KEVIN LU

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CAREER OBJECTIVE

Apply mathematical rigor and computer science principles to develop scalable machine learning algorithms that drive practical, data-driven solutions.

EDUCATION

Rutgers University, New Brunswick, NJ September 2021 - May 2026 (Expected)
PhD Candidate in Mathematics Advised by **Feng Luo** (*Math*), and **Jie Gao** (*Computer Science*)
Research Interests: Geometry, Social Learning, Generative AI
Award: Rutgers Mathematics Fellowship, Spring 2025

Georgia Institute of Technology, Atlanta, GA August 2017 - May 2021
Double Major *in Math and Computer Science*
Award: CGTA Young Researchers' Award

PUBLICATION AND PRESENTATIONS

Locality Sensitive Hashing in Hyperbolic Space, *In Submission*
Mixture of Complementary Agents for Robust LLM Ensemble, *In Submission*
Neuc-MDS: Non-Euclidean Multidimensional Scaling Through Bilinear Forms, *NeurIPS 2024*
Johnson-Lindenstrauss Lemma Beyond Euclidean Geometry, *NeurIPS 2024*
Enabling Asymptotic Truth Learning in a Social Network, *WINE 2024*
Distinct Distances with l_p Metrics, with Polymath REU, *Computational Geometry 2022*

Truth learning presentations at *DIMACS Spreading on Social Networks* and *WINE 2024*
Neuc-MDS presentations at *ATD AMPS PI Workshop 2024*, *31st annual FWCG* and *NeurIPS 2024*

SKILLS AND AREA OF INTEREST

Mathematics: (Hyperbolic/Convex) Geometry, Random Graph Theory, Automated Theorem Proving
Computer Science: Computational Geometry, Social Network Theory, Artificial Intelligence
Programming Languages: Python, Java, C, C++, SQL, HTML, Javascript

RESEARCH EXPERIENCE

Mixture of Complementary Agents for Robust LLM Ensemble January 2025 - Present

- Developed an **LLM agent selection framework** within a proposer–summarizer–mixture architecture, improving task accuracy by selecting complementary proposer agents using custom metrics including Shapley-value–based analysis.
- Analyzed trade-offs between accuracy and summarizer call complexity to identify optimal proposer subsets under compute constraints.
- Built a scalable LLM batch evaluation framework on a Linux cluster using vLLM, primarily leveraging open-source models (e.g., Qwen, LLaMA) from **Hugging Face**, and initiated theoretical modeling of **social learning dynamics** among LLM agents.

Neuc-MDS: Non-Euclidean Multidimensional Scaling Through Bilinear Forms

- Researched embedding methods and data structures/algorithms in **non-Euclidean** spaces, including MDS, PCA, LSH, and the Johnson–Lindenstrauss transform.
- Framed dimension reduction problems on general distance matrices as MDS in pseudo-Euclidean space by using non-definite signature bilinear forms
- Proposed an optimal eigenvalue selection method for approximately minimizing the STRESS objective.
- Using eigenvalue analysis of random projections, found worst case distance matrices for MDS

- Designed and implemented a research codebase (GitHub: https://github.com/KLu9812/MDSPlus)

Johnson-Lindenstrauss Lemma Beyond Euclidean Geometry

- Extended Johnson–Lindenstrauss guarantees to hollow matrices and pseudo-Euclidean spaces, developing projection methods with provable error bounds proportional to Euclidean norms.
- Proposed alternative embedding techniques using power distance and eigenvalue analysis, representing points as radius-adjusted embeddings with improved theoretical error control.
- Validated through theoretical analysis and experiments that the proposed projection methods outperform standard Johnson–Lindenstrauss projections in approximation error.

Locality Sensitive Hashing in Hyperbolic Space

- Introduced the first locality-sensitive hashing (LSH) framework for hyperbolic space, extending Crofton's formula–based random hyperplane hashing beyond Euclidean geometry.
- Extended the method to higher-dimensional hyperbolic spaces via distortion-bounded random projections to two dimensions, supported by concentration bounds and other statistical analysis.
- Established theoretical error and complexity bounds comparable to Euclidean LSH, with empirical results demonstrating efficiency and low approximation error.

DIMACs REU Program, Rutgers June - August 2023, 2024

- Proved theoretical conditions about asymptotic truth learning in general graphs; primary contributor to the paper published at WINE 2024 (2023)
- Analyzed truth learning models in various graph classes, including Erdos-Renyi graphs (2023)
- Established NP-hardness results for true learning problems, extending the theoretical framework
- Studied extensions of the model such as adding adversaries and comparisons between strategies

Polymath REU June 2020 - August 2020

- Studied the Erdős distinct distances problem, with results published in *Computational Geometry*.
- Applied and extended the Elekes–Sharir–Guth–Katz framework to non-Euclidean metrics, proving structural properties of point sets with minimal distinct distances.

Research in Automated Algorithm Design, Georgia Tech January 2020 - May 2021

- Contributed to a python library that used **genetic algorithms** to evolve populations of learners
- Participated in a sub team that studied and experimented with introducing modularity to evolution

WORK EXPERIENCE

Ernst & Young, *Summer Internship, New York, NY,* June 2022 - August 2022

- Designed and implemented a Model Inventory Management Tool to track, govern, and manage financial models across development and production lifecycles.
- Built a Python-based backend with SQL databases and developed a web front end using JavaScript, HTML, and Jinja2 templating.

Bell Curve Capital, *Summer Internship, Blue Bell, PA* June - August, 2018

- **Neural network** machine learning with applications on stock turning points and directional prediction
- Optimization of correlation in grouping stocks using **Tensorflow**
- Developed a **Monte Carlo** simulation program to price options

TEACHING EXPERIENCE

Recitation Teaching Assistant, Rutgers Fall 2023 - Fall 2024, Fall 2025

Differential Equations, Linear Algebra, Calculus, etc.

Lecturer, *Calculus,* Rutgers Spring 2026