ECE 590-3 Final Project Proposal

1) Project 13: Self-Supervised / Representation Learning
2) Lead TA: Nathan Inkawhich
3) Group of two : Abhiraj Vinnakota (agv9), Jiayue Xu (jx97)
4) **Project Execution Plan :**

- **Objectives:**

  In this project, we hope to explore the concept of self-supervised learning. This is achieved through:

  1. Exploring the SimCLR and the RotNet research paper. We hope to understand in depth the methodology and implement it from scratch on the CIFAR-10 dataset and verify our results with the paper.
  2. Use Transfer learning and implement the models on our own datasets.

- How is it done today? Provide some background information of your project topic

  Self- supervised learning is a way of classifying unlabeled data. The underlying idea is the fact that the information required for successfully classifying data is already present in the image itself.

  In supervised learning, the algorithm is provided with the X (image) and the Y (label). It then tries to learn to predict Y, using X. Labelling data, i.e., assigning Y to each of the X's is a very time-consuming process in the real world as it is mostly done manually.

  In self-supervised learning, the image is broken into X and Y, without any additional labeling involved. So, essentially, we are trying to predict what the image is, from other parts or variations of the image.

  There are multiple ways of breaking down the image. One very effective way of doing it is by using 'contrastive learning'. This is a way of trying to maximise the agreement between similar classes, considering each image as a single class and trying to learn the representation of the possible classes in the dataset (Representation is the unique characteristics that make a particular class)

  If we are able to achieve the same accuracy of algorithms based on supervised learning, using self-supervised learning, the whole process of labelling data manually is made redundant and therein lies the true potential of this concept.

- Your approach and why do you think it will be successful? include detailed experiment plan to reach your objective

  We believe that since we will closely follow the framework adopted by the original paper as well as take constant guidance from our mentor, we think we would be successful. Our experiment plan is as follows:

  - Implement the SimCLR method using ResNet-50 architecture for the CIFAR-10 dataset, following closely the setup in the paper.
  - Optimize the best batch size and number of training epochs by comparing the performance of linear evaluation models.
  - Implement SimCLR method using semi-supervised learning and evaluate if SImCLR is more suitable when there is limited labeled data than completely unlabeled data. Compare our SimCLR model to the “supervised baseline.”
  - Implement the RotNet learning framework and compare its performance to SimCLR, using the same 2 experiments.
  - Apply both the models using Transfer Learning on our own datasets. Transfer learning inspiration from the papers. We will explore both fine tuning as well as the fixed-weights approach.
  - Finally, compare these results with an equivalent model originally trained using supervised learning on CIFAR-10. The approach earlier used for transfer learning will be adopted here as well for a fair comparison.

- What are the risks? (i.e. what are the challenges)

  The original SimCLR mode is implemented with ResNet-50, trained on ImageNet dataset with 14 million images. As our implementation will be trained on CIFAR-10 dataset with only 60000 images, the results may not fully reproduce that of the original research due to insufficient training data. For the RotNet model, the original research was implemented on CIFAR-10 dataset with Network-In-Network (NIN) architectures, hence may be more similar to our implementation.

- How long will it take? (Provide a very basic 4-week schedule)

Week	Task	Team Member
(11) Oct 26	● Read SimCLR research paper and understand the methodology ● Read RotNet research paper and understand the methodology	JY Abhiraj
(12) Nov 2	● Implement SimCLR and reproduce results ● Implement RotNet and reproduce results	JY Abhiraj
(13) Nov 9	● Apply transfer learning of both model implementations on own dataset	Both
(14) Nov 16	● Prepare for poster session and draft for report	Both

- What are the final “exams” to check for success? (Indicate what final plots/graphs/tables you expect to generate in the final presentation)
    - Code implementing the method, in the form of jupyter notebooks and python scripts
    - Table showing comparison results (validation accuracy) of our implementation with the original research, as well as that of transfer learning with our own data
    - Figure for batch size and training epoch selection