My mentor, my best friend, my older brother suffered a stroke in his first year of college, paralyzing one side of his body. Watching him, my superhero brother in recovery for 6 months, I knew he would never be able to fully use his left hand again. An affliction that normally should have hindered his engineering studies was overcome through the application of years of artificial intelligence research, a speech to text app. Seeing how new natural language processing technologies alleviated aspects of his physical ailments, I decided to pursue an engineering degree at the Ohio State University in hopes of one day being able to build and research new technologies that would help those like my brother. There, I have had the pleasure of undertaking interesting projects and working in a mathematical immunology as well as computer systems lab. These fulfilling educational and research experiences have reinforced my passion for research and my commitment towards pursuing a PhD in machine learning.

Through my time in the freshman Honors Engineering Robotics competition, I learned how to tackle open-ended problems. Despite having had minimal prior experience in hardware and software design, we were tasked with building a robot to precisely navigate an obstacle course and complete complex motor tasks. In the process, I learned to write bills of materials, plan design schedules, and embrace the software challenges of programming a robot. Surprisingly, the real challenge and the biggest takeaway was not of technical, but of social aspects. The social challenges of collaborating with my peers taught me the absolute necessity for a functional, communicative, and flexible team. Whether it was balancing time commitments on top of rigorous coursework or addressing not only the technical needs of the project but also many personal needs that often arise, I had become the arbiter of group messages, building flexible schedules to meet deadlines. I realized that it was not the technical skills of the individual that drove progress, but rather the collaborative efforts of my team and I. Although the COVID 19 pandemic had shut down the final competition, our group had fully constructed and programmed the robot to complete the obstacle course as well as accomplish all bonus objectives. The project left me with a sense of deep fulfillment. I loved the idea of challenging myself with open-ended problems in a collaborative setting.

With this newfound drive, I started my first research experience in Dr. Das' mathematical immunology cancer research lab. There, I worked on developing parameter estimation software for cell models based on systems of differential equations. Initially, we started analyzing simulated time snapshot data using a set of ground truth parameters, but later applied our method to measured CD8 T cell data. Through optimizing a cost function derived from the generalized method of moments with particle swarm optimization, we were able to reproduce tight and unbiased confidence intervals around model parameters embedded in differential equations fitting the means and variances of observed data. This work led to a manuscript submission to bioinformatics as well as a poster presentation at the 2022 qBio conference. Cancer modeling has shown me that computational research was not limited to augmenting the lives of others through applications, but could also be used to explain biological processes that may even 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 and their respective rankings are heavily data dependent. Thus far, we have submitted a benchmarking paper on arXiv, which aimed to justify why a model commons is necessary as artificial intelligence expands into other fields. We hope to continue to explore 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 sparked a deep interest in machine learning model interpretability and explainability, especially in its interdisciplinary application towards the physical sciences. As datasets drastically increase in dimension, as seen with the recent development of Image Mass Cytometry datasets, conventional mechanistic modeling techniques may not be able to fully discern complex relationships embedded within each dataset. On the other hand, machine learning techniques are well-suited for discovering high dimensional patterns within datasets, but often due to their "black box" nature, fail to provide the explainability needed for scientific progress. The Computer Science graduate program at MIT would allow me to pursue this interest at the highest level. Specifically, Dr. Tommi Jaakkola and his projects in interpretable machine learning, especially in the application of trees or graph neural networks. I would also be honored to work with Dr. Bonnie Berger, and her use of deep learning to understand the structural properties of protein to protein interactions. In a more general sense, I am very excited about the applications of machine learning, and more specifically deep learning, in interdisciplinary fields**.**

In addition to my research interests, my experiences as a teaching assistant and an undergraduate ambassador for high school STEM outreach efforts have created a desire to pursue further opportunities in mentorship. As the famous physicist, Richard Feynman puts it, "if you cannot explain something in simple terms, you don't understand it." Breaking down coding concepts such as looping and variable typing into digestible chunks for first time coders was not only emotionally fulfilling, but also refined my own basic coding skills. Similarly, presenting the amazing applications of machine learning research in front of highschoolers 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 towards professorship.