

Nate Gillman

PhD Candidate at Brown University
Departments of Computer Science, Mathematics

Email: nategillman1@gmail.com
Homepage: <https://nategillman.com>

Research Interests

Video Generative Models, World Models, Mathematically Rigorous Generative Modeling, Computer Vision, Machine Learning, Artificial Intelligence, Number Theory

Education

Ph.D. (Machine Learning, Mathematics), Brown University Sept. 2020 – present

Advisor: Professor Chen Sun

Dissertation Committee: Professors Stephen Bach, Carsten Eickhoff, Jeffrey Hoffstein, Chen Sun

Awarded Sc.M. in Mathematics in May 2022

B.A. (Computer Science, Mathematics), Wesleyan University Sept. 2016 – May 2020

Honors: Class rank 1/748, Barry Goldwater Scholar, High Honors in Mathematics

Publications/Preprints (Machine Learning)

- [1] **N. Gillman**, C. Herrmann*, M. Freeman, D. Aggarwal, E. Luo, D. Sun, C. Sun*. Force Prompting: Video Generation Models Can Learn and Generalize Physics-based Control Signals (Preprint) 2025 [\[link\]](#)
- [2] **N. Gillman***, D. Aggarwal*, M. Freeman, S. Singh, C. Sun. Fourier Head: Helping Large Language Models Learn Complex Probability Distributions In *International Conference on Learning Representations (ICLR)* 2025 [\[link\]](#)
- [3] **N. Gillman**, M. Freeman, D. Aggarwal, C. H. Hsu, C. Luo, Y. Tian, C. Sun. Self-Correcting Self-Consuming Loops for Generative Model Training In *International Conference on Machine Learning (ICML)* 2024 [\[link\]](#)
- [4] W. Rudman, **N. Gillman**, T. Rayne, C. Eickhoff. IsoScore: Measuring the Uniformity of Embedding Space Utilization In *Findings of the Association for Computational Linguistics (ACL)* 2022 [\[link\]](#)

Publications (Pure Mathematics)

- [1] F. Coen, **N. Gillman**, T. Keleti, D. King, J. Zhu. Large sets with small injective projections, in *Annales Fennici Mathematici* (2021)
- [2] **N. Gillman**, M. Kural, A. Pascadi, J. Peng, A. Sah. Patterns of primes in the Sato-Tate conjecture, in *Research in Number Theory* (2020)
- [3] **N. Gillman**. Explicit subconvexity savings for sup-norms of cusp forms on $\mathrm{PGL}(n, \mathbb{R})$, in *Journal of Number Theory* (2020)
- [4] **N. Gillman**, X. Gonzalez, K. Ono, L. Rolen, M. Schoenbauer. From partitions to Hodge numbers of Hilbert schemes of surfaces, in *Philosophical Transactions of the Royal Society A* (2019)
- [5] **N. Gillman**, X. Gonzalez, M. Schoenbauer. Exact formulas for invariants of Hilbert schemes, in *Research in Number Theory* (2018)

Patents

- [1] N. Gillman, N. Laflaf, A. Parangi, J. Reilly, N. Wies. Methods and systems for automatically generating and executing computer code using a natural language description of a data manipulation to be performed on a data set. U.S. Patent No. WO 2024/073098 A1. Filed Sep 29, 2023. [\[link\]](#)

Selected Research Experience

Machine Learning Research Intern, Google Research May. 2025 – Present

Computer vision and generative modeling.

Machine Learning Research Intern, Amazon Science Aug. 2024 – Dec. 2024

Improving physical realism of human-object interaction motion generative models.

Machine Learning Research, Brown University 2022 – present

Proposed “Force Prompting”, a method of adding force controls to video generative models (2025, arXiv). Invented “Fourier Head,” a neural architecture that learns categorical distributions with a continuous structure, improving agent returns by 46% (ICLR 2025). Proposed first technique for stabilizing self-consuming generative model training, leading a team of four student researchers (ICML 2024). Invented IsoScore, a mathematically rigorous method for measuring the uniformity of spatial utilization of word embedding spaces (ACL 2022).

Pure Mathematics Research, Brown, Emory, Wesleyan, Budapest Semesters in Math 2016-2022

Studied modular forms, elliptic curves, other topics in analytic number theory; see publications list.

Selected Industry Experience

Machine Learning Engineer, various companies June 2022 – May 2023

During yearlong leave of absence from PhD, built NLP chatbot at American Express AI labs; built audio generation and classification models (speaker separation, speaker diarization, voice cloning) at Captions, a video processing iOS app startup; and built probabilistic time series forecasting models at Akkio, an enterprise SaaS startup, and integrated them into web app.

Service

Teaching: Mentoring junior machine learning researchers at Brown (2022–present), Brown mathematics teacher training (2021), mentored a directed reading program in cryptography (2021), course assistant for algebra, analysis, calculus, discrete math, number theory (2017-2022), math research seminar organization (2020-2021)

Outreach: organized activities “Numbers in Nature with Nate”, “Math Yoga” at youth summer camps.

Peer reviewing: ECCV, NeurIPS, ICLR, Research in Number Theory.

Selected Invited Talks

- [1] *Force Prompting: How to Turn Your Video Generative Model into a Controllable Physics Simulator*, Stability AI Reading Group, 2025
- [2] *Mode Collapse in Self-Consuming Generative Models*, Math ML Seminar at MPI and UCLA, 2024
- [3] *Self-Correcting Self-Consuming Loops for Generative Model Training*, NYC Computer Vision Day, 2024