Graduate Student Paper Presentation 2026 Schedule

Time	**Session**	**Speaker**
9:00 – 9:10	**Opening**	**—**
9:10 – 9:55	Plenary 1	Dr. Charles Puelz
9:55 – 10:10	**Break**	—
10:10 – 10:35	Contributed	Shumaila
10:35 – 11:00	Contributed	Murad Hossen
11:00 – 11:25	Contributed	Ziheng Guo
11:25 – 11:50	Contributed	Anish Ray
11:50 – 12:15	Contributed	Dipanwita Bose
12:15 – 12:30	Session Buffer	—
12:30 – 1:30	**Break**	**—**
1:30 – 2:15	Plenary 2	Dr. Ping Zhong
2:15 – 2:30	**Break**	**—**
2:30 – 2:55	Contributed	Tian-Li Yan
2:55 – 3:20	Contributed	Sajjadul Bari
3:20 – 3:45	Contributed	Kamrun Nahar Mily
3:45 – 4:10	Contributed	Anshi Gupta
4:10 – 4:35	Contributed	Jayasinghe Arachchillage
4:35 – 5:00	Contributed	Kenneth Evans
5-00-5:10	**Closing**	—

Graduate Student Paper Presentation 2026 Abstracts

Plenary talks

Speaker 1: Dr. Charles Puelz

Title: The promise of computation in medicine with applications to single ventricle disease

Abstract: I will begin by describing a class of congenital diseases that results in a single ventricle circulation, as opposed to a healthy bi-ventricular circulation. Some details on the physiology of this circulation will be discussed, and some questions amenable to computational modeling will be presented. I will describe some previous modeling work and important questions to consider when developing models to help inform clinical care. Some recent projects related to the Fontan circulation will be discussed, which involve ordinary and partial differential equations and image processing methods.

Speaker 2: Dr. Ping Zhong

Title: Free probability, Large-N limit of random matrix models, and applications

Abstract: Free probability theory is a framework for studying noncommutative random variables, in which classical independence is replaced by free independence. It was originally developed to address longstanding problems in the theory of von Neumann algebras associated with free groups, and has since become a powerful tool for understanding universality phenomena in random matrix theory, following the groundbreaking work of Voiculescu. In this setting, limiting laws are encoded by abstract operators, known as free random variables. The interplay between operator algebras and random matrix theory has led to deep and fruitful developments. In this talk, I will survey applications across several areas, including operator algebras, probability, quantum information theory, as well as recent advances in random graphs and geometry.

In the second part of the talk, I will present recent progress on limiting distributions for a broad class of deformed random matrix models. In particular, we compute the Brown measures of a large family of free random variables, which enables the analysis of new classes of non-Hermitian random matrix models. I will also discuss applications to full-rank deformations and the behavior of outliers in large random matrices.

Contributed talks by graduate students

1. **FNU SHUMAILA**

Title: Real Interpolation of Martingale Hardy Spaces in Continuous Times

Abstract: In the article "Randrianantoanina, N. (2023). P. Jones' interpolation theorem for noncommutative martingale Hardy spaces II," we already have the real interpolation result for discrete martingale Hardy spaces. We have derived a similar result for martingale Hardy spaces in continuous times using the Bounded Mean Oscillation (BMO) space.

2. **MURAD HOSSEN**

Title: Feature-based morphological analysis of shape graph data.

Abstract: In this presentation we will introduces and demonstrates a computational pipeline for the statistical analysis of shape graph datasets, namely geometric networks embedded in 2D or 3D spaces. Unlike traditional abstract graphs, our purpose is not only to retrieve and distinguish variations in the connectivity structure of the data but also geometric differences of the network branches. Our proposed approach relies on the extraction of a specifically curated and explicit set of topological, geometric and directional features, designed to satisfy key invariance properties. We leverage the resulting feature representation for tasks such as group comparison, clustering and classification on cohorts of shape graphs. The effectiveness of this representation is evaluated on several real-world datasets including urban road/street networks, neuronal traces and astrocyte imaging. These results are benchmarked against several alternative methods, both feature-based and not.

3. **Ziheng Guo**

Title: Noise-Aware System Identification for High-Dimensional Stochastic Dynamics

Abstract: Stochastic dynamical systems are ubiquitous in physics, biology, and engineering, where both deterministic drifts and random fluctuations govern system behavior. Learning these dynamics from data is particularly challenging in high-dimensional settings with complex, correlated, or state-dependent noise. We introduce a noise-aware system identification framework that jointly recovers the deterministic drift and full noise structure directly from the trajectory data, without requiring prior assumptions on the noise model. Our method accommodates a broad class of stochastic dynamics, including colored and multiplicative noise, that scales efficiently to high-dimensional systems, and accurately reconstructs the underlying dynamics. Numerical experiments on diverse systems validate the approach and highlight its potential for data-driven modeling in complex stochastic environments.

4. **Anish Ray**

Title: A Computational Comparison of Lang-Trotter and Hardy-Littlewood Constants for CM Elliptic Curves

Abstract: In 2021, Daqing Wan and Ping Xi investigated the connection between the Lang-Trotter conjecture for CM elliptic curves and the Hardy--Littlewood conjecture on primes represented by quadratic polynomials. Assuming the Hardy-Littlewood conjecture, they derived an alternative asymptotic formula for the Lang-Trotter conjecture involving an explicit constant $\overline{\omega}_{E,r}$, and showed that the two conjectures are in fact equivalent. To reconcile their formulation with the classical version, they further conjectured that this constant coincides with the classical Lang--Trotter constant $C_{E,r}$. We verify this conjectural equality for twenty CM elliptic curves defined over $\mathbb{Q}$. These examples cover all thirteen distinct $\overline{\mathbb{Q}}$-isomorphism classes of CM elliptic curves, for which the necessary Galois-theoretic data is available through the work of Campagna and Pengo. Our computations provide new evidence supporting the conjecture and illustrate how recent structural results on Galois representations and entanglement fields can be leveraged to perform such verifications. Although we do not establish the conjecture in full generality, our work constitutes the first systematic test across all rational CM j-invariant classes.

5. **Dipanwita Bose**

Title: Maximum Likelihood Estimation of Markov Processes with censored data for the Ehrenfest model and beyond

Abstract: In previous work by Bladt and Sørensen, likelihood maximization for continuous-time Markov chains

was investigated. They demonstrated that the maximum likelihood estimator can be found either through the EM algorithm or a Markov chain Monte Carlo procedure. Albert also presented a theory for estimating the generator Q of such a Markov process, showing the existence of the maximum likelihood estimator based on finitely many independent realizations of the process. Our work first addresses the problem of estimating the infinitesimal generator Q for a finite-state, continuous-time Markov jump process X(t) when only the endpoints X(0) and X(T) of realizations are observed. After showing that the classical MLE does not exist under this extreme censoring, we introduce a regularized likelihood functional and prove it admits a maximizer. We verify these results in a series of illustrated examples: Birth and Death Processes, in particular the Lotka-Volterra equations for Predator-Prey Model and a subset of pick-up and drop-off locations of the Yellow Cab taxis in the streets of Manhattan, New York. To enforce local movement, we constrain Q so that only neighboring zones have nonzero transition rates; this sparsity constraint is naturally encoded via the graph Dirac operator, by requiring Q to lie in the subalgebra generated by D and multiplication operators. Armed with a regularized MLE for the generator Q, we also reconstruct the unobserved trajectory between X(0) and X(T). We employ a Doob−h−transform to compute the exact conditional distribution of the path at intermediate times, and then embed this within an expectation maximization framework to obtain approximationss driven from first principles. In our poster, we demonstrate how this pipeline recovers the hidden location distribution in the Birth and Death Processes, Ehrenfest traffic model and also scales to larger graphs with sparse connectivity.

6. Tian-Li Yan

Title: Was It the Park, the Gloves, or Just Bad Luck? Estimating Ballpark Effects and Team Defense

Abstract: Baseball is full of outcomes that seem to invite arguments: was that out created by the defense, the ballpark, or just bad luck? In this talk, I propose a simple and interpretable statistical framework for separating ballpark effects from team defense using Statcast data from 2015 to 2024. The method begins by estimating expected total bases from exit velocity and launch angle, giving a baseline for batted balls with similar contact quality. I then define Total Bases Residuals (TBR) as the difference between observed and expected total bases. These residuals are used in a regression model to estimate park and defensive effects simultaneously. In several cases, the resulting estimates align better with observed home-away patterns than official MLB metrics. The main idea is that once we control for how the ball was hit, we can better understand what the stadium and the defense contributed—besides the occasional baseball chaos.

7. Sajjadul Bari

Title: Evaluating Self-Supervised Learning Approaches for Image Denoising under Non-Gaussian Noise.

Abstract: Image denoising remains a cornerstone of computational imaging, yet traditional algorithms often falter when real-world noise deviates from the idealized additive white Gaussian noise model. In real-world scenarios, noise is frequently non-Gaussian and signal-dependent, making denoising significantly more challenging. In this work, we study a class of modern self-supervised denoising methods that do not require clean ground-truth data and have shown strong performance in such settings. We compare different self-supervised strategies and analyze their advantages and limitations across varying image types and noise models. Our results demonstrate that the effectiveness of these methods depends strongly on the statistical properties of the noise and the structure of the data, providing insights into their applicability in realistic imaging problems.

8. Kamrun Nahar Mily

Title: A finite element framework for simulating residential burglary in realistic urban geometries

Abstract: We study a probabilistic agent-based model of residential burglary on a two-dimensional lattice, where criminals execute biased random walks toward sites of high attractiveness. The attractiveness itself evolves through repeat and near-repeat victimization dynamics, driving the emergence of crime hotspots governed by the strength of neighborhood effects and the background attractiveness level. Taking a mean-field limit of this discrete system yields a coupled nonlinear PDE system in two variables, namely the attractiveness field and the criminal density, analogous to the Keller Segel chemotaxis model. For the numerical solution of the PDE problem discretized in time and space, we propose a scheme that
decouples the computation of the attractiveness from the computation of the criminal density at each time step, resulting in the solution of two linear algebraic systems per iteration. In this talk, we demonstrate the robustness and efficiency of this approach through numerical experiments on both simple and realistic urban geometries, and validate the continuum model against the agent-based simulations across three representative parameter regimes, showing close agreement in hotspot formation patterns when the criminal density is large.

9. Anshi Gupta

Title: Bayesian Inference of Gene Regulatory Networks at Stochastic Steady State

Abstract: Gene Regulatory Networks (GRNs) form the regulatory backbone that coordinates gene expression. The architecture of GRNs shapes their function and constraints the biochemical pathways through which information flows. Inferring the structure of regulatory interactions is thus essential for understanding biological systems, and designing targeted therapies. Despite substantial progress in GRN inference, most approaches -- from statistical methods to deep learning -- do not take into account fundamental biochemical processes that drive regulatory dynamics.
To address this shortcoming, here we present a novel Bayesian inference approach based on using the Chemical Langevin Equation (CLE) as a model of gene expression dynamics at stochastic equilibrium. Interactions in GRNs are sparse, and we thus use a regularized horseshoe prior enabling selective shrinkage of unsupported interactions while identifying strong regulatory edges. We evaluate our method using synthetic gene expression data, allowing for benchmarking against a known ground truth. Our approach allows us to infer kinetic parameters, identify network structure, and infer regulatory cycles without the need to observe transient dynamics. This Bayesian alternative to current methods thus provides both biological interpretability and structural identifiability in GRN inference.

10. Jayasinghe Arachchillage

Title: Dynamical mechanisms of how an RNN keeps a beat, uncovered with a low-dimensional reduced model

Abstract: Despite music's omnipresence, the specific neural mechanisms responsible for perceiving and anticipating temporal patterns in music are unknown. To study potential mechanisms for keeping time in rhythmic contexts, we train a biologically constrained RNN, with excitatory (E) and inhibitory (I) units, on seven different stimulus tempos (2–8 Hz) on a synchronization and continuation task, a standard experimental paradigm. Our trained RNN generates a network oscillator that uses an input current (context parameter) to control oscillation frequency and replicates key features of neural dynamics observed in neural recordings of monkeys performing the same task. We develop a reduced three-variable rate model of the RNN and analyze its dynamic properties. By treating our understanding of the mathematical structure for oscillations in the reduced model as predictive, we confirm that the dynamical mechanisms are found also in the RNN. Our neurally plausible reduced model reveals an E-I circuit with two distinct inhibitory sub-populations, of which one is tightly synchronized with the excitatory units.

11. Kenneth Evans

Title: Alternating Anderson Acceleration for fast non-negative matrix factorization.

Abstract: Alternating Anderson Acceleration (aAA(m)[s]-FP[t]) (Y. He, S. Leveque, 2025) is a generalization of the normal Anderson Acceleration (AA) method for improving convergence of fixed-point methods. Using a window size of m, the method applies the original fixed point method t times, then applies the AA method s times, alternating between these two modes periodically. Non-negative matrix factorization (NNMF) is a non-convex non-linear optimization problem popular in image processing and data mining. Existing methods for solving NNMF include Alternating Non-negative Least-Squares, Multiplicative Update, Hierarchical Alternating Least-Squares, and Block Principal Pivoting. In this talk the alternating method is leveraged to improve the convergence of these methods, illustrated through numerical experiments.