The natural language processing (NLP) community has recently experienced a significant increase in the scale of large language models (LLMs), with some models reaching over a trillion parameters [1]. These supermodels perform well on benchmarks such as question answering and other instructional tasks, but they frequently experience trouble generalizing to specific domains. Moreover, the cost-benefit relationship between model size and quality may restrict the accessibility and inclusivity of NLP technologies. These issues motivate my two primary research interests: **to enhance the reliability and transparency of LLMs , and to optimize their efficiency for broader accessibility and environmental sustainability**. My goal is to tackle these challenges in NLP by combining cost-sensitive learning with advanced techniques and fine-tuning models for better domain performance. I am eager to pursue these research interests during my PhD, where I can further develop my skills and contribute to the field of NLP. With the guidance of your esteemed faculty, I am committed to advancing my research and preparing for a future in NLP and computer science education.

My journey into machine learning began during my undergraduate studies at **College of Engineering Guindy (CEG), Anna University,** where I worked on a project focused on Fake News detection using transfer learning and sentiment analysis of Twitter tweets. This experience piqued my initial interest in NLP. To further explore this field, I joined Bright Academy (formerly Solarillion Foundation) as a **research assistant**, where I worked on classifying unfair terms in service clauses using transformer-based models, drawing inspiration from the advances in transformer architectures [2]. While these models captured complex language patterns well, I struggled with ensuring the reliability and transparency of their outputs, particularly in nuanced, specialized contexts. These challenges made me realize the importance of building more trustworthy NLP systems, driving me to aim for developing robust methodologies that enhance the reliability of NLP in specialized domains. Additionally, during my final year at CEG, me and my colleagues developed a novel 3D scene renderer, **SQ-3D-Net** [3], which incorporated computer vision into neural radiance fields. This work was accepted at the ICDIPV 2023 conference, where I gained invaluable experience in collaboration, academic writing, and research. One of the significant challenges I faced during this project was accurately rendering complex 3D scenes, particularly when the visual data involved intricate details and varying lighting conditions. The visual model had to effectively capture and reconstruct fine-grained details from the images, which was crucial for creating realistic and reliable 3D scenes. These challenges in accurately interpreting and processing complex visual data are also prevalent in VQA models and other multimodal systems, where the integration and alignment of visual and textual information are key to achieving reliable and accurate results. This experience has further fueled my interest in developing more robust methodologies for handling visual data, particularly in the context of multimodal systems.

I spent a lot of time during my undergraduate studies developing my interests and gaining the necessary skills outside of my immediate academic environment in order to lay a strong foundation for research. I placed a greater priority on expanding my knowledge of the foundational ideas that would be essential for a career in data science and machine learning than I did on getting perfect grades. I immersed myself in extensive readings, hands-on projects, blogging, and completed MOOCs, including Andrew NG's ***Deep Learning, NLP, and Mathematics for Machine Learning series.*** These activities not only deepened my knowledge but also equipped me with the skills necessary to tackle complex challenges in NLP.

During my master's program at George Washington University, where I was honored with the Global Leaders Fellowship Award, I had the privilege to work under Professor Dr. Edwin Lo on a project titled Mapping ***Deprived Areas in Low and Middle-Income Countries (LMIC) (IDEAMAPS-funded project)***. We developed a methodology using sentinel geospatial data to map urban poverty in the Lagos, Nigeria region. This work was instrumental in formulating effective development strategies, and it also sparked my interest in integrating textual and visual data, which led me to explore multimodal analysis and

question-answering systems. Inspired by the influential research paper [4], I focused on enhancing text-image alignment to achieve more accurate results. My curiosity about this intersection of modalities has fueled my academic pursuits and has become a central theme of my research interests. In addition to formal coursework, I actively sought opportunities outside the classroom to expand my research capabilities. I engaged with **ML Collective**, an open-access research lab that supports self-motivated researchers from diverse backgrounds, where I discussed research with experts from top-tier institutions worldwide, gaining valuable insights into global research practices. My experiences were further enriched through internships in ML engineering, where I learned to translate research into scalable, real-world solutions. This combination of rigorous self-study, collaborative research, and practical experience has thoroughly prepared me for advanced research in NLP. Beyond academics, my passion for giving back to society has been a significant aspect of my journey. I have actively volunteered as a Data Scientist for Code4Volunteer at the American Red Cross and contributed to the Little Sisters of the Poor and the Society of St. Vincent De Paul. These experiences have shaped my perspective on the societal impact of technology, motivating me to pursue research that not only advances NLP but also contributes to social good. My industry experience, particularly as a Data Engineer at Marlabs, has provided practical insights into applying machine learning solutions to real-world problems. However, ***my passion for academia remains steadfast***, driven by the intellectual rigor, the pursuit of knowledge, and the opportunity to contribute to the academic community.

My long-term goal is to become a leading research scientist in the AI industry field and later a professor. I am passionate about collaborating on research projects that align with my interests and staying at the forefront of technological advancements. The real-world impact of my research drives me, and I am eager to mentor the next generation of researchers and students, just as I have benefited from the guidance of my mentors. I believe the Ph.D. program in Computer Science Engineering at Texas A & M is an ideal fit for my research aspirations. I am particularly drawn to the work of **Professors James Caverlee, Kuan-Hao Huang, and Ruihong Huang**, whose research on LLMs and trustworthy AI models aligns closely with my interests. **Prof. Kuan - Hao huang and Prof. James Caverlee's** focus on ensuring the trustworthiness of AI systems resonate with my goal of developing reliable and robust models. Their innovative research has greatly influenced my recent projects, and I am eager to contribute to their ongoing work. **Prof. Ruihong Huang'**s expertise in natural language processing, particularly in information extraction and discourse analysis, aligns directly with my research goals. I aim to develop models that extract and analyze events and their relations from texts while addressing issues like bias and deception. The collaborative environment at Texas A&M and the opportunity for co-advising will be crucial for my growth as a researcher.

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