Benjamin Jones

Department of Mathematics, Michigan State University · East Lansing, MI
Jones657@msu.edu · BenJones-math.com

Education

Michigan State University, East Lansing, MI

Ph.D. Mathematics Aug 2021 - May 2026

Dissertation: *"Aspects of Applied Algebraic and Geometric Topologies"*
Advisor: *Guowei-Wei*
Graduate biochemistry courses *in protein structure and function*

The University of Alabama, Tuscaloosa, AL

M.A. Mathematics May 2021

Thesis: *"Adaptive pseudo-time methods for the Poisson-Boltzmann equation with Eulerian solvent excluded surface."*
Graduate computer science courses *in AI, programming languages, and cryptography*

B.S. Computer Science Dec 2020

B.S. Mathematics May 2020

Minor: *Randall Research Scholars Program*
Study Abroad: *Budapest Semesters in Mathematics, Hungary* Summer 2019

Papers and Preprints

3. **Benjamin Jones** and Guowei Wei. "Persistent Directed Flag Laplacian." *arXiv:2312.02099 [math.AT], Dec. 2023.*
2. S. A. Ullah, X. Yang, **B. Jones**, S. Zhao, W. Geng, G.-W. Wei. "Bridging Eulerian and Lagrangian Poisson–Boltzmann solvers by ESES." *J. Comput. Chem. 2023, 1. DOI: doi.org/10.1002/jcc.27239*.
1. **Benjamin Jones**, Sheik Ahmed-Ullah, Siwen Wang, and Shan Zhao. "Adaptive pseudo-time methods for the Poisson-Boltzmann equation with Eulerian solvent excluded surface." *Communications in Information & Systems, (2021). DOI: dx.doi.org/10.4310/CIS.2021.v21.n1.a5*

Research Experience

Michigan State University 2021-Present

Principal Investigator: **Guowei Wei**

- Developing theoretical and applied methods in Topological Data Analysis with discrete Laplacian operators.
- Introduced persistent and non-persistent discrete Laplacian operators to directed flag complexes for graphs and to homology theories for knots and links.
- Used persistent Laplacians with machine learning to predict physical properties of biomolecules, such as protein-ligand binding affinity.
- Creating a fast and accessible interface to compute persistent Laplacians, via a C++ library with Python bindings. This work reduces computations from 1.5 hours to 12 seconds.

American Mathematical Society Math Research Community (MRC) 2024-Present

Climate Science at the Interface Between Topological Data Analysis and Dynamical Systems Theory

- Working with an interdisciplinary team to apply persistent homology of Dowker complexes and Directed Flag Complexes to directed graphs obtained from dynamical systems and climate data to detect topological features in a way that encodes the sequential nature of the data.

The University of Alabama 2017-2021

Principal Investigator: **Shan Zhao**

- Used a Proportional Integral Derivative (PID) controller to adaptively choose the time step in the numerical solution of a nonlinear PDE, the Poisson-Boltzmann Equation, to save 84% CPU time with 0.06% relative error in computing the solvation energy of proteins.

Teaching

Graduate Machine Learning, MSU (TA)	Fall 2023
Calculus III, MSU (Lecturer)	Summer 2023
Calculus II, MSU (TA)	Fall 2022

Awards and Honors

Michigan State University College of Natural Sciences Recruiting Fellowship	2021-2022
Tau Beta Pi Engineering Honors Society	2020
Outstanding Senior, Randall Research Scholars Program	2020
Phi Beta Kappa	2020
Randall Outstanding Undergraduate Research Award	2020
The top undergraduate research award at the University of Alabama	
Upsilon Pi Epsilon Computer Science Honors Society	2019

Service

President, MSU American Mathematical Society	2024-2025
MSU Graduate Employees Union Math Department Steward	2023-2024
MSU Graduate Employees Union Salary Bargaining Team	2023-2024
MSU Graduate Employees Union Retirement Benefits Bargaining Team	2023-2024
Organizing Committee, Graduate Student Geometry and Topology Conference 2024	2023-2024
Mentor, MSU Summer Topology Program	2023
President, Upsilon Pi Epsilon Computer Science Honors Society	2020
President, Pi Mu Epsilon Math Honors Society	2019

Professional Experience

Virtual Student Federal Service Intern, NOAA Fisheries Jan 2021 – Sept 2021

- Automated resource allocation for the National Coral Reef Monitoring Program.
- Unified SAS and R programs into an accessible R package for fish biologists.

Computer Science Intern, U.S. Census Bureau Aug 2020 – Jan 2021

- Developed Python software for processing Economic Census data.
- Improved CPU efficiency of a key data processing task by over 95%.