

## EDUCATION

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**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

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**A forest is more than a bunch of trees: haplotypes in inferred ARGs.** Halley Fritze, Peter Ralph, Nathaniel Pope, Jerome Kelleher. *Accepted to Genetics*, September 2025. <https://doi.org/10.1093/genetics/iyaf198>.

**TopoBench: A Framework for Benchmarking Topological Deep Learning.** Lev Telyatnikov, Guillermo Bernardez, Halley Fritze, Marissa Masden, et al. *Accepted to The Journal of Data-centric Machine Learning Research (DMLR)*, July 2025.  
Preprint

## OTHER PUBLICATIONS AND PROJECTS

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**Multiscale 2-mapper – exploratory data analysis guided by the first Betti number.** Halley Fritze, Dev Sinha. *The 11th conference in the Algebraic Topology: Methods, Computation, & Science (ATMCS)*, July 2025.  
Preprint, [GitHub Repository](#)

**Faithful Reeb Graph Reconstruction of a Tectonic Subduction Zone from Earthquake Hypocenters.** Halley Fritze, Sushovan Majhi, Marissa Masden, Atish Mitra, Michael Stickney. *The 11th conference in the Algebraic Topology: Methods, Computation, & Science (ATMCS)*, July 2025.  
Preprint

**Probabilistic Statements for Mapper Graphs.** Enrique Alvarado, Robin Belton, Nicholas Della Pesca, Aine Doherty, Halley Fritze. *Submitted to 42nd International Symposium in Computational Geometry (SoCG 2026)*.

**The Erdős Institute Data Science Bootcamp: Foursquare Location Matching.** Halley Fritze, Jay Hathaway, Max Vargas (2022).  
[GitHub Repository](#)

## ONGOING RESEARCH PROJECTS

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**Identifying orbits in atmospheric dynamical systems through temporally enriched mapper graphs.** Halley Fritze, Joshua Dorrington.

**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

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

- Advisor: *Jonathan Terhorst*

**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

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**Mathematics Department**, University of Oregon. 2019–2025  
**Instructor of Record** for the following courses:

- Introduction to Probability and Statistics (Math 243)
- Calculus I (Math 251)
- Calculus II (Math 252)

**Teaching Assistant and Grader** for the following courses:

- College Algebra (Math 111)
- Calculus for Business and Social Sciences (Math 241)  
*Lead TA: Winter 2025, Spring 2025*
- Introduction to Probability and Statistics (Math 243)  
*Lead TA: Fall 2023*
- Calculus I (Math 251)

- Stochastic Processes (Math 467/567)
- Applied Mathematics II (Math 607)

**Mathematics Department**, North Dakota State University.  
**Teaching Assistant and Grader** for the following courses:

2017–2019

- College Algebra (Math 103)
- Trigonometry (Math 105)
- College Pre-calculus (Math 107)
- Calculus I (Math 165)
- Calculus II (Math 166)

## PRESENTATIONS

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External Invited Talks

### **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, 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

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### **AMS 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

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**Marie Vitulli Scholar**, University of Oregon.

2019–2020

**Ronald E. McNair Scholar**, North Dakota State University.

2015–2017

## CONFERENCES AND JOURNALS REFEREE

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**Applied Topology: Methods, Computations, & Science (ATMCS) 11**

Montana State University

2025

## LEADERSHIP, SERVICE AND OUTREACH

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**Mathematics Directed Reading Program Mentor.** University of Oregon

Topological data analysis and applications in dynamical systems.

2024–2025

Topological data analysis and applications in neuroscience.

2024–2025

Modeling predator-prey systems with Lotka-Volterra equations.	2023–2024
<b>Mathematics Department Climate Committee.</b> University of Oregon Graduate Student Member	2021–2025
<b>Graduate Topology and Geometry Seminar.</b> University of Oregon. Organizer	2022–2024
<b>Association for Women in Mathematics.</b> University of Oregon, Graduate Student Chapter. Vice President	2022–2023
Chair of the Social and Professional Enrichment Committee	2020–2023
Member of the Speaker Series Committee	2023–2024
<b>American Mathematical Society.</b> University of Oregon, Graduate Student Chapter. Founding Member	2020
Member at Large	2020–2021
Department Liason	2023–2024
<b>uCodeGirl.</b> Non-profit Organization. Mentor	2018–2019

## PROFESSIONAL AFFILIATIONS

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

## TECHNICAL SKILLS

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### Programming Languages:

- Strong Proficiency: Python,  $\text{\LaTeX}$
- Proficiency: R, Java, C, C++, HTML

**Software:** ImageJ/Fiji