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My first exposure to a major research environment was in my junior year at Princeton University, when I conducted research in Professor Niraj Jha's lab. I was tasked with determining if a sparse ResNet-50 architecture could achieve similar levels of accuracy as a dense architecture when trained on a small retinal dataset of OCT scans. Through many binary classification experiments, between the healthy class and each retinal disease class, and multiclass classification experiments, I discovered that there was an average discrepancy of only 0.5% in performance between the dense and sparse architectures. It was a great learning experience, as I discovered the intricacies of transfer learning and PyTorch model training. Most of all, I found within me a desire to engage in research and discover new knowledge. I have since become further fascinated by topics in computer vision, machine learning, and image analysis, through rewarding research opportunities as a B.S.E. student at Princeton and as an M.S.E. student at UPenn.

During my senior year at Princeton University, I completed my Undergraduate Senior Thesis under the guidance of Professor Niraj Jha. In my first foray into computer vision, I focused on applying an image synthesis technique called DeepInversion to an instance segmentation network, reducing the need for labeled video data in future applications. To do this, I inverted a fixed Mask R-CNN architecture, from random noise, with additional image and feature distribution regularization terms to generate input frames from the DAVIS dataset. Since this was the first application of DeepInversion to an instance segmentation network, I faced several development challenges in model design and TensorFlow implementation that required me to pose novel questions and form creative solutions. After months of experimentation, I was happy to finally synthesize DAVIS video frames and have my work featured by the Princeton

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Statistics and Machine Learning Center. Through this research project, I understood the importance of persevering through challenges and appreciating the rewarding, yet difficult nature of research.

In my first year as a Robotics Master's student at UPenn, I pursued a newfound interest in Explainable Artificial Intelligence (XAI). Under the mentorship of Professor Lyle Ungar, I worked with doctors from the University of Utah on a Pediatric Sepsis study, presented in the form of Electronic Health Record (EHR) data. While XAI methods do exist to understand and analyze models trained on EHR data, our case study presented many cases of feature collinearity, which XAI models work poorly on. As a result, I used Shapley values to illustrate the need for feature set creation and feature adjustments to remove collinearity and enhance model explainability. During this interdisciplinary endeavor, I was fortunate to be able to work with doctors, so I could gain a greater understanding of the medical and biological drivers behind ML predictions. I am excited that these findings could contribute to the current XAI literature in the medical domain. This project provided me with a meaningful lens to explore the remarkable interplay between machine learning and healthcare, and showed me that scientific research can be used in service of others.

In my second year at UPenn, I completed a Master's Thesis in Professor Jianbo Shi's lab, focused on computer vision research. Motivated by applications that need adaptable 3D shape models, usually with little training data, I automatically generated a contour labeled dataset that contains crucial information for basic 3D object understanding. With this novel dataset, I explored the performance of instance segmentation architectures on detecting and labeling the

contours, and additionally demonstrated a surprising improvement in 3D reconstruction from a 2D image. Not only did my work culminate in a co-first author publication in the *Winter Conference on Applications of Computer Vision (WACV 2023)*, but it also gave me the opportunity to engage in discussions with researchers in industry and academia, and share my work with faculty in the field through thesis and conference presentations. From these formative experiences, I have learned how to confidently communicate my research, think creatively and independently, and form strong relationships in a research community.

I have expanded my interests in machine learning and computer vision through industry research as well. As an Advanced R&D Intern at Amazon Robotics, I generated synthetic data to improve the segmentation performance on a new warehouse sensor setting. To this end, I learned transformations, using GANs, that realistically placed labeled foreground objects from a pre-existing sensor setting into the new setting. After a gratifying internship at Amazon, I am now working at Agility Robotics, where I develop perception models for human-centric robots. With these experiences, I have developed the ability to solve challenging, open-ended research problems that have real world applications.

My past research and academic experiences motivate me to continue work in machine learning and computer vision, specifically for biomedical imaging analysis. For this reason, I have a strong interest to work with Professor Despina Kontos and contribute to her groundbreaking work in this field. I am especially excited by her research in the use of AI and machine learning for understanding and diagnosing cancer. I have read with great interest her work on Deep-LIBRA, which uses CNNs, superpixel generation, and radiomic machine learning,

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to achieve an impressive AUC for breast density estimation on a multi-racial, multi-hospital dataset. Also, I am very interested in her work on identifying intrinsic phenotypes for breast cancer risk, using traditional machine learning techniques. More generally, I am drawn to work with Professor Kontos because of her use of imaging for enhanced disease diagnosis and non-invasive medical care. I believe my research experiences in machine learning and computer vision, and my strong interest in biomedical imaging analysis, allow me to be a great fit for Professor Kontos' lab.

I hope to join Columbia's Ph.D. program and engage in collaborative work with researchers in the Vagelos College of Physicians and Surgeons, and develop biomedical imaging models that benefit society. I am especially excited by the possibility of working with leading biomedical researchers in the world and contributing to the interdisciplinary research in the BME department, by drawing from my background in electrical engineering, robotics, and computer science. I am also delighted to learn that the program emphasizes teaching experiences for Ph.D. students. One of my more memorable experiences as a Master's student at UPenn was working as a teaching assistant for a graduate level computer vision course. As a Ph.D student in BME, I look forward to forging more experiences as a teaching assistant and tutoring students from diverse backgrounds. In the future, I would like to lead an academic research lab, founded on innovation, collaboration, and service, and pioneer groundbreaking work in vision and ML for biomedical imaging applications. I look forward to embarking on this journey, through the Ph.D. program at Columbia University.