

Personal Statement of Computer Science PhD

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As an applicant to KCL's PhD program in Computer Science, I am very glad to have an opportunity in introducing my study objectives to you.

I am now a postgraduate student at University of Electronic Science and Technology of China (UESTC) where I major in Computer Technology. My research interests include multi-agent reinforcement learning, machine learning and game theory. I am planning to attend a Ph.D. program with a focus on multi-agent reinforcement learning and decision making. During my undergraduate period, I majored in chemistry and minored in economics.

At the time when I'm an undergraduate majored in chemistry in Xiamen University, I was inspired by a simple thought: what if an intelligent system is introduced into the experiments which can handle some homogeneous work such as pouring the liquid into a certain container? What's more, now that lots of mechanism were discovered in organic synthesis, why don't we teach the machine basic principles and let it compute the synthetic routes instead of making some clueless attempts? It was at that time when I got to know the subject of machine learning. Then I shared this idea with Professor Wenjing Hong whose research interests mainly focused on using AI methods to solve chemistry problems. I joined his lab and took part in Andrew Ng's machine learning courses on Coursera. I took part in the postgraduate entrance exams and began to pursue a computer science career in University of Electronic Science and Technology of China. In IntelliGame Lab at UESTC, my lab mates and I have explored interesting applications of game theory, contract theory and reinforcement learning. The first work is about using economics models and backward reduction method to compute the dynamic pricing strategy in a plug-in electric vehicle charging market. I took part in establishing the model and doing rebuttal afterwards. I learned a lot about how to set up a scientific model to simulate a practical environment.

Among all branches in Computer Science, I particularly like reinforcement learning. I started the experiments with establishing a simple stocking exchanging environment. From the tutorial on Towards Data Science page, I have learned how to customize an reinforcement learning environment using gym. A simple DQN algorithm is used to make decisions of how much and when a stock should be exchanged to maximize a certain objective. After that, I took part in several competitions of RL, including L2RPN(Learn to Run a Power Network) from Neurips2020 and City Brain Challenge from KDD Cup 2021. In L2RPN, I deployed several deep reinforcement learning agent on IEEE-45, a simulated electric power network with 45 nodes, to prevent grid from unexpected events and keep delivering reliable electricity. I ranked 33rd out of 256 competitors in L2RPN Neurips2020, Robustness Track. In City Brain Challenge, we learned to control traffic flow in a Medium Road Net through Deep

Reinforcement Learning. We achieved a maximum average vehicle passing delay ratio of 1.54 and a maximum serving vehicle number of 126572 on a virtual road net of 2086 intersections by developing several deep reinforcement learning algorithms such as DQN and PPO. Concretely, we designed an expert system based on maximum pressure to obtain trajectories and stacked imitation learning and reinforcement learning by adding expert data into replay buffer. Then, concatenated information of neighboring intersections served as input observation to improve accuracy. We ranked 28th out of 1156 teams in KDD Cup 2021, City Brain Challenge. Recently, I'm working on modeling a 3-party grid power market and analyzing the benefit of all participants using MARL under different assumptions.

In my opinion, reinforcement learning has the ability to make sequential decisions instead of simply making predictions. In the first stage of AI, main objective of the algorithms is the recognize things. But eventually, the function of making decision based on recognition is an important step in the development of next generation of AI. I am optimistic about future applications of reinforcement learning. I would be appreciate if I have this chance to join your PhD program.