Donald Loveland

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RESEARCH INTERESTS

I am a fourth year PhD student at the University of Michigan, Ann Arbor, focusing on fundamental questions in **machine learning**, **graph representation learning** and **graph neural networks (GNNs)**. Broadly, my research explores the learning capabilities of GNNs with respect to a graph's structural characteristics. Currently, I am investigating graph-based recommendation systems and personalization techniques to enhance user experience.

EDUCATION

University of Michigan, Ann Arbor Aug. 2021 - May 2026
Ph.D. in Computer Science Ann Arbor, MI

- **Advisor**: Danai Koutra - Graph Exploration and Mining at Scale (GEMS) Lab
- **Fellowships and Awards:** NSF Graduate Research Fellowship (GRFP), Rackham Merit Fellowship

California Polytechnic State University, San Luis Obispo Aug. 2014 - June 2018
B.S. in Physics San Luis Obispo, CA

- **Minors**: Computer Science, Mathematics, Astronomy, Ethnic Studies

RESEARCH EXPERIENCE

Amazon May 2025 - Aug. 2025
Applied Research Intern - Advised by Dr. Eddie Huang Seattle, Washington

- Research on personalized recommendations and item substitution on Amazon storefront.

Snap Research at Snap Inc. May 2024 - Aug. 2024
Research Intern - Advised by Dr. Clark Ju, Dr. Tong Zhao & Dr. Neil Shah Bellevue, Washington

- Developed an efficient training strategy for large collaborative filtering models by regularizing the singular values of the underlying embedding matrices. Comprehensive analyses demonstrated up to 65% reductions in training time while maintaining state-of-the-art performance.

MIT Lincoln Laboratory May 2023 - Sep. 2023
Research Intern - Advised by Dr. James Usevitch & Dr. Rajmonda Caceres Remote

- Developed a GNN architecture to solve continuous-cost and probabilistic bipartite assignment problems, achieving up to a 30% improvement in performance compared to previous GNN-based solvers.

MIT Lincoln Laboratory May 2022 - Aug. 2022
Research Intern - Advised by Dr. Rajmonda Caceres Remote

- Developed a gradient-based optimization method to edit graph structures and solve shortest path and substructure manipulation tasks. Performance was improved by up to 60% over heuristic and counterfactual baselines.

Lawrence Livermore National Lab Feb. 2019 - Aug. 2021
Staff Scientist Livermore, California

- Broad focus on deep learning for materials science. Highlighted research directions include explainability in image-based and graph-based deep learning systems, as well as molecular design through reinforcement learning.

PUBLICATIONS

- **D. Loveland**, C. Ju, T. Zhao, N. Shah, D. Koutra, "On the Role of Weight Decay in Collaborative Filtering: A Popularity Perspective", *KDD*, 2025
- **D. Loveland**, X. Wu, T. Zhao, D. Koutra, N. Shah, C. Ju, "Understanding and Scaling Collaborative Filtering Optimization from the Perspective of Matrix Rank", *WWW*, 2025 (**Oral Presentation - Top 10%**)
- X. Wu, **D. Loveland**, R. Chen, et al., "GraphHash: Graph Clustering Enables Parameter Efficiency in Recommender Systems", *WWW*, 2025 (**Oral Presentation - Top 10%**)
- **D. Loveland**, D. Koutra, "Unveiling the Impact of Local Homophily on GNN Fairness: In-Depth Analysis and New Benchmarks", *SDM*, 2025
- **D. Loveland**, J. Usevitch, R. Caceres, Z. Serlin, D. Koutra, "MAGNET: A Multi-Agent Graph Neural Network for Efficient Bipartite Task Assignment", *AAMAS*, 2025
- **D. Loveland**, J. Zhu, M. Heimann, B. Fish, M. Schaub, D. Koutra, "On Performance Discrepancies Across Local Homophily Levels in Graph Neural Networks", *LOG*, 2023 (**Spotlight Presentation - Top 5%)**
- **D. Loveland**, R. Caceres, "Network Design through Graph Neural Networks: Identifying Challenges and Improving Performance", *Complex Networks and Their Applications*, 2023
- **D. Loveland**, J. Zhu, M. Heimann, B. Fish, M. Schaub, D. Koutra, "On Graph Neural Network Fairness in the Presence of Heterophilous Neighborhoods", *KDD Workshop on Deep Learning on Graphs*, 2022
- J. Zhu, J. Jin, **D. Loveland**, M. Schaub, D. Koutra, "On the Relationship Between Heterophily and Robustness of Graph Neural Network", *KDD*, 2022
- **D. Loveland**, S. Liu, B. Kailkhura, A. Hiszpanski, Y. Han, "Reliable Graph Neural Network Explanations Through Adversarial Training", *ICML Workshop on Theoretic Foundation, Criticism, and Application Trend of Explainable AI*, 2021
- P. Nguyen*, **D. Loveland***, J. Kim, P. Karande, A. M. Hiszpanski, Y. Han, "Predicting Energetics Materials' Crystalline Density from Chemical Structure by Machine Learning", *Journal of Chemical Information and Modeling*, 2021
- **D. Loveland**, B. Kailkhura, P. Karande, A. M. Hiszpanski, Y. Han, "Automated Identification of Molecular Crystals' Packing Motifs", *Journal of Chemical Information and Modeling*, 2020
- B. Gallagher, M. Rever, **D. Loveland**, et al., "Predicting Compressive Strength of Consolidated Molecular Solids using Computer Vision and Deep Learning", *Materials and Design*, 2020
- S. Liu, B. Kailkhura, **D. Loveland**, Y. Han, "Generative Counterfactual Introspection for Explainable Deep Learning", *IEEE GlobalSIP*, 2019

TECHNICAL SKILLS

- **Programming Languages**: Python
- **Packages**: PyTorch, PyTorch-Geometric, Scikit-Learn, NetworkX

ADDITIONAL EXPERIENCE

Cambridge Coaching Dec. 2021 - Present

Computer Science and Math Tutor

- Tutoring students at various academic stages in courses such as high school AP computer science, undergraduate calculus, and graduate machine learning. Additionally provide admissions coaching for graduate school.

*Denotes equal contribution