# Liang Shan

twistshan1218@gmail.com
(+86)13661199541
https://twist-shan.github.io/

## Research Interest

- **Statistical Foundations and Optimization Algorithms for Modern Machine Learning (DL, RL, LLMs)**

## Education

- **Peking University** — **Beijing, China**
  *B.S. in Mathematics, School of Mathematical Sciences* — *Jun. 2024–Jul. 2028 (Expected)*
  *Second Major B.A. in Economics, National School of Development* — *Sep. 2025–Jul. 2028 (Expected)*
  - **Mathematics Courses**: Mathematical Analysis, Advanced Algebra, Geometry, Probability Theory, Complex Analysis, Ordinary Differential Equations, Mathematical Statistics, Applied Stochastic Processes, Statistical Thinking, Stochastic Analysis and Applications.
  - **Computer Science Courses**: Machine Learning and Artificial Intelligence, Fundamentals of Artificial Intelligence.
  - **Finance and Economics Courses**: Intermediate Microeconomics, Introduction to Finance, Security Investment, Mathematical Methods in Finance, Modern Quantitative Trading Systems, Topics in Quantitative Finance.
- **University of Copenhagen** — **Copenhagen, Denmark**
  *International Exchange Student, Department of SCIENCE* — *Sep. 2025–Jan. 2026*
  - **Mathematics Courses**: Topics in Statistics (MCMC), Advanced Operation Research: Stochastic Programming.
  - **Computer Science Courses**: Probability Machine Learning
- **Peking University** — **Beijing, China**
  *B.S. in Physics, School of Earth and Space Sciences* — *Sep. 2023–Jun. 2024*

## Research Experience on Machine Learning

- **Geometric Interpretability of Sequence Models** — **University of Wisconsin–Madison**
  *Advisor: Prof. Yiqiao Zhong, UW-Madison* — *Apr. 2026 – Present*
  - **Theoretical and Empirical Analysis of Memory Compression** — GitHub
    *Ongoing Research Project*
    * Investigated the representational bottlenecks of modern sequence architectures (LSTMs, Transformers, Mamba) on non-Markovian tasks (e.g., Dyck languages), demonstrating that forced-compression models develop continuous low-dimensional manifolds for abstract counting.
    * Designed causal intervention experiments and 3D geometric probing pipelines to extract and visualize hidden state dynamics, empirically validating conditional variance decay rates and orthogonal decoupling mechanisms.
- **Active Pareto Set Identification from Binary Pairwise Feedback** — **University of Pennsylvania**
  *Advisor: Prof. Zhimei Ren, UPenn* — *May. 2026 – Present*
  - **Binary-Feedback Bandits for Multi-Objective Model Evaluation**
    *Ongoing Research Project*
    * Formulated a multi-objective pure exploration problem for identifying Pareto-optimal arms from binary pairwise feedback, motivated by AI Arena-style model evaluation where latent objective scores are observed only through noisy win/loss comparisons.
    * Developed a vector Bradley–Terry framework for learning latent multi-objective arm scores, reducing the coordinate-specific setting to coupled one-dimensional comparison-graph estimation problems.
- **Optimization on Tensor Regression Model** — **The Hong Kong University of Science and Technology**
  *Advisor: Prof. Yi Chen, HKUST & Prof. Biao Cai, CityU* — *Jul. 2025 – Mar. 2026*
  - **Algorithm Implementation for Partially Observed Dynamic Tensor Regression**
    *Research Project*
    * Investigated and implemented the POSTER framework for ultra-high-dimensional dynamic tensor regression tasks, specifically handling complex random and block missing data patterns.
    * Initiated theoretical convergence analysis of the non-convex alternating minimization framework, utilizing tools from High-Dimensional Probability to try to establish error bounds under sparsity and structural constraints.
    * Designed robust simulation pipelines to evaluate tensor structure recovery.

- **Applications of LLM Agent** — **Peking University**
  *Advisor: Prof. Shanghang Zhang, PKU* — *Apr. 2025 – Jun. 2025*
  - **Wechat Agent**
    *Course Project*
    * Developed an LLM-driven typesetting plugin on the Dify platform, automating the end-to-end content generation and draft publishing pipeline via Python and WeChat APIs.
    * Engineered structural prompts using DeepSeek-VL v3 to enforce strict HTML and CSS constraints, ensuring the zero-shot generation of platform-compliant, mobile-responsive layouts.
    * Integrated a RAG-based writing assistant using embedding models and orchestrated external APIs (e.g., Firecrawl, Bing Search) for dynamic web scraping, data retrieval, and content compliance.
    * Evaluated the impact of generation parameters on layout stability and authored comprehensive technical documentation detailing the system architecture and experimental results.

## Research Experience on Finance

- **Modern Quantitative Trading Systems** — **Peking University**
  *Advisor: Prof. Changhao Jiang, PKU* — *Sep. 2024 – Jan. 2025*
  - **Quantitative Trading Backtesting Framework** — GitHub
    *Course Project*
    * Engineered a modular, object-oriented quantitative backtesting framework in Python, decoupling signal generation from order execution to support highly customizable trading algorithms.
    * Designed and implemented diverse quantitative strategies, including Momentum, Mean Reversion (Bollinger Bands), Cross-Sectional, and Time-Series, utilizing pandas and NumPy for vectorized data processing.
    * Developed an analytics module to compute key performance indicators (e.g., Sharpe Ratio, Annualized Returns) and automated the generation of visual performance reports for systematic strategy evaluation.
- **Security Investment** — **Peking University**
  *Advisor: Prof. Hai Huang, PKU* — *Mar. 2025 – Jun. 2025*
  - **Empirical Asset Pricing and Portfolio Management** — GitHub
    *Course Project*
    * Conducted empirical research on the Chinese A-share market, analyzing risk-return profiles, market volatility drivers, and sector-specific performance across historical market cycles.
    * Constructed optimal investment portfolios utilizing the Markowitz Mean-Variance framework, integrating fundamental quantitative stock selection and backtesting strategies across dynamic rebalancing frequencies.
    * Evaluated mutual fund performance by implementing Treynor-Mazuy (TM) and Henriksson-Merton (HM) models to quantitatively assess fund managers' market-timing and stock-picking capabilities.

## Skills & Others

- **Computer Skills**: Python (&PyTorch), R, C++ (Elementary), LaTeX
- **Language**: Mandarin Chinese (Native), English (Fluent)
- **The Graduate Record Examinations (GRE)**: Total 325 with 155 (Verbal) + 170 (Quant)