LINKAI MA

https://linkaima.github.io/
West Lafayette, IN
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EDUCATION

Purdue University Expected May 2027
Ph.D. in Computer Science *West Lafayette*
· GPA: 4.00/4.00
· Research Interests: numerical linear algebra, machine learning theory.
· Selected Coursework: Statistical Machine Learning, Artificial Intelligence, Deep Learning, Reinforcement Learning, Algorithms, Optimization, Numerical Linear Algebra, Stochastic Process, Quantum Computing.

New York University May 2023
Master of Science in Mathematics *New York City*
· GPA: 3.9/4.00
· Selected Coursework: Real Analysis, Complex Analysis, ODE, PDE, Probability Theory, Mathematical Statistics, Numerical Methods, Randomized Numerical Linear Algebra, Monte Carlo Methods, Machine Learning, Deep Learning Theory.

New York University May 2022
Bachelor of Arts in Mathematics (Honors) *New York City*
· GPA: 3.94/4.00
· Minor: Computer Science
· Awards: Dean's Honors List, University Honors Scholars, Dean's Undergraduate Research Fund, Phi Beta Kappa
· Selected Coursework: Honors Analysis I&II, Honors Algebra I, Fourier Analysis, Honors Linear Algebra, ODE, PDE, Dynamical Systems, Fluid Dynamics, Differential Geometry, Probability, Statistics.

RESEARCH EXPERIENCES

Stochastic Rounding Implicitly Regularizes Least-Squares Estimators February 2025 - Now
Ph.D. Research
· Investigated how stochastic rounding affects least-squares regression when the data matrix is tall-and-thin, a regime common in large-scale machine learning where the number of observations far exceeds the number of features.
· Proved probabilistic error bounds using perturbation theory, concentration inequalities, and random matrix analysis, showing that stochastic rounding yields estimators close to truncated SVD solutions.
· Designed and executed numerical experiments to validate theoretical predictions and illustrate the implicit regularization effect of quantization for both synthetic data and real image data.

Forward and Backward Stability Analysis for SMW Formula July 2024 - March 2025
Ph.D. Research
· Proved upper bounds for the forward and backward error of Sherman-Morrison-Woodbury identity.
· Demonstrated tightness of the bounds for special cases and potential applications.

Stochastic Rounding Implicitly Regularizes Tall-and-Thin Matrices September 2023 - July 2024
Ph.D. Research
· Analyzed the effect of stochastic rounding on the smallest singular value of a matrix.
· Performed numerical experiments of stochastic rounding for tall and thin matrices.

Randomized Block Krylov DMD for Online Data June 2022 - May 2023
Master Thesis Research
· Designed a randomized dynamic mode decomposition algorithm based on Krylov subspace.
· Tested the algorithm on fluid simulation data and over 20 GB sea surface temperature data.
· Proposed an efficient method to update DMD modes for large data.

Autoregressive DMD for Atmospheric Annular Mode Analysis June 2022 - May 2023
Research Assistant at Courant Institute
· Developed an autoregressive DMD method to model dynamical systems with time-evolving law.
· Performed autoregressive DMD analysis to random matrices and 500-year atmospheric data using HPC.
· Applied perturbation methods on the eigenvalue problem to reduce noise.
· Processed and applied dimension reduction algorithms on large atmospheric data.

Graph-Theoretic Markov Model for Arctic Sea Ice June 2021 - May 2022
Research Assistant at Courant Institute
· Designed a sea ice model discretizing the Boltzmann equation coupled with collision operator.
· Constructed a discrete time Markov chain to model advection and diffusion.
· Created simulations of sea ice densities and advection fields using particle methods in Python.
· Gave a presentation at Undergraduate Research Conference, New York University

TEACHING EXPERIENCES

Purdue Teaching Assistant September 2023 - May 2024
· Instructed undergraduate and graduate numerical analysis courses.
· Provided guidance on optimization, numerical linear algebra, and data visualization.

· Mentored students in implementing efficient algorithms for large-scale problems.

Courant Teaching Assistant and Undergraduate Tutor January - December 2022
· Led recitation sessions and held office hours for Calculus 1.
· Offered walk-in tutoring for a wide range of undergraduate math courses.

SKILLS

· Programming: Python, Matlab, Julia, C++, C, Java, R, SQL, MongoDB
· Packages: numpy, pandas, pytorch, xarray, netcdf4, opencv, networkx, pydmd, emcee, sklearn, tensorflow
· Language: English, Chinese

PUBLICATIONS & PREPRINTS

· Stochastic rounding implicitly regularizes tall-and-thin matrices. SIAM Journal on Matrix Analysis and Applications, 46(1), 341-369. Dexter, G., Boutsikas, C., Ma, L., Ipsen, I. C., & Drineas, P. (2025).
· A Note on the Stability of the Sherman-Morrison-Woodbury Formula. arXiv preprint arXiv:2504.04554. Ma, L., Boutsikas, C., Ghadiri, M., & Drineas, P. (2025).