

He was my best friend and my bully, my confidant and my rival. My older brother suffered a stroke in his first year of college, paralyzing the left side of his body. Watching him in recovery for 6 months, I knew he would never fully use his left hand again. Yet this injury that would typically have hindered his engineering studies was instead overcome through the application of years of artificial intelligence research; namely, a speech-to-text app. Today, my brother is a medical student finishing his dissertation. Seeing how new natural language processing technologies alleviated aspects of his physical ailments was awe-inspiring, and I embraced my acceptance to the engineering program at the Ohio State University in hopes of researching and building new technologies that would help others like my brother. Over the past four years, I have had the pleasure of undertaking interesting projects and working in both a mathematical immunology and computer systems lab. These experiences were eye-opening, and have reinforced my passion for research and my commitment to pursuing a PhD in machine learning.

I started my first research experience in Dr. Jayajit Das' lab within the Battelle Center for Mathematical Medicine. One method for understanding biological systems is building mechanistic models of cellular processes through systems of differential equations that can contain any number of unknown parameters. During my time in Dr. Das' lab, I developed parameter estimation software for mechanistic models. Initially, we started analyzing simulated data using a set of known parameters but later applied our method to experimental data. Through optimizing a cost function derived from the generalized method of moments with particle swarm optimization, we reproduced tight and unbiased confidence intervals around model parameters fitting the moments of multiple datasets. Based on this work, we submitted a manuscript that is currently under review in PLOS Computational Biology. Working with biophysicists every day has shown me that computational research is valuable not only for augmenting the lives of others through its applications but also can explain biological processes that may one day provide insights on how to better treat diseases that affect those like my brother.

For my ongoing honors senior thesis, I am exploring the idea of a model-data commons with Dr. Christopher Stewart's ReRout lab. Working with another undergraduate student, we benchmarked vision models and optimization heuristics such as Particle Swarm Optimization against multiple datasets, showing that model performance can be heavily data dependent. Thus far, we have a paper that was recently accepted by the AAAI-23 conference, exploring the relationship between conventional benchmarking datasets and digital agriculture. We hope to continue exploring many other machine learning-related questions during my last year at Ohio State, especially ones related to cancer modeling.

My time in Dr. Das' cancer research lab and Dr. Stewart's ReRout lab has furthered my interest in machine learning model interpretability, especially around its interdisciplinary application to the physical sciences. As datasets drastically increase in dimension, conventional mechanistic modeling techniques may not fully discern the complex relationships embedded within them. Although machine learning techniques are well-suited for discovering high dimensional patterns within datasets, their "black box" nature fails to provide the explainability

needed for scientific progress. The Computer Science graduate program at the University of Illinois Urbana-Champaign would allow me to pursue this interest at the highest level. Specifically, Dr. Jian Peng and his work in deep learning frameworks for protein engineering. I would also be honored to work with Dr. Bo Li and her work in machine learning robustness and domain generalization, a key topic of machine learning that is widely discussed in other fields of study such as medicine.

In addition to my research interests, my experiences as a teaching assistant and an ambassador for high school STEM outreach efforts have instilled a desire to pursue further opportunities in mentorship. As the famous physicist Richard Feynman shared, “If you cannot explain something in simple terms, you don't understand it.” Breaking down complex coding concepts into digestible chunks for first-time coders was not only emotionally fulfilling but also refined my basic coding skills. Similarly, presenting the amazing applications of machine learning in front of high schoolers and seeing their eyes light up has reinforced my desire to pursue a PhD. After graduate school, I hope to one day mentor others while pursuing research in an academic setting toward professorship.