Lacey Rose DeLucia

(347) 453-8508 | ld3276@princeton.edu | www.linkedin.com/in/lacey-rose-delucia-ab348424a |

Education

Princeton University **May 2025**

B.A. Computer Science, Applied Mathematics & Statistics and Machine Learning minors | ***GPA**: 3.9/4.0*

- **Courses**: Machine Learning, NLP, Linear Algebra, Statistics & Data Analysis, Data Science, Optimization, Reasoning about Computation, Economics & Computation, Game Theory, Cryptography, System Design

Technical Skills

Languages: Python (pandas, matplotlib, plotly, scipy, pytorch), Java, C, Go, HTML, CSS, JS

Experience

Senior Thesis July 2024 – present

Princeton University *NJ*

- Developing a framework for **auditing AI models** through a **principal-agent approach:** an auditor must decide on the fairness of a model through a likely manipulated dataset returned by the company
- The goal is to utilize election auditing tools to design a sequential test audit of AI models. I am also working on incorporating a gold standard dataset, which is collected independently of the audit, to verify the distribution of the requested samples.

Theoretical Machine Learning Research Intern June 2024 – Aug. 2024

NYU Center for Data Science *NY*

- Developed an efficient algorithm that returns **optimal policy with ϵ-accuracy** for **multi-task contextual bandits** in a **lifelong setting**.
- Utilized low rank representations and estimation parameters to **Minimize Sample Complexity O($\frac{\mathbf{k^2M+d^2k}}{\epsilon^2}$)** as well as concentration bounds to prove accuracy

Junior Independent Work Sept 2023 – May 2024

Princeton University *NJ*

- Trained **(BERT-CNN, BERT-BiLSTM, BERT+FC Layer)** for **binary detection** of depression in **granularly labeled** Reddit data
- Similar high metrics to previous works **(0.82 F1)**, but all models detected severe depression at higher rates than moderate, illustrating **disparity** in deep learning models

Software Engineer Intern June 2023 – Aug. 2023

Paramount Group *NY*

- Developed an interactive intranet page for over 200 employees to navigate important resources (HTML, JS, CSS)
- Designed an intuitive front-end interface for the team to manage live content updates seamlessly (AJAX, PHP)

Data Science Research Intern Sept. 2019 – June 2021

Harvard & McLean Hospital *Remote*

- Worked alongside a Harvard PhD Candidate to train a **Decision Tree** to detect handwashing in sample of OCD patients from smartwatch actigraphy data (**AUC of 0.99**). Visualized patterns through spectrograms.

Teaching

COS240 Grader Sept 2024 - Present

Princeton University

- Grade psets and exams for Reasoning about Computation Course
- Return constructive feedback to boost student's confidence and skills in writing clear, complete proofs

COS226/COS217 Lab TA Sept 2023 - May 2024

Princeton University

- Assisted students with assignments for Data Structures and Algorithms, Programming Systems
- Supported students in navigating open-ended problems and debugging (Java, C)

COS226 Precept Assistant Jan 2023 - May 2023

Princeton University

- Mentored students in Data Structures and Algorithms, explaining difficult concepts and theory

Projects

Predicting Food Inflation with LSTMs | *Personal Project* 2024

- Trained LSTMs to predict food inflation from economic variables (lagged food index, unemployment, interest rate most important). Final model significantly outperformed baseline ARIMA with **0.17 RMSE, 0.01 MAE**

Leadership

Co-President May 2024 - Present

Princeton Computer Science Council

- Managing and delegating the Council to serve as liaisons between the department and the student body
- Foster community through events to explore interdisciplinary interests, research opportunities, career support, and to highlight students' talents both academic and non-academic

Academic Chair Sept 2023 - May 2024

Princeton Computer Science Council

- Reached out to faculty and conducted interactive roundtables for students to engage directly with professors
- Organized small cohorts of 3-4 students with aligned interests, coursework, collaborative projects, and diverse levels of experience

Treasurer Aug 2024 - Present

Princeton Society of Asian Scientists and Engineers (SASE)

- Secured funding to sponsor 12 students to attend the National Conference and managed the club's finances

Mentorship Chair Sept 2022 - Sept 2023

Princeton Women in Computer Science

- Hosted study breaks, course selection events, and a professor panel
- Coordinated mentorship pairings of under and upperclassmen to help students navigate their path in CS

How can we disincentivize companies from returning manipulated data in black box audits of AI fairness? From the returned data, what level of confidence can we have in our findings? Motivated by these questions my current research focuses on designing a sequential test audit for AI models through the lens and machinery of election auditing. In this framework, I am working on balancing factors of data manipulation, maintaining a low false positive rate, privacy costs of a company sharing data, and efficiency. If I can encompass the many caveats of the auditing process, I hope that this project can impact policies for addressing fairness in AI. **At Columbia, I wish to continue researching areas of algorithmic fairness so that I can contribute towards AI accountability and responsibility.**

Working hands-on with large, noisy, real-world datasets with **Dr. Sebastian Caldas at Princeton** was my window into applying machine learning to tangible problems. As my independent work, I devised my own project to train transformer models including BERT-CNN, BERT-BiLSTM, along with a baseline for binary detection of depression in Reddit data. The future of classifiers like these is to develop unsupervised methods to identify mental health issues, but previous studies have not analyzed performance on various levels of depression. Through this experience, I learned that finetuning a model is truly an art as weeks of grid search were required to achieve a high F1 score. Even with similar metrics to those of previous work, all models detected severe depression at higher rates than moderate depression, illustrating disparity in these deep learning models. It was this experience that showed me I could continue to impact people's lives while focusing on machine learning as a career path.

After my awakening in applied machine learning, I desired to challenge myself with problems that would keep me up at night thinking about open-ended questions, so I pushed the boundaries of my research abilities with theoretical machine learning. With **Dr. Qi Lei at NYU**, I

built on her previous work by extending a multi-task lifelong learning algorithm to a contextual bandit setting, an unexplored intersection of topics. Unlike traditional machine learning, lifelong learners take on tasks sequentially and preserve useful knowledge as they go. The goal of the algorithm was to learn a low-rank representation for each task, considering context and focusing on minimizing samples, as data samples can be costly in real-world settings. With no experience in theoretical machine learning, I redid the proofs of similar papers and met weekly with Dr. Lei for her conceptual insight. Eventually, I was able to strategically decide which theorems I needed to prove differently and which I could cite. In this way, I was able to prove that the algorithm achieved epsilon accuracy with lower sample complexity than other works in the field. While thriving at the challenge of these proofs, I realized that even in the theoretical space I wish for my setting to have a more direct impact on society or systems.

Currently, for my thesis, I am collaborating with **Dr. Lydia Liu at Princeton and UC Berkeley graduate student Deborah Raji** on building a framework for auditing AI models. In this setting, an auditor must decide on the fairness of a model based on a dataset returned by the company, but the dataset is likely manipulated. We have tried various approaches to make our model as realistic as possible. Originally, the goal was to design a contract of potential manipulations and corresponding statistical significance levels. Due to statistical guarantees, our current aim is to utilize election auditing tools to design a sequential test audit of AI models. From a principal-agent perspective, I am working on incorporating a gold standard dataset, which is collected independently of the audit, to verify the distribution of the requested samples. Here, if a company is innocent, then they pass the audit with the least number of samples necessary. Overall, we are striving towards a future where fairness is a consideration with models and companies are held accountable otherwise.

I hope to continue pursuing research like this, and Columbia has the optimal environment for me to grow as a researcher and contribute to impactful advancements in algorithmic fairness. Specifically, I would be eager to collaborate with **Dr. Elias Bareinboim, Dr. Daniel Hsu, Dr. Tim Roughgarden**. I enjoyed reading Dr. Bareinboim's paper on "Fairness-Accuracy Trade-Offs: A Causal Perspective" as background for my senior thesis and was intrigued by the many perspectives and methods to evaluate fairness in AI models. Under Dr. Bareinboim's guidance, I could extend my research to a more causal inference setting. Similarly, I am eager to work with Dr. Daniel Hsu and build on his recent research about auditing for subgroup fairness. On the other hand, I am also excited to work on research like "Data-Driven Algorithm Design" and algorithmic game theory problems under Dr. Roughgarden. If given the opportunity I will rise to the challenge of their research.

Moreover, having switched into the computer science major late in sophomore year, I hope to continue learning in all aspects while in graduate school. At Columbia, I wish to take Dr. Roughgarden's class Analysis of Algorithms and Machine Learning Theory with Dr. Daniel Hsu. Similarly, serving as a teaching assistant during undergrad has been both a learning experience and a rewarding way for me to give back to the computer science community. I will work hard to be an impactful teacher and mentor so that younger students have a strong foundation in computer science. I believe that Columbia's environment would allow me to reach my full potential as a student, teacher, and researcher as well as prepare me with the skills for a career in algorithm design and fairness research. Overall, it would be a privilege to be a part of Columbia's Computer Science Department with its incredible professors and opportunities.