E9 246 Advanced Image Processing

Assignment 1

Due Date: 8 Feb, 2025

General Instructions:

- You can use Google Colab. You can use any opensource deep learning libraries like PyTorch, TensorFlow, etc.
- Along with your code, you should also submit a report (brief and to-the-point) with all the results and inferences.
- Put all your files into a single zip file and submit the zip file. Name the zip file in the format *AIP1_YourName*.

---

1 Local Binary Pattern (LBP) (20 Marks)

Here, you will implement a face recognition algorithm using LBP feature extractor. Download the train and test images from here.
(a) Apply LBP on each training image using a 3×3 window (i.e., radius = 1, neighborhood = 8).
(b) Compute histogram of the obtained LBP map, and store them for all the training images.
(c) Next, apply the same steps on the testing images to compute their histograms. For each test image, find the Euclidean distance of its histogram with the training images, and predict the subject id. Calculate the accuracy.
(d) For one test image, plot the image, its LBP map and the histogram.
(e) Observe the histograms of two different illuminations for one subject and comment on whether it is illumination invariant.

Note: You should implement the above using Numpy. Please do not use inbuilt functions.

2 Extracting Knowledge from Networks (20 Marks)

Here, you will learn how to increase the efficiency of small models using knowledge stored in a bigger model.
(a) Load a Resnet50 model pretrained on the ImageNet dataset. Finetune this model on the CIFAR10 dataset by modifying the last fc layer. Report the accuracy on the test set. You can download the CIFAR10 dataset from here.
(b) Build a simple custom CNN with 3 Conv layers, ReLU activation, and fc layer. Train this model on the CIFAR10 train split and report accuracy on the test split.
(c) Do the same experiment as (b) again but this time with an added loss term which minimizes the KL Divergence between the softmax of the logits from the Resnet50 model and the small CNN model which you built. Here, the Resnet50 will be frozen. Report the test accuracy.

What do you observe? Does the accuracy increase in (c) compared to (b) for the same model? Why do you think this happens?

Note: KL Divergence measures the distance between two distributions. You can use inbuilt torch module to compute the KL Divergence term.