

Drake B. Brown

PhD Student, Applied Mathematics
Department of Mathematics
University of Utah
2025 to present

Drakebenbrown@gmail.com
<https://github.com/brownthesr>
<https://scholar.google.com/citations?user=BEqMd74AAAAJ>

Education

- **University of Utah** *2025–2029 (projected)*
Ph.D., Applied Mathematics
GPA 4.00
Advisor: Bao Wang
Qualifying Exam Topics: ODEs, PDEs, Linear Models, Functional Analysis, Numerical Analysis
- **Brigham Young University** *2021–2025*
B.S., Applied & Computational Mathematics (ACME), CS Minor
Major GPA 4.00
Concentration: Deep Learning
Merit-based department scholarship
Undergraduate Advisor: Zachary M. Boyd

Primary Research Interests

- Generative modeling: flow matching, diffusion, score-based models, one-step generators, and steering pretrained generators via MCMC
- Geometric and equivariant deep learning; Neural ODEs for physical dynamical systems
- Graph neural networks: theory, expressivity, and equation-free methods on dynamic graphs
- Agentic systems: multi-agent dynamics, adversarial robustness, and Agent-as-a-Judge evaluation
- Optimal control and multi-agent coordination

Publications

1. **D. Brown**, T. Garrity, K. Parker, J. Oliphant, S. Carson, C. Hanson, Z. Boyd. “Beyond Linear: A Theoretical and Empirical Analysis of Nonlinear GNNs for Community Detection.” *SIAM Journal on Applied Mathematics*, in press (2026). **First author.**
2. J. Keller, ..., **D. Brown**. “Test-Time Guidance for Flow-Based Generative Models via Parallel Tempering on Source Distributions.” *International Conference on Machine Learning (ICML)*, 2026. Accepted.
3. **D. Brown**, T. Garrity, D. Perkins, D. Hunter, W. Pochman. “Optimal Control Strategies for Multi-Agent Sheep Herding.” arXiv:2510.25115, 2025. **First author.**
4. **D. Brown**, D. Perkins, D. Hunter, T. Garrity, W. Pochman. “Explorations of Epidemiological Dynamics across Multiple Population Hubs.” arXiv:2510.25085, 2025. **First author.**

Research Experience

- **Ph.D. Researcher**

2025–present

University of Utah, Department of Mathematics

- Accelerated training methods for one-step generative models with provable convergence guarantees
- Test-time steering of pretrained flow-based generators via parallel-tempering MCMC over source latents
- Equivariant Neural ODEs for chaotic gravitational dynamics (three-body problem)

- **Lead Research Assistant**

2022–2025

Graph Neural Networks Lab, BYU

- Theoretical and empirical analysis of nonlinear GNNs for community detection (*SIAM J. Appl. Math.*)
- Equation-free graph neural networks for forecasting epidemic dynamics on adaptive contact networks
- Led parallel experimentation training 200+ GNN models, generating 15M+ data points (PyTorch)

- **Computer Vision Research Intern**

Summer 2023

Air Force Research Laboratory

- Implemented momentum-based self-supervised vision models (BYOL, DINO) in PyTorch
- Outperformed state-of-the-art on STL-10 and CIFAR-100 by 4% on linear-probe accuracy

- **Research Assistant**

2022–2023

Perception, Cognition and Control Lab, BYU

- Probed what large language models encode about societal issues (inequality, racism) through generated narratives, using demographic-conditioned prompts to elicit first-person stories of observing or experiencing these phenomena
- Built an analysis pipeline embedding generated stories with sentence transformers and clustering in latent space, surfacing underlying patterns in how models represent these issues across demographic groups

Industry Experience

- **Applied Scientist Intern**

May–Aug 2026

Kiro Science, AWS • Santa Clara, CA

- Designing a self-improving multi-agent adversarial framework for measuring Agent-as-a-Judge robustness
- Taxonomizing attack-class biases and evaluating cross-model judge vulnerability transfer

- **Software Engineering Intern**

API Gateway, AWS • Denver, CO

Jun–Aug 2024; May–Aug 2025

- Re-architected Private API ingress by removing the NGINX proxy layer in favor of direct traffic handling in Protocol Service
- Designed and deployed an isolation fleet to mitigate large-scale DDoS attacks across 300K+ accounts
- Reduced p99 latency from 2000 ms to 20 ms under adversarial load; increased successful API transactions by 30%

Presentations

- **Talks**

2. Connecting the Performance of Graph Neural Network Architectures to the Properties of Training Data, BYU Student Research Conference, February 2024.
1. (Invited) Connecting the Performance of Graph Neural Network Architectures to the Properties of Training Data, 2nd SIAM Northern States Section Conference, April 2023.

- **Posters**

2. Test-Time Guidance for Flow-Based Generative Models via Parallel Tempering on Source Distributions, *International Conference on Machine Learning (ICML)*, 2026.
1. Connecting the Performance of GNN Architectures to the Properties of Training Data, Northeast Regional Conference on Complex Systems, March 2023.

- **Accepted Abstracts**

1. Global Minima, Recoverability Thresholds, and Higher-Order Structure in GNNs, Conference on Complex Systems, October 2023.

Selected Coursework

Advanced Deep Learning Stochastic Differential Equations Mathematics of Deep Learning
Linear & Nonlinear Analysis Modeling with Uncertainty in Data Algorithm Design & Optimization
Dynamics & Control Theory Advanced Programming Concepts

Awards and Honors

- Math Department Dean's List, BYU (2021–2024)
- Best Presentation Award, BYU Student Research Conference
- Outstanding Sophomore, BYU Mathematics Department
- Merit-based Department Scholarship, BYU Mathematics

Programming and Development

- **Languages:** Python, C++, Java, Rust, SQL, Bash, L^AT_EX, Git
- **Python Libraries:** PyTorch, PyTorch Lightning, PyTorch Geometric, NumPy, Pandas, NetworkX, Seaborn, Matplotlib
- **Research Areas:** Geometric Deep Learning, Generative Models, Graph Neural Networks, Neural ODEs, Optimal Control, Numerical Linear Algebra

Citizenship

United States