Associate Professorship of Coding and Cryptography
TUM Department of Electrical and Computer Engineering
Technical University of Munich

Seminar

Random Walks for Decentralized Learning

Fully decentralized schemes do not require a central entity and have been studied in [1, 2]. These works aim to reach consensus on a desirable machine learning model among all clients. We can mainly distinguish between i) gossip algorithms [3] where clients share their result with all neighbors, naturally leading to high communication complexities, and ii) random walk approaches like [4, 5] where the model is communicated only to a specific neighbor until matching certain convergence criteria. Such random walk approaches are used in federated learning to reduce the communication load in the network and at the clients' side.

The main task of the student is to study the work in [5], which additionally accounts for the heterogeneity of the clients' data. Further, drawbacks and limitations of the proposed approach should be determined.

[1] J. B. Predd, S. B. Kulkarni, and H. V. Poor, "Distributed learning in wireless sensor networks," IEEE Signal Process. Mag., vol. 23, no. 4, pp. 56–69, 2006.

[2] S. Boyd, N. Parikh, E. Chu, B. Peleato, J. Eckstein et al., "Distributed optimization and statistical learning via the alternating direction method of multipliers," Found. Trends Mach. Learn., vol. 3, no. 1, pp. 1–122, 2011.

[3] S. S. Ram, A. Nedi ?c, and V. V. Veeravalli, "Asynchronous gossip algorithms for stochastic optimization," in IEEE Conf. Decis. Control. IEEE, 2009, pp. 3581–3586.

[4] D. Needell, R. Ward, and N. Srebro, "Stochastic gradient descent, weighted sampling, and the randomized kaczmarz algorithm," Adv. Neural Inf. Process. Syst., vol. 27, 2014.

[5] G. Ayache, V. Dassari, and S. E. Rouayheb, "Walk for learning: A random walk approach for federated learning from heterogeneous data," arXiv preprint arXiv:2206.00737, 2022.

Prerequisites

- Machine Learning and Statistics
- Information Theory

Advisors

Maximilian Egger