# Ruizhe Zhang

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CONTACT
INFORMATION

Simons Institute for the Theory of Computing
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RESEARCH
INTERESTS

Theoretical computer science, quantum computing, and machine learning.

EMPLOYMENT

**University of California, Berkeley**                           Fall 2023 - present
*Simons Quantum Postdoctoral Fellow*
Host: Umesh Vazirani

EDUCATION

**The University of Texas at Austin**                                  August 2023
Ph.D. in Computer Science
Thesis: *Quantum Meets Optimization and Machine Learning*
Advisor: Dana Moshkovitz

**Fudan University**                                                       May 2018
B.S. in Computer Science, *Honors Class*

ACADEMIC
EXPERIENCE

**Institute for Pure & Applied Mathematics at UCLA**                   Fall 2023
Position: Departmental Scholar
Core Participant of *Mathematical and Computational Challenges in Quantum Computing*

**The University of Texas at Austin**                          Fall 2018 - Fall 2021
Position: Research Assistant
Supervisors: Dana Moshkovitz, Scott Aaronson

**Zapata Computing, Inc.**                          Summer 2021, Summer 2022
Position: Quantum Research Intern
Supervisors: Peter Johnson, Guoming Wang

HONORS AND
AWARDS

University Graduate Continuing Fellowship, UT Austin Graduate School
Fudan University First Prize Scholarship, Wonders Information
The ACM-ICPC Asia Regional Contest Gold Medal, Shanghai Site
The ACM-ICPC Asia Regional Contest Gold Medal, Hefei Site

PUBLICATIONS

[1] Lianke Qin, Zhao Song, **Ruizhe Zhang**. A General Algorithm for Solving Rank-one Matrix Sensing. To appear in *the 27th International Conference on Artificial Intelligence and Statistics* (AISTATS), 2024.

[2] Zhao Song, Junze Yin, Lichen Zhang, **Ruizhe Zhang**. Fast Dynamic Sampling for Determinantal Point Processes. To appear in *the 27th International Conference on Artificial Intelligence and Statistics* (AISTATS), 2024.

[3] Zhao Song, Lichen Zhang, **Ruizhe Zhang**. Training Multi-Layer Over-Parametrized Neural Network in Subquadratic Time. In *Proceedings of the 15th Innovations in Theoretical Computer Science Conference* (ITCS), 2024.

[4] Josh Alman, Jiehao Liang, Zhao Song, **Ruizhe Zhang**, Danyang Zhuo. Bypass exponential time preprocessing: Fast neural network training via weight-data correlation preprocessing. In *Advances in Neural Information Processing Systems 36* (NeurIPS), 2023.

[5] Zhao Song, Baocheng Sun, Omri Weinstein, **Ruizhe Zhang**. Quartic Samples Suffice for Fourier Interpolation. In *Proceedings of the 64rd Annual Symposium on Foundations of Computer Science (FOCS)*, 2023.

[6] **Ruizhe Zhang**, Xinzhi Zhang. Hyperbolic Extension of Kadison-Singer Type Results. In *Proceedings of the 50th EATCS International Colloquium on Automata, Languages, and Programming* (ICALP), 2023.

[7] Guoming Wang, Daniel Stilck França, **Ruizhe Zhang**, Shuchen Zhu, Peter D. Johnson. Quantum algorithm for ground state energy estimation using circuit depth with exponentially improved dependence on precision. In *Quantum, Volume 7, Number 1167*, 2023. In *Quantum Computing Theory in Practice* (QCTiP), 2023. (Contributed talk)

[8] Andrew Childs, Tongyang Li, Jin-Peng Liu, Chunhao Wang, **Ruizhe Zhang**. Quantum Algorithms for Sampling Log-Concave Distributions and Estimating Normalizing Constants. In *Proceedings of the 36th Conference on Neural Information Processing Systems* (NeurIPS), 2022. In *26th Annual Conference on Quantum Information Processing* (QIP), 2023. (Contributed talk)

[9] Tongyang Li, **Ruizhe Zhang**. Quantum Speedups of Optimizing Approximately Convex Functions with Applications to Logarithmic Regret Stochastic Convex Bandits. In *Proceedings of the 36th Conference on Neural Information Processing Systems* (NeurIPS), 2022.

[10] Yichuan Deng, Zhao Song, Omri Weinstein, **Ruizhe Zhang**. Fast Distance Oracles for Any Symmetric Norm. In *Proceedings of the 36th Conference on Neural Information Processing Systems* (NeurIPS), 2022.

[11] Baihe Huang, Shunhua Jiang, Zhao Song, Runzhou Tao, **Ruizhe Zhang**. Solving SDP Faster: A Robust IPM Framework and Efficient Implementation. In *Proceedings of the 63rd Annual Symposium on Foundations of Computer Science* (FOCS), 2022.

[12] **Ruizhe Zhang**, Guoming Wang, Peter Johnson. Computing Ground State Properties with Early Fault-Tolerant Quantum Computers. In *Quantum, Volume 6, Number 761*, 2022.

[13] Jason Gaitonde, Max Hopkins, Tali Kaufman, Shachar Lovett, **Ruizhe Zhang**. Eigen-stripping, Spectral Decay, and Edge-Expansion on Posets. In *Proceedings of the 26th International Conference on Randomization and Computation* (RANDOM), 2022.

[14] Zhao Song, **Ruizhe Zhang**. Hyperbolic Concentration, Anti-concentration, and Discrepancy. In *Proceedings of the 26th International Conference on Randomization and Computation* (RANDOM), 2022.

[15] Sitan Chen, Zhao Song, Runzhou Tao, **Ruizhe Zhang**. Symmetric Sparse Boolean Matrix Factorization and Applications. In *Proceedings of the 13th Innovations in Theoretical Computer Science Conference* (ITCS), 2022.

[16] Nai-Hui Chia, Chi-Ning Chou, Jiayu Zhang, **Ruizhe Zhang**. Quantum Meets Minimum Circuit Size Problem. In *Proceedings of the 13th Innovations in Theoretical Computer Science Conference* (ITCS), 2022.

[17] Zhao Song, Shuo Yang, **Ruizhe Zhang**. Does Preprocessing Help Training Over-Parameterized Neural Networks? In *Proceedings of the 35th Conference on Neural Information Processing Systems* (NeurIPS), 2021.

[18] Yuxuan Zhang, **Ruizhe Zhang**, Andrew C. Potter. QED driven QAOA for network-flow optimization. In *Quantum, Volume 5, Number 510*, 2021.

[19] Scott Aaronson, Jiahui Liu, Qipeng Liu, Mark Zhandry, **Ruizhe Zhang**. New Approaches for Quantum Copy-Protection. In *Proceedings of the 41st Annual International Cryptology Conference* (CRYPTO), 2021.

[20] Scott Aaronson, Nai-Hui Chia, Han-Hsuan Lin, Chunhao Wang, **Ruizhe Zhang**. On the Quantum Complexity of Closest Pair and Related Problems. In *Proceedings of the 35th Computational Complexity Conference* (CCC), 2020.

PREPRINTS

[1] Zhiyan Ding, Haoya Li, Lin Lin, HongKang Ni, Lexing Ying, **Ruizhe Zhang**. Quantum Multiple Eigenvalue Gaussian filtered Search: an efficient and versatile quantum phase estimation method. *arXiv preprint arXiv:2402.01013*, 2024.

[2] Yeqi Gao, Zhao Song, **Ruizhe Zhang**. Quantum Speedup for Spectral Approximation of Kronecker Products. *arXiv preprint arXiv:2402.07027*, 2024.

[3] Zhao Song, Junze Yin, **Ruizhe Zhang**. Revisiting Quantum Algorithms for Linear Regressions: Quadratic Speedups without Data-Dependent Parameters. *arXiv preprint arXiv:2311.14823*, 2023.

[4] Yeqi Gao, Zhao Song, Xin Yang, **Ruizhe Zhang**. Fast quantum algorithm for attention computation. *arXiv preprint arXiv:2307.08045*, 2023.

[5] Yichuan Deng, Zhao Song, Lichen Zhang, **Ruizhe Zhang**. Efficient Algorithm for Solving Hyperbolic Programs. *arXiv preprint arXiv:2306.07587*, 2023.

[6] Hongru Yang, Ziyu Jiang, **Ruizhe Zhang**, Zhangyang Wang, Yingbin Liang. Convergence and Generalization of Wide Neural Networks with Large Bias. *arXiv preprint arXiv:2301.00327*, 2023.

[7] Baihe Huang, Shunhua Jiang, Zhao Song, Runzhou Tao, **Ruizhe Zhang**. A Faster Quantum Algorithm for Semidefinite Programming via Robust IPM Framework. *arXiv preprint arXiv:2207.11154*, 2022.

[8] Yeqi Gao, Zhao Song, Baocheng Sun, Omri Weinstein, **Ruizhe Zhang**. Improved Reconstruction for Fourier-Sparse Signals. *arXiv preprint arXiv:2205.00658*, 2022.

[9] Baihe Huang, Zhao Song, Omri Weinstein, Hengjie Zhang, **Ruizhe Zhang**. A Dynamic Fast Gaussian Transform. *arXiv preprint arXiv:2202.12329*, 2022.

[10] Baihe Huang, Zhao Song, Runzhou Tao, **Ruizhe Zhang**, Danyang Zhuo. InstaHide's Sample Complexity When Mixing Two Private Images. *arXiv preprint arXiv:2011.11877*, 2020.

TALKS

**Quantum Speedups of Continuous Sampling and Optimization Problems**
- Invited talk at IPAM CQC 2023 Workshop I        Oct, 2023
- Invited talk at George Mason University Theory Seminar      Apr, 2023
- Invited talk at MIT Quantum Information Processing Seminar    Jan, 2023

**Quantum Algorithm for Ground State Energy Estimation Using Circuit Depth With Exponentially Improved Dependence on Precision**
- Contributed talk at APS March Meeting 2023        Mar, 2023

**Solving SDP Faster: A Robust IPM Framework and Efficient Implementation**
- Invited talk at UT Austin Theory Seminar        Apr, 2023

- The 63rd Annual Symposium on Foundations of Computer Science (FOCS 2022)  Nov, 2022

**Ground State Energy and Property Estimation with Low Quantum Circuit Depth**
- Invited talk at QUARK Lab at Peking University                                    Oct, 2022

**Hyperbolic Concentration, Anti-concentration, and Discrepancy**
- The 26th International Conference on Randomization and Computation (RANDOM 2022)                                                                          Sept, 2022

**On the Quantum Fine-Grained Complexity of Closest Pair and Related Problems**
- Invited talk at University of Washington Theory Seminar          May, 2022

**Computing Ground State Properties with Early Fault-Tolerant Quantum Computers**
- Contributed talk at APS March Meeting 2022                          Mar, 2022

**Symmetric Sparse Boolean Matrix Factorization and Applications**
- The 13th Innovations in Theoretical Computer Science Conference (ITCS 2022)    Feb, 2022

**Quantum Speedup for Annealing and Sampling**
- Invited talk at Simons Institute reading group                          Dec, 2021

**Quantum Meets the Minimum Circuit Size Problem**
- Second Kyoto Workshop on Quantum Information, Computation, and Foundation (QICF 2021)                                                                          Sept, 2021

**On the Quantum Complexity of Closest Pair and Related Problems**
- Computational Complexity Conference (CCC 2020)                     Sept, 2020

- The 15th Conference on the Theory of Quantum Computation, Communication and Cryptography (TQC 2020)                                              Aug, 2020

TEACHING    At UT Austin
- TA for CS395T, Coding Theory (graduate class)                     Spring 2022
- TA for CS388R, Randomized Algorithms (graduate class)                  Fall 2021
- TA for CS388T, Theory of Computation (graduate class)             Spring 2020

At Fudan University
- TA for Data Structure (undergraduate class)                          Fall 2016

SERVICES    Conference referee:
- ESA 2020, Eurocrypt 2021, QIP 2021, AQIS 2021, QIP 2022, STOC 2022, ICML 2022, SODA 2023, QIP 2023, AAAI 2023, STACS 2023, STOC 2023, TQC 2023, CRYPTO 2023, FOCS 2023, NeurIPS 2023, QIP 2023, AAAI 2024, ICLR 2024, AISTATS 2024

Journal referee:
- SIAM Journal on Computing, SIAM Journal on Optimization, Quantum, PRX Quantum, Physical Review Letter, Physical Review A, Physical Review Research, Transactions on Information Theory, Advances in Engineering Software, npj Quantum Information, ACM Journal on Autonomous Transportation Systems

CODING SKILLS    C/C++, Python, Matlab, Latex