communication.

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