

Zixun Huang

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RESEARCH INTEREST

Theoretical Foundations of Machine Learning, Scaling Laws, Reinforcement Learning Theory

EDUCATION

- **Peking University, School of Mathematical Sciences** Sept. 2022 – Present
 - *B.S. in Statistics*, GPA: 3.68/4.0
 - Member of Elite Undergraduate Program for Applied Mathematics (**Top 10%**)
 - **Core Coursework:** Mathematical Analysis (94), Advanced Algebra (97.5), Mathematical Modeling (91), Numerical Methods (88), Topics in Deep Learning Theory (87), Learning Data Science with Python (90), Mathematical Statistics (97)
- **University of California, Berkeley** Jan. 2025 – Aug. 2025
 - *Visiting Student*, GPA: 4.0/4.0
 - **Core Coursework:** Theoretical Statistics (A+), Advanced Topics in Probability and Stochastic Processes (A), Modern Statistical Prediction and Machine Learning (A+), Structure and Interpretation of Computer Programs (A+)

PUBLICATIONS

- Binghui Li*, Fengling Chen*, **Zixun Huang***, Lean Wang*, Lei Wu. *Functional Scaling Laws in Kernel Regression: Loss Dynamics and Learning Rate Schedules*. **NeurIPS 2025 (Spotlight)**. [\[Paper\]](#)
- **Zixun Huang***, Jiayi Sheng*, Zeyu Zheng. *OBLR-PO: A Theoretical Framework for Stable Reinforcement Learning*. Submitted to **AISTATS 2026 (Reviewer scores: 6, 5, 5 (max 7))**. [\[Paper\]](#)

RESEARCH EXPERIENCE

- **Functional Scaling Laws for Learning Rate Schedules (Core)** May. 2024 – Nov. 2025
 - *Advisor:* [Prof. Lei Wu](#)
 - Proposed a novel Functional Scaling Law (FSL) by modeling SGD as an intrinsic-time SDE
 - Analyzed learning-rate schedules under data and compute constraints, revealing efficiency trade-offs
 - Validated FSL through kernel regression and LLM pre-training, producing optimal schedules
- **OBLR-PO: Theory for Stable Reinforcement Learning (Core)** Feb. 2025 – Oct. 2025
 - *Advisor:* [Prof. Zeyu Zheng](#)
 - Established theoretical guarantees for policy optimization, including loss bounds and convergence
 - Introduced adaptive learning rate and gradient-weighted baselines for principled variance reduction
 - Implemented OBLR-PO and demonstrated superior performance compared with existing algorithms
- **Combining Simulation with Linear Algebra: COSIMLA** May. 2025 – Jul. 2025
 - *Advisor:* [Prof. Zeyu Zheng](#)
 - Implemented and evaluated five COSIMLA estimators across diverse parameter regimes
 - Analyzed variance–bias–efficiency trade-offs, confirming improved stability and speed

- Saturation Phenomenon Under Kernel Method**
Feb. 2024 – May. 2024
 - Advisor: *Prof. Lei Wu*
 - Derived loss functions for kernel ridge regression and gradient descent; analyzed the saturation phenomenon through bias–variance tradeoff and Fourier perspective
 - Identified a noiseless setup saturation effect previously overlooked in prior work
- Cross Modal Alignment**
May. 2024 – Jun. 2024
 - Advisor: *Prof. Junfeng Hu*
 - Developed an alignment strategy for movie posters and text introductions using vector embeddings
 - Established baseline accuracy and reported insights on model and network pre-training effects
- Analysis for Grokking Phenomenon**
Nov. 2023 – Jan. 2024
 - Advisor: *Prof. Lei Wu*
 - Replicated grokking phenomenon experiments (MLP, LSTM) on modular addition task
 - Conducted theoretical and empirical analysis from training-dynamics and landscape perspectives

SELECTED HONORS AND AWARDS

- Hong Sheng Scholarship (**Top 12%**) Sept. 2024
- Yau Contest Groups Prize (**Top 5%**) May. 2024
- First Prize, Chinese Mathematics Contest (**Top 1%**) Apr. 2024
- Xiaomi Scholarship (**Top 12%**) Sept. 2023
- Gold Prize, Chinese Mathematical Olympiad Dec. 2021
- Silver Prize, Chinese Mathematical Olympiad Nov. 2020

EXTRACURRICULAR ACTIVITIES

- Applied Mathematics Seminar, Peking University**
Jun. 2024 – Jul. 2024
 - Teaching Assistant for *Prof. Zhi-Qin John Xu*
 - Assisted in developing and organizing lecture materials
- Peking University Runners Association**
Oct. 2022 – Dec. 2023
 - Core Team Member
 - Organized and coordinated running events; participated in volunteer activities
 - Completed the Nanjing Half Marathon

SKILLS AND OTHERS

- Languages** Chinese (Native), English (Fluent)
- TOEFL iBT** Total 101: 28(R), 23(L), 23(S), 27(W)
- Quantitative Skills** GRE General: V160, Q170; GRE Math: 970 (95th percentile)
- Programming** Python, MATLAB, LaTeX, PyTorch, C++, Go, R, SQL