Nathaniel B. Monson, Ph.D

Contact: nmonson1@gmail.com **Location:** San Francisco, CA

Education

University of Maryland, College Park
Ph.D in Mathematics - 2022

Swarthmore College
Bachelor of the Arts (High Honors) - 2008

Research Interests

I am intensely focused on exploring the mechanisms behind the efficacy of modern ML techniques. In addition to being theoretically fascinating, I think gaining a greater understanding of these issues is potentially existentially critical. Currently, my ambition is to use interpretability tools to extract objective functions from complex models. While my background is primarily in computational topology and secondarily in algebraic geometry, I have been dedicated to AI and alignment work since spring of 2022.

Current Position

Independent AI Researcher
Supported by a grant from Effective Altruism Funds (Long-Term Future Fund)

Research Experience

University of Maryland, College Park
Advisors: Wojciech Czaja, Patrick Brosnan 2017-2022
- Thesis: Topological Data Analysis, Dimension Reduction, and Computational Efficiency
- Discovered and proved a novel result on the stability of persistent homology
- Demonstrated its usefulness for dimension reduction methods in computational topology
- Conducted numerical experiments measuring practical impact

Pacific Northwest National Laboratory
National Security Intern Program 03/2022-10/2022
- Investigated uses of topological data analysis for object detection in image data
- Created and trained bespoke convolutional neural nets in pytorch for vessel identification
- Investigated novel data augmentation techniques for topological data

Brigham Young University
Mathematics Researcher, Advisors: Michael Dorff, Denise Halverson, Gary Lawlor 06/2006-08/2006
- Worked on a research experience for undergraduates (REU) funded in part by the NSF
- Researched geometrical optimization with a focus on a variant of the isoperimetric problem

Other Professional Experience

Garoux, LLC
AI consultant for Michael Kriesel 02/2023-present
- Worked on questions involving data featurization for neural nets
- Identified SotA architectures and methods for various problem types

Stanford Existential Risks Initiative
ML/Alignment Theory Scholars Program (SERI-MATS), Advisor: John Wentworth 11/2022-12/2022
- Studied AI agent foundations questions
- Curriculum includes a wide variety of ML subjects, especially focused on robustness, distribution shift, and foundational questions

University of Maryland, College Park
Lecturer and Teaching Assistant 08/2010-12/2021
- Taught courses ranging from high school algebra to real analysis
- Explained technical mathematical concepts to non-technical audiences

LECG, LLC
Associate – Promoted from Research Analyst 08/2008-07/2010
- Applied and interpreted financial models
- Performed economic analyses and summarized data-sets with SQL

• Assisted in the preparation of expert witness reports

Swarthmore College
Joel Dean Research Fellow 05/2007-08/2007
• Read, abstracted, and summarized law review articles
• Identified critical points of the Congressional Record

Smart Documents, Inc.
Programmer 07/2002-05/2006
• Automated documents, including legal agreements
• Used technical software to create automated templates for legal documents

Selected Conferences

Summit on Singular Learning Theory Summer 2023, Berkeley, CA

FFT (February/Faraway Fourier talks) 2017-2022, College Park, Maryland

Workshop on Torsors, Motives and Cohomological Invariants Fields Institute, Toronto

Various JMMs (Joint Mathematics Meetings) 2008-2018

International Conference of Machine Learning 2022, Baltimore, MD
Topology Algebra Geometry (TAG) workshop
Principles of Distribution Shift (PoDS workshop

Publications

Topological Data Analysis, Dimension Reduction, and Computational Efficiency
Monson, Nathaniel, *2022, University of Maryland, Ph.D dissertation*

A Generalization of a Classic Stability Result in Persistent Homology
Monson, Nathaniel *2023, In progress*

Using Diffusion Techniques for Graph Neural Nets to Improve Convolutional Neural Nets
Fowl, Liam and Monson, Nathaniel *2023, In progress*

Unmanned Aircraft Applications in Radiological Surveys
Kochersberger, Kevin, et al.
2018 IEEE International Symposium on Technologies for Homeland Security (HST), IEEE, 2018

Scholarships & Awards

Long Term Future Fund Grant 2023

Lightcone Infrastructure Lightspeed Grant 2023

Nominated for 3 Excellence in Teaching Awards at University of Maryland

Dean's Fellow and Recipient of Academic Excellence Award 2010-2012, 2010-2011

McDiarmid & Ivins Scholar of Note for Academic Achievement 2007-2008

Placed in Top 400 in the William Lowell Putnam Competition in Mathematics 2006