

### Statement of Academic Purpose

We live in an exciting age where Artificial Intelligence (AI) is radically transforming our lives. Today, we can find any information using search engines, have conversations with digital assistants, and use translation services to comprehend most languages. This promise of AI, automating mundane tasks and empowering us to do so much more, is what drew me to Machine Learning (ML) and Natural Language Processing (NLP). It has been exciting to see the recent breakthroughs in NLP, with large language models (LMs) like GPT-3 single-handedly writing code, composing narratives, and summarizing any text. Despite these advances, NLP techniques still struggle with factual correctness, lack common-sense reasoning abilities, and have large carbon footprints. I wish to pursue a Master's in Computer Science (CS) at NYU Courant to gain the broad knowledge and in-depth research experience necessary to address these challenges for the wider adoption of AI. I believe that my expertise in real-world NLP systems has equipped me with the skills to excel in graduate studies and with a novel perspective to bring to NYU Courant's incoming class of future technological leaders.

As an Applied Scientist at Microsoft, I gained expertise in infusing state-of-the-art (SOTA) research into large-scale NLP systems. Working on the Suggested Replies team, providing users with automated response suggestions to email and chat messages, I modernized our biLSTM-based system to instead leverage Transformer-based pre-trained language models (PLMs) for their transfer learning benefits. To curb the resulting large training and inference times, I explored low-cost compression techniques and deployed a compressed PLM-based model to improve our user experience. Further experiments led to interesting insights into how pre-trained models, domain adaptation, and dataset size affect compression. This work, [published](#) in Microsoft's AI Journal, gave me experience in making innovative contributions to the research community.

To allow our models to adapt to user needs, I then explored the space of user-personalization. I conditioned our GPT-2-based reply generation system with trained user-specific embeddings, in a method similar to prefix-tuning, allowing us to personalize responses and lower per-user model perplexities. Since it remained expensive to periodically update user embeddings, taking inspiration from prompting in GPT-3 like models, I replaced trained user embeddings with non-trainable user-specific prompts. Through this work, I utilized the distinct constraints of the industry to research novel solutions, and our findings led to a [paper submission](#) at an upcoming NLP conference. I wish to use this experience during my Master's to explore open problems such as protecting user privacy during personalization through differential privacy techniques.

While my current role as an Applied Scientist on a product team offers opportunities to innovate and gain experience with SOTA technologies, the constraint of needing to fulfill an immediate business need

through every innovation doesn't provide me the flexibility and environment that I need to grow as a leader in NLP. Therefore, my long-term career objective is to be at a research lab in academia or industry, working on more fundamental and visionary research investments. A Master's program will enable me to gain a broad, structured understanding of the field, conduct in-depth research mentored by world-class faculty, and be surrounded by brilliant peers, and is thus the best next step for me to move towards my ambitious goals.

My broad research interests lie in Deep Learning for NLP, but the areas that particularly interest me are dialog systems and better understanding and improving pre-trained language models (PLMs). Since increasing the size of PLMs has been unsustainable and insufficient in helping them encode world knowledge and generalize to underserved domains, I wish to better understand their inner workings and pursue novel pre-training regimes. Since PLMs have saturated performance on existing benchmarks while struggling with pain points like common-sense reasoning, I also aspire to work on more robust benchmarks for natural language understanding (NLU). Dialog modeling is another crucial field with open problems like coreference resolution and tracking shifts in topic between turns. Addressing such issues could allow virtual assistants to approach human-like conversation capabilities, becoming capable of discussing open-ended questions and proactively making personalized suggestions. My research interests greatly align with those of NYU Courant's world-class faculty. I hope to collaborate with Prof. Sam Bowman on developing stronger datasets and benchmarks for NLP, building on datasets for presuppositions and long-document comprehension. My interests in better interpreting pre-trained models also align with Prof. Bowman's work on comparing layer representations in fine-tuned Transformers and on the volume of pre-training data these models need. I would love to collaborate with Prof. Kyunghyun Cho on novel pre-training techniques, such as pre-training for machine translation, and on NLP datasets for underserved domains like mathematics and low-resource languages. Prof. He He's interests in dialog systems align with my experiences, and I aspire to work together on text generation for dialog systems and on understanding the importance of context in language models.

Beyond research, NYU's exceptional offering of courses will help me gain a comprehensive understanding of ML and NLP, with courses like *Big Ideas in Artificial Intelligence* and *NLP with Representation Learning* providing the intellectual depth and breadth that I seek. NYU will also bring together some of the best minds, and I am excited to collaborate with and learn from such peers. I also dream of contributing to NYU's energizing community by taking on leadership roles in associations like NYU Courant's Women in Computing (WinC). With its excellent CS curriculum, dynamic student body, and record of trailblazing research, NYU Courant will be an ideal place for me to obtain my Master's and bring the power of NLP to people worldwide.