Halley Fritze

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ACADEMIC APPOINTMENTS

University of Michigan Ann Arbor, MI
Van Loo Postdoctoral Fellow 2026-Present
Michigan Center for Applied and Interdisciplinary Mathematics

University of Michigan Ann Arbor, MI
Postdoctoral Research Fellow 2025–2026
Department of Statistics

EDUCATION

Ph.D., Mathematics, University of Oregon. 2025

- Dissertation: *Multiscale 2-Mapper: Exploratory Data Analysis Guided by the First Betti Number*
- Advisor: *Dev Sinha*

M.S., Mathematics, University of Oregon. 2021
B.S., Mathematics, North Dakota State University. 2017

- *Magna cum laude*

JOURNAL PUBLICATIONS

A forest is more than a bunch of trees: haplotypes in inferred ARGs. Halley Fritze, Peter Ralph, Nathaniel Pope, Jerome Kelleher. *Genetics*, Volume 232, Issue 1, January 2026. https://doi.org/10.1093/genetics/iyaf198.
Link to TSCompare. Link to Extend Haplotypes.

TopoBench: A Framework for Benchmarking Topological Deep Learning. Lev Telyatnikov, Guillermo Bernardez, Marco Montagna, Mustafa Hajij, Martin Carrasco, Pavlo Vasylenko, Mathilde Papillon, Ghada Zamzmi, Michael T Schaub, Jonas Verhellen, Pavel Snopov, Bertran Miquel-Oliver, Manel Gil-Sorribes, Alexis Molina, Victor Guallar, Theodore Long, Julian Suk, Patryk Rygiel, Alexander V Nikitin, Giordan Escalona, Michael Banf, Dominik Filipiak, Liliya Imasheva, Max Schattauer, Alvaro L. Martinez, Halley Fritze, Marissa Masden, Valentina Sánchez, Manuel Lecha, Andrea Cavallo, Claudio Battiloro, Matthew Piekenbrock, Mauricio Tec, George Dasoulas, Nina Miolane, Simone Scardapane, and Theodore Papamarkou. *The Journal of Data-centric Machine Learning Research*, Volume 2(20):1-39, 2025. https://data.mlr.press/assets/pdf/v02-20.pdf
GitHub Repository. Contributing Method.

PREPRINTS AND PROJECTS

Population-scale Ancestral Recombination Graphs with tskit 1.0. Ben Jeffery, Yan Wong, Halley Fritze, et al. *Submitted to nature methods*, February 2026.
Preprint

Faithful Reeb Graph Reconstruction of a Tectonic Subduction Zone from Earthquake Hypocenters. Halley Fritze, Sushovan Majhi, Marissa Masden, Atish Mitra, Michael Stickney. *Submitted to LaMatematica*, January 2026.
Preprint

Multiscale 2-mapper – exploratory data analysis guided by the first Betti number. Halley Fritze.
Preprint. GitHub Repository

The Erdös Institute Data Science Bootcamp: Foursquare Location Matching. Halley Fritze, Jay Hathaway, Max Vargas. June 2022.
GitHub Repository

ONGOING RESEARCH PROJECTS

Probabilistic Statements for Mapper Graphs. Enrique Alvarado, Robin Belton, Nicholas Della Pesca, Aine Doherty, Halley Fritze.

Neutrophil State-space Modeling: Combining morphology and dynamics. Halley Fritze, Bhagirath Mehta, Alexandra Stavrianidi, Arianna Cao, Ishani Mukherji, Dev Sinha, Ronald Davis, Sharada Kalanidhi.

Restricted Mapper Classes. Enrique Alvarado, Robin Belton, Halley Fritze.

Topological Data Analysis for Prediction for Recombination in ARGs. Halley Fritze and Jonathan Terhorst.

Extending Haplotypes to Improve Accuracy for Geographic Ancestry Inference. Isla Roy, Halley Fritze, Gideon Bradburd.

ACADEMIC RESEARCH EXPERIENCE

University of Michigan, Ann Arbor, MI. 2025–2026
Department of Statistics: Postdoctoral Research Fellow

- Advisor: *Jonathan Terhorst*
- Funding: NIH 5R35GM151145

Stanford Genome Technology Center, San Jose, CA. 2023–2025
Applied Statistician and Data Scientist Internship

- Principle Investigator: *Sharada Kalanidhi*

University of Oregon, Eugene, OR. 2019–2025
Mathematics Department: Graduate Research 2021–2025

- Advisor: *Dev Sinha*

Institute of Evolution and Ecology: Kern-Ralph Co-Lab 2022–2025

- Advisor: *Peter Ralph*

Sam Houston State University, Huntsville, TX. Summer 2016
NSF Research Experience for Undergraduates Program

North Dakota State University, Fargo, ND. 2015–2017
Ronald E. McNair Scholar

TEACHING EXPERIENCE

INSTRUCTOR OF RECORD

University of Oregon, Mathematics Department.

- **MATH 252Z:** Integral Calculus (Calculus II) Spring 2023, Winter 2022
  Riemann sums, definite integrals, and indefinite integrals for real-valued functions of a single variable. Topic sare explored graphically, numerically, and symbolically in real-life applications.

- **MATH 251Z:** Differential Calculus (Calculus I) Winter 2023, Fall 2022, Fall 2021
  Limits, continuity, derivatives, and their applications for real-valued functions of a single variable. Topics are explored graphically, numerically, and symbolically in real-life applications.

- **STAT 243Z:** Introduction to Probability and Statistics Summer 2022, Summer 2020
  A first course in statistics focusing on the interpretation and communication of statistical concepts. Introduces exploratory data analysis, descriptive statistics, sampling methods and distributions, point and interval estimates, hypothesis tests for means and proportions, and elements of probability and correlation.

TEACHING ASSISTANT

* Teach discussion sessions, grade quizzes and exams.
* Lead Teaching Assistant (appointments marked with †) duties include creating solution keys and managing other TAs.

University of Oregon, Mathematics Department.

- **MATH 241:** Calculus for Business and Social Science I Spring 2025†, Winter 2025†
  Introduction to topics in differential and integral calculus including some aspects of the calculus of several variables.

- **STAT 243Z.** Fall 2024, Fall 2023†, Spring 2022, Spring 2021

- **MATH 251Z.** Winter 2021

- **MATH 111Z:** Precalculus I Fall 2019
  A course primarily designed for students preparing for trigonometry or calculus. Focuses on functions and their properties, including polynomial, rational, exponential, logarithmic, piecewise-defined, and inverse functions.

North Dakota State University, Mathematics Department.

- **MATH 103:** College Algebra Spring 2017, Fall 2016
- **MATH 105:** Trigonometry Spring 2017, Fall 2016
- **MATH 107:** Precalculus Spring 2017, Fall 2016
- **MATH 165:** Calculus I Spring 2018, Fall 2017
- **MATH 166:** Calculus II Fall 2018, Spring 2019

GRADER

University of Oregon, Mathematics Department.

- **MATH 467/567:** Stochastic Processes Winter 2024
  Basics of stochastic processes including Markov chains, martingales, Poisson processes, Brownian motion and their applications.

- **MATH 607:** Applied Mathematics II Winter 2024
  Machine learning algorithms and methods. Topics include classification, support vector machines, regression, and hidden Markov models studied both theoretically and in application with Python. The textbook used for this course was *Pattern Recognition and Machine Learning* by Bishop.

RESEARCH MENTORSHIP

Extending Haplotypes to Improve Accuracy for GAIA. University of Michigan
Guided research with post-baccalaureate Isla Roy in the lab of Dr. Gideon Bradburd. 2025–Present

Mathematics Directed Reading Program Mentor. University of Oregon
Topolgical data analysis and applications in dynamical systems. 2024–2025
Topolgical data analysis and applications in neuroscience. 2024–2025
Modeling predator-prey systems with Lotka-Volterra equations. 2023–2024

PRESENTATIONS

EXTERNAL INVITED TALKS

Mapper through a higher dimensional perspective.
Graph Based Methods in Topological Data Analysis, Michigan State University July 2026

Probabilistic Statements for Mapper graphs.
15th AIMS Conference, National and Kapodistrian University of Athens. July 2026

A forest is more than its trees: haplotypes and inferred ARGs.
AMS Spring Central Sectional Meeting, North Dakota State University. April 2026

Topological Data Analysis for Inferring Genetic Recombination.
Topological Data Analysis Seminar, Michigan State University. November 2025

Mapper Complexes: Probabilistic Guarantees and Empirical Outcomes.
Applied Topology Seminar, SUNY Albany. November 2025

Multiscale 2-Mapper: Exploratory Data Analysis through the First Betti Number.
AMS Fall Southeastern Sectional Meeting, Tulane University. October 2025

Faithful Reeb Graph Reconstruction of a Tectonic Subduction Zone from Earthquake Hypocenters.
Invited Speaker, ATMCS 11, Montana State University. July 2025

Multiscale 2-Mapper: Exploratory Data Analysis through the First Betti Number.
Invited Speaker (Talk and Software Demo), TDV, University of Iowa. June 2025

A forest is more than its trees: haplotypes and ancestral recombination graphs.
TSKIT-dev Seminar. April 2025

Topological Exploration through higher dimensional mapper graphs.
AWM Pittsburgh Graduate Seminar, University of Pittsburgh. March 2025

Identifying orbits in atmospheric dynamical systems through temporally enriched mapper graphs.
Invited Speaker, Joint Mathematics Meetings, Seattle, WA. January 2025

Stability of higher-order covers for mapper.
Invited Speaker, Topology and Geometry Seminar, Oregon State University. November 2024

Embedded graph reconstruction under Hausdorff noise.
Invited Speaker, Fall Workshop in Computational Geometry, Tufts University. November 2024

INTERNAL TALKS

Fast Estimation of Recombination Rates using Topological Data Analysis.
Genetics Reading Seminar, University of Michigan. September 2025

2-mapper and stability for lattice covers.
Topology Seminar, University of Oregon. January 2025

Algebraic-topological tools for understanding higher-order structure in neural data.
Neuroscience Journal Club, University of Oregon. November 2024

Towers of Covers and Mapper.
Student Topology and Geometry Seminar, University of Oregon. May 2024

Inference in Hidden Markov Models.
Neuroscience Journal Club, University of Oregon. January 2024

Controllability of Nonlinear Systems.
Neuroscience Journal Club, University of Oregon. November 2023

Persistence Homology, an Overview.
Student Topology and Geometry Seminar, University of Oregon. April 2023

Topological Morphology Descriptors and Neuron Classification.
Neuroscience Journal Club, University of Oregon. March 2023

Topological Data Analysis and Tracking C. Elegans.
Student Topology and Geometry Seminar, University of Oregon. January 2023

Lefschetz Fibrations and Dehn Twists.
Topology Geometry Seminar, North Dakota State University April 2019

From Symplectic Geometry to Chaos.
Graduate Colloquium, North Dakota State University September 2018

Analysis of a Mathematical Model of the Carolina Wolfberry Plant.
Applied Mathematics Seminar, North Dakota State University August 2018

POSTER PRESENTATIONS

Multiscale 2-Mapper: Exploratory Data Analysis through the First Betti Number.
Invited Poster, Foundations of Computational Geometry and Topology, ICERM. May 2026

Multiscale 2-Mapper: Exploratory Data Analysis through the First Betti Number.
Invited Poster, ATMCS 11, Montana State University. July 2025

Enhanced topological inference through higher dimensional mapper graphs.
AWM Workshop Poster Presentations, Joint Mathematics Meetings, Seattle, WA. January 2025

CONFERENCES AND WORKSHOPS ATTENDED

Graph Based Methods in Topological Data Analysis. Michigan State University.
Invited Speaker July 2026

The 15th American Institute of Mathematical Sciences (AIMS) Conference.
Athens, Greece. July 2026
Invited Speaker for the Special Session: Topological Data Analysis Theory, Algorithms, and Applications.

Modeling and Theory in Population Biology.
Institute for Computational and Experimental Research in Mathematics. June 2026

Foundations of Computational Geometry and Topology.
Institute for Computational and Experimental Research in Mathematics (ICERM). May 2026

AMS Spring Central Sectional Meeting. North Dakota State University. April 2026

Probabilistic Modeling in Genomics Conference. March 2026
The Center for Theoretical and Evolutionary Genomics at University of California Berkeley.

AMS Fall Southeastern Sectional Meeting. Tulane University. October 2025
Invited Speaker in Advances in Applied Topology and Topological Data Analysis Special Session.

The Geometric Realization of AATRN. August 2025
Institute for Mathematical and Statistical Innovation (ISMI).

Algebraic Topology: Methods, Computation, & Science (ATMCS) 11.
Montana State University. July 2025
Accepted Abstracts for a Poster and Presentation.

Topological Data Visualization Workshop. University of Iowa. June 2025
Invited Speaker.

Joint Mathematics Meetings. Seattle, WA. January 2025
Invited Speaker and Poster Presenter.

31st Annual Fall Workshop on Computational Geometry. Tufts University. November 2024
Accepted Abstract for Presentation.

Climate Science at the Interface Between Topological Data Analysis and Dynamical Systems Theory.
Java Center, NY. June 2024
AMS Mathematics Research Communities Summer Workshop.

Topology and Geometry in Neuroscience.
Institute for Computational and Experimental Research in Mathematics (ICERM). October 2023
Workshop in ICERM Semester Program Math+Neuroscience: Strengthening the Interplay Between Theory and Mathematics.

Simons Laufer Mathematical Sciences Institute Summer Graduate School: Machine Learning.
University of California San Diego. June 2023
Topological data analysis and deep learning.

Simons Laufer Mathematical Sciences Institute Summer Graduate School: From Symplectic Geometry to Chaos.
University of California Berkeley. July 2018
Symplectic geometry and dynamics related to the n-body problem.

HONORS AND AWARDS

Van Loo Postdoctoral Fellowship, University of Michigan. 2026–Present
Marie Vitulli Scholar, University of Oregon. 2019–2020
Ronald E. McNair Scholar, North Dakota State University. 2015–2017

CONFERENCES AND JOURNALS REFEREE

Applied Topology: Methods, Computations, & Science (ATMCS) 11
Montana State University 2025

LEADERSHIP, SERVICE AND OUTREACH

COMMUNITY OUTREACH

uCodeGirl. Non-profit Organization.
Mentor 2018–2019

Sonia Kovalevsky Day. North Dakota State University
Speaker October 2018

COMMITTEE SERVICE

Mathematics Department Climate Committee. University of Oregon
Graduate Student Member 2021–2025

Graduate Topology and Geometry Seminar. University of Oregon.
Organizer 2022–2024

Association for Women in Mathematics. University of Oregon, Graduate Student Chapter.

Member of the Speaker Series Committee 2023–2024
Vice President 2022–2023
Chair of the Social and Professional Enrichment Committee 2020–2023

American Mathematical Society. University of Oregon, Graduate Student Chapter.
Department Liason 2023–2024
Member at Large 2020–2021
Founding Member 2020

American Mathematical Society. North Dakota State University, Graduate Student Chapter.
Treasurer 2018–2019

Math Club: President North Dakota State University
President 2016–2017

College of Science and Math Ambassadors. North Dakota State University
President 2016–2017

PROFESSIONAL AFFILIATIONS

American Statistical Association. Member since 2025.
The Erdös Institute. Member since 2022.
American Mathematical Society. Member since 2020.
Association for Women in Mathematics. Member since 2020.

TECHNICAL SKILLS

Programming Languages:

- Strong Proficiency: Python, LaTeX
- Proficiency: R, Java, C, C++, HTML

Software: ImageJ/Fiji