Nate Gillman

PhD Candidate at Brown University
Departments of Computer Science, Mathematics

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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
In *Neural Information Processing Systems* (NeurIPS) 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 2024/0028312 A1. Jan 25, 2024. [link]

Selected Research Experience

ML Research Intern, then Student Researcher, Google Research May. 2025 – Present

Computer vision and generative modeling.

ML Research Intern, Amazon Science Aug. 2024 – Dec. 2024

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

ML Research, Brown University 2022 – present

Proposed "Force Prompting", a method of adding force controls to video generative models (NeurIPS 2025). Invented "Fourier Head," a neural architecture that learns categorical distributions with a continuous structure, improving agentic 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: Co-instructor for graduate level Deep Learning (2025-present), 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, ICML, NeurIPS (Top Reviewer in 2025), 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