ECE661: Homework 7

Fall 2018

Deadline : October 30, 2018, 1:30 pm

Turn in your solution via Blackboard. Additional instructions given at [I]

1 Introduction

The goal in this homework is to implement a very simple image classification algorithm using Local Binary Pattern (LBP) features and Nearest Neighbor (NN) classifier. You are provided with two sets of images – one for training and the other for testing. The images in the database belong to five different classes – building facades, trees, mountainous ranges, cars, and beaches.

The first step is to extract feature vectors from all the images. You will implement your own Local Binary Pattern (LBP) feature extraction procedure as discussed in class and obtain a feature vector for each of the images in the training and testing datasets. Then use NN classifier to assign labels to the testing images by comparing feature vectors of testing images with feature vectors of training images.

2 Tasks

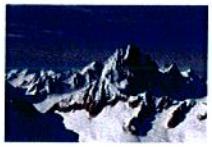
You will use the dataset available at [I]. Your assignment consists of the following steps:

2.1 Understanding the dataset

- You are provided with a dataset containing 5 types of images – building facades, trees, mountainous ranges, cars, and beaches. There are 20 training images and 5 testing images for each class. One sample image from each class is shown in Figure I.
- The dataset folder available at [I] contains two subfolders called 'training' and 'testing'. Inside the 'training' folder, there are five subfolders belonging to each of the five classes of images. Each training subfolder contains 20 training images. The images inside 'testing' folder are named as follows: <class of image>_<image number>.jpg. Note that there are 5 images for each class in the 'testing' folder.

(a) building

(b) car



(c) mountain

(d) tree

(e) beach

Figure 1: Sample images

2.2 LBP Feature Extraction

- Implement **your own LBP feature extraction** algorithm to obtain a histogram feature vector for each image in the database. You can refer to Prof. Avi Kak's implementation [II].

2.3 NN-Classifier

- Using Euclidean distance metric find the k-nearest neighbors of the feature vector of each testing image in the feature space of training images. As a result you will obtain k possible labels to associate with the testing image. You can empirically set $k = 5$.

- To choose which label – out of the k labels – to assign to the testing image, you need to find the label which appears maximum number of times in the set of k labels.

2.4 Performance Measures

- Construct a confusion matrix based on your classification results. Your confusion matrix will be a 5×5 matrix since there are 5 classes. Rows correspond to the actual class labels while columns correspond to the predicted class labels. Note that a perfect confusion matrix will be a diagonal matrix with all diagonal values equal to 5. For more information on confusion matrix please see the wikipedia page [III].
- Calculate the overall accuracy of your algorithm.

3 Submission

You can download the dataset from [I].

1. Turn in a typed pdf of your report via Blackboard.
2. Your pdf must include the following : -
    - A good description how you implemented each of the tasks above.
    - LBP histogram feature vector of at least one image from each class.
    - Your performance measures as described above.
    - Your observations on the performance of your image recognition system.
    - Your source code.

References

[I] `https://engineering.purdue.edu/RVL/ECE661_2018/`
[II] `https://engineering.purdue.edu/kak/distTextureAndColor/CodeForTextureAndColorTutorial.tar.gz`
[III] `https://en.wikipedia.org/wiki/Confusion\_matrix`