

# Henry Fleischmann

henryfl@umich.edu | +1 (734) 985-5957

## EDUCATION

<b>Carnegie Mellon University</b> (expected)	Pittsburgh, PA
Ph.D. in Computer Science	Sep. 2024 –
<b>University of Cambridge</b> (expected)	Cambridge, England
MASt in Pure Mathematics	Oct. 2023 – June 2024
<b>University of Michigan</b>	Ann Arbor, MI
Honors Program, Residential College	Sep. 2019 – May 2023
B.S., Highest Honors in Mathematics and Highest Honors in Computer Science. GPA: 4.0.	

---

## RESEARCH EXPERIENCE

<b>Weizmann Institute of Science</b> (expected)	Rehovot, Israel
<i>Visiting student</i>	July 2023 – Aug 2023
Advisor: Amir Abboud	

- Will investigate problems in fine-grained complexity theory.

<b>University of Michigan</b>	Ann Arbor, MI
<i>Computer Science Honors Thesis</i>	Aug. 2022 – Current
Advisor: Greg Bodwin	

- Studied adjacency oracles for multiplicative distance spanners, finding the first sublinear algorithms for optimal size spanners.

<b>Rutgers, the State University of New Jersey</b>	Piscataway, NJ
<i>Center for Discrete Math and Theor. Computer Science (DIMACS) NSF REU</i>	June 2023 – Current
Advisor: Karthik C. S.	

- Served as a graduate student mentor for Karthik's projects.
- Proved hardness of approximation results for a myriad of variants of clustering from machine learning.
- Studied the construction of optimal Euclidean Steiner trees for the regular simplex.

<b>Rutgers, the State University of New Jersey</b>	Piscataway, NJ
<i>Center for Discrete Math and Theor. Computer Science (DIMACS) NSF REU</i>	May 2022 – June 2023
Advisor: Karthik C. S.	

- Introduced a new gap preserving hardness reduction from Set Packing to Metric Steiner Tree.
- Proved APX-hardness of Metric Steiner Tree with edge weights restricted to any  $l_p$ -metric.
- Proved APX-hardness of the Euclidean Discrete Steiner Tree problem, suggesting that the Euclidean Steiner Tree problem is APX-hard in high dimensions, contrasting Arora's seminal PTAS.
- Proved APX-hardness of the max norm Continuous Steiner Tree problem via reduction from graph coloring, the first new hardness result on the continuous problem in several decades.
- Subreviewer for the International Colloquium on Automata, Languages, and Programming

(ICALP).

## University of Michigan

Ann Arbor, MI

LoG(M), Policy Analyst for the CLOSUP at the Ford School of Public Policy

Jan. 2021–June 2022

Advisors: Jon X. Eguia, Gregory Herschlag, Jonathan Mattingly, Tim Ryan, and Samuel Hansen

- Quantified the state of redistricting in Michigan using Monte Carlo Markov Chain methods from the MGGG Redistricting Lab (Recombination and Merge-Split).
- Developed a computational tool for quantifying fairness of redistricting proposals for the Michigan Independent Citizens Redistricting Commission.
- Synthesized Michigan voting, census, and precinct shapefile data to construct a Multi-Scale Merge-Split Markov Chain Monte Carlo compatible graph, working alongside the Duke redistricting group.
- Applied Jurisdictional Partisan advantage measure to each enacted state map in the country.
- Co-Developer of the IPPSR Partisan Advantage Tracker, an online tool to evaluate redistricting maps available at [ippsr.msu.edu/pat](http://ippsr.msu.edu/pat).
- Issued [policy report](#) summarizing partisan advantage results and analyzing trends in results based on map authors, comparison to other common measures, and methodology.

## Williams College

Williamstown, MA

SMALL Mathematics NSF REU

June 2021–Aug. 2021

Advisors: Steven J. Miller, Eyvindur Palsson, Charles Wolf, and Leo Goldmakher

- Worked on a wide range of projects encompassing discrete geometry, additive combinatorics, random matrix theory, and combinatorial game theory.
- Studied variations of the Erdős Distance problem in the angle setting, proving the new best lower and upper bounds for numerous central quantities.
- Contributed in resolving a conjecture of Kim and Roush about the additive irreducibility of subsets of the integers.
- Described a new ensemble of matrices converging to the symmetrized Rayleigh distribution and provided a new proof of the convergence of the circulant Hankel ensemble.
- Explored the game theoretic structure of the generalized Zeckendorf game, a method of construction of base  $\phi$  decompositions of integers.
- Refereed several papers for the Journal of Number Theory.

## Rochester Institute of Technology

Rochester, NY

NSF REU in Extremal Graph Theory and Dynamical Systems

June 2020–Aug. 2020

Advisor: Brendan Rooney

- Studied a generalization of domination problems in graphs, efficient  $(j,k)$ -domination.
- Extended known results to strong products of graphs, Cayley graphs, and quotient graphs.
- Established necessary and sufficient conditions for the existence of dominating functions using spectral graph theory.

---

## ACCEPTED PAPERS

1. B. Baily, J. Dell, I. Durmić, H. L. Fleischmann, F. Jackson, I. Mijares, S. J. Miller, E. Pesikoff, L. Reifenberg, A. S. Reina, Y. Yang, The Bergman Game, *The Fibonacci Quarterly*, **60(5)** (2022), 18–39.
2. H. L. Fleischmann, H. B. Hu, F. Jackson, S. J. Miller, E. A. Palsson, E. Pesikoff, and C. Wolf, Distinct Angle Problems and Variants, *Discrete & Computational Geometry*, (2023).

<https://arxiv.org/abs/2108.12015>.

3. H. L. Fleischmann, S. V. Konyagin, S. J. Miller, E. A. Palsson, E. Pesikoff, and C. Wolf, Distinct Angles in General Position, *Discrete Mathematics*, **346**(4) (2023), 113283.  
<https://arxiv.org/abs/2206.04367>.
4. T. Dunn, H. L. Fleischmann, F. Jackson, S. Khunger, S. J. Miller, L. Reifenberg, A. Shashkov, and S. Willis, Limiting Spectral Distributions of Families of Block Matrix Ensembles, *PUMP Journal of Undergraduate Research*, **5** (2022), 122–147.

## SUBMITTED PAPERS

5. On Approximability of Steiner Tree in  $l_p$ -metrics (with Surya Teja Gavva and Karthik C. S.). Submitted to *IEEE Symposium on Foundations of Computer Science 2023*.
6. The Generalized Bergman Game (with Benjamin Baily, Justine Dell, Irfan Durmić, Faye Jackson, Isaac Mijares, Steven J. Miller, Ethan Pesikoff, Luke Reifenberg, Alicia Smith Reina, and Yingzi Yang). Submitted to *Conference Proceedings of the Twentieth Annual Workshop on Combinatorial and Additive Number Theory*. <https://arxiv.org/abs/2109.00117>.
7. Optimal Point Sets Determining Few Distinct Angles (with Steven J. Miller, Eyvindur A. Palsson, Ethan Pesikoff, and Charles Wolf). Submitted to *Journal of Computational Geometry*.  
<https://arxiv.org/abs/2108.12034>.
8. Irreducibility Over the Max-Min Semiring (with Benjamin Baily, Justine Dell, Faye Jackson, Steven J. Miller, Ethan Pesikoff, and Luke Reifenberg). <https://arxiv.org/abs/2111.09786>. Submitted to *Journal of Integer Sequences*.

## PREPRINTS/IN PREPARATION

9. Large sets are sumsets (with Benjamin Baily, Justine Dell, Charlie Dever, Adam Dionne, Faye Jackson, Leo Goldmakher, Gal Gross, Steven J. Miller, Ethan Pesikoff, Huy Pham, Luke Reifenberg, and Vidya Venkatesh). In preparation.

## OTHER PAPERS

10. Evaluating the Outcome of the 2022 United States Redistricting Cycle: A Nonpartisan Review. Gerald R. Ford School of Public Policy CLOSUP [Student Working paper](#).

---

## RESEARCH PRESENTATIONS

### 2023 Joint Mathematics Meetings

*Angle Variants of the Erdős Distinct Distance Problem*

Boston, MA

January 7, 2023

### University of Michigan CS Theory Lunch Seminar

*Inapproximability of the Discrete Steiner Tree Problem in  $l_p$ -metrics*

Ann Arbor, MI

December 9, 2022

### University of Michigan Undergraduate Student Mathematics Seminar

*A correspondence between Vertex Cover and Steiner Trees in Hamming Space*

Ann Arbor, MI

September 9, 2022

### Combinatorial Structures and Processes Student Workshop 2022

*Hardness of Approximation of Steiner Trees in Metric Spaces*

Prague, Czechia

August 1, 2022

<b>Annual Workshop in Combinatorial and Additive Number Theory 2022</b> <i>Erdos Distinct Angle Problems</i>	New York City, NY May 26, 2022
<b>2022 Joint Mathematics Meetings</b> <i>Modeling Redistricting with Gerrychain</i> <i>Angle Variants of the Erdős Distinct Distance Problem</i> <i>The Erdős Distance Problem for Angles</i>	Seattle, WA April 4, 2022 April 4, 2022 April 4, 2022
<b>2021 Young Mathematicians Conference</b> <i>Erdos Distinct Angle Problems</i> <i>Reducibility of Sets in Generalized Settings</i> <i>Limiting spectral measure of random circulant Hankel matrices.</i>	Columbus, OH August 20, 2021 August 21, 2021 August 22, 2021
<b>Goldwater Scholar Community 2021 Symposium</b> <i>Efficient <math>(j, k)</math>-domination in chess graphs</i>	Fully Remote August 7, 2021
<b>Southeastern Intl. Conf. on Combinatorics, Graph Theory and Computing</b> <i>Conditions for Efficient <math>(j, k)</math>-Domination</i>	Boca Raton, FL March 8, 2021
<b>2021 Joint Mathematics Meetings</b> <i>Efficient <math>(j, k)</math>-domination in chess graphs</i>	Washington, D.C. January 7, 2021
<b>Discrete and Computational Mathematics Seminar at RIT</b> <i>Efficient <math>(j, k)</math>-domination in chess graphs</i>	Rochester, NY October 23, 2020
<b>2020 Young Mathematicians Conference</b> <i>Efficient <math>(j, k)</math>-domination in chess graphs</i>	Columbus, OH August 15, 2020

---

## EMPLOYMENT

<b>University of Michigan</b> <i>Instructional Aide for EECS 477, Introduction to Algorithms</i>	Ann Arbor, MI Aug. 2022—Dec. 2022
<ul style="list-style-type: none"> <li>Wrote solutions for biweekly problem sets. Designed and taught weekly discussion sections. Held office hours. Graded exams.</li> </ul>	
<b>University of Michigan</b> <i>Grader for Math 465, Introduction to Combinatorics</i>	Ann Arbor, MI Aug. 2020—Dec. 2020
<ul style="list-style-type: none"> <li>Managed shifting class homework to an online format via Gradescope for the pandemic. Graded weekly homework assignments with detailed feedback on proof structure. Handled regrade requests.</li> </ul>	

---

## ON-CAMPUS INVOLVEMENT

<b>University of Michigan</b>	Ann Arbor, MI
-------------------------------	---------------

<i>Computer Science Theory Lunches</i>	Sep. 2022–Apr. 2023
<ul style="list-style-type: none"> <li>• Attended weekly meetings of the computer science theory group and their doctoral students, including both lunch and an informal talk on current research or other areas of interest.</li> </ul>	
<i>Math Club, Member</i>	Jan. 2020–Apr. 2022
<ul style="list-style-type: none"> <li>• Attended math talks on a variety of topics including the critical group and calculus on integers</li> </ul>	
<i>Diversity and Politics Forum, Member</i>	Sep. 2019–Apr. 2023
<ul style="list-style-type: none"> <li>• Debated contemporary topics and diversity and politics such as environmental racism, impeachment, the South Sudan crisis, and the social and economic implications of COVID-19</li> <li>• Designed and performed a presentation on the historical and modern implications of the Israeli–Palestinian Conflict</li> </ul>	
<i>Directed Readings Program, Mentee</i>	Sep. 2021–Dec. 2021
<ul style="list-style-type: none"> <li>• Read select portions of Adam Sheffer’s <i>Polynomial Methods and Incidence Theory</i> and other sources related to topological graph theory and discrete geometry. The program culminated in a presentation to the math club.</li> </ul>	
<i>COVID-19 Campus Challenge, Student Contributor</i>	Apr. 2020–June 2020
<ul style="list-style-type: none"> <li>• Met with campus administrators to develop COVID-19 response plans for the Fall semester.</li> <li>• Researched and presented a plan to overhaul campus card readers to reduce fomite transmission of COVID-19 across campus.</li> </ul>	
<i>Directed Readings Program, Mentee</i>	Jan. 2020–Mar. 2020
<ul style="list-style-type: none"> <li>• Studied group theory with a PhD student mentor for a semester</li> </ul>	
<i>Student Ambassadors, Ambassador</i>	Sep. 2019–Mar. 2020
<ul style="list-style-type: none"> <li>• Represented the university via shadowing and phone question-and-answer sessions.</li> </ul>	

---

## VOLUNTEER EXPERIENCE

<b>University of Michigan</b>	Ann Arbor, MI
<i>STEM Society</i>	Aug. 2021–Apr. 2023
<ul style="list-style-type: none"> <li>• Wrote and taught lesson plans for “STEM Saturday” events every semester—days of teaching local underserved students fun STEM topics (cryptography, etc.).</li> </ul>	
<i>University of Michigan Math Circles</i>	Jan. 2020–Apr. 2022
<ul style="list-style-type: none"> <li>• Guided middle school and high school students during interactive math talks.</li> </ul>	
<i>University of Michigan Science Olympiad</i>	Feb. 2020
<ul style="list-style-type: none"> <li>• Volunteered as an event supervisor for a Division B event, proctoring and grading for the event</li> </ul>	
<b>Williams College</b>	Williamstown, MA
<i>SMALL REU Outreach</i>	June 2021–Aug. 2021
<ul style="list-style-type: none"> <li>• Wrote engaging, thought-provoking lesson plans for local elementary schools to increase interest in mathematics. The lessons centered on the so-called “chocolate bar game,” parity game arguments, basic geometry, and spreadsheet fluency.</li> </ul>	

---

## HONORS/AWARDS

<i>Outstanding Graduating Senior Award, UM Math Dept.</i>	Apr. 2023
<i>National Science Foundation Graduate Research Fellowship, NSF</i>	Mar. 2023
<i>Churchill Scholar</i>	Dec. 2022
<i>Marshall Scholar alternate</i>	Nov. 2022

<i>Rhodes Scholarship finalist</i>	Nov. 2022
<i>Distinguished Staff Scholarship, University of Michigan</i>	June 2022
<i>Jack Meiland Scholar, UM LSA Honors Program (awarded to one top rising senior)</i>	Apr. 2022
<i>Outstanding Undergrad. Researcher Award Hon. Mention, CRA</i>	Dec. 2021, 2022
<i>Pamela J. Mackintosh Undergraduate Research Award, UM Library</i>	June 2021
<i>Book Industry Charitable Foundation Scholarship, Binc</i>	Aug. 2020, June 2021
<i>Evelyn O. Bychinsky Award, UM Math Dept.</i>	May 2021
<i>Goldwater Scholar, Barry Goldwater Scholarship Foundation</i>	Mar. 2021
<i>Frank H. and Agnes A. Davis Scholarship, UM Math Dept.</i>	Mar. 2019

---

## SKILLS

**Technical:** C++, Python, C, LaTeX, ARMv8, OCaml, Rust

**Language:** Spanish, full professional proficiency