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 - Present
University of California, San Diego, San Diego, CA

- Advised by Prof. Julian McAuley
- *Selectec Coursework:*
  - *In Progress:* Deep Generative Models, Recommender Systems

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

Preprints

- **Zachary Novack**, Saurabh Garg, Zachary Lipton; *CHiLS: Zero-Shot Image Classification with Hierarchical Label Sets*, Preprint, 2022
- **Zachary Novack**, Simran Kaur, Tanya Marwah, Saurabh Garg, Zachary Lipton; *Disentangling the Mechanisms Behind Implicit Regularization in SGD*, Preprint, 2022

Course Research Projects

- **Zachary Novack**; *Down the Rabbit Hole: Modeling Twitter Dynamics through Bayesian Inference*, Carnegie Mellon University, Thesis, 2022
- **Zachary Novack**, Qi Xuan Teo, Ryan Steed; *Approximating Optimal Transport via GANs for Recourse Disparity Analysis*, Carnegie Mellon University, 10-708 Course Project, 2022
- **Zachary Novack**; *Lunch at the EigenSalad Bar: Linear Approaches to Dimensionality Reduction for Image Processing*, Carnegie Mellon University, 21-344 Course Project, 2021

Poster Presentations

- **Zachary Novack**, Eden Hu, and Mason Lin; *Tracking Political Sentiment on Cold War China in Congressional Speeches*, Carnegie Mellon University Statistics and Data Science Research Showcase, 2021

Blog Posts

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

WORK EXPERIENCE

AI/ML Intern Summer 2020 - Spring 2021
Unisys Corporation, Blue Bell, PA

- 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

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.

Studio Intern Summer 2019
Joy Records, Tel Aviv, Israel

- Analyzed commercial streaming data to construct customized playlists for clients
- Assisted in website development for Hebrew-to-English translations

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

TEACHING EXPERIENCE

Teaching Assistant
Carnegie Mellon University, Pittsburgh, PA
- *10-600: **M**achine **L**earning **P**rimer* Summer 2022
  - 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
- *10-301/601: Introduction to Machine Learning* *Fall 2021 - Present*
  - 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
- *85-340: Research Methods for Social Psychology* *Fall 2021*
  - 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
- *36-225: Introduction to Probability Theory* *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 Online Radicalization in Extremist Communities", Carnegie Mellon University, June 2021
- *Dietrich Senior Honors Research Fellowship* for "Autoregressive Models of Online 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