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I am a third year (will complete in May 2023) regular degree student pursuing a B. Tech in Computer Science and Engineering (specialization in Machine Learning and Deep Learning) at the Indian Institute of Information Technology, Sonapat [Delhi NCR]. My 6th semester will be complete in May 2023 leaving me enough time to get ready for my GSoC project. If I am selected, I shall be able to work around 30 hrs a week on the project, though am open to putting in more effort if the work requires it. Also I have prior experience in form of internships and projects in this field which give me confidence for applying in this prestigious organization.

Why this Organization?

Most people are spending their time in the ML for business purposes. But the base behind the ML is dependent on science. By putting ML in science, we can achieve a business purpose. For that first, we need to use ML in science. This idea affected me. And I started my ML journey in science. While most GSoC organizations follow the method of bug fixing and new feature addition, ML4SCI follows the core values of science. I am as an engineering student with a science background, I would like to contribute to ML4SCI with my maximum efforts to achieve the goals of the ML4SCI organization.

Why the DeepLense project?

As I know **DeepLense** is a deep learning pipeline for particle dark matter searches with strong gravitational lensing. I have already read the paper under [\[1909.07346\] Deep Learning the Morphology of Dark Matter Substructure \(arxiv.org\)](#). I found this project interesting according to my technical knowledge of Machine Learning and Deep Learning. Moreover, I also tried the evaluation test for this project, and I found very satisfying results related to this paper mentioned above on DeepLense. So, finally, I have committed to contributing and am ready for further development in this DeepLense project with all my effort.

Why me for this DeepLense project?

When the evaluation tests were released for this project, at the same time I picked up them and tested them on my hand. As I previously said that I have already read DeepLense's paper on arxiv, I found my results satisfactory on the amount of data provided for evaluation. **I have achieved an AUC of about 0.97 for Common Test I. Multi-Class Classification, an AUC of about 0.99 for Specific Test IV. Exploring Equivariant Neural Networks and an AUC of about 0.99 for specific test V. Exploring Transformers.** I assure you that if I am provided more data than the results will be more satisfactory.

My project timeline

Please notice that the project timeline mentioned below can be made flexible for mentors. This means that I am ready to give my full time to this project on holidays and weekends.

→ Week 1 [May, 31 - Jun, 12] Community Bonding period

(Because I have my end semester examination from 18th May to 30 May, my week 1 starts on 31st May.)

First, I will communicate with the mentor of my corresponding projects and know about further processing, their requirements, expectations, rules, etc. I will tell them my project requirements like data resources and expected time for coding. I also tell them about results that were achieved on evaluation data. If they give any suggestion regarding improvements or anything, then I will consider it and goes to my work.

→ Week 2 [Jun 13 - June 19] Deep Analysis of the Prospective

I will first dive deeply into the given project of DeepLense. I will carefully analyze it. See what it says. What is it all about? What is the science behind it? What solutions exist for it currently? How can ML solve this?

→ Week 3 [Jun 20 - June 26] Look at the Data Provided

During this week, the data that they will provide I will look at that. Will analyze it. Extract meaningful information like frequency count, distribution, simulated or not, etc. Then I will be able to decide how I will start training. During this phase, I will also pre-process the data that can be implemented into the training phase. Finally, I will convert the data into a useful format for training.

→ Week 4 [Jun 27 - Jul 4] Report 1 submission

I will submit a report, Report 1 based on previous three-week developments. I.e., brief description of the problem statement, and an overview of the data that is finalized for further processing.

→ Week 5 [Jul 5 - Jul 11], Week 6 [Jul 12 - Jul 19], Week 7 [Jul 20 - Jul 26]
Training Phase

Let us finally come to our most important part of the project training. The useful data that I have created in previous weeks, will be used for training. Throughout the project, I will use Python as the programming language and TensorFlow as my main framework for this task. My initial trial is to create a model described in the DeepLense paper on arxiv (ResNet, AlexNet, VGG). After that, I will go for the model that I created during the evaluation test (Xception). For training purposes, I will use Google Collaboratory or Kaggle notebooks. If required, then I am ready to use cloud resources like Google Colab Pro or AWS Sagemaker which are more powerful. I will use GPU and TPU during training.

→ Week 8 [Jul 27 - Aug 2], Week 9 [Aug 3 - Aug 9] Optimizing Phase

In these two weeks, I will try other methods like data augmentation if results during the training phase are not satisfactory. Also, I will try to train the model on data that has lower over the higher resolution of images.

→ Week 10 [Aug 10 - Aug 16] Report 2 submission

Now, time for our next report, Report 2. In this report, I will include all the strategies that I have applied in the training and optimizing phase. I will include why I have chosen this or that model for training. Report 2 also includes the learning curves like loss improvements, Receiver

Operating Characteristics (ROC) curve, and Area under the Curve. Results are also compared with the results mentioned in the DeepLense paper.

→ Week 11 [Aug 17 - Aug 23] Further Processing Related to Accuracy Measurement improvements.

If mentors fill that this model should have more satisfactory results like more AUC, then I will try to achieve this.

→ Week 12 [Aug 24 - Aug, 30] Finalisation of the Models

Now I have completed the complete model training and optimization. The time has come to pick up the best model that is most accurate. After the selection of the best model, I will convert them as required. The model directly can be saved, and its only weights are saved.

→ Week 13 [Aug 31 – Sep 6] Final Report submission

This is the final report in which I include All the aspects of the project, approach, metadata of the data and model, accuracy plots, ROS, and AUC. Final report will also include GitHub repo links, notebook links, etc.

→ Week 14 [Sep 7 - Sep 12] Thanks

After the completion of the task, I am eagerly waiting for the response related to my behaviour, approach, performance, etc from mentors.

My Internship in ML

1) Data Science Intern (Exposys Data Labs)

- i) Construct Different Regression algorithms.
- ii) Divide the data into train set and test set.
- iii) Calculate different regression metrics.
- iv) Choose the best model.

2) Intelligent Data Processing and Computer Vision Intern (Kryptonias)

- i) Design and develop robust, efficient, and real-time algorithms for analysis, classification, object detection/segmentation, etc., of images using state-of-art techniques from image processing, OCR, pattern recognition, computer vision, machine learning, deep learning, etc.
- ii) Develop innovative solutions for various problems related to segmentation, object detection, feature analysis, and classification of text-heavy images for applications in retail.
- iii) Research & implement high-end efficient models in machine learning (e.g., deep learning) for accurate analysis, and classification of detailed images.
- iv) Learn and update oneself on the emerging trends of technology and apply them in the projects for better results leading to publications and patents.
- v) Explore new areas of expert systems, cognitive computing, artificial intelligence, computational photography, etc.

My Projects on Science using ML.

- 1) Court Judgment Prediction and Explanation (NLP, Deep Learning, AI in Law) – [Self]

How can ML help in judgment prediction? A project for helping judges to help whether the PIL should be accepted or rejected, explain the arguments for acceptance or rejection and recommend similar cases occurred in past.

- 2) Football match prediction and Kelly Betting (Data Science) –[Self]

Predict football match outcome based on given and some derived features. Then Kelly betting mathematical theory is used to maximizing profit in betting.

- 3) Brain Tumour Detection (Computer Vision, Deep Learning, AI in Health) – [Self]

A complex neural network will detect the tumour present in MRI images of patients. With an accuracy of 94%.

- 4) Detection of Criminal Activities/Criminal through CCTV by analysing live footage for melee, mob formation, the body language of the suspect, etc. (Deep Learning, AI in Security)– [Self, SIH2022 Problem Statement]

The state CCTV Control Room receives feeds from a number of CCTV Cameras across the state. It is not possible to monitor all the camera feeds in a live scenario. The solution Should be capable of reading the feeds being received from the cameras and analysing the feeds for any criminal activity. I developed an ML model that identifies many activities like robbery, Abusing, Vandalism, Burglary, etc. from real-time CCTV footage.

5) Early Diabetes Prediction (Deep Learning, AI in Health) – [Self]

A Simple DNN based model predicts diabetes in early stages based on age, gender, polyuria, polydipsia, sudden weight loss, weakness, polyphagia, genital thrush, visual blurring, itching, irritability, delayed healing, partial paresis, muscle stiffness, alopecia, and obesity. With an accuracy of 96%.

6) Estimating Aqueous Solubility Directly from Molecular Structure (AI in Drug Discovery) – [Self]

Predicting log of solubility LogS based on molecule's Wildman-Crippen LogP value, molecular weight, number of rotatable bonds, and aromatic proportion.

7) AI-based real-time identification of Crop Nutrient Disasters in agricultural crops (Computer Vision, Deep Learning, AI in Agriculture) – [with FOSS4Gov and VJHackathon]

To develop an intelligent system for the detection of nutrient deficiency in major crops taken in a local area.

Online Courses and Certification

Machine Learning [[Stanford University - Coursera](#)]

Master The C language [[Udemy](#)]

Deep Learning [[IBM](#)]

Applied Data Science [[IBM](#)]

Problem Solving Basic [[HackerRank](#)]

Problem Solving Intermediate [[HackerRank](#)]