

YUXING LIU

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Education

University of Illinois Urbana-Champaign

Ph.D. student in Computer Science, advised by Prof. Tong Zhang

Aug. 2024 – present

Illinois, U.S.

Fudan University

B.S. in Data Science

Sep. 2020 – Jun. 2024

Shanghai, China

Research Interests

My research interests mainly lie in the intersection of machine learning and optimization. Currently, I am particularly interested in exploring the effectiveness of practical algorithms and corresponding theoretical explanations and further designing even more efficient algorithms for modern machine learning.

Publications and Preprints

- [1] Adagrad under Anisotropic Smoothness.
Yuxing Liu*, Rui Pan*, and Tong Zhang. [Preprint]
- [2] Decentralized Convex Finite-Sum Optimization with Better Dependence on Condition Numbers.
Yuxing Liu, Lesi Chen, and Luo Luo. [ICML 2024]
- [3] On the Complexity of Finite-Sum Smooth Optimization under the Polyak-Lojasiewicz Condition.
Yunyan Bai, **Yuxing Liu**, and Luo Luo. [ICML 2024]
- [4] Accelerated Convergence of Stochastic Heavy Ball Method under Anisotropic Gradient Noise.
Rui Pan*, **Yuxing Liu***, Xiaoyu Wang, and Tong Zhang. [ICLR 2024]

Research

Adagrad under Anisotropic Smoothness

Nov. 2023 – Sep. 2024

Advisor: Prof. Tong Zhang, University of Illinois Urbana-Champaign

Illinois, U.S.

- We attempted to theoretically explain the benefits of adaptive gradient methods over classical gradient methods with uniform step sizes across all coordinates.
- We analyzed AdaGrad under the anisotropic smoothness and noise assumptions. We further extended the results to more practical settings by introducing a generalized form of anisotropic smoothness.
- We discussed how the convergence results indicate the potential benefits of AdaGrad compared to classical gradient methods in terms of better dimensional dependence, which was also verified by multiple experiments.

Momentum Accelerates SGD in Large Batch Settings

Jun. 2023 – Sep. 2023

Advisor: Prof. Tong Zhang, Hong Kong University of Science and Technology

Hong Kong, China

- We aimed to theoretically explain the benefits of SGD with Heavy Ball Momentum (SHB) over vanilla SGD.
- We developed and applied novel analysis techniques on bounding non-commutative matrix products in order to prove convergence results when a decaying step size scheduler is employed.
- We proved that SHB achieves an overall (near)-minimax convergence rate and converges within fewer iterations than SGD on quadratic objectives under the large batch setting.

Complexity of Decentralized Optimization

Mar. 2023 – Jan. 2024

Advisor: Prof. Luo Luo, Fudan University

Shanghai, China

- We proposed a novel algorithm with better time complexity in the decentralized finite-sum optimization setting by improving the dependence on local condition number to global condition number.
- The key design of the algorithm is the novel sampling method when applying variance reduction techniques, which also led to a much smaller total first-order oracle complexity of all agents compared to existing methods.
- We proved that the time complexity results are near-optimal with respect to the condition numbers.

Experience

Hong Kong University of Science and Technology

Undergraduate Visiting Internship Student, Advised by Prof. Tong Zhang

Aug. 2023 – Sep. 2023

Hong Kong, China

Guangdong Yuecai Holdings

Assistant in Apartment of Equity Investment

Aug. 2022 – Sep. 2022

Guangdong, China

Technical Skills

Programming: Python, Pytorch, MATLAB, R, C/C++