Project : Search for Strong Gravitational Lenses

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About Me:

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To whom it may concern

I am writing to express my interest in the ML4SCI program, specifically in the project "Search for Strong Gravitational Lenses". I am a pre final year student pursuing B.Tech in Artificial Intelligence and Data Science at Graphic Era Deemed To Be University , with a strong foundation in machine learning and experience in developing real-world applications using Python. I have a strong interest in astrophysics and am thrilled about the potential of this research to help us comprehend dark matter haloes and other astronomical events.

Strong gravitational lensing is a great tool for investigating different astrophysical topics, such as probing the substructure in the lensing galaxies' dark matter haloes. The very small number of known lens candidates and proven lens systems, however, is one of the fundamental drawbacks of such study. Recent research has demonstrated the use of CNNs in the task of lens discovery, which requires classifying pictures received from telescopes into lensed and non-lensed systems.

I have completed the project's Common Test I and Special Test II and think that my abilities and experience qualify me for the position. I have prior expertise with Python and PyTorch, as well as a number of related courses in mathematics, statistics, and machine learning. Furthermore, I have expertise with deep learning applications, such as CNNs, which I feel will be useful for this project.

My approach to this project involve the following steps:

I have used Keras to train a convolutional neural network (CNN) to identify pictures as lenses or non- lenses . I have imported the data from the provided dataset , normalized, Resize the images . and split the data into training and testing sets using the train test split function . Then to conduct the binary classification , i have created a CNN with two layers , two max-pooling layers , a flatten layer , two fully connected layers , and a sigmoid a activation function in the output layer to perform binary classification.

I have compiled the model using binary cross-entropy loss and Adam optimizer , and trained the model using the fit method for 51 epochs with a batch size of 32 . Finally , i have evaluated the training by computing the ROC curve and AUC score , and plotting the roc curve using matplotlib library.Overall 97.52 training accuracy achieved in (**Specific Test II. Lens Finding)** 35.12 training accuracy in (**Common Test I. Multi-Class Classification)*.**

Test Result : Lens Finding

I will attempt the following to increase the model's performance:

- To extract more complicated information from photos, use a larger or more sophisticated CNN architecture.
- Increase the variety of the training data via picture augmentation techniques to boost the model's generalized performance.
- Adjust the model's hyperparameters, such as the learning rate, dropout rate, and number of epochs, to improve the model's performance.
- Transfer learning is used to fine-tune pre-trained models for the lens locating job.

I am available for full time work this summer because I have no vacation plan other than this project. In the official GSoC period, I will devote the sufficient time per week which is required for this project. I will remain in contact all time through the e-mail .

After GSOC i want to keep in touch with you for further exploration of any topics related to cosmos . I'm also planning to do my Masters in this domain and your guidance will be great for me.

I am confident that I have the necessary skills and experience to undertake this project and deliver it successfully within the allocated time frame. I look forward to working with the ML4SCI team on this exciting project.

Thank you for considering my proposal.

Best regards,
Shashank Bhardwaj