Marissa Masden

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Education

Ph.D., Mathematics (Applied Topology) University of Oregon, Eugene, OR *June 2023*

- Dissertation: Accessing the Topological Properties of Neural Network Functions
- Advisor: Dev Sinha

Bachelor's of Science, majors in **Mathematics and Chemistry** Walla Walla University, College Place, WA *June 2015*

- With honors: *summa cum laude*
- Honors program general studies
- WA State teaching certification

Papers

- **Automated Grain Boundary (GB) Segmentation and Microstructural Analysis in 347H Stainless Steel Using Deep Learning and Multimodal Microscopy.** Shoieb Ahmed Chowdhury, M. F. N. Taufique, Jing Wang, **Marissa Masden**, Madison Wenzlick, Ram Devanathan, Alan L Schemer-Kohrn, Keerti S Kappagantula. Integr Mater Manuf Innov (2024). https://doi.org/10.1007/s40192-023-00305-7
- **Algorithmic Determination of the Combinatorial Structure of the Linear Regions of ReLU Neural Networks**. **Marissa Masden** (2022). See https://arxiv.org/abs/2207.07696.
- **Local and global topological complexity measures of ReLU neural network functions.** J. Elisenda Grigsby, Kathryn Lindsey and **Marissa Masden** (2022). See https://arxiv.org/abs/2204.06062.
- **Linear discriminant intitialization for feedforward neural networks. Marissa Masden** and Dev Sinha (2019). See arxiv.org/abs/2007.12782.

Research Experience

Brown University Providence, RI *September 2023-May 2024*
Institute Postdoctoral Fellow at the Institute for Computational and Experimental Research in Mathematics (ICERM).

University of Oregon Eugene, OR *September 2017 - June 2023*
Graduate research Advisor: Dev Sinha

Pacific Northwest National Laboratory Richland, WA (remote) *Summer 2021*
NSF Math Sciences Graduate Intern (ORISE) Ram Devanathan lab

Washington State University Pullman, WA *Summers 2013-2014*
Undergraduate Research Intern Aurora Clark lab

Loma Linda University Loma Linda, CA *Summer 2013*
Biomedical Undergraduate Research Program Intern Jonathan Neihdigh lab

Teaching Experience

Mathematics Department University of Oregon, Eugene OR *2017-2023*

Instructor of Record for the following courses:

- Math 111 (College Algebra)
- Math 112 (Elementary Functions)
- Math 231 (Elements of Discrete Mathematics I)
- Math 243 (Intro. to Methods of Probability and Statistics)
- Math 251 (Calculus I)
- Math 281 (Multivariate Calculus I)
- Math 282 (Multivariate Calculus II)
- Math 341 (Linear Algebra I)

Teaching Assistant and Grader for the following courses:

- Math 243 (Intro. to Methods of Probability and Statistics)
  - Lead TA, Fall 2021
- Math 461/561 (Intro. to Mathematical Methods of Statistics I)
- Math 635-636 (Algebraic Topology)

Henrietta Lacks Health and Bioscience High School Vancouver, WA *2015-2017*

Certificated Teacher.

- Geometry. Developed curriculum meeting state standards to balance the needs of a diverse student population.
- AP Statistics. Designed post-exam interdisciplinary project alongside epidemiology teacher, introducing advanced methods for statistical analysis. Increased course enrollment by over 50% between first and second year.
- Faculty sponsor of Math Club and supervisor of after-school tutoring.

Walla Walla University College Place, WA *2011-2015*

- Contract Instructor, Developmental Geometry *Fall terms 2013 and 2014*
- Teaching Assistant, Introductory Statistics Lab *Winter 2013-2015*
- Mathematics Tutor, Teaching Learning Center *2011-2015*

Teaching portfolio at https://mmasden.github.io/teaching.

Select Presentations

Research and Invited Talks

- Topology of ReLU Neural Networks' Decision Boundaries. *Invited to speak at Data Analysis, Machine Learning and AI (DAMLAI) session in GEOTOP-A International Conference, Mérida, Mexico, January 2024.*
- Level set topology for piecewise linear functions: From ReLU neural networks to more general polyhedral domains. *Invited to speak at JMM 2024 Special Session on Applied Topology Beyond Persistence Diagrams.*
- Tracking Topological Properties of Neural Networks as they Train. *Invited to speak at Spring Topology and Dynamical Systems Conference (STDC), March 2023.*
- Topological properties of ReLU network functions, at initialization and during training. *Invited to speak at JMM 2023 Special Session Mathematical Methods in Machine Learning and Optimization*.
- Precise computation of cellular topology of neural network functions. *Invited to speak at JMM 2023 Special Session Applied Topology: Theory and Implementation*.
- Geometric Duality, Neural Networks, and Decision Boundaries. *Invited to speak at Cascade Topology Seminar, Portland State University, November 2022.*
- Exact Combinatorial and Topological Data for ReLU Networks' Linear Regions. Northeastern University Topology Seminar, May 2022.
- Persistent Homology for Machine Learning in Microstructure Analysis. NSF Math Sciences Graduate Internship 2021 Summer Presentations, Summer 2021.
- Neural Networks at Initialization. Boston College Math and Machine Learning Seminar, Boston College, Fall 2020.

Expository Talks and Posters

- Piecewise Linear Morse theory: An overview. Geometry-Topology Seminar, Oregon State University, Fall 2021.
- Understanding ReLU Activation Patterns through the Sign Sequence Cubical Complex. Poster at Applied Algebraic Topology Network Poster Session, Fall 2021.
- Using Persistence Signatures in Machine Learning. Geometry-Topology Seminar, Oregon State University, Spring 2020.
- Understanding Neural Networks through Geometry. 1st Midwest Graduate Student Conference: Geometry and Topology Meet Data Analysis and Machine Learning, The Ohio State University, 2019

Conferences and Workshops Attended

- **GEOTOP-A International Conference on Applications of Geometry and Topology**. Merida, Mexico, January 2024. *Invited to speak in session on applications in Data Science, Machine Learning and AI.*
- **Joint Mathematics Meetings, 2024.** San Francisco, California, January 2024. *Invited to speak at AMS Special Session on Applied Topology Beyond Persistence Diagrams.*
- **Neural Coding and Combinatorics.** Providence, Rhode Island, September 2023. Workshop in ICERM Semester Program Math + Neuroscience: Strengthening the Interplay Between Theory and Mathematics.
- **Topology and Geometry in Neuroscience.** Providence, Rhode Island, September 2023. Workshop in ICERM Semester Program Math + Neuroscience: Strengthening the Interplay Between Theory and Mathematics.
- **Mathematical Challenges in Neuronal Network Dynamics.** Providence, Rhode Island, September 2023. Workshop in ICERM Semester Program Math + Neuroscience: Strengthening the Interplay Between Theory and Mathematics.
- **Joint Mathematics Meetings 2023.** Boston, Massachusetts, January 2023. *Invited to speak at AMS Special Session on Mathematical Methods in Machine Learning and Optimization* and *AMS Special Session on Applied Topology: Theory and Implementation.*
- **Cascade Topology Seminar.** Fariborz Maseeh Department of Mathematics and Statistics, Portland State University, Portland OR, November 2022. *Invited to speak, awarded travel funding*.
- **Institute of Advanced Studies 2022 Women and Mathematics program: The Mathematics of Machine Learning.** Princeton, NJ, May 2022.
  One of 50 attendees to a program focused on interpretable and distributed machine learning.
- **Oxford Applied Topology School.** University of Oxford, Oxford, UK, March 2020.
  Awarded travel funding. Cancelled due to COVID-19.
- **Neural Information Processing Systems (NeurIPS).** Vancouver, BC, Canada, December 2019.
- **FRG Workshop on Discrete Shapes.** University of California, Davis, 2019.
  Awarded travel funding.
- **The 1st Midwest Graduate Student Conference: Geometry and Topology meet Data Science and Machine Learning.** The Ohio State University, 2019. *Speaker, awarded travel funding.*

Honors and Awards

University of Oregon

- *NSF Research Training Grant*, UO Mathematics Department — Summer 2022
- *Johnson Fellowship*, UO Mathematics Deparatment — Summer 2019
- *Dean's First Year Merit Award*, UO Mathematics Department — AY 2017-2018

Walla Walla University

- *Schofield Memorial Scholarship*, WWU Education Department — 2015
- *Honors Program Scholarship*, WWU Honors General Studies Program — 2015
- *Schottlauer Math Scholarship*, WWU Mathematics Department — 2015
- *M&I Johnstone Scholarship*, WWU Mathematics Department — 2014-2015
- *President's Scholarship for National Merit Scholars*, WWU — 2010-2014
- *C&L Jones Chemistry Scholarship*, WWU Chemistry Department — 2010-2011

Boeing National Merit Scholarship — 2010-2011

Leadership, Service and Outreach

Association for Women in Mathematics, UO Student Chapter

- President, AY 2020-2021 and 2022-2023
- Secretary, AY 2019-2020

UO AWM K-12 Outreach Committee member 2018-2023; co-chair 2019-2023.
Coordinated teams of two-six volunteers and budgeted materials. Established post-pandemic chapter involvement in:

- Girls' Science Adventure Days, Eugene Science Center, with Women in Graduate Sciences (WiGS). Co-designed and led *Math Games* (2023) and *Mathemagic and Maps* (2022), two three-hour enrichment programs for 10-15 girls in grades 4-6.
- Eugene Math Festival (2023). Independently developed two activity booths, *Math Doodling* and *Mystery Shadows*.
- Willagillespie Math and Science Night (2023). Selected activities and coordinated volunteers for three math-focused activity booths at a local elementary school's math and science night.

Directed Reading Program Mentor, University of Oregon Mathematics Department AY 2021-2022

- Lead an undergraduate through a 12-week directed reading on finite-state Markov chains and stochastic processes. Selected readings and appropriate problems, designed code exercises in Jupyter notebooks, and met 1-2 hours weekly.
- Guided the undergraduate through preparing a 10-minute academic mathematics talk about Markov chains and absorbing states to their peers.

American Mathematical Society, UO Student Chapter

- Departmental Liaison (elected position), 2021-2022

Graduate Affairs Committee, UO Mathematics Department

- Graduate student representative (nominated position), 2018-2020
- Graduate Student Peer Mentor, 2019-2023

Graduate Student Mathematics Teaching Seminar, UO Mathematics Department

- Co-organizer, 2019-2023

Professional Affiliations

American Mathematical Society (AMS) member 2021-present

Association for Women in Mathematics (AWM) member 2019-present