Peter Hoffman

hoffmanp@mit.edu
personal webpage

Education

Massachusetts Institute of Technology, Ph.D. in Operations Research   *2024–Expected 2029*

- Affiliations: MIT Laboratory for Information and Decision Systems (LIDS)
- GPA: 5.0/5.0
- Research areas: diffusion models, deep learning, statistics, stochastic differential equations.
- Advisors: Prof. Pablo Parrilo & Prof. Gabriele Farina

Massachusetts Institute of Technology, B.S. in Mathematics   *2019–2024*

- GPA: 4.8/5.0

Research Affiliations

Laboratory for Information and Decision Systems (LIDS), MIT   *September 2024–Present*

- Graduate Researcher
- Researching mixing times under diffusion stochastic differential equations to prove foundational properties of diffusion models relevant to fine-tuning and guidance

Laboratory for Information and Decision Systems (LIDS), MIT   *December 2022–June 2024*

- Undergraduate Researcher
- Designed a large-scale optimization using probability flows over layered graphs to solve variants of the Blotto game in algorithmic game theory

TIES Research Group, MIT Sloan   *September 2019–February 2022*

- Undergraduate Research Assistant
- Conducted research under Prof. Robert Pozen on topics relating to public policy and financial governance
- Produced comprehensive literature overviews to inform research and proposed financial policies
- Project topics included index fund strategies, corporate tax credit policies, and sustainable financial reporting

Research Projects

1. **Consistent Diffusion for Gaussian Blur and General Linear Processes with Additive Gaussian Noise** (Working paper, June 2025) with K. Bangachev, V. Butoi, and G. Magakyan:
   Proved approximation results for the score function in SDEs under various corruption processes

2. **Kolmogorov–Arnold Networks: Representation and Architecture** (Working paper, December 2024) with F. Wu and P. Prastakos:
   Investigated the effect of theory-motivated network architectures on model performance

3. **An Overview of the Nested Sampling Algorithm** (May 2023) supervised by Prof. Peter Kempthorne:
   Analyzed nested sampling for computing normalizing factors in Bayesian inference

4. **An Integer Program Approach to Non-Planar Graph Coloring** (May 2023) with A. Hu, S. Konduru, A. Li:
   Designed a polynomial-size integer program to generate proper colorings of non-planar graphs

5. **Expander Graphs and Their Construction** (MIT Math project, 2023):
   Proved existence of expander graphs via randomized constructions and unique-neighbor expansion

6. **Polygon Dynamics Under Reflection Operations** (MIT Math project, December 2022) with Peter W. Hoffman, Oscar P. Lores, and Cathy Yung:
   Studied the dynamics of a polygon as its vertices are iteratively reflected across the perpendicular bisector of their neighbors.

7. **Billiards Mathematics in the Unit Square and Equilateral Triangle** (MIT Math project, October 2022) with Peter W. Hoffman, Oscar P. Lores, and Cathy Yung:
   Characterized mathematical billiards in the square and equilateral triangle. For the square, we find when a billiards trajectory is periodic and find an explicit formula for the kth bounce of the billiards sequence.

8. **Random Matrix Initialization Methods in Machine Learning** (May 2021) with S. Simhon, V. Urvantsev, and M. Yunus:
   Evaluated randomized initialization schemes to boost performance of two-layer feed-forward neural networks

Financial Research Publications

1. **The Hill** – "An effective and politically viable option for corporate tax reform" (with Robert Pozen) *June 10, 2021.* Evaluated international tax policy and proposed an alternative system to reduce corporate profit shifting to tax havens. `link`

2. **MarketWatch** – "Muni-bond investors need straight talk about climate-change risk" (with Robert Pozen) *March 30, 2021.* Researched transparency gaps in municipal bond markets and climate-risk disclosure impacts on yields; proposed policy solutions. `link`

3. **MarketWatch** – "Congress must provide real incentives to employers and workers to boost job growth" (with Robert Pozen) *July 23, 2020.* Analyzed fiscal impact of $600 stimulus checks and resulting employer/employee incentives.

Talks

1. Thayer Engineering Poster Session (Dartmouth College) *2024*

Industry Experience

Citigroup Boston, MA
Summer Analyst *June 2022–August 2022*

- Gained in-depth exposure to institutional trading across equity derivatives, global rates, and securitized products
- Generated, backtested, and tracked trades in derivatives and global rates markets using quantitative and fundamental research
- Helped design a machine learning model to approximate the Black–Scholes option pricing formula from high-dimensional market data

Point72 New York, NY
Summer Quantitative Researcher *June 2021–August 2021*

- Aided development and backtesting of a semi-automated global credit default swap trading strategy using large-scale datasets from Bloomberg terminal
- Applied principal component analysis to analyze and risk-adjust returns across cross-market CDS products

Teaching Experience

Instructor, *6.S095 Intermediate Probability*, MIT Computer Science   *December 2021–January 2024*

- Helped design and run a student-run, for-credit January term class (supervised by Prof. Guy Bresler)
- Delivered lectures on generating functions, recurrences, random variables, and stochastic processes for 120 students

Grader, *18.211 Combinatorial Analysis*, MIT Mathematics   *September 2023–December 2023*

- Evaluated and provided feedback on homework and exams for a 25-student course

Teaching Assistant, *15.053 Optimization Methods*, MIT   *February 2023–May 2023*

- Designed and led weekly recitation sessions on linear and nonlinear optimization for a class of 110 students

Instructor, *Optimization in Graph Theory*, MIT HSSP Summer Program   *June 2022–July 2022*

- Developed and taught a six-week advanced course on graph-theoretic optimization applications (coloring, shortest paths, matching)

Personal Projects

1. **Triple Health,** (October 2025)   `project page`
   Built an analytics platform for chronic disease prevention, helping public health officials and community organizers increase the effectiveness of preventive measures. Includes a feature to match the right person to the right intervention at the right time (primary care, mental health care, or social services), with built-in analytics to improve resource allocation.
   Joint collaboration with Juliana Ochacher.

2. **Triple II,** (January 2026)   `project page`
   Ongoing project to design health insurance tools tailored to the gig economy (variable income, fluctuating hours, changing eligibility).
   Joint collaboration with Juliana Ochacher.

3. **LegalChat,** (August 2025)   `project page` `github`
   Developed an AI-chatbot to translate dense legal clauses into clear explanations and structured summaries, helping users identify key terms, risks, and obligations and formulate better questions for a lawyer when needed.
   Joint collaboration with Carol Gao and Cenhao Zhu.

Skills

- **Machine Learning & Deep Learning:** diffusion models; fine-tuning and guidance; score-based generative modeling
- **Mathematics:** statistics; stochastic differential equations; optimization
- **Programming:** Python (scikit-learn, PyTorch, torchvision, cvxpy, streamlit); LaTeX; Julia
- **Tools:** Git/GitHub; high-performance computing

Other Activities

- MIT Varsity Sailing team, 2021-2023
- Varsity Rowing: US National Champion (2018); New York State Champion (2017, 2018)