University of North Carolina at Chapel Hill
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Karen Medlin

Ph.D. Candidate in Applied Mathematics

Summary

- Applied Math Ph.D. Candidate applying optimization, statistics and numerical methods in the development of novel ML/AI algorithms for handling imbalanced datasets. Expected graduation in May 2025.
- Experience developing and deploying mathematical models for real-world problems, with specific investigation into airborne viruses inside the human respiratory tract.
- Coding proficiency in Python (including PyTorch, TensorFlow, sci-kit learn, pandas, NumPy), Java and R; with Git version control.
- Proven ability to work across diverse fields, including experience at an R1 research university, a national lab and a globally recognized arts organization, showcasing versatility and collaboration skills with multidisciplinary teams.
- Track record of accomplishment having been awarded fellowships from the National Science Foundation and the U.S. Department of Energy.

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 Leyffer[1], Krishnan Raghavan[1]

- Dissertation research: Developing ML algorithms to address the common challenge of model bias caused by imbalanced data. Introducing novel sampling techniques while employing standard deep neural networks for training and testing, the algorithms are featured in first-author publications being submitted to conferences such as AAAI, ICML, ICLR, and NeurIPS. To create new sampling approaches that deliver superior performance results, we leverage classic math tools from optimization alongside new tools from the PyTorch library.
- Master's project: Deployed a numerical model of the human respiratory tract to investigate how airborne viruses, including variants of Covid-19, travel and grow upon entering our nasal passages. Worked in Python and ran simulations on a Linux-based supercomputer.
- Courses: data structures, machine learning, mathematics of data science, numerical linear algebra, optimization, probability, scientific computing, and statistical modeling

IBM Research, Almaden, CA
Attended the MSRI/Simons Laufer Mathematical Sciences Institute's (SLMath) summer school "Mathematics of Data: Sketching and Tensor Algebra" Summer 2023

University of Washington, Seattle, WA
Masters degree coursework in mathematics 2018 - 2019

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

1 Computational Mathematicians Drs. Leyffer and Raghavan work in the Mathematics and Computer Sciences Division at Argonne National Laboratory.

Papers

Karen Medlin, Sven Leyffer and Krishnan Raghavan. A Bilevel Optimization Framework for Imbalanced Data Classification. *arXiv CoRR, abs/2410.11171*, 2024. (pre-print)

Leyi Zhang, Han Cao, Karen Medlin, Jason Pearson, Andreas C. Aristotelous, Alexander Chen, Timothy Wessler and M. Gregory Forest. Computational Modeling Insights into Extreme Heterogeneity in COVID-19 Nasal Swab Data. *Viruses*, 16(1): 69, 2024.

Nathan Davidov, Amanda Hernandez, Justin Jian, Patrick McKenna, Karen Medlin, Roadra Mojumder, Megan Owen, Andrew Quijano, Katherine St John, Katherine Thai and Meliza Uraga. 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 Nov. 2022
Super Computing Conference (SC22)

Data Science Certificate Summer 2018
Principal Analytics Prep

- Awarded scholarship to attend 200+ hours of in-person instruction from 20 senior industry professionals with expertise in: Python, R, SQL, AWS, A/B testing; statistical reasoning and modeling; data wrangling and visualization; and business strategy.

Minority Science Education Improvement Program Grant 2017, 2018

Work Experience

Graduate Research/Teaching Assistant 2019 - present
UNC Chapel Hill Mathematics Department, Chapel Hill, NC

U.S. Department of Energy Graduate Fellow 2022 - 2024
Argonne National Laboratory, Darien, IL

- Working on team led by Sven Leyffer and Krishnan Raghavan, developed a novel algorithm and its theoretical underpinnings featured in my first first-author paper.
- Began what became my dissertation while working in the Laboratory for Applied Mathematics, Numerical Software and Statistics (LANS) group as a NSF MSGI summer intern.

Senior Grants Manager 2012 - 2017
The Joyce Theater Foundation, Inc., New York, NY

- Exceeded fundraising targets year over year for an operational budget of $10+ million. Increased annual contributed income by $1 million (50%) over five years.

Teaching Experience

Recitation Leader

- Math 233: Calculus III, UNC Chapel Hill Fall 2023
- Math 232: Calculus II, UNC Chapel Hill Spring 2023
- Math 125: Calculus with Analytic Geometry II, Univ. of Washington Fall 2018, Winter 2019, Spring 2019

Assistant

- Math 347: Linear Algebra for Applications, UNC Chapel Hill Fall 2020, 2021, 2022
- Math 383: First Course in Differential Equations, UNC Chapel Hill Fall 2021, 2022
- Math 566: Introduction to Numerical Analysis, UNC Chapel Hill Fall 2020
- Math 381: Discrete Mathematics, UNC Chapel Hill Spring 2019

Conferences, Talks & Posters

SIAM Conference on the Mathematics of Data Science (MDS24) Oct. 2024
Minisymposium: Towards a Notion of Model Correctness for Deep Learning
Poster: Classifying Imbalanced Data

National Science Foundation's MSGI Virtual Symposium Aug.2023
Talk: Classifying Imbalanced Data

Triangle Computational and Applied Mathematics Symposium Sept. 2022
North Carolina State University
Lightning Talk and Poster: To Classify Imbalanced Data Correctly, Find the Best ~~Model~~ Data

Underrepresented Students in Topology and Algebra Research Symposium (USTARS) Apr. 2018
Reed College
Poster: Neural Networks and the Shape of Data

BMCC/CUNY Annual Research Symposium May 2017
Borough of Manhattan Community College
Talk: The Perceptron: An Introduction to Machine Learning

Joint Mathematics Meeting Jan. 2017
Poster: The Perceptron: An Introduction to Machine Learning

Community Service

Graduate Mathematics Association 2019 - present
UNC Chapel Hill Mathematics Department
- Treasurer, 2021-2022

Anti-Racism Community Group (ARC) 2020 - 2022
UNC Chapel Hill Mathematics Department
- Founder and Organizer

UNC Chapel Hill Mathematics Department 2020 - 2022
Invited Speaker
- Facilitated workshop on unconscious bias during the Graduate Student Teaching Seminar.
- Spoke about UNC Math's ARC group to prospective graduate students.

Professional Affiliations

Association for Computing Machinery/IEEE Computer Society 2022 - present
- Supercomputing Conferences Student Volunteer, SC22-SC24

Society for Industrial and Applied Mathematics (SIAM) 2019 - present
- National Math Festival Student Volunteer, April 2021

Association for Women in Mathematics (AWM) 2018 - present
- Local UNC chapter Treasurer, 2021-2022

Reference Contact Information

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