Statement of Purpose for Computer Engineering, M.S. in CSE, UCSD

The first time I used computer was during an information competition in high school when I tried to program in Pascal under the guidance of my computer teacher. As I grow up, Computer Engineering has become an increasingly important subject in my life, which inspires me to learn more about computer and programming. How could AlphaGo program defeat Lee Sedol? What is the use of Nakamoto's Bitcoin? How do computers store and process massive data? All of these aroused my interests to dive into this field. Due to my passion for computers and talents in mathematics, I chose Software Engineering as my undergraduate major in Sun Yat-sen University. Gradually, I realized that I still need to accumulate more knowledge and technical skills in graduate program to give further play to my capability and creativity in this promising field. With a prestige faculty and a wide platform, the Master program in CS76 in UCSD can provide me with the opportunity to study in-depth specialization about this subject to achieve my dream, and the alumni network of USC can be a great asset to my future development. Thus, I would like to pursue my graduate program in the Department of Computer Science and Engineering, UCSD.

In my undergraduate study, I have accumulated a fair amount of knowledge and skills about Machine Learning, especially Data Mining and Computer Vision. In 2019 Mathematical Contest in Modeling, my teammates and I completed a 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 which are highly relevant to drug abuse. Based on it, we made a breakouts prediction, *i.e.* when and where a drug epidemic will occur, and recommended administration to strengthen control for some specific groups. Moreover, I predicted the NBA players' salary in my final projects of *Introduction to Data Mining* course (scored 99, ranked 1st). In this project, I first made a correlation analysis between players' performance and earnings from Basketball Reference records, and then employed various regression methods to predict their future salaries. From these experiences, I become familiar with the process and methods of Data Mining, such as data preparation, correlation analysis, classification algorithms, and etc. My understanding of Computer Vision stemmed from my *Artificial Neural Networks* course (scored 99, ranked 1st) and research in China University of Mining & Technology (CUMT). During this course, I employed several neural networks, such as VGGNet, ResNet, DenseNet, and etc., to recognize objects in images and implemented a Cycle-Consistent Adversary Network to realize style transmission. I also led a team in a Kaggle competition relevant to cactus identification and achieved a 99.97% identification accuracy in the test set. After that, I extended my study to dynamic objects capture through my research in CUMT. I managed to use 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*. The knowledge I have gained from aforementioned experiences has prepared me well for my further studies in the Center for Visual Computing, CSE, USCD.

Based on my knowledge and experiences in Machine Learning, I further explore the area of Reinforcement Learning while interning in the Institute of Automation, Chinese Academy of Science (CASIA). Because of my interests in Game AI, 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 satisfactory outcomes, *i.e.*, about 2,100 and 2,600 wins in every 10,000 battles respectively. After communicating with my advisor and colleagues, I enhanced my DDPG-based work by allowing the soldiers to cooperate. By referring to *Multi-Agent Actor-Critic for Mixed Cooperative-Competitive Environments*, I applied the novel Multi-Agents Deep Deterministic Policy

Gradient (MADDPG) algorithm to this scenario and took more factors into consideration in the rewards. Derived from DDPG, the MADDPG critic not only inputs its own state and action, but also includes others' information to make a global optimization. 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 business cases where Reinforcement Learning methods are being applied, which inspires me to integrate them into other studies in the future. I think this experience matches well with the concentration of Professor Sicun Gao in Decision Optimization and Henrik Christensen in AI for Robots, thus I am willing to explore these areas in CSE, UCSD.

Moreover, I researched in the Smart Internet of Things (IoT) and Edge Computing group in Professor Chen's Inplus Lab for about 2 years, focusing on the contract and application layer of Blockchain technology. Referring to 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 some numerical experiments in Jupyter Notebook beforehand. After months of hard work, we completed a paper *Blockchain-Based Digital Goods Trading Mechanism in Internet of Vehicles: A Stackelberg Game Approach* and submitted it to 2019 International Conference on Service Oriented Computing (ICSOC). Initially, our work did not win the satisfaction of the ICSOC committee. They offered me suggestions for further improvement. With their advice, we evaluated the robustness and efficiency of my algorithms by implementing several smart contracts on Rinkeby, a test net of Ethereum. With specific scenarios to support this protocol system, I confidently submitted this paper to the IEEE Cloud this time. During this process, I realized that there was a big gap between idea origination and perfect implementation. To ensure the stability and efficiency of operation in the system, we need to take more factors into consideration, such as security and cost of execution and storage, *i.e.*, gas cost. Currently, I am working on the Decentralized Data Storage and Sharing on Blockchain (BCShare) project with my colleagues. BCShare employs InterPlanetary File System and certificateless cryptography to address the control on user data from the giant companies. The research not only helps to improve my mastery of Blockchain technology, but also to further my understanding of Trustworthy Systems, Cryptography, and Distributed Systems. As the Blockchain technology aims to build the security system by using Cryptography methods, this research could be of great value to the research of UCSD Theory group and Complexity and Cryptography group. Thus, I look forward to further exploring Security and Cryptography under the instruction of Professor Nadia Heninger, Deian Stefan, and Russell Impagliazzo. Plus, I believe the work in this area can serve as a great inspiration for Professor Kamalika Chaudhuri in Machine Learning with privacy, and I would like to devote myself to facilitate this interdisciplinary collaboration if possible.

The experiences mentioned above clearly demonstrate my innovative thoughts, teamwork spirits, and firm will, which makes me well-qualified for your program. If admitted, I am inclined to work in the areas, such as Computer Vision, AI, and Cryptography, to make full use of my past experiences. I am also interested in exploring Diverse Human Data Processing, lectured by Professor Taylor Berg-Kirkpatrick as a new field of study, because such research can be instrumental to the daily life. In the short term, upon obtaining my master degree, I expect to complete my project plan with excellent performance to broaden my horizon and consolidate my knowledge. In the next 3-5 year, I aspire to become a reliable researcher by pursuing a doctor degree. In the long run, I would like to work as a professor to educate future 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.