Goals Statement
of Muhtasim Noor Alif (PhD applicant for Fall—2024)

My long-term career goal is to be actively involved in research as a faculty member or as a researcher. From an early age, I have been fascinated by the world of science and the breakthroughs achieved by scientists. As I grew up, I came to realize that the world advances through the dedicated work of scientists and researchers. Since then, I have consistently nurtured the dream of becoming a prominent researcher, contributing to the progress of humanity to the best of my ability. Pursuing an advanced degree is the initial step toward achieving my long-term goals. My research interests lie in the fields of Data Mining, Machine Learning and Human Computer Interaction. I am confident that the Department of Computer Science at George Mason University provides the ideal environment, considering its consistent and unique contributions to these fields.

When I was first surfing through different social media like Facebook and YouTube back in the early 2010s, one thing that amazed me was the suggestion system. The platforms suggested different contents based on the user's preferences, and it blew me away. Later in my junior year of university, I came to know about Machine Learning and began to understand the high-level workings of several ML algorithms. I was quite surprised to discover that the fundamental mathematics behind these algorithms, such as regression and classification, were concepts I had learned back in high school, unaware of their extensive applications. I realized that in the realm of science, even the most seemingly straightforward elements can have limitless potential. And thus my love for Machine Learning began.

In my undergraduate years, I went through a range of theory and lab courses, but I enjoyed the courses most which involved a lot of algorithms and mathematics. I loved the courses of discrete math, data structures and algorithms, linear algebra, probability and statistics, artificial intelligence, simulation and modeling, and of course, machine learning. During the COVID pandemic, I had some free time to explore topics of personal interest. I completed the deep learning specialization course on Coursera offered by Dr. Andrew Ng during that period. It was my first hand-on experience with ML and DL, and I vividly enjoyed the assignments. During the later years of my undergraduate studies, I had the opportunity to study courses on 'Artificial Intelligence' and 'Machine Learning'. The courses had various interesting assignments. In the AI lab assignments, I got to make an AI agent for a two player game using adversarial search, predict the position of a ghost in a grid using hidden markov model, and perform various other tasks. In the ML course, I had to dive deep into various fundamental ML theories like linear/logistic regressions, support vector machines, clustering algorithms, etc. I also learned about some of the cutting-edge deep learning models like GANs, Transformers, etc. In the lab, I hands-on implemented Logistic Regression, the Expectation-Maximization algorithm, a CNN from scratch, and numerous other key ML concepts. I also did a project in the ML lab where I made a Bangla news classifier using BERT. All these coursework and assignments made me even more interested in the field of ML, and I decided that ML should be the focus of my attention.

I grew a knack for research while I was working on my undergraduate thesis under the supervision of Dr. Tanzima Hashem. In my thesis, I worked on conducting a comprehensive analysis and comparison on the state-of-the-art deep learning based crime prediction models. Crime prediction is currently a prominent topic in the field of data mining, and there are various models and architectures that are being proposed to do this task more accurately and efficiently. However, we figured that there is a significant research gap in existing literature on the applicability of different models in different real-life scenarios and in a unified setting. So, we first decided to use the Chicago crime dataset available on the city portal as the input for our models after careful deliberation. During dataset analysis, I identified notable variations in crime density among regions, strongly correlated with external factors like traffic patterns, point of interests, etc. In addition, the models employed varied architectures, integrating components like diverse Graph Neural Networks, Attention Mechanisms, Convolution and Diffusion Modules, Recurrent Modules, etc., for the task of space-time aware crime prediction. As a result, I conducted numerous experiments on the models, altering the data sparsity, prediction timesteps, ablation study of external features, and different model components. We have submitted our manuscript in Neurocomputing, and it is currently under review. In the course of

this research, I was introduced to the extensive domain of Data Mining, further fueling my enthusiasm for ML. I came to understand that data is of unparalleled importance in today's world. With systematic analysis and effective modeling, we can unveil novel and noteworthy insights, infer and predict diverse phenomena that were once seemingly inexplicable. I firmly believe that there is substantial potential for research in the field of Data Mining.

After my graduation, I got involved in a research project under the guidance of Dr. A. B. M. Alim Al Islam. Our goal is to assess and enhance the applicability of GPT-based large language models(ChatGPT and GPT-4) for English as a Foreign Language (EFL) education among young learners. We aim to build a system using a custom mobile app specifically for students at the school level, where we assign various tasks to them and provide them with feedback generated by ChatGPT. We will gather, analyze, and refine the system based on the collected data from the students. This work is being done with the collaboration of Pennsylvania State University. At present, we have finished developing the app. I have had experiences of developing web-based systems before, but this was my first experience developing a mobile app. Thanks to my undergraduate studies, it has prepared me to quickly learn new things and apply the knowledge efficiently within a short amount of time. As I incorporated ChatGPT into the system for providing the students with feedback, I discovered several issues with enabling direct student interaction with ChatGPT. The interactions may lack relevance to the problem, and there is a need to filter for potential toxicity. These issues led me to engineer the prompts for ChatGPT carefully, so that any unpleasant results can be avoided and high-quality feedback can be ensured. Doing this research, I realized that while modeling and building intelligent systems is needed, the interactions that ordinary individuals have with these systems are equally significant. Extensive analysis and dedicated efforts are necessary to extract the best possible user experience from these advanced technologies. Therefore, I see significant research opportunities in this particular field.

Motivated by my aspiration for an academic career, I currently serve as a lecturer in the Department of Computer Science and Engineering at the University of Asia Pacific. I conduct the theory and lab courses on 'Numerical Methods', and the lab course on 'Artificial Intelligence', driven by my sheer interest in mathematics and ML. While teaching, I actively look for ways to ensure students attain a solid understanding of the subject, craft problems that allow them to apply their acquired knowledge effectively, and enhance the overall enjoyment of the learning process. I have a genuine passion for teaching, and I like to think of it as a two-way experience. While I am dedicated to spreading knowledge, the process itself is enriching, allowing me to learn and adapt continuously. I believe these teaching experiences have paved the way for my ambition to excel as a faculty member in the future.

I consider the Department of Computer Science at George Mason University one of the most suitable places to pursue my Ph.D. I am particularly enthusiastic about the prospect of collaborating with Dr. Sanmay Das at the intersection of Computational Social Science and Machine Learning, as this resonates with my own interests. I would also like to collaborate with Dr. Huzefa Rangwala in the fields of Machine Learning and Data Mining. I am very interested in the work of Shehu Lab and would like to work with Dr. Amarda Shehu's group as well. I am also familiar with Dr. Jessica Lin's contributions to Data Mining, and I am eager to explore potential collaboration with her. I am equally open to working with other researchers who share an interest in data mining and the development of machine learning algorithms to solve real-life socio-economic problems or problems arising in different branches of science. I believe an opportunity to pursue my Ph.D. at George Mason University will enable me to conduct impactful research and help me to advance towards a research-oriented career in academia.