Statement of Purpose for M.S. in ECE

Shuo Liu

The first time I used computer was during my information competition in high school when I tried to program in Pascal under the guidance of my computer teacher. Gradually, I discoved my interests in computer programming and talents in mathematics, thus I chose Software Engineering as my undergraduate major in Sun Yat-sen University. Gradually, I realized that I still needed to accumulate more knowledge and technical skills in graduate program, so as to give further play to my capability and creativity in this promising field.

As an undergraduate student, I managed to accumulate a fair amount of technical knowledge and improve my programming skills. In the first two years of my study, my coursework mainly focused on the basics of mathematics and programming. I studied elementary methods to consolidate mathematical basics, and solved many rudimentary puzzles in different languages to hone my programming skills. My scores were ranked top in *Probabiity and Statistics, Data Structures and Algorithms*, *Java and Object-oriented Design*, and etc. As I've laid solid groundwork for the fundamentals, I managed to achieve high in more professional engineering courses later on. I got the best scores in *Principles of Animation and Design of Network-Based Games*, *Practice of Artificial Neural Networks*, *Software Engineering Training*, and etc. With these courses as the foundation, I think I am well-prepared for pursuing further studies in ECE, CMU.

In sophomore year, I joined the Smart Internet of Things and Edge Computing group in Professor Chen's Inplus Lab to gain more research experiences. Based on theories in *A Primer in Game Theory* and *Convex Optimization*, my colleagues and I proposed a two-layer Stackelberg Game data trading mechanism in Blockchain-based Internet of Vehicles (IoV) and verified our methods in numerical experiments in Jupyter Notebook beforehand. After months of hard work, we completed a paper named *Blockchain-Based Digital Goods Trading Mechanism in IoV* and submitted it to the International Conference on Service Oriented Computing (ICSOC). Despite failed, I got many valuable suggestions for further improvement. With the advice, we evaluated the robustness and efficiency of my algorithms by implementing several smart contracts on Rinkeby, a test net of Ethereum, and confidently submitted new revision to the IEEE Cloud this time. During this process, I realized that there was a big gap between idea origination and implementation. To ensure the stability and efficiency of the system, we need to consider more factors, such as security and cost of execution and storage. This research is definitely one of the most beneficial experiences in my academic life, as it improves my mastery of Game Theory and Blockchain technology. I believe this research experience shares great similarity with the study of Professor Giulia Fanti (in Cryptocurrencies), Professor Carlee Joe-Wong (in Data Pricing), and Professor Datta Anupam (in Trustworthy Systems). I look forward to exploring these areas under their instruction.

In the summer of 2018, I started my first internship in the Institute of Automation, Chinese Academy of Science (CASIA). I participated in StarCraft team to build StarCraft Ⅱ Learning Environment with Tensorflow. Initially, I trained the soldiers with Advantage-Actor-Critic and Deep Deterministic Policy Gradient (DDPG) algorithms, but neither brought any satisfactory outcome. After communicating with my advisor and colleagues, I tried to enhance my DDPG-based work by allowing the soldiers to cooperate. I applied the novel Multi-Agents Deep Deterministic Policy Gradient (MADDPG) algorithm to this scenario and took more factors into consideration in the reward. Due to this revision, the average winning rate of soldiers was improved from 26% to 43% with only 120 training epochs. From this internship, I picked up more knowledge in reinforcement learning, including traditional algorithms, training methods, evaluating criteria, and etc. Furthermore, I learned more about the business cases where reinforce learning methods are being applied, which inspires me to integrate them in other studies in the future.

After this internship, I was attracted to Computer Networks, which aroused my interests to explore other application scenarios as I realized how powerful and scalable this technology could be. After many rounds of interviews, I was offered the chance to intern at Microsoft to work on the Predictable Remote Direct Memory Access (RDMA) for AI Training project. Our goal is to guarantee 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 think this experience deepens my understanding of transmission and storage machanisms of Computer Networks, which contributes my research in Trustworthy Systems. From then on, I shifted my research focus of Blockchain Technology from the application layer to the network layer.

Aforementioned experience demonstrates my firm will, innovative thoughts and broad scope of knowledge, which make me well-qualified for your program. With a prestige faculty and a wide platform, the M.S. in ECE program in CMU provides me with the opportunity to study in-depth specialization about this subject to achieve my dream. In addition, I think my experience matches well to the concentration of Computer Security and Data and Network Science in your department. If admitted, I am inclined to work on the Cryptography, Data Pricing and Trustworthy Systems due to my past research experience, or to concentrate on Deep Reinforce Learning because of my undergraduate studies and intern experiences in CASIA.

In the short term, upon obtaining my master degree, I will complete my project plan with excellent performance to broaden my horizon and consolidate my knowledge. In the next 3 to 5 years, I aspire to become a reliable researcher by pursuing a doctor degree. In the long run, I hope to work as a professor to educate students and to promote promising technologies to better our lives. The road ahead is destined to be a bumpy ride, but I am strong-willed enough to overcome whatever challenges lying ahead to accomplish my dream.