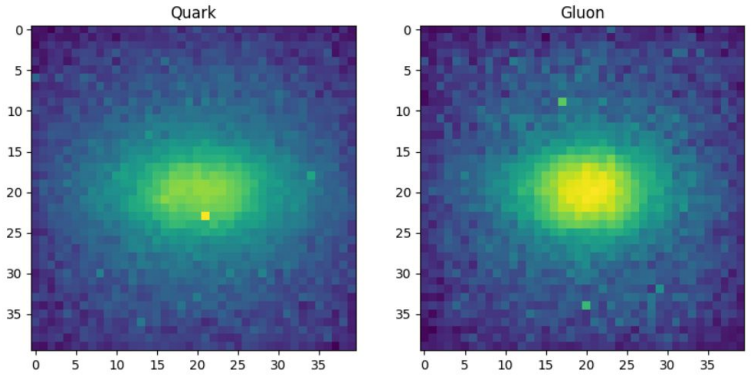
Google Summer of Code

Sanya Nanda

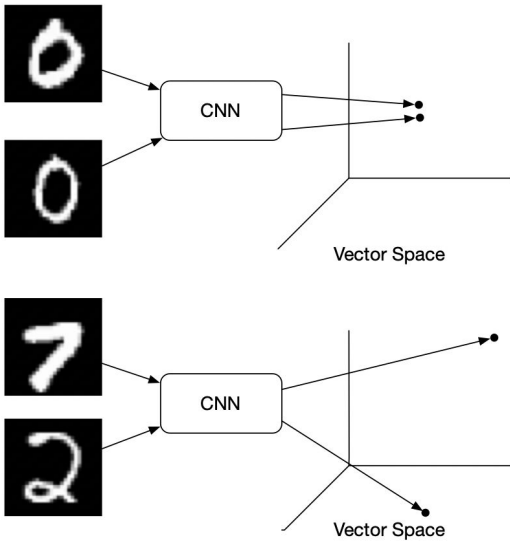
Machine Learning for Science (ML4Sci)

Project Objective: Learning quantum representations of classical high energy physics data with contrastive learning

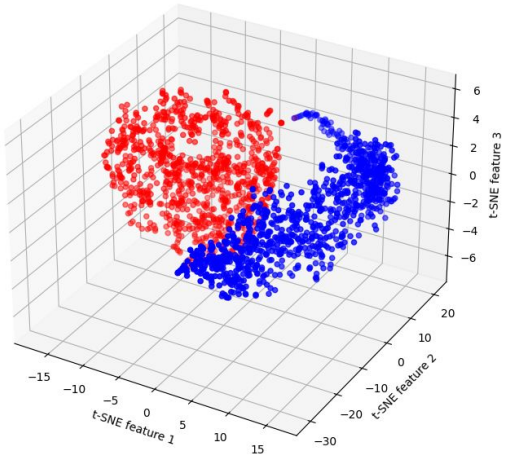


High Energy Physics Data:

Quark-Gluon (Avg of Tracks channel)



Contrastive Learning

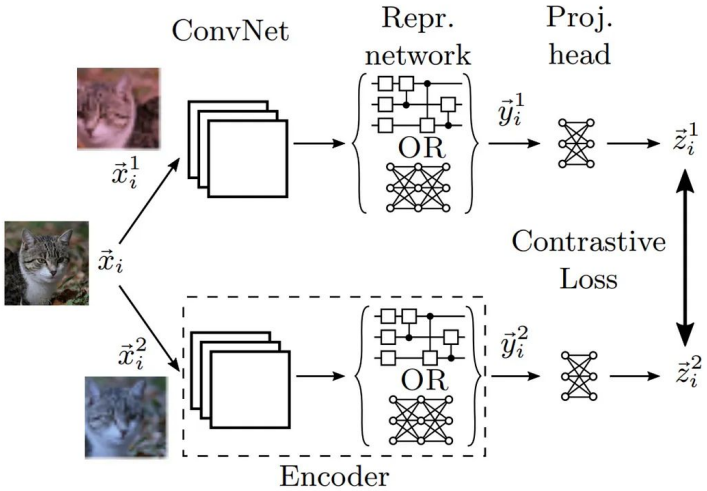


Representation embeddings

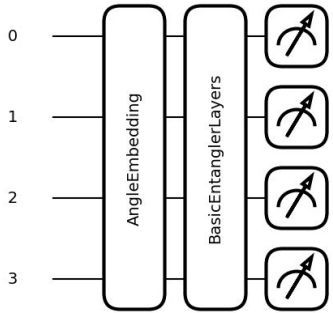
python™ TensorFlow PyTorch PENNYLANE W&B

Work Accomplished

- Experimented with computer vision and graph-based contrastive learning models like CNN, Resnet, GCN etc on MNIST and quark-gluon dataset
- Demonstrated an effort to prove quantum advantage using Quantum ML-based hybrid models
- Documented experimentations and results in wandb (**Final Blog**)



[1] - Contrastive learning framework



Quantum circuit

[1]: Jaderberg, B, et al 2022. Quantum self-supervised learning. *Quantum Science and Technology*, *7*(3), p.035005.

Conclusion

Outcomes

Dataset	Model + Loss	Validation Loss	AUC	Validation Accuracy	Weights and Biases Report
3-8 mnist	QCNN + contrastive pair	0.004080	1.00	0.9977	https://api.wandb.ai/links/team-sanya/ckm7lfdf

Future Scope

Experimenting with fully quantum model and applying contrastive learning to more HEP datasets

Learnings

Technical Growth: I dived deep into coding machine learning workflows, while refining my skills in writing clean, efficient code.

Personal Development: Through our weekly sync-up calls, I immensely improved my presentation skills and also connected with a wonderful global community.

"The best part of GSoC; the people I met - mentors, peers and contributors who shaped this journey with shared experiences, learnings and camaraderie "