Total Marks: 150 **Advanced Machine Learning** **Assignment-4**

Question 1: Triplet Loss

Construct a 5 layer CNN network **(**[Conv(32, 3x3) Relu Pool] x 5**)**. Use the triplet loss on the CIFAR-10 database for object recognition using this 5 layer network. Use the standard train-test split of the database.

A. Generate triplets using the training data. Train the model with triplet loss. Do not use a pre-trained model. Plot training loss and training accuracy over the epochs. You may select triplets by any methods and are NOT required to generate all combinations of triplets from training data.
B. Test the model on the testing split of the database by using the following matching protocol. Take 50% samples for each class as the probe and the remaining 50% as the gallery. Match each probe with all gallery images and see if the closest match (least distance score or highest match score) is of the same class as the probe. If so, it is a correct classification, else, it is a misclassification. Report overall classification accuracy.
C. **Bonus:** Assuming you used an L2 loss for each of the terms in triplet loss, change the metric to (i) cosine or (ii) correlation distance. What is the test accuracy now? Can you think of a reason for increase/decrease in the accuracy?

[20+15+10 marks]

Question 2: GAN

Use any GAN of your choice (preferably DCGAN [1]) to generate images from noise. Perform the following experiments.

A. Use the CIFAR 10 database to learn the GAN network. Generate images once the learning is complete.
B. Plot generator and discriminator losses and show how can you ascertain the convergence of the GAN training process.

[1] https://arxiv.org/abs/1511.06434 **[40 marks]**

Question 3: Fine-tuning

Take a ResNet50 model and database to be used for this question is CIFAR-10. Remove its classification layer and place a 2-layer neural network followed by a Softmax layer. Calculate classification accuracy on a train set, test set, and plot accuracies over epochs when:

A. The complete network is trained from scratch (i.e, random weights)
B. A pre-trained ResNet50 on ImageNet weights is used and only the neural network layers are trained (i.e, weights of layers of ResNet50 are kept frozen and unchanged)
C. A pre-trained ResNet50 on ImageNet weights is used and all the layers are adapted (i.e, weights of layers of ResNet50 are also updated now)
D. **Bonus**: Using a ResNet50 model for CIFAR-10, propose your own domain adaptation algorithm. To get full credits for this part, the accuracy on the test set should be more than what was reported in part 3. You may build upon part(3) to propose your own algorithm. Explain why your proposed algorithm is working better. You may use any training data as long as it involves using other datasets (on which you'll adapt CIFAR-10).

Report classification accuracy on the test set and explain why there is an increase/decrease in accuracy across all the cases.

[10+10+10+30 marks]

Viva+Report: [25+20 marks]

Submission Policy and Requirements

1. Any kind of plagiarism is not accepted. We will strictly follow institute policies for plagiarism.
2. Recommended programming languages: MATLAB, python.
3. You may use any external libraries or GitHub codes. However, the evaluation will test your knowledge of the algorithm and the choice of hyperparameters. Do cite the libraries/codes.
4. **Submission should include:** Working code for each of the part separately and a report to show the analysis of results in each of the parts.

Assessment criterion

The assessment will be done on basis of the following components:

1. Working codes
2. Analysis and clarity of results (drawing comparisons across different parts) & clarity of the report
3. Understanding the theoretical concepts and the choice of hyperparameters.