

Anthony E. Pizzimenti

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Education

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| George Mason University <i>Doctorate, Mathematics</i> | May 2027 (Expected) |
| 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

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 a team of three undergraduate mathematics researchers on an investigation of numerical Monte Carlo and Las Vegas algorithms and their quantum counterparts.
- ♦ 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 L^AT_EX, 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 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 are classical statistical methods of simulating magnetism in an atomic structure. Much of the existing literature, however, is limited: regardless of the structure's dimensionality, focus is placed primarily on the interaction between the spins of individual atoms (vertices) and bonds (edges). How can we use the rich topology of integer lattices — which are used to model molecules and the bonds between them — to study the interaction between spins on *entire collections* of vertices, collections of edges, or higher-dimensional substructures?

- ♦ **Algebraic geometry**

- ↔ *Combinatorics in the Petersen variety.* When determining points fixed by matrices over basis elements of the Petersen variety, we utilize the correspondence between permutation matrices in \mathbb{C}^n and reduced words of transpositions in \mathcal{S}_n . What can the group — and graph — structure of reduced words tell us about term cancellation in Billey's Formula? Is there a general formula which can determine whether a particular linear combination of basis elements fixes a point?

Research Associate Metric Geometry and Gerrymandering Group Redistricting Lab

June 2018 — Present

- ♦ **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*

January 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. [Fast Sequential Computation of Convex Regions](#). Anthony E. Pizzimenti. In progress.
2. [A \$k\$ -medoids approach to exploring districting plans](#). J. Grove, S. Oliveira, A. Pizzimenti, and D. Stewart. Preprint. March 2023.
3. [Aggregating community maps](#). Chambers, *et al.* Proceedings of the 30th International Conference on Advances in Geographic Information Systems (SIGSPATIAL). November 2022.
4. [Modeling the Fair Representation Act](#). Moon Duchin, Anthony E. Pizzimenti, MGGG Redistricting Lab. Report. July 2022.

Conferences, Posters, and Presentations

1. Quantum Monte Carlo Systems. Poster, MEGL Symposium, December 2023.
2. [Group Theory and Number Theory: Interactions](#). Princeton University, October 2023.
3. [Exploring higher-dimensional phase transitions](#). Presenter, GMU StReeTs, September 2023.
4. [Redistricting: Math, Politics, and People](#). Presenter, GMU StReeTs, October 2022.
5. [Un-Stacking the Deck](#). Invited speaker, University of Indianapolis Center for Data Science, April 2022
6. [Fast Districting Assignment Compression](#). Presenter, MGGG Lab Meeting, October 2021.
7. [Elections Reimagined: the Fair Representation Act](#). Panelist, Netroots Nation, October 2021.
8. [mathematics and redistricting](#). Invited speaker, University of Iowa GAUSS, September 2021.
9. [Ranked-Choice Voting and Brexit](#). Presenter, FairVote Leadership Meeting, August 2019.
10. [Seeds of Democracy](#). Presenter, MAA Texas Section Meeting, August 2019.

Awards and Honors

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| Graduate Travel Grant | GMU Department of Mathematical Sciences | October 2023 |
| Graduate Research Assistantship | GMU Department of Mathematical Sciences | Spring 2023 — Present |
| Graduate Learning Assistantship | GMU Department of Mathematical Sciences | Summer 2023 |
| Graduate Teaching Assistantship | GMU Department of Mathematical Sciences | Fall 2022 — Spring 2023 |
| Dean's Excellence in Graduate Teaching | GMU College of Science | Spring 2023 |
| Dean's List | UI College of Liberal Arts and Sciences | Spring 2019, Spring 2020 |
| Tisch Fellow | Tufts University Tisch College of Civic Life | Summer 2018 |
| Undergraduate Research Assistantship | UI Department of Mathematics | Spring 2017 — Spring 2020 |
| Undergraduate Teaching Assistantship | UI Department of Mathematics | Summer 2017 |
| Arthur Collins Scholarship | UI Department of Computer Science | Spring 2017 |

Leadership

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| PhD Representative | Graduate and Professional Student Association, George Mason University | Spring 2023 — Present |
| Co-Manager | Mason Experimental Geometry Lab (MEGL), George Mason University | Spring 2023 — Present |
| Treasurer | SIAM, UI Department of Mathematics | Fall 2019 — Spring 2020 |
| Webmaster | SIAM, UI Department of Mathematics | Fall 2018 — Spring 2020 |
| Student Ambassador | UI Department of Mathematics | Fall 2017 — Spring 2020 |
| Student Ambassador | UI Department of Computer Science | Fall 2017 — Spring 2020 |
| Student Technology Fees Grant Panelist | UI College of Liberal Arts and Sciences | Fall 2017 — Spring 2020 |

Professional Experience

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| Data Scientist | Metric Geometry and Gerrymandering Group Redistricting Lab | July 2021 — July 2022 |
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- ◆ 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 ◆ L^AT_EX ◆ macOS
◆ C ◆ C++ ◆ Mathematica ◆ Rust