Henry Fleischmann

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EDUCATION

Carnegie Mellon University   Pittsburgh, PA
Ph.D. in Computer Science   Aug. 2024–
University of Cambridge   Cambridge, England
MASt in Pure Mathematics with Distinction   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.

RESEARCH EXPERIENCE

Carnegie Mellon University   Pittsburgh, PA
Ph.D. in Computer Science   Aug. 2024–Current
Advisor: Jason Li
- Studied fast algorithms for graph problems and related lower bound constructions. Some
  problems of interest include: directed min cut, expander decompositions, Steiner shortcut
  sets, max flow, etc.
- Gave a new almost linear time algorithm for directed expander decompositions on
  capacitated graphs.
- Gave a new fastest algorithm for approximate max flow.
- Subreviewer for ICALP '24, SODA '25, ITCS '25, ISAAC '25, SODA '26

University of Michigan   Ann Arbor, MI
Research visit   July 2025
Advisor: Thatchaphol Saranurak
- Studied the Steiner shortcut set problem, improving the best known lower bound from
  sqrt(log n) to log n. See https://arxiv.org/abs/2510.24954.

New York University   New York, NY
Visiting Academic   May 2025–July 2025
Advisor: Anupam Gupta
- Studied the k-median clustering problem. Gave a new faster FPT algorithm for optimal $1 + 2/e$ approximation.

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.
- 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 φ 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.

ACCEPTED PAPERS

1. R. Cen, H. Fleischmann, G. Z. Li, J. Li, D. Panigrahi, Fast Algorithms for Graph Arboricity and Related Problems, *66th IEEE Annual Symposium on Foundations of Computer Science* (FOCS 2025). https://arxiv.org/abs/2507.15598

2. H. Fleischmann, K. Fragkia, R. E. Berker, Beyond Symmetry in Repeated Games with Restarts, *Proceedings of the Thirty-Fourth International Joint Conference on Artificial Intelligence* (IJCAI 2025), 3866–3873. https://arxiv.org/abs/2505.14847

3. B. Bailey, J. Dell, H. L. Fleischmann, F. Jackson, S. J. Miller, E. Pesikoff, and L. Reifenberg, Indecomposability Over the Max–Min Semiring, *Journal of Integer Sequences* **28** (2025), Article 25.2.7. https://cs.uwaterloo.ca/journals/JIS/VOL28/Jackson/jackson5.pdf

4. H. Fleischmann, G. A. Gamboa Q., Karthik C.S., J. Matějka, and J. Petr, On Steiner trees of the regular simplex, *Journal of Computational Geometry* **16(1)** (2025), 1-34. https://arxiv.org/abs/2312.01252

5. H. Fleischmann, K. Karlov, Karthik C.S., A. Padaki, and S. Zharkov, Inapproximability of Minimum Diameter Clustering for Few Clusters, *Proceedings of the 2025 Annual ACM-SIAM Symposium on Discrete Algorithms* (SODA 2025), 4707-4731. https://arxiv.org/abs/2312.02097.

6. G. Bodwin and H. Fleischmann, Spanning adjacency oracles in sublinear time, *15th Innovations in Theoretical Computer Science* **287** (ITCS 2024), 19:1–19:21. https://arxiv.org/abs/2308.13890.

7. H. Fleischmann, S. Gavva, and Karthik C.S., On Approximability of Steiner Tree in l_p-metrics, *TheoretiCS*, **4** (2025), Article 4, 1-53. https://theoretics.episciences.org/15104.

8. H. Fleischmann, S. Gavva, and Karthik C.S., On Approximability of Steiner Tree in l_p-metrics, *Proceedings of the 2024 Annual ACM-SIAM Symposium on Discrete Algorithms* (SODA 2024), 1669–1703. https://arxiv.org/abs/2306.02189.

9. 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.

10. 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.

11. 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 Geome*try, (2023). https://arxiv.org/abs/2108.12015.
12. 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.
13. 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

14. Faster Weak Expander Decompositions and Approximate Max Flow (with George Z. Li and Jason Li). https://arxiv.org/abs/2511.02943
15. Improved Directed Expander Decompositions (with George Z. Li and Jason Li). https://arxiv.org/abs/2507.09729
16. Reviving Thorup's Shortcut Conjecture (with Aaron Bernstein, Henry Fleischmann, Maximilian Probst Gutenberg, Bernhard Haeupler, Gary Hoppenworth, Yonggang Jiang, George Z. Li, Seth Pettie, Thatchaphol Saranurak, and Leon Schiller). https://arxiv.org/abs/2510.24954

PREPRINTS/IN PREPARATION

OTHER PAPERS

17. Evaluating the Outcome of the 2022 United States Redistricting Cycle: A Nonpartisan Review. Gerald R. Ford School of Public Policy CLOSUP Student Working paper.
18. Efficient (j,k)-Domination on Chess Graphs (with Daniela Elizondo, Brendan Rooney, and Rachel Thornton).
19. 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).

RESEARCH PRESENTATIONS

Carnegie Mellon Theory Lunch   Pittsburgh, PA
Directed Expander Decompositions: a Gardener's Guide   November 19, 2025

Carnegie Mellon Algorithms and Complexity Seminar   Pittsburgh, PA
Using pseudoapproximations for k-median   September 15, 2025

New York University Tandon Theory Reading Group   New York, NY
Simpler and Faster Directed Expander Decompositions   July 10, 2025

Carnegie Mellon Algorithms and Complexity Seminar   Pittsburgh, PA
The Crossing Number Inequality and Applications   February 17, 2025

Carnegie Mellon Algorithms and Complexity Seminar
Spanning Adjacency Oracles in Sublinear Time

Pittsburgh, PA
October 22, 2024

15th Innovations in Theoretical Computer Science (ITCS24)
On Approximability of Steiner Tree in l_p-metrics

Berkeley, CA
February 2, 2024

ACM–SIAM Symposium on Discrete Algorithms (SODA24)
On Approximability of Steiner Tree in l_p-metrics

Alexandria, VA
January 8, 2024

Weizmann Institute of Science Algorithms Seminar
Spanning Adjacency Oracles in Sublinear Time

Rehovot, Israel
August 2, 2023

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

Annual Workshop in Combinatorial and Additive Number Theory 2022
Erdos Distinct Angle Problems

New York City, NY
May 26, 2022

2022 Joint Mathematics Meetings
Modeling Redistricting with Gerrychain
Angle Variants of the Erdős Distinct Distance Problem
The Erdős Distance Problem for Angles

Seattle, WA
April 4, 2022
April 4, 2022
April 4, 2022

2021 Young Mathematicians Conference
Erdos Distinct Angle Problems
Reducibility of Sets in Generalized Settings
Limiting spectral measure of random circulant Hankel matrices.

Columbus, OH
August 20, 2021
August 21, 2021
August 22, 2021

Goldwater Scholar Community 2021 Symposium
Efficient (j, k)-domination in chess graphs

Fully Remote
August 7, 2021

Southeastern Intl. Conf. on Combinatorics, Graph Theory and Computing

Boca Raton, FL

2021 Joint Mathematics Meetings　　　　　　　　　　　　　　　　　　Washington, D.C.
Efficient (j,k)-domination in chess graphs　　　　　　　　　　　　　　　January 7, 2021

Discrete and Computational Mathematics Seminar at RIT　　　　　　　　Rochester, NY
Efficient (j,k)-domination in chess graphs　　　　　　　　　　　　　　October 23, 2020

2020 Young Mathematicians Conference　　　　　　　　　　　　　　　Columbus, OH
Efficient (j,k)-domination in chess graphs　　　　　　　　　　　　　　August 15, 2020

EMPLOYMENT

University of Michigan　　　　　　　　　　　　　　　　　　　　　　Ann Arbor, MI
Instructional Aide for EECS 477, Introduction to Algorithms　　　　　Aug. 2022—Dec. 2022
- Wrote solutions for biweekly problem sets. Designed and taught weekly discussion sections. Held office hours. Graded exams.

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.

SERVICE

Carnegie Mellon University　　　　　　　　　　　　　　　　　　　Pittsburgh, PA
Theory Lunch Organizer　　　　　　　　　　　　　　　　　　　　Aug. 2025–May 2026
- Designed the semesterly talk schedule and invited speakers for the CMU theory lunch. Also coordinated the day-to-day operations of the lunch include: maintaining the Theory Lunch YouTube channel, maintaining the Theory Lunch website, announcing invited speakers and serving as point person during their visits, and coordinating food deliveries for the lunches.

Introductory Course (IC) organizer　　　　　　　　　　　　　　　Aug. 2025–Oct. 2025
- Organized three group outings for the new CSD Ph.D. students (a trip to the Monongahela Incline + dinner, a trip to the Andy Warhol museum, and a trip to Row House Cinema)

CSD Ph.D. Open House organizer　　　　　　　　　　　　　　　　Jan. 2025–Mar. 2025
- Served as point person for the theory lunch, met with prospective theory students, and organized an outing to the Phipps Conservatory.

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.

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

SKILLS

Technical: C++, Python, C, LaTeX, ARMv8, OCaml, Rust
Language: Spanish, full professional proficiency