

Karen Medlin

PH.D. CANDIDATE IN APPLIED MATHEMATICS

University of North Carolina at Chapel Hill
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SUMMARY

- Applied Math Ph.D. Candidate developing novel machine learning algorithms using optimization and statistics to improve classification on imbalanced datasets. Expected graduation: May 2025.
- Experienced in modeling real-world systems, including virus behavior in the human respiratory tract, with high-performance computing.
- Proficient in Python (PyTorch, TensorFlow, scikit-learn, pandas, NumPy), Java, and R; HPC tools (Bash, Vim); and Git version control.
- Cross-disciplinary collaborator with experience at an R1 university, a national lab, and a major arts organization—bringing adaptability and a broad perspective to research teams.
- Recognized by the NSF, DOE, and UNC for contributions to machine learning and applied mathematics, including multiple research fellowships.

EDUCATION

University of North Carolina at Chapel Hill, Chapel Hill, NC
Ph.D. Applied Mathematics (M.S. in Mathematics, 2022) 2019 – 2025 (expected)
Co-advisors: Greg Forest, Sven Leyffer¹

- Dissertation: Developed a multi-objective bilevel optimization framework for learning from imbalanced data. The method integrates novel sampling strategies into standard deep learning pipelines, improving accuracy on underrepresented classes. First-author papers submitted to ICML, AAAI, and NeurIPS.
- M.S. project: Simulated virus behavior in the human respiratory tract using Python and HPC tools.
- Relevant coursework: Machine Learning, Optimization, Numerical Analysis, Scientific Computing, Probability, Statistical Modeling, Data Structures.

IBM Research, Almaden, CA
MSRI Summer Graduate School: Mathematics of Data — Sketching and Tensor Algebra 2023

University of Washington, Seattle, WA
Graduate coursework in mathematics 2018 – 2019

City University of New York, New York, NY
Post-baccalaureate coursework in mathematics, programming, and statistics 2014 – 2018

¹ Senior Computational Mathematician Dr. Sven Leyffer is Deputy Division Director of the Mathematics and Computer Sciences Division at Argonne National Laboratory.

RESEARCH & PUBLICATIONS

Karen Medlin, Sven Leyffer and Krishnan Raghavan. Sampling Imbalanced Data with Multi-objective Bilevel Optimization, 2025. (under review at ICML)

Karen Medlin, Sven Leyffer and Krishnan Raghavan. A Bilevel Optimization Framework for Dynamically Correcting Imbalance in Two-class Classification Problems, 2025.(accepted at IJCNN)

Leyi Zhang, Karen Medlin, Greg Forest, et al. Computational Modeling Insights into Extreme Heterogeneity in COVID-19 Nasal Swab Data. *Viruses*, 16(1): 69, 2024.

Nathan Davidov, Karen Medlin, et al. Maximum Covering Subtrees for Phylogenetic Networks. *IEEE/ACM Transactions on Computational Biology and Bioinformatics*, 18(6): 2823-2827, 2021.

AWARDS & CERTIFICATES	UNC Dissertation Completion Fellowship	2024 - 2025
	U.S. Department of Energy Office of Science SCGSR Fellowship	2023 - 2024
	National Science Foundation Math Sciences Graduate Internship	2022, 2023
	UNC ARPA Graduate Degree Completion Grant (Master's degree)	2021 - 2022
	Introduction to High Performance Computing (HPC) Certificate Super Computing Conference (SC22)	Nov. 2022

WORK EXPERIENCE	Graduate Research Fellow	2019 – present
	University of North Carolina at Chapel Hill, Mathematics Department	
	<ul style="list-style-type: none"> • Developed bilevel optimization algorithms to address data imbalance in deep learning, with applications in fairness-aware modeling. • Led research projects bridging applied mathematics and machine learning, culminating in publications and submissions to top venues (e.g., NeurIPS, ICML). 	
	Graduate Research Fellow (SCGSR)	2022 – 2024
	Argonne National Laboratory, Mathematics and Computer Science Division	
	<ul style="list-style-type: none"> • Designed multi-objective optimization methods for learning from imbalanced and structured data, with emphasis on generalization and model robustness. • Worked with Sven Leyffer and Krishnan Raghavan to explore applications of mathematical programming to machine learning. • Initiated work as NSF Math Sciences Graduate Intern (2022); project matured into central component of dissertation research. 	
	Senior Grants Manager	2012 – 2017
	The Joyce Theater Foundation, Inc., New York, NY	
	<ul style="list-style-type: none"> • Managed public and private funding portfolios supporting supporting The Joyce's internationally recognized dance performance programming. • Raised over \$1M in new revenue, contributing to a 50% increase in contributed income and supporting multi-year institutional growth. • Bridged strategy and execution through cross-functional collaboration, narrative framing, and evidence-based reporting. 	

TEACHING EXPERIENCE	Recitation Leader	
	<ul style="list-style-type: none"> • Math 233: Calculus III, UNC Chapel Hill • Math 232: Calculus II, UNC Chapel Hill • Math 125: Calculus with Analytic Geometry II, Univ. of Washington 	Fall 2023 Spring 2023 Fall 2018, Winter 2019, Spring 2019
	Assistant	
	<ul style="list-style-type: none"> • Math 347: Linear Algebra for Applications, UNC Chapel Hill • Math 566: Introduction to Numerical Analysis, UNC Chapel Hill • Math 381: Discrete Mathematics, UNC Chapel Hill 	Fall 2020, 2021, 2022 Fall 2020 Spring 2019

CONFERENCES, TALKS & POSTERS	International Joint Conference on Neural Networks (IJCNN) Rome, Italy Talk: A Bilevel Optimization Framework for Dynamically Correcting Imbalance in Two-class Classification Problems	June 2025
	SIAM Conference on the Mathematics of Data Science (MDS24) Atlanta Minisymposium: Towards a Notion of Model Correctness for Deep Learning Poster: Classifying Imbalanced Data	Oct. 2024
	National Science Foundation's MSGI Symposium Talk: Classifying Imbalanced Data	Aug. 2023
	BMCC/CUNY Annual Research Symposium Borough of Manhattan Community College Talk: The Perceptron: An Introduction to Machine Learning	May 2017
	Joint Mathematics Meeting Poster: The Perceptron: An Introduction to Machine Learning	Jan. 2017
PROFESSIONAL AFFILIATIONS	Association for Computing Machinery/IEEE Computer Society • Supercomputing Conferences Student Volunteer, SC22-SC23	2022 - present
	Society for Industrial and Applied Mathematics (SIAM) • National Math Festival Student Volunteer, April 2021	2019 - present
	Association for Women in Mathematics (AWM) • Local UNC chapter Treasurer, 2021-2022	2018 - present