Title: Abhay Anand - Self-Supervised Learning for Strong Gravitational Lensing

About Me: I'm Abhay, a Computer Science student at VIT University, graduating in 2024. I'm applying for the Google Summer of Code program with Jina AI, where I aim to contribute to the ANNLite project. My passion for programming has led me to participate in open-source development, contributing to various organizations on GitHub and gaining team experience.

I've also interned in Product Development at Shabang, an Indian company, where I developed and maintained web applications while working with clients and meeting deadlines. My academic focus includes machine learning and deep learning techniques, such as computer vision, natural language processing, and deep neural networks. I've worked on AI projects like image classification and sentiment analysis models.

In addition to my studies, I've contributed to open-source projects like Ardupilot and worked on a deep learning project to determine bone age from X-rays. My skills include Python programming, experience with PyTorch and TensorFlow, computer vision, natural language processing, teamwork, and a strong desire to learn.

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GitHub; Resume

University/Major/Graduation: Vellore Institute of Technology / Computer Science / 2024

Time Zone: Indian Standard Time (IST); EDT + 9.5 hrs

Project Abstract:

This project aims to develop self-supervised learning techniques using transformers for strong gravitational lensing data. The trained models will be fine-tuned for specific tasks such as classification or regression. The project will explore the use of transformers/hybrid architectures with self-supervised learning for representation learning and investigate the use of equivariant transformers with self-supervised learning for other strong lensing tasks. The goal is to expand the DeepLense functionality with self-supervised learning algorithms suitable for computer vision tasks applicable to strong gravitational lensing data.

Detailed Description:

Strong gravitational lensing is an area of active research with the potential to uncover valuable information about the substructure of dark matter. This project will focus on developing self-supervised learning techniques with transformers for strong gravitational lensing data. The main objectives of the project are:

Explore the use of transformers/hybrid architectures with self-supervised learning for representation learning. The trained model can then be fine-tuned for specific tasks such as regression or classification.

Investigate the use of equivariant transformers with self-supervised learning for representation learning. The trained model could then be fine-tuned for specific tasks such as regression or classification.

Expand the DeepLense functionality with self-supervised learning algorithms suitable for computer vision tasks applicable to strong gravitational lensing data.

During the community bonding period, I plan to:

- Familiarize myself with the project codebase, documentation, and datasets.
- Set up my development environment and dependencies.
- Discuss project goals and timelines with my mentors.

Weekly Timeline:

May 4 - 28, Community Bonding

Week 1: (May 29 - June 4)

Study the basics of transformers, self-supervised learning, and their application to computer vision tasks.

Explore the use of transformers/hybrid architectures with self-supervised learning for representation learning in strong gravitational lensing data.

Week 2: (June 7 - June 13)

Implement and test the transformer-based self-supervised learning model for strong gravitational lensing data.

Experiment with different hyperparameters and model architectures.

Week 3: (June 14 - June 20)

Investigate the use of equivariant transformers with self-supervised learning for representation learning.

Study the basics of equivariance in deep learning.

Week 4: (June 21 - June 27)

Implement and test the equivariant transformer-based self-supervised learning model for strong gravitational lensing data.

Experiment with different hyperparameters and model architectures.

Week 5: (June 28 - July 4)

Evaluate the performance of the models developed so far.

Work on improving the model's performance by fine-tuning for specific tasks such as classification or regression.

July 10, Week 6 Midterm Evaluations

Week 7: (July 12 - July 18)

Implement and test the expanded DeepLense functionality with self-supervised learning algorithms.

Experiment with different computer vision tasks applicable to strong gravitational lensing data.

Week 8: (July 19 - July 25)

Evaluate the performance of the expanded DeepLense functionality with self-supervised learning algorithms.

Work on improving the model's performance for the identified computer vision tasks.

Week 9: (July 26 - August 1)

Implement Equivariant Transformers with self-supervised learning for representation learning.

Test the Equivariant Transformers model and compare its performance with the previously developed Transformer and Hybrid architectures.

Document the implementation and results in the project report.

Week 10: (August 2 - August 8)

Implement DeepLense functionality with self-supervised learning algorithms suitable for computer vision tasks applicable to strong gravitational lensing data.

Test the DeepLense functionality with the self-supervised learning algorithms and compare its performance with other models.

Document the implementation and results in the project report.

<u>Week 11: (August 9 - August 15)</u>

Finalize the project report and submit it for review.

Prepare the final presentation and practice presenting it.

Make any necessary revisions to the code and documentation based on feedback from the mentors.

<u>August 21, Week 12 Final Week</u>

Submit the final code and project report to the mentor.

Give the final presentation to the mentor and the community.

Participate in the final evaluations and discussions.

<u>Commitment:</u>

I am committed to dedicating at least 35 hours per week to this project, with the exception of the community bonding period. I will be available for regular communication with my mentor and other project contributors via email, Slack, and other agreed-upon communication channels. I will adhere to the project timeline and will inform my mentor promptly if any issues arise that may impact my ability to complete the project as scheduled. I will document my progress and any code or algorithm implementations in the appropriate project repository and will make sure that all work is well-documented and commented for future reference.