

# Henry Fleischmann

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## EDUCATION

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

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## RESEARCH EXPERIENCE

**University of Michigan** Ann Arbor, MI  
*Computer Science Honors Thesis* Aug. 2022–Aug. 2023  
*Advisor: Greg Bodwin*

- Studied adjacency oracles for problems in network design, finding optimal sublinear time algorithms for spanning subgraphs and sublinear time algorithms for multiplicative distance spanners.

**Rutgers, the State University of New Jersey** Piscataway, NJ  
*Center for Discrete Math and Theor. Computer Science (DIMACS)* June 2023–Sept. 2023  
*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 Euclidean Steiner trees for the regular simplex, proving new high-dimensional structural results and providing the first explicit construction of candidate-optimal Euclidean Steiner trees for the regular simplex.

**Rutgers, the State University of New Jersey** Piscataway, NJ  
*Center for Discrete Math and Theor. Computer Science (DIMACS) NSF REU* 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 '23) and the Symposium on Discrete Algorithms (SODA '23).

## 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](https://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  $\varphi$  decompositions of integers.
- Refereed several papers for the Journal of Number Theory and Rose-Hulman Undergraduate Mathematics Journal.

## 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.

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## ACCEPTED PAPERS

1. Spanning adjacency oracles in sublinear time (with Greg Bodwin). Accepted to *Innovations in Theoretical Computer Science (ITCS24)*. <https://arxiv.org/abs/2308.13890>.
2. On Approximability of Steiner Tree in  $l_p$ -metrics (with Surya Teja Gavva and Karthik C. S.). Accepted to *ACM-SIAM Symposium on Discrete Algorithms (SODA24)*. <https://arxiv.org/abs/2306.02189>.

3. H. L. Fleischmann, S. J. Miller, E. A. Palsson, E. Pesikoff, and C. Wolf, Optimal point sets determining few distinct angles, *Australasian Journal of Combinatorics*, **87(1)** (2023), 165–181.
4. 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.
5. 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>.
6. 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>.
7. 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

8. Inapproximability of Minimum Diameter Clustering for Few Clusters (with Kyrylo Karlov, Karthik C. S., Ashwin Padaki, and Stepan Zharkov). <https://arxiv.org/abs/2312.02097>.
9. On Steiner trees of the regular simplex (with Guillermo A. Gamboa Q., Karthik C. S., Josef Matějka, and Jakub Petr). <https://arxiv.org/abs/2312.01252>.
10. 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). <https://arxiv.org/abs/2109.00117>.
11. 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>.

## PREPRINTS/IN PREPARATION

12. 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

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

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## RESEARCH PRESENTATIONS

**ACM–SIAM Symposium on Discrete Algorithms (SODA24)** (expected) Alexandria, VA  
*On Approximability of Steiner Tree in  $l_p$ -metrics* January 7–10, 2024

**Weizmann Institute of Science Algorithms Seminar** Rehovot, Israel  
[Spanning Adjacency Oracles in Sublinear Time](#) August 2, 2023

**2023 Joint Mathematics Meetings** Boston, MA  
*Angle Variants of the Erdős Distinct Distance Problem* January 7, 2023

<b>University of Michigan CS Theory Lunch Seminar</b> <i>Inapproximability of the Discrete Steiner Tree Problem in <math>l_p</math>-metrics</i>	Ann Arbor, MI December 9, 2022
<b>University of Michigan Undergraduate Student Mathematics Seminar</b> <i>A correspondence between Vertex Cover and Steiner Trees in Hamming Space</i>	Ann Arbor, MI September 9, 2022
<b>Combinatorial Structures and Processes Student Workshop 2022</b> <i>Hardness of Approximation of Steiner Trees in Metric Spaces</i>	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

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## 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>	

## University of Michigan

Ann Arbor, MI

*Grader for Math 465, Introduction to Combinatorics*

Aug. 2020–Dec. 2020

- 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.
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## VOLUNTEER EXPERIENCE

### University of Michigan

Ann Arbor, MI

*STEM Society*

Aug. 2021–Apr. 2023

- Wrote and taught lesson plans for “STEM Saturday” events every semester—days of teaching local underserved students fun STEM topics (cryptography, etc.).

*University of Michigan Math Circles*

Jan. 2020–Apr. 2022

- Guided middle school and high school students during interactive math talks.

*University of Michigan Science Olympiad*

Feb. 2020

- Volunteered as an event supervisor for a Division B event, proctoring and grading for the event

### Williams College

Williamstown, MA

*SMALL REU Outreach*

June 2021–Aug. 2021

- 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.
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## HONORS/AWARDS

*Outstanding Graduating Senior Award, UM Math Dept.*

Apr. 2023

*National Science Foundation Graduate Research Fellowship, NSF*

Mar. 2023

*Churchill Scholar*

Dec. 2022

*Marshall Scholar alternate*

Nov. 2022

*Rhodes Scholarship finalist*

Nov. 2022

*Distinguished Staff Scholarship, University of Michigan*

June 2022

*Jack Meiland Scholar, UM LSA Honors Program (awarded to one top rising senior)*

Apr. 2022

*Outstanding Undergrad. Researcher Award Hon. Mention, CRA*

Dec. 2021, 2022

*Pamela J. Mackintosh Undergraduate Research Award, UM Library*

June 2021

*Book Industry Charitable Foundation Scholarship, Binc*

Aug. 2020, June 2021

*Evelyn O. Bychinsky Award, UM Math Dept.*

May 2021

*Goldwater Scholar, Barry Goldwater Scholarship Foundation*

Mar. 2021

*Frank H. and Agnes A. Davis Scholarship, UM Math Dept.*

Mar. 2019

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## SKILLS

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

**Language:** Spanish, full professional proficiency