



ML4SCL

Equivariant Neural Networks for Dark Matter Morphology with Strong Gravitational Lensing

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About Me :

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I'm a 1st Year student, pursuing my MTech in the Department of CSE at National Institute of Technology Hamirpur. My semester will complete in Mid May leaving an ample amount of time to be dedicated to the GSoC project. If I'm selected then I'll give my best shot and will contribute around 40+ hours in a week although I'm willing to put more effort if required.

Currently I am serving as the Class Representative of the Department of CSE . Since our college has no history in registering for events like Google Developer Club and Codechef, so the duty is immense to put the college name in frontline. Also I'm being given the charge of Training and Placement for the Computer Science and Engineering Department for time being. I'm enjoying every ounce of my work on a daily basis along working on my research papers.



Why this Project ?

This technique of implementing the Equivalent Neural Networks with the PyAutoLens for strong gravitational lens modeling as deep learning models have potential to accurately identify the images containing substructure. I look at this from the perspective of research in the field of neural networks. So , the main objective here is to implement the DeepLens functionality with equivariant networks for computer vision to be applicable to DeepLens Data. Hence it unlocks the new direction in this field.

Technical Knowledge:

I am a 1st year student at NIT Hamirpur. I am enrolled in the MTech program in the Department of Computer Science and Engineering. My specialization is in the field of Fuzzy Logic and NLP . The courses that I've done includes:

- Fuzzy Logic
- Neural Networks
- Computer Networks
- Advanced Data Structures and Algorithms
- NLP for fake News identification in Social Media
- Wireless Body Area Networks

I've been enrolled in the Data Science PG Diploma program in the IIIT Bangalore for further polishing my skills and enrolled in various Udemy courses.

Some of my projects in Data Science and Machine Learning are:

- Generic Engineering Attribution Challenge
- OpenVaccine: Covid-19 mRNA Vaccine Degradation Prediction
- NFL Big Data Bowl 2021
- SwiftPay: Universal AI based Payment providing system.

Some of my research areas I'm currently working on are listed below :

- Fake News Identification in the Social media handles (Research project with Dr. Pradeep Singh).
- Use of WBAN in the Covid-19 pandemic.
- Increasing the sensitivity of the Neural Networks (Working on Perceptron Model)

The Programming languages I've been working on includes Python 3.5x , R, C and C++. I am learning SQL nowadays.

Also I am comfortable with working with people across various time zones and also dependable and trustworthy .

Abstract :

"Machine intelligence is the last invention that humanity will ever need to make" : Nick Bostrom

Deep Learning has been a game changer in the modern world. Since human calculations are error bound. So, we look into various other technologies which will help to reduce the errors in the systems. Machine learning, and particularly deep learning, methods have found wide reaching applications in cosmology. Deep Learning has tremendous potential in solving the problems which are very difficult for human beings.

The project here will be focusing on :

- Application of Deep Learning Techniques like Neural Networks
- Training the PyAutoLens lensing simulations with Deep Learning models

The main objective of this project will be :

- Combine the PyAutoLense functionality with Equivalent Neural Networks and develop the Deep Learning Model out of it.

Proposal Timeline :

1. **Before May 18:**

- To familiarize myself with the workings of the PyAutoLens and Equivalent Neural Networks.

- Study the concepts of the Equivalent Neural Networks
2. **May 18 - June 6 (Before the official Coding time) :**
 - Perform self evaluating coding on neural Networks to further improve my understanding on the aspects of neural networks
 - During this phase I'll keep in touch with my mentors and ML4SCL team .I'll be active on phone , whatsapp and mailing list to discuss further modifications on existing schemas.
 - Thus clearing my doubts regarding the future of the project.
 - Help to modify the project according to the needs.
 3. **June 7 - August 16 (Official Coding Period Starts) :**
 - Download the necessary Libraries
 - Run a premature testing on the neural network to ensure it's working properly.
 - Test the PyAutoLens api for the type of inputs and outputs required
 4. **August 16 - August 23 (Student Submission Code) :**
 - Bring the desired changes in the system for further use
 - Replacing the redundant code if it exists.
 - Test the written code
 5. **August 16 - August 23 (Submission of Code for Evaluation) :**
 - Test and document the periodic changes in the repository.
 - Bug fixing

Personal Inspiration for the Project :

I am really excited to work in the field of Deep Learning and Neural Networks. I've been pursuing these topics since I heard about them in the Books and Magazines. I am also working to improve the sensitivity of the neural networks (mainly on perceptron model) since my dream is to become a researcher in the field of AI. I am working with various activation functions along with the weightage in the Neural Network to increase its sensitivity.

Since I'll be free this summer I can devote myself with full concentration and dedication. My aim will be implementing this model so that I can contribute something for the improvement of society. I already have several plans on implementing these technologies. I would be glad If I

5

could do this as a part of GSoC along with the ML4SCL team. You can be assured of my motivation to complete this project.

References:

The details and reference for this project are given below:

Equivalent Neural Networks:

Link: <https://openreview.net/pdf?id=BkxDthVtvS>

Graph Neural Networks:

Link: [https://arxiv.org/pdf/1812.08434.pdf#:~:text=Graph%20neural%20networks%20\(GNNs\)%20are,its%20neighborhood%20with%20arbitrary%20depth.](https://arxiv.org/pdf/1812.08434.pdf#:~:text=Graph%20neural%20networks%20(GNNs)%20are,its%20neighborhood%20with%20arbitrary%20depth.)