

Anthony E. Pizzimenti

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Education

George Mason University <i>Doctorate, Mathematics</i>	May 2027 (Expected)
George Mason University <i>Master of Science, Mathematics</i>	Fall 2024
The University of Iowa <i>Bachelor of Science, Mathematics</i>	May 2020
The University of Iowa <i>Bachelor of Science, Computer Science</i>	May 2020
The University of Iowa <i>Certificate, Large Data Analysis</i>	May 2020

Teaching

Lead Instructor *Computing Workshops, GMU Department of Mathematical Sciences* August 2024 — Present

- ♦ Designed curriculum for and instructed weekly two-hour workshops to help mathematics students and faculty improve their high-performance computing skills, document creation and design proficiency, and familiarity with GMU's suite of software and hardware tools.
- ♦ Covered the basics of high-performance numerical libraries and languages like NumPy (via Python), MATLAB, and Wolfram Mathematica.
- ♦ Taught the use of typesetting and markup tools like $\LaTeX$, HTML, and Markdown.
- ♦ Ensured attendees had knowledge of and access to GMU's collection of licensed software, high-performance compute resources, and on-campus web tools.

Co-Manager, Research Mentor *Mason Experimental Geometry Lab (MEGL)* August 2023 — Present

- ♦ Co-coordinated funding, faculty scheduling, undergraduate recruitment, logistics, and community outreach for the [Mason Experimental Geometry Lab](#) (MEGL), a GMU College of Sciences mathematics research incubator.
- ♦ Mentored teams of 3-4 undergraduate mathematics researchers exploring ideas in randomized algorithms, logic synthesis, superoptimization, percolation, and computational topology.
- ♦ Won best poster at the Fall 2023 MEGL Symposium.

Graduate Learning Assistant *GMU Department of Mathematical Sciences* July 2023 — August 2023

- ♦ Worked with incoming PhD and Master's students to ease their transition to the George Mason University graduate mathematics program.
- ♦ Led problem-solving sessions in an active learning environment designed to refresh students' knowledge of algebra and analysis, communicate expectations for their fall coursework, allow students to explore on-campus resources, and help students settle into the DC metro area, setting the stage for their first year of graduate study.
- ♦ Designed a professional development day, helping students set up individualized academic websites, write $\LaTeX$, use common mathematical tools like MATLAB and Mathematica, and create other professional materials like CVs, résumés, and LinkedIn pages.
- ♦ Assisted faculty in managing program logistics, including planning field trips and extra-curricular gatherings, lining up speakers, and organizing transportation.

Graduate Teaching Assistant *GMU Department of Mathematical Sciences*

August 2022 — May 2023

- ◆ Prepared teaching materials and instructed recitations for introductory mathematics courses of 45-90 students, including calculus I-III and elementary ordinary differential equations.
- ◆ Collaborated with faculty to develop new active learning strategies and curricula, focusing on the development of students' mathematical intuition, study habits, and communal learning.
- ◆ Graded and held drop-in hours for a multitude of courses, including linear algebra, discrete math and combinatorics, introduction to proofs, abstract algebra, data structures, and algorithms courses.
- ◆ Received the College of Science's Dean's Excellence in Graduate Teaching award for the 2022-2023 academic year.

Tutor *UI Student-Athlete Academic Services*

January 2020 — May 2020

- ◆ Worked with individual and small groups of NCAA D-I student athletes on upper- and lower-division mathematics and computer science courses.

Guest Instructor *MIT, Tufts University, Harvard University*

July 2019

- ◆ Instructed 50 undergraduate and graduate students attending the Voting Rights Data Institute summer research program in a large-group setting.
- ◆ Guided the exploration of algorithmic approaches to redistricting, programming patterns for computerized redistricting experimentation, statistical analyses of geographic and demographic data, and data visualization.

Tutor *UI Department of Mathematics, UI Department of Computer Science*

January 2017 — May 2020

- ◆ Certified by the University of Iowa departments of Mathematics and Computer Science as a private tutor for lower-, upper-, and graduate-level mathematics and computer science courses.
- ◆ Taught more than 30 individual students across three and a half years, with many students seeking continued instruction across multiple semesters of study.
- ◆ Spent more than 20 hours per week preparing materials and working with students during my final four semesters of undergraduate study.

Research Interests and Experience

Graduate Research Fellow *National Science Foundation*

April 2024 — Present

Graduate Research Assistant *GMU Department of Mathematical Sciences*

April 2023 — Present

- ◆ **Graph theory, algebra, topology, statistical computing**

↪ *Statistical mechanics and computing in higher dimensions.* The *Ising* and *Potts models* for simulating ferromagnetism are longstanding topics of interest in statistical mechanics. By borrowing ideas from algebraic topology, we can generalize these models and their computational counterparts; importantly, we can develop higher-dimensional analogues for well-studied simulation procedures like the *Swendsen-Wang* and *invaded cluster* algorithms.

- ◆ **Random algorithms and optimization**

↪ *Simulated annealing* is a flexible optimization heuristic that often gets stuck in local minima, even when the algorithm is allowed to alternate between “risky” and “safe” behavior. *Parallel tempering* sets multiple simulated annealing random walkers loose on the same space, all tuned to different levels of risk or safety, then facilitates communication between the walkers. What is parallel tempering's *stationary distribution*, if it exists? Does parallel tempering converge more quickly than simulated annealing? Does this strategy actually result in better outcomes?

♦ **Graph theory, topology, algebra**

- ↪ *Exploring the duality of redistricting.* Because detailed geometric data aren't always relevant to redistricting study, we treat the arrangement of units (e.g. precincts, counties) as a tiling of a region of $\mathbb{R}^2$ or S^2 and study the tiling's *dual graph* instead. In particular, we study *equipartitions* of these graphs: what can the algebraic properties of these graphs tell us about the space of possible equipartitions? What additional tools can we borrow from (linear) algebra and topology to help us talk about these graphs and equipartitions more precisely? How can we translate these ideas into better algorithms?
- ↪ *Metagraphs.* Algorithmically generating large sets of equipartitions leads naturally to questions about the connectedness of the *space* of equipartitions: that is, we think about the relationships between graph equipartitions *as a graph itself*. In particular, is it always possible to transform one equipartition into another via a series of re-coloring moves? If not, when can — and, more importantly, when *can't* — we get from one equipartition to another?

♦ **Statistical computing**

- ↪ *Monte Carlo Markov chain methods for redistricting.* The set of possible equipartitions of a graph is finite in size, but astronomically large. How can we implement the treatment of districting plans as graphs — and moving between these graphs — in a computational setting? When generating large sets of districting plans, can we accurately describe distributions of plans with certain properties? How can we do so efficiently?
- ↪ *Ranked-choice voting.* A family of electoral systems where voters rank candidates preferentially, ranked-choice voting (RCV) can often be difficult to model. How can we account for the vast space of possible ballots, and how can we tune models based on the demographics of an electorate? Which systems best reflect the ground-truth desired electoral outcomes for a set of voters? *Are there any?*

Undergraduate Research Assistant *University of Iowa Department of Mathematics*

Jan. 2017 — May 2020

- ♦ Conducted research with the Numerical, Parallel, and Optimization Algorithms Group, a Department of Mathematics and Department of Computer Science joint research collective.
- ♦ Researched applications of classical clustering methods to graphs and combinatorial optimization algorithms, especially in parallel computing contexts.
- ♦ Presented research and co-facilitated the Math vs. Gerrymandering Workshop at the Texas MAA conference at Tarleton State University in Spring 2019.
- ♦ Invited to present research and co-facilitate a second Math vs. Gerrymandering workshop during the Texas MAA conference at the University of North Texas in Spring 2020 (cancelled due to COVID-19).

Data Science and Research Intern *FairVote*

June 2019 — August 2019

- ♦ Developed probabilistic methods to analyze voting records for ranked-choice voting experiments in the UK Parliament.
- ♦ Authored a series of blog posts detailing the mathematics of potential redistricting action in Houston, Texas.
- ♦ Began re-development of FairVote's Monopoly Politics 2020 web application.
- ♦ Generated map ensembles and ensemble data for FairVote's lobbying efforts to enact ranked-choice voting legislation in Lowell, Mass., pursuant to the city's May 2019 consent decree.

Tisch Summer Fellow *MIT, Tufts University, Harvard University*

June 2018 — August 2018

- ♦ Participated in the inaugural Voting Rights Data Institute, a six-week mathematics-of-redistricting program run by the Metric Geometry and Gerrymandering Group Redistricting Lab.
- ♦ Worked with 51 peer researchers on the detection and prevention of gerrymandering through statistical analysis, legal review, and mathematical modeling.
- ♦ Developed a first implementation of [GerryChain](#) with a tight-knit, six-member team.

Publications

1. [*ATEAMS: Algebraic Topology-Enabled Algorithms for Spin Systems.*](#). Anthony E. Pizzimenti, Benjamin Schweinhart, and Paul Duncan.
2. [*Generalized cluster algorithms for Potts lattice gauge theory.*](#) Anthony E. Pizzimenti, Benjamin Schweinhart, and Paul Duncan. July 2025.
3. [*Reconstructing edge-deleted unicyclic graphs.*](#) Anthony E. Pizzimenti and Umarkhon Rakhimov. November 2024.
4. [*Fast Sequential Computation of Convex Regions.*](#) Anthony E. Pizzimenti. In progress.
5. [*A k-medoids approach to exploring districting plans.*](#) J. Grove, S. Oliveira, A. Pizzimenti, and D. Stewart. March 2023.
6. [*Aggregating community maps.*](#) Chambers, *et al.* Proceedings of the 30th International Conference on Advances in Geographic Information Systems (SIGSPATIAL). November 2022.
7. [*Modeling the Fair Representation Act.*](#) Moon Duchin, Anthony E. Pizzimenti, MGGG Redistricting Lab. Report. July 2022.

Conferences, Posters, and Presentations

1. *Homological generalization for random graphs.* Invited speaker, [GMU CAGS](#). October 2025.
2. *Generalized cluster algorithms for Potts lattice gauge theory.* Talk + poster, [The Geometric Realization of AATRN](#). August 2025.
3. *General algorithms for physical models.* Presenter, GMU StReeTs. September 2024.
4. *politics and 'puters.* Presenter, GMU StReeTs. September 2024.
5. *cubes, cohomology, and computers.* Talk + poster, [Statistical Mechanics Beyond 2D](#). May 2024.
6. *Monte Carlo Algorithms for Quantum Systems.* Poster, MEGL Symposium. April 2024.
7. *Quantum Monte Carlo Systems.* Poster, MEGL Symposium. December 2023.
8. [Group Theory and Number Theory: Interactions](#). Princeton University. October 2023.
9. [Exploring higher-dimensional phase transitions.](#) Presenter, GMU StReeTs. September 2023.
10. [Redistricting: Math, Politics, and People.](#) Presenter, GMU StReeTs. October 2022.
11. [Un-Stacking the Deck.](#) Invited speaker, University of Indianapolis Center for Data Science. April 2022
12. [Fast Districting Assignment Compression.](#) Presenter, MGGG Lab Meeting. October 2021.
13. [Elections Reimagined: the Fair Representation Act.](#) Panelist, Netroots Nation. October 2021.
14. [mathematics and redistricting.](#) Invited speaker, University of Iowa GAUSS. September 2021.
15. *Ranked-Choice Voting and Brexit.* Presenter, FairVote Leadership Meeting. August 2019.
16. *Seeds of Democracy.* Presenter, MAA Texas Section Meeting. August 2019.

Awards and Honors

Dean's Student Leadership and Advisory Council	<i>GMU College of Science</i>	Fall 2025 — Present
Graduate Research Fellow	<i>National Science Foundation</i>	Spring 2024 — Present
Graduate Research Assistantship	<i>GMU Department of Mathematical Sciences</i>	Spring 2023 — Present
Graduate Travel Grant	<i>GMU Department of Mathematical Sciences</i>	Fall '23, Spring '24, Spring '25
Graduate Learning Assistantship	<i>GMU Department of Mathematical Sciences</i>	Summer 2023
Dean's Excellence in Graduate Teaching	<i>GMU College of Science</i>	Spring 2023
Graduate Teaching Assistantship	<i>GMU Department of Mathematical Sciences</i>	Fall 2022 — Spring 2023
Dean's List	<i>UI College of Liberal Arts and Sciences</i>	Spring '19, Spring '20
Tisch Fellow	<i>Tufts University Tisch College of Civic Life</i>	Summer 2018
Undergraduate Research Assistantship	<i>UI Department of Mathematics</i>	Spring 2017 — Spring 2020
Undergraduate Teaching Assistantship	<i>UI Department of Mathematics</i>	Summer 2017
Arthur Collins Scholarship	<i>UI Department of Computer Science</i>	Spring 2017

Leadership

Member <i>College of Science Dean's Student Advisory Board, GMU</i>	Fall 2025 — Present
Co-Organizer <i>Mathematical Sciences Graduate Student Town Halls, GMU</i>	Spring 2025 — Present
Lead Instructor <i>Mathematical Sciences Computing Workshops, GMU</i>	Fall 2024 — Present
Co-Manager <i>Mason Experimental Geometry Lab (MEGL), GMU</i>	Spring 2023 — Present
Graduate Mentor <i>Mason Experimental Geometry Lab (MEGL), GMU</i>	Spring 2023 — Present
PhD Representative <i>Graduate and Professional Student Association, GMU</i>	Spring 2023 — Fall 2024
Treasurer <i>SIAM, UI Department of Mathematics</i>	Fall 2019 — Spring 2020
Webmaster <i>SIAM, UI Department of Mathematics</i>	Fall 2018 — Spring 2020
Student Ambassador <i>UI Department of Mathematics</i>	Fall 2017 — Spring 2020
Student Ambassador <i>UI Department of Computer Science</i>	Fall 2017 — Spring 2020
Student Technology Fees Grant Panelist <i>UI College of Liberal Arts and Sciences</i>	Fall 2017 — Spring 2020

Professional Experience

Data Scientist *Metric Geometry and Gerrymandering Group Redistricting Lab* July 2021 — July 2022

- ♦ Led development of [GerryChain](#), Monte Carlo Markov chain software for redistricting.
- ♦ Led development of [districtr](#), the Lab's redistricting web application.
- ♦ Led development of [GerryTools](#), a toolkit for advanced redistricting analysis.
- ♦ Conducted analyses for redistricting litigation across the United States.
- ♦ Conducted research at the intersection of mathematics, computer science, and civics.
- ♦ Prepared and analyzed large, complex datasets for a variety of projects.

Political Mapping Analyst *National Democratic Redistricting Committee* June 2020 — July 2021

- ♦ Wrote software for organizing, analyzing, and visualizing statistical and geographic data.
- ♦ Drew and analyzed potential districting plans in key states.
- ♦ Crafted responsible language for community-based redistricting legislation.
- ♦ Wrote and synthesized research to train colleagues and provide honest, quantitative redistricting information to internal and external stakeholders.

Student Application Developer *University of Iowa IT Services* September 2015 — May 2019

- ♦ Developed, documented, and maintained software projects for the University of Iowa from individual to enterprise scale.
- ♦ Developed web applications for individual faculty and departmental groups as a member of the Rich Internet Applications Group from 2015 to 2018.
- ♦ Developed backend software for institution-wide applications as a member of the C# .NET Applications Group from 2018 to 2019.

Technologies and Technical Skills

Python ♦ JavaScript ♦ TypeScript ♦ Java ♦ Bash ♦ R ♦ MATLAB ♦ git ♦ Julia ♦ AWS ♦ $\LaTeX$ ♦ macOS ♦ C ♦ C++ ♦ Mathematica ♦ Rust