

# 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

- [1] Adagrad under Anisotropic Smoothness.  
**Yuxing Liu\***, Rui Pan\*, and Tong Zhang. [ICLR 2025]
- [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–Łojasiewicz 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**

*Joint work with Rui Pan and Tong Zhang*

*In ICLR 2025*

- 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**

*Joint work with Rui Pan and Tong Zhang*

*In ICLR 2024*

- 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**

*Joint work with Lesi Chen and Luo Luo*

*In ICML 2024*

- 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++