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Research Experience

1. Ongoing or previous research experience, its relevance with the profile and how it can be utilized in job

As a Masters' student at IIT I came across different projects both in my coursework and Masters' projects. I have successfully participated in projects considering Deep Learning and Optimization.

I acquired the skills of Deep Learning while doing a project on the Lottery Ticket Hypothesis. In this project, we (this was a team project with another two students) were investigating how to effectively reduce the parameters of a neural network to deploy the training and inference on a mobile device. In my project, I learned how to efficiently minimize parameters so users can train deep learning models in mobile devices. In my project, I investigated the lottery ticket hypothesis where researchers have claimed a subnetwork that can be trained from scratch with the initializations of the original network. To find the required subnetwork, we implemented the algorithm proposed by Jonathan et al. In the proposed algorithm; I investigated the lottery ticket hypothesis on Lenet. While working on this project, I became curious about two related questions: How can I solve the huge computation time required for finding the subnetwork in high-end models, and if this pruning and finding an equivalent subnetwork robust against adversarial attacks in the form of data perturbations. In my follow-up project work, I tried to answer the first problem of computation time. I tried to use a subnetwork obtained from one data set and tried on different partitions of other data set from a similar distribution. While investigating the work, the adversarial question came to my mind, i.e., if the neural network is working on false data or working accurately to its senses. Suppose the proposed subnetwork obtained from the algorithm is not robust against attacks. In that case, data perturbations can easily cause problems in the models changing the models' outputs, failing the outcomes in the deep learning models in inexplicable ways.

I am currently actively participating in a project to propose a warning-based mechanism to control fake news propagation among the masses. I am improving the technique where a user receives a piece of news from a parent user with a tag and a warning from the system. Based on the information from the system and parent user and intrinsic knowledge, they forward the message to their friends with a suitable tag. The model initially considered users with ideal nature. I have currently worked on incorporating factors like users who found it fake news would not like to forward further (reluctant user). We have observed with Monte-Carlo simulations that with a 20% reluctance factor, there is a 10% rise in the extinction and a 0.06 increase in the fraction of people with authentic tag, thus highlighting the mechanism's effectiveness. We have also incorporated that some users might be naïve and fall into the trap of fake news spreaders. In the case of naïve users, we have designed a new warning mechanism to see that it works as it is supposed to be for a lower percentage of the naïve population. I am improving the model further to incorporate external attackers and their optimal policy using Markov Decision Process to attack to create significant harm to the propagation and observe how the warning mechanism handles the attacks.

Motivation

1. Please tell us why you wish to join FUJITSU. (Not more than 300 words)

I am interested in the role 'Researcher (Recognition) Permanent' advertised by your company. During my graduate study, I worked on several different image analysis projects, including medical image analysis, which has prepared me for a potential role in an industry similar to that I am applying. For example, in one of my machine learning projects, I teamed up with a diverse group of my colleagues to implement an automated deep learning method for Covid-19 detection using pre-processed 2-D CT scan images. As a sub-task, to segment the lung images from the recorded data, we trained a deep neural network to segment out lungs with a considerable amount of accuracy. And use it for predicting chances of Covid infection of a patient (based on the DenseNet model). It will help as a low-cost covid detection method and help reduce the strength of rays used during the CT scans. I am currently working with my colleagues to implement a diffusion-based technique for depth estimation and image restoration from defocused images. Image restoration is an important problem for blurred CT scans that can happen due to patients' autonomous or involuntary movements, and we can use such technology to improve it. This project has exposed me to the current cutting-edge machine learning research being applied to medical imaging and has inspired me to work more in this direction.

FUJITSU has a magnificent work culture & full of talented people that I think will help me learn a lot and apply my knowledge to solve different problems. I also enjoy working with people as it brings out different perspectives and approaches to the task. In my opinion, meeting people from diverse backgrounds gives one exposure and altogether a unique experience.

Suitability:

2. Please tell us why you think you are a suitable candidate and how your experience and skills would be of benefit to the company (Not more than 300 words)

During my graduate study at IIT Bombay, I have taken several classes and worked on several projects involving Machine Learning, Deep Learning, and Digital Image Processing. Some representative courses and projects are described below.

In the Deep Learning domain, I have taken courses where I have learned about different Deep Learning and Machine Learning models and the right way. In Deep Learning Course, I came across different Convolutional networks and worked on a project in that course on how to use pruning to find a subnetwork that trains faster but gives a commensurate accuracy. In the course, I also got an introductory idea on more state of the art neural networks like Recurrent Neural Network and Generative Adversarial Network.

In Image processing, I am currently taking a class on Digital Image Processing where I came across statistical and mathematical methods underlying different image processing algorithms on image enhancement, noise removal, segmentation, edge detection, corner detection, and doing a project where we are trying to implement an image restoration technique which can help in analysing defocused images.

In the Machine Learning domain, I have taken a class on Statistical Machine Learning and Data Mining where I learned about mathematical underpinnings of different Machine Learning models, and with a diverse group of students, I tried to implement a Deep Learning based Image Analysis model to detect covid in the CT scan images of lungs.

Additionally, in my MSc project, I learned about using Recurrent Neural networks and LSTM (Long Short-Term Memory) to solve demand forecasting in high-dimensional data settings

Career Goals

3. Please tell us about your career aspirations and what you would like to achieve with FUJITSU (Not more than 300 words)

After earning an undergraduate degree in math, I decided to pursue a graduate degree in

IEOR. I wanted to apply the mathematics that I learned to solve real-world problems. To achieve this, at IIT B, I have taken industry-oriented courses. I could learn to develop and use concepts from mathematics and computing to real-world problems, including but not limited to applying deep learning techniques in medical imaging and optimize models to train faster through pruning.

I am very much interested in the mathematics of machine learning and interested in applying efficient Deep Learning models in Image processing and other real-world problems. As I come from a pure math background, I can quickly grasp the mathematical concepts underlying things. Therefore, apart from being an end-user of deep learning algorithms, I am also interested in the mathematical details of the problems like robustness and computational efficiency. Also, I have a keen interest in the theoretical backgrounds of different algorithms and developed my interest in statistical and mathematical methods underlying different image processing algorithms such as image enhancement, noise removal, segmentation, edge detection, corner detection.

I want to use my mathematical and statistical knowledge to learn more about machine learning, deep learning, image processing to study and use more efficient, less time-consuming algorithms for different works in solving real-world projects undertaken by the . I believe FUJITSU, through this position, is offering a possibility for me to continue the path of using my mathematical and computing skills to solve real-world problems.