Yuhang Cai

EDUCATION

University of California, Berkeley Ph.D. Candidate in Math Advisors: Profs. Michael Lindsey and Peter L. Bartlett

University of Chicago M.S. in Statistics Advisors: Profs. Lek-Heng Lim, Mladen Kolar, and Jingshu Wang

Peking University B.S. in Math

EXPERIENCE

MIT, Summer research internship Work with Prof. Philippe Rigollet

Research Interest

My research focuses on creating efficient algorithms to address real-world challenges and providing a deep understanding of the theoretical principles behind them. By connecting theoretical foundations with practical applications, my work aims to advance both academic knowledge and technological innovation.

I specialize in optimizations for high-dimensional problems, particularly in **Multimodal Learning** and **Large Language Model**.

PUBLICATIONS

- Y. Cai, J. Wu, S. Mei, M. Lindsey, and P. L. Bartlett, "Large stepsize gradient descent for non-homogeneous two-layer networks: Margin improvement and fast optimization", Advances in Neural Information Processing Systems, 2025.
- [2] K. Oko, L. Lin, Y. Cai, and S. Mei, "A statistical theory of contrastive pre-training and multimodal generative ai", arXiv preprint arXiv:2501.04641, 2025.
- [3] Y. Cai and L.-H. Lim, "Distances between probability distributions of different dimensions", *IEEE Transactions on Information Theory*, vol. 68, no. 6, pp. 4020–4031, 2022.
- [4] T. Wu, Y. Cai, R. Zhang, Z. Wang, L. Tao, and Z.-C. Xiao, "Multi-band oscillations emerge from a simple spiking network", arXiv preprint arXiv:2206.14942, 2022.
- [5] R. Zhang, Z. Wang, T. Wu, Y. Cai, L. Tao, Z.-C. Xiao, and Y. Li, "Learning biological neuronal networks with artificial neural networks: Neural oscillations", *arXiv preprint arXiv:2211.11169*, 2022.
- [6] Y. Cai, T. Wu, L. Tao, and Z.-C. Xiao, "Model reduction captures stochastic gamma oscillations on low-dimensional manifolds", Frontiers in Computational Neuroscience, p. 74, 2021.

Berkeley, California 2021–present

> Chicago, Illinois 2019–2021

> > Bejing, China 2015–2019

Cambridge, Massachusetts Summer 2018

Referee Services

- Reviewer for ICLR, TMLR
- Reviewer for Journal of Machine Learning Research
- Reviewer for Linear and Multilinear Algebra
- Reviewer for Linear Algebra and Its Applications

TEACHING

• Graduate Student Instructor at University of California, Berkeley MATH 16A: Analytic Geometry and Calculus, 2021 Fall Math 54: Linear Algebra and Differential Equations, 2022 Spring Math 1B: Calculus, 2022 Fall STAT 134: Concepts of Probability, 2023 Fall Math 128B: Numerical Analysis II, 2024 Spring

• Teaching Assistant at University of Chicago BUS 41204: Machine Learning, 2021 Spring

Computer Skills

- Language: Python, C/C++, Matlab, R, LATEX, Markdown, Typst
- Tools: Linux, Git, PyTorch, Keras, Virtual Machines, Anaconda
- Optimization Tools: CVX, Mosek, Gurobi, Cplex, SDPT3

LANGUAGES

- English: fluent
- Chinese: native

2021-present

2020-2021