Brendan Mallery

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Education

Tufts University — **Medford, MA**
PhD in Mathematics — *Expected Spring 2026*

University at Albany, SUNY — **Albany, NY**
Masters of Arts in Mathematics — *Spring 2020*

Bowdoin College — **Brunswick, ME**
Bachelor of Arts in Mathematics and Chemistry — *Spring 2018*

Work Experience

Research Assistant — Medford, MA
Tufts University — *September 2022-Present*

- Ongoing work with P.I.'s Prof. James Murphy and Prof. Shuchin Aeron on applications of optimal transportation to statistics, data science and machine learning.
- Project 1: Developing nonlinear methods for decomposing high-dimensional data distributions into interpretable, low-complexity components via optimal transportation, with applications to dimensionality-reduction.
- Project 2: Developing and analyzing iterative optimization methods on probability distributions, with applications to inference, sampling, and generative modeling.

SCaN Internship Program — Remote
NASA Goddard Space Flight Center — *June-August 2022, June-August 2023*

- Developed Python software to simulate and analyze time-evolving networks, compatible with NASA's Satellite Orbit Analysis Program (SOAP).
- Defined and developed time-evolving Ricci curvature for the analysis of dynamic networks, with applications to dynamical community detection and bottleneck detection.

SCaN Internship Program — Remote
NASA Glenn Research Center — *June-December 2021*

- Worked with PI's Dr. Alan Hylton and Dr. Robert Short on applications of geometry and topology to modeling time-evolving and delay tolerant networks.

Researcher — Remote
PI: Professor Justin Curry, SUNY Albany — *June-August 2020, January-June 2021*

- Worked with P.I. Professor Justin Curry to investigate mathematical aspects of topological inverse problems arising from neuroscience.

Data Scientist — Remote
VisioStack, Inc. — *August-November 2020*

- Provided mathematical consulting for a signal processing application.
- Wrote Python software that improved upon methods for detecting events in high-noise vibration data with the goal of fault prediction, and integrated software into existing VisioStack framework.

Selected Publications

1. *Synthesis and Analysis of Data as Probability Measures With Entropy-Regularized Optimal Transport*, with Shuchin Aeron and James Murphy. *Under review.*

2. *Linearized Wasserstein Barycenters: Synthesis, Analysis, Representational Capacity, and Applications*, with Shuchin Aeron, James Murphy and Matthew Werenski. *Under review.*

3. *Temporal Distance and Curvature for the Analysis of Time-Evolving Networks*, with William Bernardoni, Robert Cardona, Justin Curry, Alan Hylton and Robert Kassouf-Short. *In progress.*

4. *From Trees to Barcodes and Back Again II: Combinatorial and Probabilistic Aspects of a Topological Inverse Problem*, with Jordan DeSha, Adélie Garin, Kathryn Hess and Lida Kanari. Accepted to CGTA Special Issue on Computational and Applied Topology Spring 2021.

All Publications

1. *Houghton-like Groups From "Shift-Similar" Groups*, with Matthew Zaremsky. Accepted to The Journal of Combinatorial Algebra, Fall 2024.

2. *Multi-domain routing in Delay Tolerant Networks* with Alan Hylton, Jihun Hwang, Mark Ronnenberg, Miguel Opez, Oliver Chiriac, Sriram Gopalakrishnan and Tatum Rask. Accepted to the 2023 IEEE Aerospace Conference.

3. *Towards Time Synchronization in Delay Tolerant Network-based Solar System Internetworking* with Alan Hylton, Natalie Tsuei, Mark Ronnenberg, Jihun Hwang, Jonathan Quartin, Colin Levaunt, and Jeremy Quail. Accepted to the 2023 IEEE Aerospace Conference

4. *A Lattice-Theoretic Perspective on the Persistence Map* with Adelie Garin and Justin Curry. Accepted March 1, 2022 to the 38th International Symposium on Computational Geometry Young Researchers Forum.

5. *Sheaf Theoretic Models for Routing in Delay Tolerant Networks* with Robert Short, Alan Hylton, Jacob Cleveland, Michael Moy, Robert Cardona, Robert Green, Justin Curry, Gabriel Bainbridge and Zara Memon. Accepted November 16, 2021 to the 2022 IEEE Aerospace Conference.

6. *Introducing Tropical Geometric Approaches to Delay Tolerant Networking Optimization* with Jacob Cleveland, Alan Hylton, Robert Short, Robert Green, Justin Curry, Devavrat Vivek Dabke, Olivia Freides. Accepted November 16, 2021 to the 2022 IEEE Aerospace Conference.

7. *A Survey of Mathematical Structures for Lunar Networks* with Alan Hylton, Robert Short, Jacob Cleveland, Olivia Freides, Zara Memon, Robert Cardona, Robert Green, Justin Curry, Sriram Gopalakrishnan, Devavrat Vivek Dabke, Brittany Story and Michael Moy. Accepted November 16, 2021 to the 2022 IEEE Aerospace Conference.

8. *Medium-scale Curvature at Larger Radii in Finitely Generated Groups*, with Robert Kropholler. Submitted to The Journal of Algebra and Computation Spring 2020.

Teaching & Mentoring

Teaching Assistant Fall 2021-Ongoing
Tufts University *Medford, MA*

- Led weekly recitation sessions, wrote problem sets, held office hours and graded problem sets for the following classes: Introduction to Mathematical Statistics with R (Spring 2024), Ordinary Differential Equations (Spring 2023), Introduction to Mathematical Modeling with Python (Spring 2022),Calculus III (Fall 2021)

Teaching Assistant Fall 2018-Spring 2021
SUNY Albany *Albany, NY*

- Tutor and grader for: Introductory Statistics, Introduction to Mathematical Probability, and Calculus (I-III) courses at SUNY Albany.

Lecturer Fall 2019
SUNY Albany *Albany, NY*

- Lecturer for Precalculus (AMAT 100) at SUNY Albany.

I have also guided several high school students through research projects on topics including spectral clustering of biomedical data, permutation statistics, and Ollivier Ricci curvature of networks.

Workshops & Conferences

SIAM Conference on Mathematical Data Science Fall 2024
Poster: Synthesis and Analysis of Data with Entropy-Regularized Optimal Transport *Atlanta, GA*

Princeton Machine Learning Theory Summer School Summer 2024
Princeton, NJ

Interacting Particle Systems Workshop at ICERM Summer 2024
Providence, RI

Optimal Transport in Data Science at ICERM Summer 2024
Providence, RI

AMS-MRC: Ricci Curvatures of Graphs and Applications to Data Science Summer 2023
Buffalo, NY

Symposium on Computational Geometry 2022 Summer 2022
Talk: A Lattice-Theoretic Perspective on the Persistence Map *Berlin, GER*

AMS-MRC: Data Science at the Crossroads of Analysis, Geometry, and Topology Summer 2022
Buffalo, NY

UPenn Applied Topology Seminar Winter 2020
Talk: Combinatorial Aspects of the Merge Tree to Barcode Inverse Problem *Philadelphia, PA*