UNIVERSITY OF CENTRAL FLORIDA

COLLOQUIUM

Multi-Attractor GNNs: Set-Valued Expressivity Beyond Unique Equilibria

Speaker: Dr. Jialin Liu

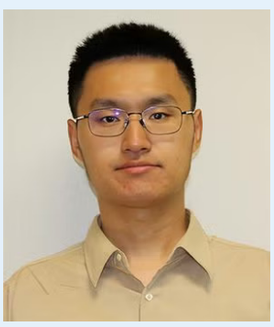
Affiliation: University of Central Florida

Abstract

Recurrent and equilibrium graph neural networks (GNNs) often enforce a unique fixed point or use one training target per graph. Yet many combinatorial and scientific problems admit multiple valid solutions, with no preferred one. A designated target can then impose an arbitrary selection rule. For tasks invariant to node relabeling, a symmetric graph may have a symmetric solution set but no symmetric solution.

We show that multiple equilibria enable one weight-tied message-passing GNN to represent set-valued equivariant maps: different initializations approach different valid solutions. Under stated regularity assumptions, we first construct globally Lipschitz, permutation-equivariant dynamics that converge almost surely to valid solutions and reach every solution branch with positive probability. We then establish approximate realization by recurrent message passing with continuous component maps, with arbitrarily small update and limiting errors and arbitrarily high probability. This goes beyond standard universality arguments: although message passing alone cannot distinguish symmetric nodes, the evolving state keeps nodes distinguishable at every finite step without auxiliary node identifiers. Such dynamics can be learned without solution labels using problem-specific energies. On Ising ground states, structural module detection in protein graphs, and chemical reaction steady states, the learned updates produce multiple high-quality predictions with high numerical convergence rates. They achieve better average solution quality than the tested unique-equilibrium, single-target, and feedforward baselines, while remaining competitive with much larger diffusion-based solvers.

Speaker Bio



Dr. Jialin Liu is an Assistant Professor in Dr. Yvette Kanouff School of Data, Mathematical, and Statistical Sciences at the University of Central Florida. His research bridges machine learning theory and AI for mathematics (optimization, partial differential equations, etc.). He previously held a Senior Algorithm Engineer position at Alibaba DAMO Academy and received his Ph.D. in Mathematics from UCLA. Dedicated to developing stable, explainable, and mathematically grounded AI, his contributions have earned top-rated and spotlight recognitions at ICLR and NeurIPS.

Event Details

- **Date:** Monday, November 9, 2026
- **Time:** 3:30 PM – 4:30 PM
- **Location:** MSB 318

Refreshments will be served from 2:30pm–3:30pm in MSB 201

Dr. Yvette Kanouff School of Data, Mathematical, and Statistical Sciences