Alex Xu

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Skills

Programming Languages: Python, Java, C/C++, Rust, PyTorch, Scikit-learn, Numpy, Pandas, Polars, SQL, LaTeX

Mathematics & Statistics: Bayesian Statistics, Variational Inference, Convex Optimization, Linear Regression, Partial Differential Equations, Differential Geometry, Riemannian Manifolds

Machine Learning: Variational Autoencoders, Diffusion Models, Transformers, Retrieval Augmented Generation, Low Rank Adaption

Languages: Native proficiency in English and Chinese

Experience

Columbia University, Graduate Student Instructor — New York, NY — Sept 2020 – June 2025

- Created course curriculum and taught biweekly 30 student classes for Calculus 1 as Instructor of Record
- Graduate TA for Calculus and Optimization, Linear Algebra, Calculus 3, Calculus 2, Calculus 1, and Algebraic Topology

Education

PhD **Columbia University**, Mathematics — New York, NY — Sept 2020 – June 2025

- Advisor: Prof. Francesco Lin
- Thesis: The Seiberg—Witten Equations and Asymptotically Hyperbolic Einstein Metrics

MA **Columbia University**, Mathematics — New York, NY — Sept 2020 – June 2022

- Advisor: Prof. Francesco Lin

BS **University of California, Santa Barbara**, Mathematics — Santa Barbara, CA — Sept 2016 – June 2020

- Advisor: Prof. Xianzhe Dai
- Thesis: Adiabatic Limits and Hodge Leray Theory

Projects

localRAG

- Implemented retrieval augmented generation (RAG) for a local collection of academic texts using open source models

mini-diffusion

- Implemented a tiny (825k) parameter U-net diffusion model in PyTorch for generation of self-portraits.

LoRA_gpt2

- Implemented low-rank adaption (LoRA) fine tuning on the GPT2 124M checkpoint in PyTorch to generate text in the style of different authors.

VAEs

- Implementation of a variational autoencoder (VAE) to learn the MNIST dataset.

Publications

Seiberg-Witten Equations and Einstein Metrics on Finite Volume 4-Manifolds with Asymptotically Hyperbolic Ends — Feb 2024

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arxiv.org/abs/2402.1036