YUN'AI LI

Chengdu, Sichuan, China | Tel: +86 13808028528 | Email: li5yun2ai8@gmail.com

EDUCATION

Shanghai Jiao Tong University（SJTU）   **Shanghai, China**
Zhiyuan College (Zhiyuan Honors Program), Junior   Sep 2021 - Jul 2025
Major: Mathematics and Applied Mathematics (Zhiyuan Honors Program)

Coursework: Advanced Algebra, Mathematical Analysis, ODE, PDE, Complex Analysis, Real Analysis, Abstract Algebra, Numerical Analysis, Probability, Stochastic Process, Differential Geometry, Dynamic System(Ergodic theory), Graph and Network (combinatorics), Number Theory, Data Science (Machine Learning), Mathematical Programming(Optimization), Topic courses (seminars in pure/applied math with credits)

Nanyang Technological University (NTU)   **Singapore**
School of Physical and Mathematical Sciences   Jan 2024-June 2024
Visiting student for undergraduate research

PROFESSIONAL SKILLS

Language: Chinese, English （IELTS 7.5, TOEFL 103）
Programming Skills: Python (PyTorch), MATLAB, LATEX

RESEARCH EXPERIENCE

New York University, Center for Data Science   **New York, USA**
Research Intern   Supervisor: Prof Qi Lei   upcoming
Final year project (graduation thesis for bachelor's degree)

Nanyang Technological University, School of Physical & Mathematical Sciences   **Singapore**
Research Intern   Supervisor: Prof Juan-Pablo Ortega (Associate Chair)   Jan 2024 – Jun 2024
Research Topic: Reservoir computing for Reinforcement learning
Key Words: Reservoir Computing, Reinforcement Learning, Echo State Network, Dynamic System
- Ongoing: Currently doing the theoretical proof and convergence analysis of the proposed algorithm.

Shanghai Jiao Tong University, School of Mathematics   **Shanghai, China**
Research Assistant   Supervisor: Prof Xiaoqun Zhang   Sep 2023 –Dec 2023
Research Topic: Improving A multi-autoencoder fusion network for fast image prediction of aircraft ice accretion with Generative models
Key Words: AI4SCIENCE, image prediction, autoencoder, airfoil ice
- Employed data-driven models, specifically variational autoencoders (VAEs) and generative adversarial networks (GANs), to address challenges in ice airworthiness certification. This involved predicting icing images under complex conditions, including extreme air velocity and low temperatures, which cannot be easily simulated in wind tunnel experiments.
- **Some research results:** Developed VAE models to generate icing images based on input icing conditions and original wing images without ice. Addressed challenges such as vanishing KL loss by implementing batch normalization to maintain positive lower bounds of the KL's distribution, enhancing model stability and preventing posterior collapse. Utilized GAN models to generate realistic icing images through adversarial training. Overcame issues like diminishing discriminator loss and escalating generator loss by transitioning to Wasserstein GAN (WGAN), which introduced a Wasserstein distance metric for more stable training. Implemented optimizer momentum methods, parameter clipping for Lipschitz continuity, and removal of log term in the loss function to enhance model performance. Tried a weighting strategy for learning the contours of the icing area.

Institute of Mathematics and Systems Science, Chinese Academy of Sciences   **Beijing, China**
Independent Researcher   Supervisor: Wensheng Zhang (full research fellow)   Jul 2023 – Nov 2023
Research Topic: Solving Helmholtz Equations' Forward and Inverse Problems in Different Fields by PINN
Key Words: PINN, forward problems, inverse problems, Helmholtz equation
- Used PINN (physics-informed neural network) to solve the Helmholtz Equation in different fields (constant, smooth function, discontinuous function). This includes solving both the forward and the inverse problems. Analyze the factors' (sampling, the fields' smoothness, the dimensions) influence on the accuracy of solutions. Compare the effectiveness with FEM methods.

- **Some research findings:** The inverse problems are more sensitive than the forward problems w.r.t the choices of parameters; Increasing sampling at steep areas or discontinuities in parameters or solutions improves convergence; The difficulty of solving inverse problems depends on the shape of the tensor to train, function's steepness, continuity, and the range of function values compared to the sampling range. However, smoother functions do not necessarily guarantee easier fitting. Some easy inverse problems have good noise immunity when solved by PINN.

Shanghai Jiao Tong University, Antai College of Economics & Management　　　　　**Shanghai, China**
Team Member　　　　　Supervisor: Prof Yufeng Cao　　　　　　　　　　　　Feb 2023 – Sep 2023
Research Topic: Using Multiple Optimization Methods for the Analysis of Air Passenger Ticketing Behavior
Key Words: line search methods, trust region methods, assortment optimization, discrete choice model, context-dependent utility
- This project feature engineered the factors (independent variables) affecting ticket purchasing among them through the real data set collected, used the multinomial logit model from the discrete optimization model to maximize the utility by integrating the optimization methods and evaluated the magnitude of the influence of each factor on the ticket purchasing behavior.
- This study focuses on putting the various methods of optimization into application-optimizing the maximum likelihood function for this air traveling scenario and comparing the convergence of the different methods and attempting to give interpretations using numerical analysis and other mathematics tools.
- **Some research findings:** Among multiple factors including booking date, refund and change policy and booking channel, etc., the prices play a dominant role in influencing purchasing behavior; The extent to which other factors influence travelers' ticket purchases is also quantified and verified. The results have been compiled as a paper. (Undergraduate research report)

COURSE PROJECTS
Essays for **Mathematical Analysis**:
Investigation of the Condition of the Fourier Series' Convergence
The Relationship of the Ordered Fields' Completeness and the Archimedean Property
The Convergence Estimation Method of the Series of Function Terms and its Applicability Conditions
Essay for **ODE**: The Solution and Properties of Three-Dimensional Linear Systems with Constant Coefficients
Essay for **Abstract Algebra**: Classification of 18-Element Groups
Essay for **Graph and Network**: Exterior Algebra, Hypergraph and Some Relative Inequalities about the Bollobas Two Families Theorem　　A Review On C. E. Shannon's Original Paper And Discussions About Graph Entropy
Essay for **Mathematical Programming**: Image Denoising via Sparse Coding
Group Projects for **Seminars in Mathematics**:
The Variational Method in Rare Events
Geometric Properties in Hyperbolic Geometry: Axioms, Linear Polygons, Areas, Trigonometry
Neural Encoding in Balanced Networks: Data-Driven Exploration

HONERS & AWARDS

Zhiyuan Outstanding Research Visiting Fund (for visiting CAS)　　　　　　　　Dec 2023

Mathematical Contest in Modeling: Honorable Mention　　　　　　　　　　　May 2023
Project Topic: Data Analysis and Prediction in the WORDLE Game
Contribution: Modeling and coding of LSTM, bp neural network, Random forest algorithm, and visualization

CUMCM (China Undergraduate Mathematical Contest in Modeling), Shanghai Division: Third Prize（Team Leader）　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　Nov 2022
Project Topic: A Multi-dimensional Investigation on the Chemical Composition of Ancient Glass: (compositional analysis of weathered glass)
Contribution: Modeling and coding of SVM, Q-clustering, R-clustering, grey relative analysis methods, and visualization

Shanghai Jiao Tong University Class C Scholarship　　　　　　　　　　　　　Dec 2022

Zhiyuan Honorary Scholarship　　　　　　　　　　　　　　　　　　　　Dec 2022 / Dec 2021

ACADEMIC INTEREST
- Optimization
- Machine Learning