# Zixun Huang

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## Profile

I am an undergraduate student in Statistics at Peking University and participated in an academic exchange at the University of California, Berkeley. Throughout my academic journey, I have been fortunate to work closely with Professors Lei Wu, Zeyu Zheng and Junfeng Hu. My research focuses on the theoretical foundations of machine learning, including scaling laws, and 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), Deep Learning Theory (87), Leaming 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. *Unveiling the Role of Learning Rate Schedules via Functional Scaling Laws.* **NeurIPS 2025 (Spotlight)**.
- **Zixun Huang***, Jiayi Sheng*, Zeyu Zheng. *OBLR-PO: A Theoretical Framework for Stable Reinforcement Learning.* Submitted to **AISTATS 2026**.

## 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 variance bounds and convergence
– Introduced gradient-weighted baselines for principled variance reduction
– Implemented OBLR-PO and demonstrated superior performance on Qwen3-4B/8B vs. GRPO

**Efficiently 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

## Honors and Awards

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| Hong Sheng Scholarship (Top 12%) | 2024 |
| First Prize, Chinese Mathematics Contest (Top 1%) | 2024 |
| Yau Contest Groups Prize (Top 5%) | 2024 |
| Xiaomi Scholarship (Top 12%) | 2023 |
| Gold Prize, Chinese Mathematical Olympiad | 2021 |
| Silver Prize, Chinese Mathematical Olympiad | 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 Other

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| Languages | Chinese (Native), English (Fluent, TOEFL 101) |
| Quantitative Skills | GRE (160+170+3.5), GRE Math (970, 95th percentile) |
| Programming | Python, MATLAB, LaTeX, PyTorch, C++, Go, R, SQL |