Lin Wang

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EDUCATION

- **Zhejiang University, Department of Mathematical Sciences** *Sep. 2021 - Jun. 2025(Expected)*
  BSc in Mathematics and Applied Mathematics Hangzhou, China
  - **GPA:** 3.96/4.00; Ranked 1st/79
  - **Core Courses:** Abstract Algebra, Complex Variable Functions, Real Variable Functions, Probability Theory, Topology, Partial Differential Equations, Functional Analysis, Differential Geometry, Numerical Analysis.

SUBMITTED

[C.1]   Lin Wang, et al. (2024). **Enhancing Numerical Reasoning in Language Models through Rule Learning**.

HONORS AND AWARDS

- **National Scholarship** *Oct. 2024*
- **First Prize, Mathematics Competition for College Students, China** *Nov. 2023 & Nov. 2022*
- **Ling Jun Investment Corporation Scholarship** *Oct. 2023*
- **Zhejiang Provincial Government Scholarship** *Oct. 2022*
- **First Prize, Mathematics Competition, Zhejiang Province** *Oct. 2022*
- **Second Prize, Physics Innovation Competition, Zhejiang Province** *Feb. 2023*
- **Winning Prize, Mathematical Contest in Modeling, Zhejiang University** *May. 2023*

RESEARCH EXPERIENCE

- **Model-Based Continuous-Time Policy Evaluation with Unknown Lévy Process Dynamics** *Online*
  University of California, San Diego (UCSD) Jun. 2024 - Onging
  - **Objective:** Developed a robust model to recover the policy and the value function parameters for a model-based continuous-time reinforcement learning framework. The model leverages a set of trajectories sampled from either real-world data or simulated density functions.
  - **Approach:** Utilized the recovery of value functiton from **Fokker-Planck Equation** to model the evolution of the system, applying **Wasserstein distance** and **Maximum Likelihood Estimation (MLE)** as loss functions to minimize functional recovery errors.
    Applied **Physics-Informed Neural Networks (PINNs)**, which provided an efficient framework for solving Partial Differential Equations (PDEs), to solve the Fractional Fokker-Planck Equation. This allowed for real-time policy evaluation with an initial Dirac-Delta condition.
    Deployed the **Model-Based Policy Optimization (MBPO)** algorithm to efficiently solve policy optimization in reinforcement learning, reducing cumulative error of the model, so as to ensure the final sampling efficiency and strategy performance.
  - **Key Contribution:** Implemented a **Lévy process-based model**, effectively capturing abrupt changes in market and system dynamics. This model surpasses traditional Gaussian-based models by accounting for extreme, heavy-tailed events.
    Theoretical results demonstrated improved policy evaluation accuracy and provided a more reliable framework for continuous-time decision-making, particularly beneficial in fields like robotics and financial modeling, where precise control over dynamic systems is required.

- **Enhancing Numerical Reasoning in Language Models through Rule Learning** *Hangzhou*
  Zhejiang University Jun. 2024 - Ongoing
  - **Objective:** Developed **MetaRuleGPT**, a language model designed to enhance numerical reasoning and logical operations through rule-based learning, addressing the limitations of traditional language models in handling complex mathematical calculations.
  - **Approach:** Introduced a **Transformer-based** model architecture incorporating a structured rule-learning mechanism. Trained on a dataset of basic arithmetic rule (e.g., carry rule, borrow rule, and mapping rules) to ensure accuracy.
    Employed recursive reasoning methods inspired by **meta-learning** to enhance the model's adaptability across tasks, allowing flexible combination and application of learned rules.
  - **Key Contribution:** Demonstrated that rule-based learning significantly improves accuracy in high-digit and complex calculations, achieving 100% accuracy in test scenarios where other language models struggle.
    MetaRuleGPT establishes a foundation for integrating rule learning to bolster the mathematical reasoning capabilities of language models with minimal computational resources.

- **Crystals Physical Properties Prediction with Equivariant Graph Neural Networks** *Hangzhou*
  Zhejiang University Jun. 2023 - Ongoing
  - **Objective:** Developed a machine-learning model to predict the physical properties of crystals, such as force constants and superconducting temperature, using equivariant graph neural networks.

- **Approach:** Calculated the phonon properties of crystals using **VASP** (Vienna Ab initio Simulation Package) and **Phonopy**, and extracted the **force constant matrix** as ground truth data.
  Encoded crystal structures as graphs, where nodes represented atoms and edges carried force constants. Developed a **Crystal Equivariant Graph Neural Network (CEGNN)** that predicted force constants between atoms, expressed as 3x3 matrices capturing interactions in three-dimensional space which is equivariant under operator in E(3). Compared various **equivariant GNNs** and assessed their performance in predicting force constants.

- **Key Contribution:** Demonstrated the efficacy of using CEGNNs to predict crystal properties with minimal computational cost, significantly reducing the need for expensive physical simulations.

- **Vision Training at Test Time (Vision TTT)** *Hangzhou*
  Zhejiang University Jul. 2024 - Oct.2024

  - **Objective:** Explored the application of **Training at Test Time (TTT)** models to improve classification accuracy in scenarios where training and testing data distributions differ.

  - **Approach:** Built a classification model inspired by **Vision Mamba** and extended it to **Vision TTT**, where the model parameters are slightly adjusted during testing to account for distributional shifts.
    Experimented with various techniques such as down-sampling, convolutional layers with different kernel sizes, and the addition of global patches and **CLS (classification)** tags. Incorporated **model distillation** to transfer knowledge from a larger, pre-trained model to a smaller, more efficient one.
    Conducted extensive testing on **CIFAR-100** and **ImageNet 2012** datasets, achieving a top-1 accuracy of 80.09% on **CIFAR-100** (surpassing Vision Mamba's 72.5%), but found limitations in multi-label classification tasks for ImageNet.

  - **Key Contribution:** The project highlighted the strengths of TTT models in handling few-shot and zero-shot tasks, demonstrating their potential for small-scale, distribution-shifted datasets. Further exploration is needed for large-scale, multi-label tasks.

- **Spline Curve Construction** *Hangzhou*
  Zhejiang University Nov. 2023 - Jan.2024

  - **Objective:** Developed algorithms for the construction of spline and B-spline curves, focusing on different forms of endpoint conditions and their influence on curve fitting accuracy.

  - **Approach:** Implemented **piecewise-polynomial splines** and **B-splines** using C++, providing solutions for both open and closed curves.
    Investigated the effects of non-smooth points and the number of interpolation nodes on curve fitting quality, leading to optimized spline fitting techniques for various geometrical applications.

  - **Key Contribution:** The project offered practical insights into computational geometry, specifically in designing curves for use in computer graphics and geometric modeling.

INTERNSHIP EXPERIENCE

- **Hangzhou Kezan Data Technology Co., Ltd** *Hangzhou*
  Quantitative Intern Feb. 2024 - Jun. 2024

  - Developed and optimized an end-to-end time series model using GRU for stock market prediction, processing data at daily and minute-level frequencies. The model generated buy and sell signals, achieving an annualized return of 26% with a 2.7% drawdown.

  - Integrated transformer-based techniques, enabling the interaction between time series and cross-sectional data, which improved the annualized return to 32% with a reduced 2.1% drawdown.

  - Addressed the issue of missing data in the Chinese stock market by applying methods that preserved data integrity and minimized loss of predictive power.

  - Reproduced and encapsulated financial factors from research reports for efficient integration into the model. Ensured selected factors maintained stable correlations with market returns and adjusted them for model input.

  - Used neural networks, including CrossGRU, to enhance data utilization efficiency and extract market features, followed by rigorous backtesting to evaluate model performance.

LANGUAGE & OTHER SKILLS

- **Language Skills:** Native proficiency in Chinese; Proficient in English (TOFEL 102 ; GRE 325)
- **Technical Skills:** Python, C++, Linux Operating System
- **Mathematical Skills:** Probability Analysis, Algebra, Differential Equations(GRE Math Subject 900)
- **Interests:** Statistical Learning, Machine Learning, Computational Mathematics

LEADERSHIP EXPERIENCE

- **Sports Center Leader** *Hangzhou*
  Student Union of School of Mathematical Sciences Sep. 2022 - Jun. 2023

  - Established an organization to support students by providing academic guidance, Q&A sessions, and life services.

  - Led various extracurricular sports activities and hosted calculus Q&A sessions for international students, fostering a balanced academic and physical fitness environment.

- ◦ Organized large-scale campus events, including the New Year's Party and Graduation Party, contributing to community building within the university.

- **Participant**   *Hangzhou*
  Student Quality Training Project   Feb. 2022 - Jun. 2022
  - ◦ Conducted research on food safety issues in university canteens, identifying causes of common food borne illnesses.
  - ◦ Distributed questionnaires to assess students' awareness of food safety, gathering data to inform food safety workshops.
  - ◦ Organized educational sessions, demonstrating the risks of unsafe foods such as sprouted potatoes and poisonous mushrooms, raising student awareness of food safety practices.

VOLUNTEER EXPERIENCE

- **Volunteer Participant**   *Hangzhou*
  Zhejiang University & Charitable Organizations   Sep. 2021 - Ongoing
  - ◦ Accumulated over 250 hours of volunteer service, including organizing activities at Senior Activity Centers, supporting library functions, and assisting with logistics for the Southeast China University College Basketball Tournament.