Zachary Novack

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RESEARCH INTERESTS

Generative AI for Music/Audio, Controllable Generative Models, Efficient AI

EDUCATION BACKGROUND

Ph.D. in Computer Science — Fall 2022 - Present
University of California – San Diego, San Diego, CA
Advisors: Julian McAuley, Taylor Berg-Kirkpatrick

M.S. in Computer Science — Fall 2022 - Spring 2024
University of California – San Diego, San Diego, CA
Advisors: Julian McAuley, Taylor Berg-Kirkpatrick

B.S. in Statistics & Machine Learning — August 2018 - May 2022
Carnegie Mellon University, Pittsburgh, PA
Advisors: Zachary Lipton, Simon DeDeo

- Minor in Sonic Arts (music technology)
- 3.93/4.0 GPA

SELECTED RESEARCH

DITTO: Diffusion Inference-Time T-Optimization for Music Generation.
Zachary Novack, Julian McAuley, Taylor Berg-Kirkpatrick, Nicholas J. Bryan.
ICML (**Oral, Top 1.5%**) 2024.

DITTO-2: Distilled Diffusion Inference-Time T-Optimization for Music Generation.
Zachary Novack, Julian McAuley, Taylor Berg-Kirkpatrick, Nicholas J. Bryan.
ISMIR 2024.

Presto! Distilling Steps and Layers for Accelerating Music Generation.
Zachary Novack, Ge Zhu, Jonah Casebeer, Julian McAuley, Taylor Berg-Kirkpatrick, Nicholas J. Bryan
2024

CHiLS: Zero-Shot Image Classification with Hierarchical Label Sets.
Zachary Novack, Julian McAuley, Zachary Lipton, Saurabh Garg.
ICLR MRL Workshop, 2023. ICML 2023.

SELECTED ACCOLADES

Malcolm R. Stacey Memorial Fellowship	Spring 2024
1st Place: Adobe Intern Project Expo	August 2023
NSF Graduate Research Fellowship - Honorable Mention	Spring 2022
Phi Beta Kappa Member	October 2021 - Present
Andrew Carnegie Society Scholar	September 2021 - Present
Small Undergraduate Research Grant (SURG)	June 2021
Dietrich Senior Honors Research Fellowship	May 2021
1st Place: Statistics & Data Science Research Showcase	May 2021
Summer Undergraduate Research Fellowship (SURF)	June 2020
2nd Place: 15-112 Term Project Showcase	April 2019
Dean's List: High Honors	December 2018 - May 2022
Quantitative Social Science Scholar	August 2018 - May 2022
Paul Mellon Memorial Presidential Scholarship	August 2018 - May 2022

INVITED TALKS

DITTO: Diffusion Inference-Time T-Optimization for Music Generation

- University of Rochester AI Audio Lab — December 2023
- MIT AI Music Reading Group — February 2024
- Spotify MIQ Reading Group — February 2024
- UC San Diego AI Seminar — March 2024
- ICML Oral — July 2024
- BISH Bash – Adobe — August 2024

Unsupervised Lead Sheet Generation via Semantic Compression

- AES AI & the Musician Symposium — June 2024

Disentangling the Mechanisms Behind Implicit Regularization in SGD

- HOOML Workshop, NeurIPS — December 2022

PAPERS & PUBLIC WORKS

Tutorials

- **Connecting Music Audio and Natural Language**
  SeungHeon Doh, Ilaria Manco, **Zachary Novack**, Jong Wook Kim, Ke Chen
  International Society of Music Information Retrieval (ISMIR), 2024

Preprints

- **Presto! Distilling Steps and Layers for Accelerating Music Generation**.
  Zachary Novack, Ge Zhu, Jonah Casebeer, Julian McAuley, Taylor Berg-Kirkpatrick, Nicholas J. Bryan
  2024

Conference Papers

- **DITTO-2: Distilled Diffusion Inference-Time T-Optimization for Music Generation**.
  Zachary Novack, Julian McAuley, Taylor Berg-Kirkpatrick, Nicholas J. Bryan
  International Society of Music Information Retrieval (ISMIR), 2024

- **DITTO: Diffusion Inference-Time T-Optimization for Music Generation**.
  Zachary Novack, Julian McAuley, Taylor Berg-Kirkpatrick, Nicholas J. Bryan
  Oral (Top 1.5%) at International Conference on Machine Learning (ICML), 2024

- **CHiLS: Zero-Shot Image Classification with Hierarchical Label Sets**
  Zachary Novack, Julian McAuley, Zachary Lipton, Saurabh Garg
  International Conference on Machine Learning (ICML), 2023
  ICLR Workshop on Multimodal Representation Learning, 2023

- **Disentangling the Mechanisms Behind Implicit Regularization in SGD**
  Zachary Novack, Simran Kaur, Tanya Marwah, Saurabh Garg, Zachary Lipton
  International Conference on Learning Representations (ICLR), 2023
  Spotlight and **Best Poster** at NeurIPS Workshop on The Benefits of Higher-Order Optimization in Machine Learning, 2022

Workshops

- **PDMX: A Large-Scale Public Domain MusicXML Dataset for Symbolic Music Processing**.
  Phillip Long, **Zachary Novack**, Taylor Berg-Kirkpatrick, Julian McAuley
  NeurIPS Workshop on Creativity & Generative AI, 2024
- **CoLLAP: Contrastive Long-form Language-Audio Pretraining with Musical Temporal Structure Augmentation**.
  Junda Wu, Warren Li, **Zachary Novack**, Amit Namburi, Carol Chen, Julian McAuley
  SoCal NLP Symposium, 2024
- **FUTGA: Towards Fine-grained Music Understanding through Temporally-Enhanced Generative Augmentation**
  Junda Wu, **Zachary Novack**, Amit Namburi, Jiaheng Dai, Hao-Wen Dong, Zhouhang Xie, Carol Chen, Julian McAuley
  3rd Workshop on NLP for Music and Audio, 2024
- **Unsupervised Lead Sheet Generation via Semantic Compression**
  Zachary Novack, Nikita Srivatsan, Taylor Berg-Kirkpatrick, Julian McAuley
  AES International Symposium on AI and the Musician, 2024

Nonrefereed Papers

- **Down the Rabbit Hole: Modeling Twitter Dynamics through Bayesian Inference**
  Zachary Novack
  Senior Honors Thesis (Carnegie Mellon University), 2022
- **Personalized Sequential Recommendation for Adaptive Itemization in MOBA Games**
  Zachary Novack
  Web Mining and Recommender Systems (CSE 258) Course Project (UC San Diego), 2022
- **Towards Generalizable Deep Speech Anonymization**
  Aaron Broukhim, **Zachary Novack**
  Deep Generative Models (CSE 291) Course Project (UC San Diego), 2022
- **Approximating Optimal Transport via GANs for Recourse Disparity Analysis**
  Zachary Novack, Qi Xuan Teo, Ryan Steed
  Probabilistic Graphic Models (10-708) Course Project (Carnegie Mellon University), 2022
- **Tracking Political Sentiment on Cold War China in Congressional Speeches**
  Zachary Novack, Eden Hu, and Mason Lin
  1st Place at Statistics and Data Science Research Showcase (Carnegie Mellon University), 2021
- **Lunch at the EigenSalad Bar: Linear Approaches to Dimensionality Reduction for Image Processing**
  Zachary Novack
  Numerical Linear Algebra (21-344) Course Project (Carnegie Mellon University), 2021

Blog Posts

- **Armchair Statistics: Benford's Law and other Misconceptions in the Age of Data**
  Zachary Novack
  Carnegie Mellon University Triple Helix, 2021

TEACHING EXPERIENCE

Graduate Teaching Assistant
University of California - San Diego, San Diego, CA

- CSE 258: Web Mining and Recommender Systems — Fall 2023
  Prof. Julian McAuley

Undergraduate Teaching Assistant
Carnegie Mellon University, Pittsburgh, PA

- 10-600: **M**achine **L**earning **P**rimer — Summer 2022
  Prof. Matthew Gormley
- 10-301/601: Introduction to Machine Learning — Fall 2021 - Summer 2022
  Prof. Matthew Gormley and Henry Chai
- 85-340: Research Methods for Social Psychology — Fall 2021
  Prof. David Creswell
- 36-225: Introduction to Probability Theory — Summer 2021
  Prof. Peter Freeman
- 36-226: Introduction to Statistical Inference — Spring 2021
  Prof. Peter Freeman and Nynke Niezink
- 88-300: Programming for Social Scientists — Summer 2020 - Spring 2021
  Prof. Mark Patterson

WORK EXPERIENCE

Adobe – Audio Group — Summer 2023 - Present
Research Scientist Intern under Nicholas Bryan

- Investigating methods for interactive control (ICML 2024) and efficient generation (ISMIR 2024) for audio-domain generative music models.

ACMI Lab (CMU) — Spring 2021 - Spring 2023
Research Assistant under Zachary Lipton

- Developed new method to leverage hierarchical class information for zero-shot prediction in CLIP models (ICML 2023).
- Performed large-scale verification study validate explicit regularization mechanisms for SGD across modern image benchmarks and model types (ICLR 2023).

Laboratory for Social Minds (CMU) — Summer 2020 - Fall 2022
Research Assistant under Simon DeDeo

- Designed a temporal Bayesian framework to analyze social media addiction.
- Investigated ideological network evolution on the fringe web forums /pol/ (4chan) and The Red Pill (Reddit).

Unisys Corporation — Summer 2020 - Spring 2021
AI/ML Intern

- Designed time-series models (ARIMA, LSTM, Facebook Prophet) for computer resource utilization prediction under distribution shift

ACADEMIC SERVICE

Reviewer: ICLR (2023-2024), ICASSP (2023-2024), NeurIPS (2023), ISMIR (2024)
Ph.D. Admissions Committee: UCSD (CSE, 2023)
Ph.D. Visit Day Committee (AI/ML Area Chair): UCSD (CSE, 2023-Present)

MUSICAL ACTIVITIES

Teaching Experience

Front Ensemble Technician Fall 2023 - Present
POW Percussion Ensemble, Anaheim, CA

Audio Team Summer 2023 - Present
Pacific Crest Drum & Bugle Corps, Diamond Bar, CA

- Facilitated design and live interfacing with large-scale audio rig for 150 active performers

Front Ensemble Coordinator Fall 2019 - Summer 2020
Gateway Senior High School, Monroeville, PA

- Led rehearsals and designed pedagogical structure for the front ensemble (non-mobile percussion) in Gateway's marching band and indoor percussion programs, working with a group of 10-15 students from ages 14-18.

Performer and Composer Spring 2019 - Spring 2020
Exploded Ensemble, Carnegie Mellon University, Pittsburgh, PA

- Designed large-scale Max/MSP programs for multimedia interactive performances
- Composed electro-acoustic pieces for mixed instrumentation ensembles

Percussion Arranger Fall 2018 - Spring 2019
Tomball High School Indoor Percussion, Tomball, TX

- Arranged musical production for large percussion ensemble in order to compete in the Winter Guard International (WGI) national circuit

Projects

RoboPierre Spring 2020
Adaptive Impressionist Music via Generative Modeling

- Developed interactive web app to randomly generate polyphonic music trained on impressionistic composers
- Implemented using Google Magenta's Polyphony RNN and custom stochastic voice leading algorithm

ThereMyn Spring 2019
Motion-Controlled Monophonic Synthesizer

- Used infrared distance monitor to drive audio signal creation
- Created front-end GUI to translate audio signals into a usable motion-controlled synthesizer

SKILLS

Programming Languages and Packages

- Python (Pytorch, Tensorflow, Scikit-Learn, PySpark, CVXPY), R (dplyr, tscount, zoo), C, Matlab, SQL (postgres, MySQL), Stan, Git, Shell, Max/MSP/Jitter

Other Skills

- AWS (S3, EC2, EMR), Microsoft Azure, Docker, Agile, Jira, Grafana, Ableton Live

SELECTED COURSEWORK

UC San Diego
Deep Generative Models, Search and Optimization, Information Visualization, Recommender Systems, Computing Education, Math for Robotics

Carnegie Mellon University
Probabilistic Graphical Models, Convex Optimization, Multimedia Signal Processing, ML w/Large Datasets, Real Analysis, Numerical Linear Algebra, Probability & Statistics, Statistical Computing, Linear Algebra, Philosophy of ML, Algorithms & Data Structures