Elizabeth Newman $\mid$ Curriculum Vitae

Department of Mathematics

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pronouns: she/her/hers

Professional Information

Emory University, Department of Mathematics

Assistant Professor	2022 – present
Distinguished Visiting Assistant Professor in Scientific Computing	2019 – 2022

Emory University, NSF REU/RET Computational Mathematics for Data Science

Mentor	Summer 2023, 2021
Executive Board Member	Summer 2021

Spelman-Morehouse Directed Reading Program

Mentor	Spring 2022, Fall 2021

Previous Positions

Tufts University	Research and Teaching Assistant	2014 – 2019
Mathnasium Sudbury	Instructor	2015 – 2019
IBM TJ Watson Research Center	Visiting Scholar	Summer 2017, 2018
Haverford College	MQC Employee	2012 – 2014
University of Minnesota	MAXIMA REU Participant	Summer 2013
Carnegie Melon University	SUAMI Participant	Summer 2012

Education

Ph.D.	Tufts University, Department of Mathematics Thesis: *A Step in the Right Dimension: Tensor Algebra and Applications* Advisor: Misha Kilmer	2014 – 2019
M.S.	Tufts University, Department of Mathematics	2014 – 2016
B.S.	Haverford College, Department of Mathematics and Statistics Major: Mathematics, Minor: Statistics and Psychology Thesis: *Understanding Bruhat Order for Hyperbolic Coxeter Groups* Advisor: Elizabeth Miličeviç (née Beazley)	2010 – 2014
Member	Haverford Varsity Women's Soccer and Softball Teams All-Conference: 2011 – 2014 Conference Honor Role: 2010 – 2014	2010 – 2014

Research Interests

numerical (multi)-linear algebra, deep learning, optimization, scientific computing, reinforcement learning, and more

Funding and Awards

Grants

[G3] Building open machine-learning benchmarks: improving pipelines for blended data and performance evaluation frameworks
        September 1, 2023 – August 31, 2025
Source: *SANDIA National Laboratories LDRD*
PI(s): Amelia Henriksen (Sandia)
Co-PI(s): Miranda Mundt (Sandia), Tomas Babuska (Sandia), Andy Wilson (Sandia), Danny Dunlavy (Sandia), Elizabeth Newman (Emory)
Amount: $140,000

[G2] Learnable Tensor Algebras for Harnessing Implicit Correlations in Multiway Data
        September 1, 2023 – August 31, 2026
Source: *NSF DMS-2309751*
PI(s): Elizabeth Newman
Co-PI(s): —
Amount: $230,000

[G1] AI-Assisted Social Justice in Tissue and Organ Biomanufacturing
        January 1, 2023 – December 31, 2023
Source: *Emory/Georgia Tech AI.Humanity with a Social Justice Lens*
PI(s): Saman Zonouz (Georgia Tech), Vahid Serpooshan (Emory, Georgia Tech)
Co-PI(s): Aaron Levine (Georgia Tech), Elizabeth Newman (Emory)
Amount: $100,000

Research Awards

[A1] Best Poster   June 2022
XXI Householder Symposium on Numerical Linear Algebra

Travel Awards

[T6] Postdoctoral Association Professional Development Award   January 2022
[T5] SIAM Student Travel Award   February 2019
[T4] Gradute Student Travel Fund   February 2019
[T3] SIAM Student Travel Award   May 2018
[T2] Conference Student/Post-doc Travel Awards   May 2018

[T1]   Gradute Student Travel Fund   June 2018

Teaching Awards

[T1]   Distinguished Teaching Prize   Fall 2016 – Spring 2017
        Tufts University Department of Mathematics

Scholarly Work

In Preparation

[IP4]   MRI-based auto-Segmentation in Pituitary macro-adenomas using
        Convolutional Neural Networks: Methodology, Results and Potential
        application

[IP3]   Learnable Tensor Algebras: Optimal Tensor-Tensor Products via
        Variable Projection
        E. Newman and K. Keegan

[IP2]   GNFlow: Towards Fast and Automated Reinforcement Learning
        E. Newman, K. Kan, L. Ruthotto, and B. Peters

[IP1]   Gauss-Newton for Deep Neural Networks
        L. Ruthotto, E. Newman, D. Verma, S. Wu Fung

Submitted

[S4]   Stable Tensor Neural Networks for Efficient Deep Learning   January 2024
        E. Newman, L. Horesh, H. Avron, and M. Kilmer
        Frontiers in Big Data: Statistical Inference for Tensor Data

[S3]   Fast & Fair: Efficient Second-Order Robust Optimization for Fairness   February 2024
        in Machine Learning
        H. Anh Vu, A. Minch, and A. Warren
        SIAM Undergraduate Research Online

Preprints

[Pre2] Image Reconstructions Using Sparse Dictionary Representations and   December 2023
        Implicit, Non-negative Mappings
        E. Newman, J. M. Solomon, and M. Chung

[Pre1] Stable Tensor Neural Networks for Rapid Deep Learning   November 2018
        E. Newman, L. Horesh, H. Avron, and M. Kilmer

Journal Articles

[J5]   slimTrain - A Stochastic Approximation Method for Training Separable Deep Neural Networks   August 2022
E. Newman, J. Chung, M. Chung, and L. Ruthotto
SIAM Journal on Scientific Computing

[J4]   hessQuik: Fast Hessian Computation of Composite Functions   April 2022
E. Newman and L. Ruthotto
Journal of Open Source Software

[J3]   Tensor-Tensor Algebra for Optimal Representation and Compression of Multiway Data   July 2021
M. Kilmer, L. Horesh, H. Avron, and E. Newman
Proceedings of the National Academy of Sciences

[J2]   Train Like a (Var)Pro: Efficient Training of Neural Networks with Variable Projection   October 2021
E. Newman, L. Ruthotto, J. Hart, and B. van Bloemen Waanders
SIAM Journal on Mathematics of Data Science

[J1]   Non-negative Tensor Patch Dictionary Approaches for Image Compression and Deblurring Applications   October 2021
E. Newman and M. Kilmer
SIAM Journal on Imaging Sciences

Conference Proceedings

[CP2]   AI/ML-derived mechanistically-interpretable whole-genome biomarkers of patient survival in pre-treatment primary neuroblastoma tumors and whole blood   2024
O. Alter, E. Newman, S. Ponnapalli, and J. Tsai
American Society of Clinical Oncology

[CP1]   Image Classification Using Local Tensor Singular Value Decompositions   2017
E. Newman, M. Klimer, and L. Horesh
IEEE 7th International Workshop on Computational Advances in Multi-Sensor Adaptive Processing (CAMSAP)

Patents

[Pat2]   System and Method for Optimal Multidimensional Data Compression by Tensor-tensor Decomposition   March 2019
Klimer (Tufts), Horesh (IBM), Avron (Tel Aviv), and Newman (Tufts)
Patent reference P201807026US01

[Pat1]   Generating and Managing Deep Tensor Neural Networks   November 2018
Klimer (Tufts), Horesh (IBM), Avron (Tel Aviv), and Newman (Tufts)
Patent reference P201803885US01

Code Repositories

[R7]	DL4IP: Dictionary learning for inverse problems	2023
[R6]	fast-n-fair: Fast adversarial training for fair machine learning	2023
[R5]	tnn: A lightweight repository for tensor neural networks and stable architectures.	2023
[R4]	hessQuik: Computing gradients and Hessians of feed-forward networks with GPU acceleration	2022
[R3]	slimTrain: Sampled Limited-Memory DNN Training using Pytorch	2022
[R2]	tensor-fmri: Tensor-based approaches for fMRI classification	2021
[R1]	Meganet.m: A fresh approach to deep learning written in MATLAB	2019 – present

Advised Publications

[A2]	A Tensor SVD-based Classification Algorithm Applied to fMRI Data	August 2022
	K. Keegan, T. Vishwanath, and Y. Xu	
	SIAM Undergraduate Research Online	
	Third Place, *The Undergraduate Statistics Project Competition*	

Conferences, Workshops, and More

Upcoming

[U7]	Modeling and Optimization: Theory and Applications (Presenter)	August 2024
[U6]	SIAM Conference on the Mathematics of Data Science (Organizer)	October 2024
[U5]	SIAM Annual Meeting (Organizer)	July 2024
[U4]	SIAM Conference on Imaging Science (Organizer)	May 2024
[U3]	SIAM Conference on Imaging Science (Presenter)	May 2024
[U2]	ICMS Workshop on Big Data Inverse Problem (Presenter)	May 2024
[U1]	SIAM Conference on Applied Linear Algebra (Presenter)	May 2024

Conference Organizer

[O1]	Georgia Scientific Computing Symposium	February 2024

Plenary Speaker

[P1]	Georgia Scientific Computing Symposium	February 2023

Workshops

[W11]	ICERM Connecting Higher-Order Statistics and Symmetric Tensors	January 2024
[W10]	Workshop on Sparse Tensor Computations	October 2023
[W9]	AFOSR Computational Math Annual Review	August 2023
[W8]	Emory University NSF CAREER Academy	June 2023
[W7]	BIRS Workshop: Scientific Machine Learning	June 2023

[W6]	Scientific Machine Learning for Complex Systems: Beyond Forward Simulation to Inference and Optimization	October 2022
[W5]	ICERM Spring 2020 Reunion Event	May 2022
[W4]	Rising Stars 2022	April 2022
[W3]	Simons Institute: Workshop on Dynamics and Discretization: PDEs, Sampling, and Optimization	October 2021
[W2]	ICCV 2021 Workshop on Topology, Algebra and Geometry in Computer Vision	October 2021
[W1]	BIRS Workshop: Optimization under Uncertainty: Learning and Decision Making	February 2021

Minisymposium Organizer

[O6]	SIAM Conference on Optimization	May 2023
	Efficient Optimization In High Dimensions	
[O5]	AMS Sectional Meeting	March 2023
	Special Session on Recent Advances and Applications in Imaging Sciences	
[O4]	Joint Mathematics Meeting	January 2023
	Numerical Linear Algebra: Algorithms, Computations, and Applications	
[O3]	SIAM Conference on Data Science	September 2022
	Tensor Methods and Applications to Real-World Data	
[O2]	17th Copper Mountain Conference on Iterative Methods	April 2022
	Iterative Methods for Neural Net Training	
[O1]	SIAM Annual Meeting *(accepted, canceled due to COVID-19)*	July 2020
	A Deep Look at Neural Networks with Applications in Scientific Machine Learning	

Tutorials

| [T1] | Deep Learning Tutorial | April 2023 |

Invited Speaker

[I18]	Worchester Polytechnical Institute	November 2023
[I17]	Colorado School of Mines	November 2023
[I16]	Numerical Analysis Seminar	April 2023
[I15]	One World MINDS Seminar	March 2023
[I14]	Seminar @ISPGroup	March 2023
[I13]	Oxford Data Science Seminar	March 2023
[I12]	Center for Mathematics and Artifical Intelligence Colloquium	February 2023
[I11]	Data Enabled Science Seminar	March 2022
[I10]	Center for Computing Research Seminar Series	November 2021
[I9]	Computational and Applied Mathematics Seminar	November 2021

[I8]	Applied Numerical Analysis Seminar	October 2021
[I7]	Communications in NLA	November 2020
[I6]	Bi-College Math/Stat Colloquium	December 2019
[I5]	Scientific Computing Seminar	September 2019
[I4]	Schlumberger Doll Research	May 2019
[I3]	SIAM Tufts Student Chapter	September 2018
[I2]	IBM TJ Watson Research Center	August 2018
[I1]	Computational and Applied Math Seminar	March 2018

Conference Presenter

[C20]	SIAM Conference on Uncertainty Quantification	February 2024
[C19]	Joint Mathematics Meeting	January 2024
[C18]	AWM Research Symposium	September 2023
[C17]	10th International Congress on Industrial and Applied Mathematics	August 2023
[C16]	SIAM Conference on Computational Science and Engineering	February 2023
[C15]	SIAM Conference on Uncertainty Quantification	April 2022
[C14]	Joint Mathematics Meeting	April 2022
[C13]	Mechanistic Machine Learning and Digital Twins for Computational Science, Engineering, and Technology	September 2021
[C12]	SIAM Conference on Optimization	July 2021
[C11]	SIAM Annual Meeting	July 2021
[C10]	SAMSI Workshop on Numerical Analysis for Data Science	May 2021
[C9]	SIAM Conference on Computational Science and Engineering	March 2021
[C8]	Georgia Scientific Computing Symposium	February 2021
[C7]	SIAM Conference on Imaging Science	July 2020
[C6]	SIAM Conference on Data Science	May 2020
[C5]	SIAM Southeastern Atlantic Section	September 2019
[C4]	SIAM Conference on Computational Science and Engineering	February 2019
[C3]	SIAM Conference on Imaging Science	June 2018
[C2]	SIAM Conference on Applied Linear Algebra	May 2018
[C1]	15th Copper Mountain Conference on Iterative Methods	March 2018

Teaching

Graduate Courses

| [T6] | MATH789: Topics in Analysis: Introduction to Tensor Decompositions | Fall 2023 |
| [T5] | MATH789: Research Training Group Seminar | Fall 2022 |

Undergraduate Courses

[T6]	MATH315: Numerical Analysis	Fall 2023, Spring 2022
[T5]	MATH221: Linear Algebra	Spring 2022, Fall 2020, Spring 2020, Fall 2019
[T4]	MATH347: Introduction to Nonlinear Optimization	Spring 2024, Fall 2021, Spring 2021
[T3]	MATH0034: Calculus II	Spring 2016

Teaching Assistant

[T7]	MATH0042: Calculus III	Spring 2019
[T6]	MATH0034: Calculus II	Spring 2017
[T5]	MATH0128: Numerical Linear Algebra	Spring 2019
[T4]	MATH0126: Numerical Analysis	Fall 2018
[T3]	MATH0019: Math of Social Choice	Fall 2015
[T2]	MATH0136: Analysis II	Spring 2015
[T1]	MATH0135: Analysis I	Fall 2014

Advisees

Ph.D. Students

Katherine Keegan	Fall 2022 – present
DOE Computational Science Graduate Fellowship, Emory Women in Natural Sciences Fellowship	

Current Undergraduate Advisees

Jafer Hasnain	Summer 2023 – present
Emory Honors Program and Emory SIRE Program	
Project: Reinforcement Learning with Manifold Optimization	

Rudy Nunez	Fall 2023 – present
Emory SIRE Program	
Project: Bayesian Neural Networks	

Math Data Collection Initiative Advisees

Nia Jobson (*Project: Generative Modeling*)	Spring 2024
Mia Sager (*Project: Fairnss in Machine Learning*)	Spring 2024
Nathaniel Schrader (*Project: Climate Modeling*)	Spring 2024
Malia Walewski (*Project: Reinforcement Learning*)	Spring 2024
Sam Wang (*Project: Climate Modeling*)	Spring 2024

Former Advisees

Jonathan Valyou   Fall 2021 – Spring 2021
Program: Emory Honors Program and Emory SIRE Program
First Job: Ph.D Student in Applied and Computational Mathematics at Florida State University

Storm Chin   Spring 2022
Program: Spelman-Morehouse Directed Reading Program
First Job: Business Analyst at McKinsey & Company

Geoffrey Thorpe   Fall 2021
Program: Spelman-Morehouse Directed Reading Program
First Job: Pricing Analyst at Payroc

Emory REU Advisees

Allen Minch	*Brandeis University*	Summer 2023
Hung Anh Vu	*University of Maryland*	Summer 2023
Annie Warren	*University of Minnesota*	Summer 2023
Vida John	*Tessellations School*	Summer 2021
Katherine Keegan	*Mary Baldwin University*	Summer 2021
Tanvi Vishwanath	*Texas A & M*	Summer 2021
Yihua Xu	*Georgia Tech*	Summer 2021
Neeharika Kotte	*Washington University in St. Louis*	Summer 2019
(Co-advised with Lars Ruthotto)		
Haoruo Zhao	*University of Wisconsin-Madison*	Summer 2019
(Co-advised with Lars Ruthotto)		

Emory Ph.D Dissertation Committee

Alex Dunbar	*Department of Mathematics*	Spring 2024
Benjamin Yellin	*Department of Mathematics*	Spring 2024
Xingjian Li	*Department of Mathematics*	Fall 2023

Emory Ph.D Qualifying Exam Committee

Abigail Julian	*Department of Computer Science*	Fall 2022

Emory Honors Thesis Committee

Zoe Li	*Department of Mathematics*	Spring 2024
Hung Ngo	*Department of Mathematics*	Spring 2024
Yujia (Judy) Hao	*Department of Mathematics*	Spring 2023
Ravij Lade	*Department of Economics*	Spring 2023
Zirui (Ray) Chen	*Department of Neuroscience*	Spring 2022
Xiaoyuan (Sophy) Huang	*Department of Computer Science*	Spring 2022

Service and Memberships

Memberships

Society for Industrial and Applied Mathematics	Fall 2014 – present
American Mathematical Society	Fall 2014 – present
Association for Women in Mathematics	Fall 2014 – present

Committee Work

Computational Mathematics for AI Tenure-Track Search *Committee Member*	Fall 2022 – Spring 2023
Postdoctoral Council for Diversity *Member*	Spring 2021 – Fall 2021
Diversity, Equity, and Inclusion Committee *Member of Postdoctoral Subgroup*	Spring 2021 – Fall 2021

Funding Reviewer

National Science Foundation *Panelist*	2024/03/01
Department of Energy *Panelist*	Spring 2023
University Research Committee *Reviewer*	Spring 2023
Emory University Postdoctoral Association Professional Develop Award *Reviewer*	Spring 2022

Service

Math DEI Book Group *Emory University*	Spring 2024
Mathematical and Interdisciplinary Contest in Modeling *COMAP*	Spring 2020
Graduate Student Council *Tufts University*	Fall 2015 – Spring 2016
Organization of Graduate Students in Mathematics	Fall 2014 – Spring 2015

Tufts University

Outreach

Broader Engagement Guided Affinity Group, *SIAM*   2024/10/01

Math Superstars, *Mary Lin Elementary School*   March 2024

Extracurricular Activities

Biden Campaign   Fall 2020

Fair Fight Action   Fall 2020

Paper Reviewer

Inverse Problems and Imaging, *AIMS*   Ocotber 2023

Association for Women in Mathematics (AWM), *WISDM*   July 2024

Transactions on Machine Learning Research, *TMLR*   April 2024

Journal on Scientific Computing, *SIAM*   May 2024

Journal on Mathematics of Data Science, *SIAM*   October 2021

Undergraduate Research Journal Online, *SIAM*   March 2022

Numerical Linear Algebra with Applications, *Wiley Online Library*   February 2022

Transactions on Signal Processing, *IEEE*   September 2022

Transactions on Cybernetics, *IEEE*   August 2020

Journal of Selected Topics in Signal Processing, *IEEE*   June 2020

Journal of Mathematical Imaging and Vision, *Springer*   September 2023

Journal of Machine Learning for Modeling and Computing, *Begell House Online*   December 2022

BIT Numerical Mathematics, *Springer*   August 2022

Applied Mathematical Modelling, *Elsevier*   August 2020

Applied Mathematics and Computations, *Science Direct*   June 2020

Linear Algebra and Its Applications,   July 2019

Inverse Problems and Imaging,   September 2023

Mathematical and Scientific Machine Learning,   December 2019