

# TANSHENG ZHU

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## EDUCATION

### Shanghai Jiao Tong University

*B.S. in Mathematics (Zhiyuan Honors Program), Minor in Finance*  
Advisor: Prof. Zhenli Xu

Aug. 2021 – June 2025 (expected)  
Shanghai, China

### The Chinese University of Hong Kong

*Exchange Student, Department of Mathematics*

Jan. 2024 – May 2024  
Hong Kong, China

## COURSEWORK

**Research Interests:** Machine Learning Theory, Optimization, High-dimensional Probability.

**GPA:** 90.34/100; 3.92/4.3.

**Selected Courses:** Foundations of Data Science (97/100), Probability (96/100),  
Optimization Methods (97/100), Mathematical Programming (94/100),  
Numerical Analysis (91/100), Numerical Methods for ODEs and PDEs (96/100).

## RESEARCH EXPERIENCE

### Scaling Limits of Infinitely Deep Neural Networks

Advisor: Prof. Fenglei Fan, The Chinese University of Hong Kong

Jan. 2024 – Present

- Established the theoretical framework of neural networks with infinite depth and finite width by weakly dependent random processes.
- Analyzed the Gaussian process behavior and neural tangent kernels of infinitely deep networks, and leveraged the ergodic theory to interpret the width-depth equivalence of neural networks.

### Density-based Exploration Strategy for Scalable Bayesian Optimization

Advisor: Prof. Zhenli Xu, Shanghai Jiao Tong University

Feb. 2024 – June 2025

- Proposed the Bayesian optimization by kernel regression and density-based exploration (BOKE) algorithm, which generalized the count-based exploration to Bayesian optimization, and proved its global convergence
- Conducted experiments to verify its competitive performance in space-filling design and optimization.

### Monte-Carlo Tree Search in Continuous Action Spaces via Kernel Regression

Advisor: Prof. Zhenli Xu, Shanghai Jiao Tong University

Nov. 2022 – Feb. 2024

- Proposed the BOKR-MCTS algorithm to leverage Monte-Carlo tree search into continuous state-action spaces.
- Conducted experiments to show its computational efficiency and competitive performance in online planning tasks.

## HONORS AND AWARDS

### MATHEMATICS COMPETITIONS

<b>Winning Prize</b> in S.-T. Yau College Student Mathematics Contest on Appl. & Comp. Mathematics	May 2024
<b>Finalist Winner</b> in Mathematical Contest in Modeling (Top 3% in 18000+ teams)	May 2024
<b>1<sup>st</sup> Prize</b> in Shanghai Region of Chinese Mathematics Competitions	Nov. 2023
<b>1<sup>st</sup> Prize</b> in Huashu Cup National Mathematical Contest in Modeling	Aug. 2023
<b>1<sup>st</sup> Prize</b> in Chinese High School Mathematics League	Oct. 2020

### HONORS

<b>Huawei Scholarship</b> (Top 5%, Shanghai Jiao Tong University)	2023
<b>Zhiyuan Outstanding Leader Scholarship</b> (25 winners each year, Shanghai Jiao Tong University)	2022
<b>A-class Academic Excellence Scholarship</b> (Top 1%, Shanghai Jiao Tong University)	2022
<b>Merit Student</b> (Top 1/21, Shanghai Jiao Tong University)	2022
<b>Zhiyuan Honors Scholarship</b> (Top 10%, Shanghai Jiao Tong University)	2021, 2022, 2023

## PUBLICATIONS

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- [1] **Tansheng Zhu**, Hongyu Zhou, Ke Jin, Xusheng Xu, Qiufan Yuan, and Lijie Ji. *Bayesian Optimization by Kernel Regression and Density-based Exploration*. 2025. arXiv: 2502.06178 [math.OC]. Submitted.
- [2] Ke Jin, **Tansheng Zhu**, Hongyu Zhou, Xusheng Xu, Qiufan Yuan, and Lijie Ji. *Bayesian-Optimized Progressive Widening via Kernel Regression for Monte Carlo Tree Search in Continuous Action Spaces*. Submitted.

## COURSE PROJECTS

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- Dendritic Computing with Bilinear Rules and Artificial Neural Networks** Fall 2023  
*Topic Course III, 95/100*, lectured by Prof. Douglas Zhou
- Constructed bilinear rules of dendrite integration from theory to practice. Implemented artificial neural network models hLN and DBNN to fit real neuron data, and discussed the limitation of ANN's parametric space.
- Solving Differential Equations with Deep Learning** Fall 2023  
*Foundations of Data Science, 97/100*, lectured by Prof. Zhi-Qin John Xu
- Implemented the framework of physics-informed neural network (PINN) for both direct and inverse problems. Analyzed the components of prediction error and improved them by incorporating more physics information.
- Modeling and Optimization of Biological Transport Networks** Spring 2023  
*Topic Course II, 99/100*, lectured by Prof. Dan Hu
- Analyzed the dynamics of the biological transport network. Implemented different optimization algorithms, and explained the entangled-network phenomenon of results based on the spectrum of the graph Laplacian matrix.
- Computational Mean-field Optimal Control** Spring 2023  
*Numerical Methods for ODEs and PDEs, 96/100*, lectured by Prof. Lei Li
- Studied a class of reaction-diffusion equation mean-field information dynamics. Implemented the primal-dual hybrid gradient algorithm to solve the concerned saddle point problem.

## SKILLS

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**Programming Languages:** Python, Matlab, C/C++, R  
**Toolkits:** NumPy, SciPy, Sklearn, Pandas, Statsmodels, Matplotlib, PyTorch, Numba, CVXPY, COPT  
**Leadership:** Class monitor from 2021 to 2023; Executive of Mathematical Modelling Association of SJTU

## REFERENCES

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**Zhenli Xu**, xuzl@sjtu.edu.cn  
Professor of Shanghai Jiao Tong University, Shanghai, China.  
**Fenglei Fan**, hitfanfenglei@gmail.com,  
Assistant Professor of the City University of Hong Kong, Hong Kong, China.