Statement of Purpose

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I still remember the moment of euphoria when my manager from the internship at Pariksha.co (a startup for digitizing education) called me. He congratulated me that the adaptive recommender system I implemented was helping more than 50 thousand students learn better. The critical thinking, experimentation, and impact that machine learning algorithms can provide motivates me. I aim to pursue a career in research because of the intellectual challenges accompanied by ample opportunities for innovation offered by it and am therefore highly motivated for graduate studies in Computer Science, more specifically, **Machine Learning** and **Recommender Systems**. With this aim, I am applying for Masters in Computer Science at UMassAmherst.

Being with a hacky mindset and good with science and mathematics, engineering was a natural choice for me. I joined the Computer Science and Engineering department at IIT Kanpur after being ranked 191 among 1.5 million students in India in IIT JEE Advanced 2013. My curiosity to explore dwelled me to be a part of IITK Motorsports team which consisted of 17 students. The team designed and manufactured an All Terrain Vehicle competition called BAJA Student India. As the member of chassis subsystem, I researched and analyzed various materials and design possibilities using advanced software like ANSYS and Solidworks. We won the trophy of "**Best Incoming team**" and secured the **fourth position in the design event** among 44 teams countrywide. I am very fortunate to be part of this industry level project at such an initial stage of my undergraduate studies.

My journey in the field of machine learning began during my second-year internship at Pariksha.co. I was given a task to design an **adaptive recommender system** to recommend questions to students. The problem was challenging as the question rating and user rating were interdependent entities. Moreover, I've to also deal with the cold start problem. As I was new in the field, I had to read a lot to strengthen my understanding. With two months of constant hard work, I was able to design and launch an adaptive recommender system.

The success of adaptive recommender system motivated me to take an undergraduate project on **Multiple Kernel Learning** with **Professor Harish Karnick**. The aim of the project was to explore various combinations (linear/quadratic) of kernels to be used in SVM in order to achieve results as good as CNN for object classification task. Understanding Multiple Kernel Learning required me to learn deep theoretical concepts like Relative Kernel Hilbert Space and Riesz Representation theorem. Apart from theoretical gains, the whole process equipped me with the skills to implement and work with CNN and GPUs.

In the summer of 2016, I was a research intern at **Adobe Research Labs, India**. The team consisting of two mentors and three interns created an automated approach which designs smart geo-fences based on location dependent product affinity of users. Since the problem was noble and not very well formulated, I've explored existing literature from various areas including location-based user similarities and e-commerce recommendations based on user behavior on websites. While exploring literature, I was amazed to see the huge productive potential that lay in the intelligent exploitation of the available data. To make e-commerce data usable in our case, I wrote a web crawler to link product id's present in the dataset to the product hierarchy. The extreme sparsity of data was tackled by incorporating intrinsic interest of users towards products, the similarity between users and semantic similarity between locations. It was very satisfying to see the system producing geo-fences for user segments at locations we never thought of. Adobe **patented** the whole research and the project was also selected for showcasing in Adobe Tech Summit 2017, San Jose. Our work titled **Smart Geo-fencing with Location Sensitive Product Affinity** has been published as a conference paper in the conference **ACM SIGSPATIAL 2017**. Apart from the technical skills that I gained from the above experience, I also learned the way to go about addressing a research problem.

From exploring scientific literature to formulating the problem statement and further on developing, implementing and testing the required heuristics, I now know that none of these can be undermined in importance.

Motivated by the internship experience, I decided to explore the field more rigorously. Following year, I took four machine learning courses. As the course project of "Recent advances in Computer Vision" course, we extended the work **DenseCap** by Andrej Karpathy et. al. We were facing difficulty in reproducing the results due to limited 2GB GPU. To make it work, I trimmed down the fully connected layer of object detection module which contains most (around 90%) of the parameters of the entire architecture. The authors were using Greedy non maximum suppression(NMS) for removing overlapping bounding boxes for predicted objects. We replaced the original NMS module with our implementation of tyrolean network and retrained the entire model. Results were surprising and we actually **surpassed the MAP reported by the authors**. In another course project, motivated by the ubiquitous need of deploying the machine learning models on limited resources environment like mobile phones, I implemented a module for decomposing the input weight matrix of a trained model into a low-rank matrix and a sparse matrix. These courses strengthened my foundations in machine learning and project work allowed me to implement my learnings on real-world datasets.

Due to the financial issues, I decided to go for a job before higher studies. Currently, I am employed as **Member of Technical Staff** with **Adobe Systems India Pvt. Ltd.** I work on developing new features for Adobe Acrobat using C++. I am also learning the level of technicalities involved with maintaining and deploying humongous amount of code. During a week-long hackathon, I developed POC of a unified smart tool for all annotation types which was highly appreciated by the management and got selected for shipping with the March Release. I am also a part of GRP-ACROML, a hobby group for discussing and implementing possible ML applications inside Adobe Acrobat. As a part of the group, I am working on a problem of recommending a relevant tool to the user based on pdf content type. Working with the Adobe made me realize the immense potential of machine learning algorithms in industry. It made me realize about the AI revolution the world is going to encounter in upcoming decades and how badly, I want to be a part of it.

My aim to pursue master's degree is an essential step towards a research career, be it through a Ph.D. or a research-oriented job. UMassAmherst being one of the premier institutes pursuing research in this discipline is ideal for me. It would be great opportunity for me to work with Professor Sholoma Zilberstein. I am deeply inspired by his work on designing autonomous agents. I would also like to work with Professor Akshay Krishnamurthy on interactive learning. At UMassAmherst, the diversity offered by the various research groups would provide me ample opportunities to explore the different ways in which each of these fields can contribute to the research going on in the other fields.

What started as a mere curiosity to explore things, has now developed into something I am passionate and confident about. Each project has brought along a different experience for me. Each of them provided me with something new to learn and to gain from, helping me develop as a researcher. I expect that my research aptitude, persistence, and enthusiasm towards solving challenging problems would add value to the already established research culture of the institute. Given my research experience, strong academic background and experience of tutoring students as a part of the Counselling Service, I believe that I would be successful as a graduate student.