

Nicole Cosme-Clifford

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SUMMARY

PhD candidate at Yale University studying how architectural constraints shape representational capacity in modern neural audio models. Experience includes reimplementing and reverse engineering widely used models in Python (e.g., SampleCNN, EnCodec, NanoGPT), running model intervention experiments to analyze learned features, and communicating results to diverse audiences.

Research Interests: Mechanistic Interpretability, Representation Learning, Deep Neural Networks

EDUCATION

Yale University — New Haven, CT *Expected Dec 2026*

Ph.D., Music Theory — Dissertation: Architectural Constraints on Feature Emergence in Neural Audio Models
Relevant Coursework: Probability Theory; Statistical Theory; Machine Learning; Deep Learning Theory; Natural Language Processing

Queens College — Flushing, NY

M.A., Music Theory — Thesis: Mathematical modeling of music via structured operator composition May 2018

Stony Brook University — Stony Brook, NY

B.A., Music; Minor in Applied Data Science May 2014

SELECTED RESEARCH EXPERIENCE

Yale University — Graduate Researcher (Neural Network Interpretability), New Haven, CT Aug 2020 – Present

Dissertation: Architectural Constraints on Feature Emergence in Neural Audio Models

- Derived theoretical limits on feature stabilization in convolutional neural audio encoders.
- Conducted mechanistic interpretability experiments on neural networks, analyzing feature learning, representation geometry, and semantic alignment using custom intervention tools.
- Constructed minimal toy models to test hypotheses about feature stabilization and representational capacity.

AI and Music Research Group — Deep Learning Researcher, Remote Jun 2023 – Present

- Reimplemented and trained a transformer (NanoGPT architecture) on symbolic music corpora.
- Analyzed representation geometry to study emergence of harmonic structure in simple transformer models.
- Built intervention tools for tracing feature propagation and separability across layers.

Oxford Machine Learning Summer School — Research Project (Finance & NLP), Remote May 2023 – Jul 2023

- Fine-tuned a transformer-based large language model for financial text classification in Python.
- Designed data preprocessing and hyperparameter optimization pipeline.
- Top performer in the program's text-classification competition (top 3 out of ~350 submissions).

TECHNICAL COMMUNICATION & CONSULTING

Yale Digital Humanities Lab — Deep Learning Specialist Consultant, New Haven, CT Aug 2022 – Present

- Advised AI and data science projects across domains, providing model debugging, architecture guidance, and interpretability support.
- Developed the "Deep Learning for Digital Humanists" workshop series, advancing an accessible approach to the use of deep neural networks in humanities research.

Yale Graduate Writing Lab — Consultant, New Haven, CT

Aug 2023 – Present

- Co-developed and delivered “AI for Research & Writing” workshop series, educating graduate researchers on effective and responsible generative AI use.
- Provided individualized consultations and workshops on writing and research communication.

Yale Tsai Center for Innovative Thinking — AI Fellow, New Haven, CT

Jan 2024 – Jan 2025

- Advised development of AI curriculum for non-technical student founders and conducted research on AI adoption within academic institutions.

Yale Office of Strategic Analysis — Swensen Fellow in Strategic Analysis, New Haven, CT

Jun 2024 – Aug 2024

- Used statistical modeling and strategic analysis to assess progress toward university sustainability targets and recommend strategic actions to institutional stakeholders.

SKILLS

Programming: Python, PyTorch, NumPy

Modeling: Transformer models (decoder-only), convolutional neural networks, representation learning

Methods: Mechanistic interpretability, activation analysis, feature attribution, probing, model intervention, representation geometry, deep learning, machine learning, statistical modeling, signal processing

PUBLICATIONS

N. Cosme-Clifford, “Decomposing Audio into Timbral Features with Convolutional Neural Networks”, *2024 IEEE International Conference on Big Data (BigData)*, Washington D.C., 2024, pp. 3168-3173.

N. Cosme-Clifford, J. Symons, K. Kapoor and C. W. White, "Musicological Interpretability in Generative Transformers," *4th International Symposium on the Internet of Sounds*, Pisa, Italy, 2023, pp. 1-9.

C.W. White, K. Kapoor, **N. Cosme-Clifford**, J. Symons, L. von Mutius, “Humans Perceive Ai-Generated Music as Less Expressive than Comparable Human-Made Content,” preprint, 2024, <http://dx.doi.org/10.2139/ssrn.5087035>

SELECTED PRESENTATIONS

Decomposing Audio Features with Deep Neural Networks

- IEEE BigData 2024, *Washington D.C. (Dec 2024)*
- Acoustical Society of America Annual Meeting, *Virtual (Nov 2024)*
- New England Conference of Music Theorists, *Boston University (Apr 2024)* — Keynote panel

Musicological Interpretability in Generative Transformers

- Society for Music Perception and Cognition Annual Meeting, *BANFF, CA (Jul 2024)*
- 4th International Symposium on the Internet of Sounds, *Pisa, It. (Oct 2023)*

Generative AI & Music Systems (Jukebox and Beyond)

- Society for Music Theory Annual Meeting, *Denver CO (Nov 2023)* — won Student Presentation Award
- Keystone Digital Humanities Conference, *Johns Hopkins University (Jun 2023)*
- New England Conference of Music Theorists, *Yale University (Apr 2023)*