THE UNIVERSITY OF CHICAGO | THE COMMITTEE ON COMPUTATIONAL AND APPLIED MATHEMATICS

Dissertation Defense:

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"FAST NUMERICAL LINEAR ALGEBRA FOR GENERATIVE MODELING"

Wednesday, April 22, 2026, at 4:00 PM
Location: Jones 111, 5747 S. Ellis
(Also via Zoom)
https://uchicago.zoom.us/j/92810780383?pwd=K6IrEbDIVFROrOzbdepcsb8kTRSPH6.1

Meeting ID: 928 1078 0383
Passcode: 708401

ABSTRACT

Generative modeling aims to learn the underlying probability distribution of observed data and to generate new samples that resemble the training data. Many modern approaches rely on highly overparameterized neural network architectures. Although these methods have achieved strong empirical success, they are often computationally expensive, difficult to interpret, and less effective at revealing the intrinsic structure of the data distribution.

In this defense, we investigate an alternative framework for generative modeling based on techniques from numerical linear algebra. The first part focuses on density estimation. We develop a method based on tensor networks, which provide structured and interpretable representations of high-dimensional density functions. This framework achieves computational complexity that scales linearly with the dimensionality while maintaining high accuracy across a range of applications. In the second part, we turn to diffusion models. We propose an approach that expands the score function in a sparse set of selected basis functions. This reformulates score estimation as the solution of a linear system, thereby avoiding both iterative nonconvex optimization and repeated time-dependent sample generation. We provide an error analysis based on perturbation theory and demonstrate the effectiveness of the proposed method on high-dimensional problems.