Earning my master's degree in AI with excellent grades in 2024 was a significant achievement. However, my graduation project still revealed imperfections and regrets that have shaped my perspective. My research focused on intelligent multi-agent decision-making under conditions of imperfect information, utilizing the CFR algorithm for stochastic decision-making in mixed strategies. Despite being successful finding the optimal parameters for state-of-the-art performance in poker experiments, we didn't observe the logical reasoning capabilities as we initially expected for advanced decision-making algorithms. These insights have motivated me to pursue doctoral studies in a more open and advanced research atmosphere. For me, pursuing a doctoral degree is not just an academic endeavor but a passionate commitment to impact the future of algorithm innovation and AI development.

In preparation for my future doctoral studies, my strong performance in past scientific research and competitions underscores my potential for success in doctoral coursework. During my time at the Deep Learning and Advanced Intelligent Planning Institute of Northeastern University from April 2022 to April 2024, I engaged in a pivotal project titled "Intelligent Adversarial Agents Based on Decision Making and Game Theory."  I developed a groundbreaking Regret - Growing Counterfactual Regret Minimization (RGCFR) algorithm, outperforming existing methods in Imperfect-Information Games and achieving faster convergence to the Nash equilibrium. My research investigated the iteration dynamics of existing CFR algorithm, and also revealed that the rewards of Best-Response agents in non-zero-sum decision-making problems exhibit a lower order of smoothness than their counterparts in zero-sum problems, allowing me to introduce a self-adaptive discounting mechanism that significantly enhanced performance. Additionally, I was instrumental in creating the Game Theory Supported Big Data Decision System, which not only applied my theoretical knowledge but also led to an intellectual property protection certificate in April 2024. This project demonstrated my strong capabilities in algorithm development, decision-making analysis, and system implementation within game theory and artificial intelligence. Consequently, I completed my thesis and wrote two papers presenting innovative methods for addressing non-zero-sum game theory problems. These papers are currently under review and are poised for publication.

Previously, as a research assistant at the Institute of Image Recognition and Machine Intelligence (September 2021 - January 2022), I participated in the project "Autonomous Driving Image Recognition and 3D Positioning System Based on YOLO-V5 and PSM-Net". I enhanced the CSPNet in YOLOv5 by adding new convolutional layers to improve deep feature extraction and positioning accuracy. This work resulted in superior performance for small object detection on various datasets. Through this project, I gained vital object detection and model training skills while staying updated on the latest research trends in autonomous driving.

My work on an oscilloscope program using the STM32 embedded system showcased the rewarding nature of pursuing mathematics. As a research assistant at NEU from March 2018 to April 2020, I developed a real-time signal analysis model utilizing my expertise in Fourier Transformation and spectrum leakage, creating a harmonic analysis system and advanced frequency estimation algorithm and introduced a "Pure Overtone Signal Stable Trigger" for signal stabilization. These achievements led to third-place awards in the National Undergraduate Electronics Design Contest in 2018 and the NEU Electronics Design Contest in 2019. This project significantly enhanced my signal processing expertise and coding skills, bridging theoretical mathematics with practical application and preparing me for future graduate studies.

Another instance of rewarding nature by pursuing mathematics was when I was an undergraduate. I have had a natural talent for mathematics and physics from a young age, inspired by exceptional teachers who encouraged my participation in competitions. In my sophomore year, I became a teaching assistant, leveraging my top 5% ranking to tutor struggling first-year students in Calculus and Linear Algebra at NEU. My effective teaching style, which emphasized the origins of critical definitions, earned me recognition as one of the top 10 "Popular Senior Mentors" among 102 peers. Most notably, I tackled their pedagogical curse, like demystifying how the Fourier Series approaches the functions and how the determinants in Linear Algebra got their complicated yet profound definition. This experience not only deepened my understanding of the subjects but also shaped my educational path and fueled my ambition to pursue a doctoral degree, where I can continue to support others' learning and grow as an educator.

As we look to the future of AI, I believe the ideal research should emphasize two key features. First, a genuinely intelligent AI must respect and capture the inherent structure of a problem, moving beyond reliance on brute-force techniques. My experience with the CFR poker AI exposed significant limitations due to its disruption of problem structure. Second, AI should actively formulate plans, like crafting an open-ended essay, rather than paradigms that are only capable of performing numerical calculations like optimizing the weights and biases. Instead, we expect it to be featured by logic operations, and to be both rigorous and also ready for open questions. This capacity serves as a benchmark for assessing whether AI employs rigorous logical reasoning. Unfortunately, my postgraduate research did not achieve this goal, as it relied on brute-force enumeration to identify feasible solutions, with parameter iterations relegated to simply evaluating the merits of each. Relying solely on performance-driven paradigms can be risky. For a classic example, no matter how strong performance do Taylor series approximants have on the data they have seen, the exploding nature of finite-degree polynomials determines such approximation will eventually fails on large extrapolation. Without a solid and rigorous foundation like causal inference, current AI systems may struggle with complex reasoning. True AI should be able to identify patterns, formulate hypotheses, and provide proofs based on logical reasoning or validated empirical evidence.

Furthermore, my recent experience of replicating GPT-2 provided valuable heuristics, serving as an excellent example that deepened my understanding of interference in large language models, particularly the critical issue of catastrophic forgetting. This phenomenon occurs when new learning disrupts prior knowledge, posing challenges for developing AI systems that can learn continuously while maintaining existing capabilities. This focus on interference and catastrophic forgetting remains vibrant within the AI community, especially as models become more complex and are applied in dynamic environments. Ongoing research in this area highlights the commitment to improving mitigation strategies and ensuring model reliability, aligning closely with my aspirations for my doctoral studies.

I am eager to explore these topics further in a program that fosters innovation and collaboration. My goal is to make significant contributions to control theory, algorithms, and robotics—fields that can greatly enhance industrial efficiency, improve quality of life, and drive technological advancement. I am particularly drawn to Texas A&M University’s distinguished Ph.D. program in computer science. The university’s commitment to bringing together diverse students and faculty to tackle technological challenges creates a rich environment for groundbreaking research. I look forward to joining this vibrant community and collaborating with experts such as Professor Tim Davis in High-Performance Combinatorial Scientific Computing and Dr. Tomer Galanti in machine learning, deep learning, large language models, and artificial intelligence. Taking advantage of the top-notch facilities in a collaborative atmosphere is an exciting opportunity. After earning my Ph.D., I plan to pursue a research-related position to continue making impactful contributions to the field. Ultimately, my mission is to expand the boundaries of technology for the benefit of humanity, and I believe that Texas A&M University is the perfect place to help realize this aspiration.