

Zachary Novack

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RESEARCH INTERESTS Machine Learning (ML) for education, music information retrieval, empirical deep learning, computational social science

EDUCATION BACKGROUND *Ph.D. in Computer Science* Fall 2022 - May 2027 (Expected)
[University of California, San Diego](#), San Diego, CA

- Advised by Prof. Julian McAuley
- *Selectec Coursework:*
 - Deep Generative Models, Recommender Systems
 - *In Progress:* Search and Optimization, Information Visualization

B.S. in Statistics & Machine Learning August 2018 - May 2022

[Carnegie Mellon University](#), Pittsburgh, PA

- Minor in Sonic Arts (music technology)
- 3.93/4.0 GPA
- *Selected Coursework:*
 - 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

RESEARCH EXPERIENCE *Research Assistant* Spring 2021 - Present
[ACMI Lab](#), Carnegie Mellon University, Pittsburgh, PA

- Investigated how to recycle the final layer of pre-trained neural networks, rather than retraining it from scratch, for few-shot classification tasks (ongoing).
- Proposed new method to leverage hierarchical class information for zero-shot prediction in CLIP models (in submission).
- Designed a large-scale verification study validate explicit regularization mechanisms for SGD across modern image benchmarks and model types (in submission).

Research Assistant Summer 2020 - Present

[Laboratory for Social Minds](#), Carnegie Mellon University, Pittsburgh, PA

- Designed a Bayesian autoregressive model to analyze addiction effects on social media websites (ongoing).
- Implemented Latent Dirichlet Allocation (LDA) to investigate ideological network evolution on the fringe web forums /pol/ (4chan) and The Red Pill (Reddit).

Undergraduate Researcher Summer 2020 - Spring 2021

[Dietrich College](#), Carnegie Mellon University, Pittsburgh, PA

- Constructed filtering algorithm to parse sparse text documents for specific topic occurrences

- Modified existing sentiment analysis implementation to account for valence-shifters in congressional speeches
- Implemented multiple behavioral game theoretic models in matlab to simulate strategic choice patterns in asymmetric two-player games

PAPERS & PUBLIC WORKS

Conference Papers

- **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 / Preprints

- **CHiLS: Zero-Shot Image Classification with Hierarchical Label Sets**
Zachary Novack, Saurabh Garg, Zachary Lipton
Under Submission, 2022
- **Down the Rabbit Hole: Modeling Twitter Dynamics through Bayesian Inference**
Zachary Novack
Senior Honors Thesis (Carnegie Mellon University), 2022

Course Research Projects

- **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

WORK EXPERIENCE	<i>AI/ML Intern</i> Summer 2020 - Spring 2021 Unisys Corporation , Blue Bell, PA
	<ul style="list-style-type: none"> Designed python implementation of categorical distance metrics to interface with scikit-learn clustering algorithms Deployed time-series models (ARIMA, LSTM, Facebook Prophet) to predict computer resource utilization Developed model retraining infrastructure to automatically track distribution shift in time-series models
	<i>Front Ensemble Coordinator</i> Fall 2019 - Summer 2020 Gateway Senior High School , Monroeville, PA
	<ul style="list-style-type: none"> 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.
	<i>Studio Intern</i> Summer 2019 Joy Records , Tel Aviv, Israel
TEACHING EXPERIENCE	<ul style="list-style-type: none"> Analyzed commercial streaming data to construct customized playlists for clients Assisted in website development for Hebrew-to-English translations
	<i>Percussion Arranger</i> Fall 2018 - Spring 2019 Tomball High School Indoor Percussion , Tomball, TX
	<ul style="list-style-type: none"> Arranged musical production for large percussion ensemble in order to compete in the Winter Guard International (WGI) national circuit
	<i>Teaching Assistant</i> Carnegie Mellon University, Pittsburgh, PA
	<ul style="list-style-type: none"> <i>10-600: Machine Learning Primer</i> Summer 2022 <ul style="list-style-type: none"> Designed and demoed online course structure on prerequisite knowledge for further machine learning courses Topics Covered: Basic Python programming, coding linear algebra, Big-O notation, basic calculus, IDE set-up and environment management <i>10-301/601: Introduction to Machine Learning</i> Fall 2021 - Present <ul style="list-style-type: none"> Spearheaded team maintaining autograder implementation for coding assignments Led recitation and designed homework questions for class of 500+ students Topics Covered: Decision Trees, Linear & Logistic Regression, Regularization, Dense and Convolutional Neural Networks, PAC Learning, Generative Models, MAP Estimation, Bayesian Networks, Hidden Markov Models, Markov Decision Processes, Clustering, Ensemble Methods <i>85-340: Research Methods for Social Psychology</i> Fall 2021 <ul style="list-style-type: none"> Fully created and taught course module introducing R for psychology students, including computer science fundamentals and applications for experiment design and data analysis Topics Covered: Basic types, functions, vectorized programming, workflow in dplyr, basic statistical analysis, one-way and two-way ANOVA <i>36-225: Introduction to Probability Theory</i> Summer 2021

- Topics Covered: Basic probability, random variables, univariate/multivariate probability distributions, moment-generating functions, central limit theorem
- 36-226: *Introduction to Statistical Inference* Spring 2021
 - Topics Covered: Maximum likelihood estimation, method of moments, large & small sample hypothesis testing, properties of point estimators, confidence intervals, order statistics, Type I & Type II errors, ANOVA
- 88-300: *Programming for Social Scientists* Summer 2020 - Spring 2021
 - Topics Covered: Basic data analysis, workflow in dplyr, basic text analysis, linear regression

MUSIC 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

ACCOLADES

Honors Programs

- *Phi Beta Kappa*, October 2021 - Present
- *Andrew Carnegie Society Scholar*, September 2021 - Present
- *Quantitative Social Science Scholar*, August 2018 - May 2022
- *Dean’s List: High Honors*, December 2018 - May 2022

Awards

- *Small Undergraduate Research Grant (SURG)* for “Statistical Inference of On-line Radicalization in Extremist Communities”, Carnegie Mellon University, June 2021
- *Dietrich Senior Honors Research Fellowship* for “Autoregressive Models of On-line Addiction”, Dietrich College, Carnegie Mellon University, May 2021
- *First Place: Statistics & Data Science Research Showcase*, for “Tracking Political Sentiment on Cold War China in Congressional Speeches”, Carnegie Mellon University, May 2021
- *Summer Undergraduate Research Fellowship (SURF)*, for “Empirical Test of the Dual Accumulator Model”, Carnegie Mellon University, June 2020
- *Second Place: 15-112 Term Project Showcase* for “ThereMyn: Motion-Controlled Monophonic Synthesizer”, School of Computer Science, Carnegie Mellon University, April 2019

Scholarships

- *National Science Foundation Graduate Research Fellowship*, honorary mention, Spring 2022

- *Paul Mellon Memorial Presidential Scholarship* (merit-based), August 2018 - Present

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

EXTERNAL ACTIVITIES

Statistics Department Student Representative Spring 2022 - Present
[Dietrich College Council](#), Carnegie Mellon University, Pittsburgh, PA

- Took part in monthly council meetings to deliberate on proposals for small-to-large scale changes to Dietrich curricula and other college activities

Professional Event Coordinator Spring 2021 - Present
 American Statistical Association, Carnegie Mellon University, Pittsburgh, PA

- Coordinated multi-part speaker series featuring both faculty and external researchers
- Facilitated peer-mentorship program within the Statistics environment for future course planning

Staff Writer Fall 2020 - Present
[The Triple Helix](#), Carnegie Mellon University, Pittsburgh, PA

- Wrote journal articles on wide-scale statistical literacy and societal impacts of misreporting experimental results

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