Statement of Purpose

Shuo Liu

I. Duke is Right for me

During the summer vacation in 2017, I travelled the U.S. and visited Duke University for the first time. The visit was love at first sight. I was drawn to the gorgeous architectures and beautiful scenery of Duke. Other than that, I felt at home during the visit, because Duke University has lots of Chinese alumni and there were many Chinese restaurants around. The thought of studying at Duke University came to me after the visit. After conducting some research afterwards, I found the the M.Eng. in ECE at Duke a great fit for me as I can make full use of my experiences to understand the theories taught in this program. In return, Duke's prestige faculty and wide platform will provide me with the opportunities to study in-depth specialization about this subject. This is why I am motivated to pursue M.Eng. in ECE at Duke University.

II. I am Right for Duke

In my undergraduate study, I accumulated a fair amount of knowledge and developed interdisciplinary skills through my work experiences in many different areas. I believe my strong will, hands-on skills, and teamwork spirits make me a qualified candidate for the Master program in ECE at Duke.

Learning & Competitions

My knowledge of Machine Learning mainly derives from my undergraduate courses and academic competitions. In 2019 Mathematical Contest in Modeling, I led my teammates to complete a Data Mining project about Opioid Crisis. We analyzed the data from National Forensic Laboratory Information System, and found growth pattern of drug reported quantity and important demographic features to make a breakouts prediction, *i.e.*, when and where a drug epidemic will occur. Besides, in my final projects in *Introduction to Data Mining* course (scored 99, ranked 1st), I made a prediction for NBA players' salary by analyzing the correlation between their performance and earnings. Through these experiences, I become familiar with the process and methods of Data Mining, *e.g.*, data preprocessing, correlation analysis, classification algorithms, *etc.*, which has prepared me well for the study of Prof. Rudin in Prediction Analysis.

My interest in Machine Learning involves other fields, too. I started to learn about Computer Vision from *Artificial Neural Networks* course (scored 99, ranked 1st), where I practiced many kinds of neural networks. To further study, I led a team in a Kaggle competition relevant to cactus identification and achieved a 99.97% accuracy in the test set. Afterwards, I extended my study to dynamic objects captured through my research in China University of Mining & Technology. I employed Back Propagation Neural Network and Partial Swarm Optimization to track targets timely and published a paper *Optimal Analysis of Target Dynamic Tracking Strategy Based on Computer Vision*. I think these experiences could be of great value to the work of Prof. Bartesaghi in Computer Vision.

Research & Publications

Since my sophomore year, I have researched in Prof. Chen's Inplus Lab and focus on the contract and application layer of Blockchain technology. Referring to theories in *A Primer in Game Theory* and *Convex Optimization*, I proposed a two-layer Stackelberg Game data trading mechanism in Blockchain-based Internet of Vehicles (IoV) and evaluated the robustness and efficiency of my methods by implementing several smart contracts on Rinkeby, a test net of Ethereum. I completed a paper *Blockchain-Based Digital Goods Trading Mechanism in Internet of Vehicles: A Stackelberg Game Approach* with my colleagues and submitted it to 2020 IEEE Cloud. During this process, I realized that there was a big gap between idea origination and perfect implementation. Specifically, we need to take more factors into consideration to ensure the stability and efficiency of operation in the system, such as security and cost of execution and storage, *i.e.*, gas cost. As this work employs a consortium Blockchain to guarantee trading security and uses

Game Theory methods to facilitate trading in IoV, it is aligned with Dr. Gorlatova's research of intelligent behaviors in IoT and Prof. Gong's studies in IoT Security and Privacy. During my research in Inplus Lab, I also participated in *Perishable Digital Goods Trading Mechanism for Blockchain-based Vehicular Network* and published a survey *Application of Blockchain in IoT Data Trust and Information Available Technology*. Currently, I am working on *BCShare: A Decentralized Data Storage and Sharing on Blockchain*, which employs InterPlanetary File System and certificateless cryptography to address the control on user data from the giant companies. The research in Inplus Lab not only helps me to master Blockchain technology, but also deepens my understanding of Trustworthy Systems, Cryptography, Distributed Systems, *etc.*

Internship

In junior year, I was attracted to Computer Networks, which inspired me to explore other application scenarios, as I realized how powerful and scalable this technology could be. After many rounds of interviews, I seized the chance to intern at Microsoft to work on the *Predictable Remote Direct Memory Access (RDMA) for AI Training* project. We aimed at guaranteeing bandwidth for Data Manipulation Language training tasks in RDMA networks. In this project, I managed to implement the central logic controller and the adaptive data backup mechanism, *i.e.*, adaptively specifying the traffic classes of VM-pairs to guarantee the bandwidth of users. I think this work matches well with Prof. Hai Li and Hilton's focus on architectural design for high performance, and I am well-prepared to further explore this field under their instruction.

III. My Future Goals

If admitted with honor, I am inclined to work on Prediction Analysis, Computer Vision, Intelligent IoT, and Computer Architecture to make full use of my experiences. In the short term, upon obtaining my master degree, I expect to complete my program with excellent performance to consolidate my knowledge. In the next 3-5 year, I aspire to become a reliable employer in a reputable company. In the long run, I would like to set up my own company and to promote promising products or service to better our lives. I firmly believe I can lay a solid foundation and develop useful skills at Duke to achieve my dream.