Nathan Pruyne

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Education

Northwestern University Evanston, IL

B.S in Computer Science, 2nd Major in Music Technology, Minor in Sound Design *2021 - 2025*

- Relevant Coursework: Machine Learning, Generative Deep Models, Human Computer Interaction, Signals and Systems, Design and Analysis of Algorithms, Recording Techniques, Technology-Based Performance, Studio Techniques in Electro-acoustic Music
- Current Coursework: Human-AI Interaction Research, Composing with Computers
- GPA: 3.99/4.0; Major GPA: 4.0/4.0

Technical Skills

- **Machine Learning**: Deep Learning: CNNs, GANs, Transformers; Vocoders; Data Augmentation; Tensorboard
- **Audio Processing**: Torchaudio, Librosa
- **Frameworks**: PyTorch, NumPy, OpenCV, TensorFlow, Pandas, Scikit-learn, Matplotlib, Jupyter, JUCE
- **Languages**: Python, C, C++, MaxMSP, Arduino
- **Tools**: Git, Linux, Slurm, LaTeX

Research Experience

Interactive Audio Lab Northwestern University

Undergraduate Researcher; Advisor: Dr. Bryan Pardo *April 2022 - Present*

- Co-develop HARP, an editor for remote-hosted audio generation and analysis machine learning models in C++ and JUCE.
- Create interface and implementation to attribute generative music to melodically and timbrally similar songs in training data using audio embeddings.
- Implemented and evaluated pitch estimation neural networks on speech and music datasets using PyTorch and Tensorboard.
- Detected emphasized words in speech using pitch estimation, phoneme alignment, PyTorch convolutional and transformer neural networks.
- Implemented experiments and evaluated generative neural networks for fine-grain speech editing.

TIDAL Lab Northwestern University

Summer Intern; Advisor: Dr. Michael Horn *June 2023 - August 2023*

- Taught Python via music composition and creation over Zoom and in person to students ages 10-18 using TunePad.
- Implemented digital audio workspace features into TunePad using Dart and JavaScript.

Globus Labs AI Team Argonne National Laboratory

Computer Science Research Aide; Advisors: Dr. Ian Foster, Dr. Ben Blaiszik *August 2021 - August 2022*

- Adapted framework for Convolutional Neural Networks to segment oxygen-evolution electrocatalysis video data.
- Implemented ML code for high performance computing, including the Argonne Theta supercomputer.
- Documented implementations of machine learning frameworks for use by materials scientists.

Materials Data Facility The University of Chicago

Research Intern; Advisor: Dr. Ben Blaiszik *June 2020 - August 2021*

- Achieved 5000x speedup on classification of dendrite segmentation imagery via 3D convolutional neural networks.
- Advised creation of Northwestern University materials science course module (MAT_SCI 395-6) on applying neural networks to materials data. Coursework includes Jupyter notebooks hosted on Google Colab.
- Organized and plotted cyclic voltammetry data using Pandas and Matplotlib.
- Applied SIFT, SURF, and other computer vision methods to electron microscopy data.

Publications

[1] C. Benetatos, F. Cwitkowitz, **N. Pruyne**, H. F. Garcia, P. O'Reilly, Z. Duan, and B. Pardo, "Harp 2.0: Expanding hosted, asynchronous, remote processing for deep learning in the daw," in *ISMIR 2024 Late Breaking Demos*, 2024.

[2] M. Morrison, C. Churchwell, **N. Pruyne**, and B. Pardo, "Fine-grained and interpretable neural speech editing," in *INTERSPEECH 2024*, 2024.

[3] M. Morrison, P. Pawar, **N. Pruyne**, J. Cole, and B. Pardo, "Crowdsourced and automatic speech prominence estimation," in *2024 IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP)*, pp. 12281–12285, 2024.

[4] J. R. Lake, S. Rufer, J. James, **N. Pruyne**, A. Scourtas, M. Schwarting, A. Ambadkar, I. Foster, B. Blaiszik, and K. K. Varanasi, "Machine learning-guided discovery of gas evolving electrode bubble inactivation," *Nanoscale*, 2024.

[5] M. Morrison, C. Hsieh, **N. Pruyne**, and B. Pardo, "Cross-domain neural pitch and periodicity estimation," in *arXiv preprint arXiv:2301.12258*, 2023.

[6] J. James, **N. Pruyne**, T. Stan, M. Schwarting, J. Yeom, S. Hong, P. Voorhees, B. Blaiszik, and I. Foster, "Segmentation of tomography datasets using 3d convolutional neural networks," *Computational Materials Science*, vol. 216, p. 111847, 2023.

Presentations

[1] **N. Pruyne** and B. Pardo, "Allowing attribution for generative music models," in *Northwestern Undergraduate Research Showcase 2024*, October 2024.

[2] S. Rufer, J. Lake, A. Scourtas, J. James, **N. Pruyne**, M. Schwarting, B. Blaiszik, and K. Varanasi, "Machine learning guided interrogation of gas evolving electrode catalyst activity," in *MRS 2022: AI for Characterization*, August 2022.

[3] T. Stan, **N. Pruyne**, J. James, M. Schwarting, J. Yeom, P. Voorhees, B. Blaiszik, and I. Foster, "Analysis of in-situ x-ray tomography datasets of dendritic solidification using 2d and 3d machine learning algorithms," in *TMS 2022: Advanced Real Time Imaging Symposium*, February 2022.

Educational Modules

[1] T. Stan, J. James, **N. Pruyne**, M. Schwarting, J. Yeom, P. Voorhees, B. J. Blaiszik, I. Foster, and J. D. Emery, "Machine learning in materials science: Image analysis using convolutional neural networks in matcnn," Nov 2021. Available on nanoHUB.

Teaching Experience

CS 449: Deep Learning — Northwestern University
Peer Mentor, Dr. Bryan Pardo — *Spring 2024, Winter 2025*

- Advised students on homework projects including implementing MLPs, CNNs, GANs, autoencoders, RNNs, and reinforcement learning.
- Aided in development of new assignments.
- Graded student work and provided feedback on assignments.

CS 354: Computer System Security — Northwestern University
Peer Mentor, Dr. Yan Chen — *Winter 2024*

- Advised students in labs introducing vulnerabilities such as buffer overflows, reverse engineering, cross-site scripting, and SQL injection during office hours and via Piazza.
- Brainstormed and tested quarter-end capture-the-flag competition.
- Graded student work and provided feedback on assignments.

A New Sound — YWCA Metropolitan Chicago and Northwestern University
Instructor — *Summer 2023*

- Developed curriculum for six-week course teaching basic Python and music production concepts using TunePad, a system for creating music through code.
- Hosted three-hour/day, four-day/week content presentation and project feedback sessions.

Northwestern CS Summer Camp — Northwestern University and DuPage NAACP
Instructor — *Summer 2023*

- Guided elementary and middle school students in creating original music and learning Python concepts using TunePad.
- Organized and lead student activities on North Central College and Northwestern University campuses.

Awards & Honors

Robert and Barbara Feldmann Undergraduate Research Fellowship 2024
Tau Beta Pi Engineering Honor Society 2023 - Present
National Merit Scholarship 2020 - 2021

Extracurricular Activities

Songwriters Association at Northwestern Northwestern University
Co-President *2022 - Present*

- Plan, promote, and run student music festivals, band showcases, guest speaker events, and student-written and produced original music compilations.
- Create environment for student musicians and songwriters to share and improve their work through feedback sessions, music production workshops, and band formation events.

Electronic Music Composition/Production
2016 - Present

- Compose and produce original and collaborative music using Acoustica Mixcraft and various plug-ins for publication on all major streaming platforms (Spotify, Apple Music, SoundCloud, etc.) under a pseudonym.
- Collaborate with other songwriters, singers, and musicians.
- 13 total released songs with four collaborators.

Phi Mu Alpha Sinfonia Iota Chapter Northwestern University
Alumni Relations Officer *2024 - Present*

- Maintain alumni email list and send updates of activities to alumni.
- Organize annual homecoming brunch.

Northwestern University Robotics Club Northwestern University
Competitive Autonomous Team Lead *2021 - 2024*

- Led team of six students in mechanical and electrical system design, CAD modeling, and Arduino programming for fully autonomous Micromouse robot.
- Competed in National Robotics Challenge, won silver award in 2022.

Northwestern University Wildcat Marching Band
Mellophone Player *2021 - Present*

Northwestern University Basketball Band
Mellophone Player *2021 - Present*

WNUR Radio
Streetbeat Student DJ *2021 - Present*

Northwestern Video Game Music Ensemble
French Horn Player, Concert and Jazz Band Arranger *2023 - 2024*