

Statement of Purpose

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One of the major discussion topics addressed in an exciting *webinar*^[?] on Artificial Intelligence (AI) and Machine Learning (ML) by Dr. Peter Norvig, Director of Research at Google, was the resurgent interest in AI, which he credited to the increase in the computing power and data available to researchers allowing them to leap from theory to implementation. For me it all started after the completion of my 4th semester with the introductory Machine Learning course on Coursera by Prof. Andrew Ng. The course material and projects kindled my curiosity in ML and provided an overview of various topics in the field.

All along my academic years I have shown a fair amount of competitiveness and academic excellence essential for being a successful researcher. In my high school I secured an All India Rank of 6 in International Master's Mathematics Olympiad (IMMO-2011), 93.8% and 92.6% marks in my 10th and 12th standards respectively. Further in 2012, I secured above 99 percentile in several entrance exams of prestigious universities which included IIT-JEE, AIEEE and ISAT. As a result I was granted admission in the Electronics and Electrical Engineering (EEE) Department of Indian Institute of Technology-Guwahati (IIT-G), one of the premier institutes in India. But having moved to a completely new surrounding in college added with multitudes of research fields, it took me some time to decide the direction for my efforts. Being overly ambitious in pursuing a field too many culminated in a slight decline in my CGPA in the 4th semester. The Coursera course played a huge role in drawing my attention towards ML and AI, following which I started focusing my efforts in the field. To strengthen the fundamental concepts and to attain a solid foundation, I undertook Pattern Recognition Machine Learning (PRML) elective by Dr. Suresh Sundaram, Assistant Professor, Dept of EEE, IIT-G. Besides course-work, I developed several DIY projects including Handwritten Digit Recognition Tool and Image compression to support my academic learning and achieve a more hands-on experience.

After the completion of my 6th semester I was accepted as a research intern in the prestigious Institute of Research and Development in Banking Technology (IDRBT) established by the Reserve Bank Of India (RBI). I successfully completed a couple of research projects under the guidance of Dr. Vadlamani Ravi, Professor & Head, Center of Excellence in Analytics. These projects exposed me to research and allowed further indulgence in the field of ML, especially Deep Learning. The first project focused on tackling feature subset selection (FSS) problem using the Differential Evolution (DE) algorithm along with the essence of Quantum computation. The second project involved the use of Deep Models such as Restricted Boltzmann Machine (RBM) and Probabilistic Neural Network (PNN) for Sentiment Classification. Meanwhile, I acquired the experience of writing academic papers and publishing them in conferences. Both research projects were successfully converted into academic papers and were published in reputed publications. Along with Dr. Ravi, the first paper^[?] was presented in the Multi-Disciplinary International Workshop on Artificial Intelligence (MIWAI 2015) held at Fuzhou, China. Our other paper^[?] was presented in the IEEE Conference on Recent Advances in Information Technology (RAIT 2016).

Following my internship, I undertook more specialized courses like Digital Image Processing by Dr. Sundaram and Computer Vision elective by Dr. M.K. Bhuyan, Associate Professor, Dept of EEE, IIT-G. I successfully completed a project under the guidance of Dr. Bhuyan for detection of defect in a PCB (printed circuit board) from its images with the use of a supervised classifier (Support Vector Machine, SVM) on SIFT (scale-invariant feature transform) features and finally using various image processing techniques to automatically annotate the defected areas. The desire to tackle some problem statements in the Vision field prompted me to undertake my Bachelor Thesis Project in the field of Computational Pathology under the guidance of Dr. Amit Sethi, Associate Professor, Dept of EEE, IIT-G. The scope of the project was to research on the use of computational methods on the biopsy slide images to segment out the glands and further predicting the type of cancer using the structural and spatial information of the glands. On the Warwick-QU Dataset consisting of Haematoxylin and Eosin (H&E) stained biopsy slides, a colour-normalisation algorithm to standardise the colour variations followed by a Convolutional Neural Network (CNN) based architecture was adopted. The efficacy of the proposed approach was

computed using various evaluation metrics at pixel as well as object level and the architecture achieved greater than 85% accuracy, comparable to some state-of-the-art approaches.

In order to gain professional experience and exposure to the software industry I joined the Advanced Software (Adv-S/W) Team in Samsung R&D Institute-Delhi (SRI-D). My work revolves around researching and applying the techniques of NLP and Vision domain to commercial products. During the year 2016, I worked on a project of Samsung S/W Center, HQ South Korea, under the leadership of Mr. Arun Kumar Singh, Deputy General Manager of Adv-S/W Department, SRI-D. The aim of the research project was to develop a smart Customer Relation Management (CRM) engine that used NLP to extract the type of defect and then recommend relevant diagnosis steps for Samsung Visual Display units. Further we used clustering (Affinity Propagation) on top of the supervised classifier (SVM on word2vec features) to detect new defects, establish a similarity between the existing known defects and recommend diagnosis steps for these new hidden defects. The successful completion of the project saw model achieve more than 80% accuracy and the approach being accepted by HQ South Korea. Currently, I am working on Predictive Analytics System project that involves Time Series event prediction and rule extraction from various supervised classifier models using machine sensor data to provide fault prediction on Samsung's digital appliances and further recommending diagnosis steps to reduce human effort. The project is led by Mr. Arun and Mr. JinHe Jung, Senior Engineer at AI Lab, Samsung S/W Center, HQ South Korea. Apart from these project related activities, I proposed a method for Network Traffic Prediction using Bayesian Networks and Long Short Term Memory (LSTM) Networks. The application of the above framework is to predict the bandwidth available by learning the time-series network usage pattern of Smart TV users and thus develop an efficient scheduler for sending the OTN (Over the network) software updates. The submitted abstract^[2] has been accepted for the Samsung Best Paper Award (SBPA'17) which sees participation from Samsung's research institutes from all over the world.

The research aspect of the job makes it absolutely essential to explore various research papers and producing various Proof of Concepts (POCs) through quick implementations. Also, much importance is placed on the quality of code which makes it essential to have the ability to ship scalable production software, thus greatly improving my programming skills. Though these projects matured me by posing numerous obstacles, be it data availability, data sparsity or algorithm selection, at the same time it added to the desire to attain a more in-depth knowledge and to be an independent researcher in the field. Having acquired a solid foundation in Natural Language Processing (NLP) and Vision domain through a rigorous undergraduate program, along with internship and work experience in the IT industry, I feel that it is the right time to take up graduate studies. My interests and research aims align with those of Prof. Ricardo Gutierrez Osuna's Perception Sensing and Instrumentation Lab in the form of projects like Caricature perception and facial animation. The possibilities of Deep Learning and the interplay of NLP and Vision domain, be it in the form of Natural Language Generation, Auto Scene Understanding frameworks or Human emotion descriptors has drawn my attention and I plan to carry out further research in these areas. The ongoing projects in Prof. Tracy Hammonds Sketch Recognition Lab also excites me. Additionally, by subjecting myself to various environments during internships and in the software industry, I ensured that I am capable of maintaining my focus in diverse surroundings and carry out research independently.

References

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- [3] R. Ghosh, K. Ravi, and V. Ravi. *A novel deep learning architecture for sentiment classification*, 3rd International Conference on Recent Advances in Information Technology (RAIT), IEEE, 2016.
- [4] R. Ghosh, Nishant Chaprana, Maneesh Jain and Arun Kumar Singh. *Intelligent Tizen Network Platform*, Samsung Best Paper Award, SBPA 2017, Samsung S/W Centre, HQ South Korea.