

# ZHENGXIN ZHANG

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## Education

Cornell University, US, Ph.D in Applied Mathematics

Aug 2019 -

- **Thesis committee:** Ziv Goldfeld (advisor), Laurent Pascal Saloff-Coste, Kengo Kato
- **Thesis:** New Paradigm in Optimal Transport: Statistics and Calculus of Gromov-Wasserstein Distance

Shanghai Jiao Tong University, China, B.S. in Mathematics and Applied Mathematics

Sep 2015 - Jun 2019

## Publications

- Zhang, Zhengxin, Ziv Goldfeld, Kristjan Greenewald, Youssef Mroueh, and Bharath K. Sriperumbudur. "Gradient Flows and Riemannian Structure in the Gromov-Wasserstein Geometry." arXiv preprint arXiv:2407.11800 (2024). Accepted at **Foundations of Computational Mathematics**.
- Zhang, Zhengxin, Ziv Goldfeld, Youssef Mroueh, and Bharath K. Sriperumbudur. "Gromov-Wasserstein distances: Entropic regularization, duality and sample complexity." **The Annals of Statistics** 52, no. 4 (2024): 1616-1645.
- Zhang, Zhengxin, Youssef Mroueh, Ziv Goldfeld, and Bharath Sriperumbudur. "Cycle consistent probability divergences across different spaces." In **International Conference on Artificial Intelligence and Statistics**, pp. 7257-7285. PMLR, 2022.
- Sreekumar, Sreejith, Zhengxin Zhang, and Ziv Goldfeld. "Non-asymptotic performance guarantees for neural estimation of f-divergences." In **International Conference on Artificial Intelligence and Statistics**, pp. 3322-3330. PMLR, 2021.

## Professional Experiences

Research intern, MIT-IBM Watson AI Lab – Cambridge, MA

May 2023 - Aug 2023

- **Mentor:** Kristjan Greenewald
- **Project:** Gradient flow in space of probability measures

**Reviewer:** IEEE Transactions on Information Theory; Philosophical Transactions of the Royal Society A; AISTATS 2022 2024 2025; ICLR 2024 2025; NeurIPS 2023; AAAI 2025

## Research Interests

**Key words:** Optimal transport, Gromov-Wasserstein distance, Test-time scaling of large models, Statistical learning theory, High dimensional statistics, Kernel methods, LLM for Math

I have a broad interest in mathematical foundations of machine learning, with a particular focus on the theory of optimal transport (OT), across various facets including variational analysis/duality, statistics, computations, gradient flow, among others. The core philosophy here is that operating on data can be viewed as operations on probability distributions, where deep mathematical insights could be incorporated organically, such as geometry/symmetry, statistical efficiency, and dynamics. Recently, my work has been dedicated to the Gromov-Wasserstein distance (GW), which consists a fascinating interplay of classical OT and metric geometry. This pursuit aims to uncover inherent structural similarities within heterogeneous data, presenting a new methodology for multi-modal data analysis. A recent progress uncovered the dynamics of GW, enabling novel evolution and interpolation methods of probability distributions while maintaining symmetry of data.

My interests further extends into demystifying the recent advances of large language models (LLM). My recent work on test-time scaling of the LLMs aims to uncover the dynamics of inference and reasoning, in particular whether these methods extends the boundary of AI capabilities. Through a statistical and information theoretic perspective, I aim to provide theoretical interpretation of the most powerful AI models by exploring the geometric landscape of machine intelligence.

Built on the mathematical foundations of OT and geometrized data analysis, I aim to contribute both to a deeper

understanding of the new paradigms of OT theory, and to the principles shaping neural network theory in this era of large models, including scalability, interpretability and principled multi-modality.

## Awards and Hornors

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- Cornell Graduate School Fellowship, 2019
- National Scholarship (PRC), 2016
- Zhiyuan Honor Scholarship, SJTU , 2016,2017
- Hanyingjuhua Scholarship, SJTU, 2017
- Kaiyuan Encouragement Scholarship, SJTU, 2017
- Winner Prize, S.T. Yau College Student Mathematics Contests, Computational and Applied Mathematics, 2018
- Winner Prize, S.T. Yau College Student Mathematics Contests, Geometry and Topology, 2018
- Team Winner Prize, S.T. Yau College Student Mathematics Contests, 2018

## Technologies

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**Languages:** Python, Julia, Matlab, C++ ,