Linrong Cai

Linrong Cai | lcai54@wisc.edu | clrt19@outlook.com | clrt19.com | +01 6087338085

Education

University of Wisconsin-Madison Sept. 2021 – present
B.S in Computer Science (Honors) and Mathematics (Honors) Madison, WI
GPA: 3.987/4.000

Publications

– **Stronger Than You Think: Benchmarking Weak Supervision on Realistic Tasks (NeurIPS 2024)**
Linrong Cai*, Tianyi Zhang*, Jeffrey Li, Nicholas Robert, Neel Guha, Frederic Sala

– **Zero-Shot Robustification of Zero-Shot Models (ICLR 2024)**
Dyah Adila*, Changho Shin*, **Linrong Cai**, Frederic Sala

* Indicates equal contribution

Research Experience

Undergraduate Researcher with Professor Jelena Diakonikolas June 2022 - present
– Collaborated with Nikos Zarifis to work on learning algorithms for **Learning with Noisy Labels**.
– Reading latest research papers and studying the field of **Theoretical ML** and **Optimization**.
– Attending weekly reading group meetings on Riemannian Optimization and Optimization in Hadamard Spaces.

Machine Learning Research Assistant with Professor Frederic Sala June 2022 - present
– Developed realistic benchmarks for **Weak Supervision** and novel techniques for adaptability of label functions.
– Worked on **Robustification of Zero-Shot Models** towards spurious correlations and distribution shift.
– Experimented with **Diffusion Models** for generating synthetic data for breast cancer and zero-shot classification.
– Designed and implemented data collection optimization model using Learn-Optimize-Collect (LOC) framework

Undergraduate Mathematics Research with Professor Caglar Uyanik Jan. 2022 - Sep. 2022
Madison Experimental Mathematics Lab
– Collaborated with a group of 4 to research on given two random elements of $SL_2(\mathbb{Z})$, what is the **probability** that they generate a **free group**.
– Use knowledge in **Hyperbolic Geometry**, Ping-Pong lemma, Group theory to develop theoretical support for the conjecture that most matrix in $SL_2(\mathbb{Z})$ are **loxodromic**.
– Implement an algorithm in **Python** to show that most matrices are loxodromic.

Relevant Coursework

Computer Science: Machine Learning, Deep Learning, Computer Vision, Introduction to Artificial Intelligence, Algorithms, Operating Systems, Database Management Systems, Data Science
Mathematics: Probability Theory, Real Analysis (graduate level), Measure Theory, Numerical Analysis, Stochastic Process, Abstract Algebra, Topology, Combinatorics, Cryptography
Optimization: Linear Programming, Integer Programming, Nonlinear Optimization

Workshop

– **Stronger Than You Think: Benchmarking Weak Supervision on Realistic Tasks (DMLR at ICML 2024)**
Linrong Cai*, Tianyi Zhang*, Jeffrey Li, Nicholas Robert, Neel Guha, Frederic Sala

– **Foundation Models Can Robustify Themselves, For Free (NeurIPS 2023 R0-FoMo) Oral (best paper honorable mention)**
Dyah Adila*, Changho Shin*, **Linrong Cai**, Frederic Sala

* Indicates equal contribution

Tutoring & Work Experience

Math Tutor at UW-Madison Housing Sept. 2024 - present

– Led weekly tutor sections, covering Calculus I, II, III, Linear Algebra, and Differential Equations

– Provided personalized support and guidance to students, helping them understand complex mathematical concepts and improve problem-solving skills

Machine Learning Peer Mentor Jan. 2024 - May 2024

– Hosting weekly office hours to help students with lecture, homework, and exam preparation

– Guiding students implementing machine learning algorithms, including PCA, Clustering, CNN, Q-Learning, A* search...

Combinatorics Grader, Math Department Sept. 2023 - May 2024

– Graded weekly assignments for Math 475 (Combinatorics) for two semesters, providing constructive feedback on proofs and problem-solving approaches

– Maintained accurate grade records and coordinated with the course instructor to ensure consistent grading standards

Quantitative Researcher Intern at Orient Securities June 2023 - Aug. 2023

– Collaborated in the development of **backtest** codes that can trade based on the value of **factors** to evaluate the efficacy and performance of various trading algorithms

– Experimented with **Convolutional Neural Networks (CNN)**, **Long Short-Term Memory (LSTM)** for predicting financial market trends

– Utilized statistical tests to analyze the relationship between stocks and futures and develop trading strategies

Cryptography Grader, CS Department Jan. 2023 - May 2023

– Graded assignments for CS 435 (Cryptography), providing detailed feedback to improve student understanding

– Maintained accurate grade records and coordinated with the course instructor to ensure consistent grading standards

Awards

NeurIPS 2024 Scholar Award
Best paper award honorable mention at NeurIPS 2023 R0-FoMo
National Gold Award in Canadian Open Mathematics Challenge
Second Prize in China Mathematical Olympiad Province
First Prize in Australian Mathematics Competition
Dean's List for Every Semester

Projects

– Developed ImageEditNet, a text-prompt-based image editing tool that enhances InstructPix2Pix by leveraging GPT's in-context learning with GANs for synthetic dataset generation, improving CLIP and directional similarity scores.

– Designed and implemented a data collection optimization algorithm using the Learn-Optimize-Collect (LOC) framework and ResNet, managing performance statistics, data requirements, and sampling

– Built a miniature database management system with clock algorithm, buffer management, heap files, and relational operators

– Developed neural network projects, including U-Net for image segmentation, ResNet/MobileNet transfer learning for distribution shift analysis, and LeNet-5 for computer vision tasks

Skills

Languages:	English (TOEFL 110 2020, Best Score 115), Chinese (Native)
Programming Languages:	C++/C, Java, Python, SQL, CSS, JavaScript, R, Bash, Assembly (LC-3)
Mathematics Skills:	Analysis, Linear Algebra, Probability, Topology, Optimization, Combinatorics, Cryptography
Technologies and Tools:	PyTorch, TensorFlow, NumPy, SciKit-Learn, Git