Pattern Recognition and Machine Learning : Assignment 1

- You are expected to upload a soft copy of the code and a report highlighting your inferences on the moodle page.
- **Plagiarism of any kind will result in a failing grade in the course. This also includes downloading codes that are freely available from the internet and using it**.

1(a)

In this assignment, I expect you to build a rudimentary pattern recognizer by exploring out on the Bayesian classifier concepts, that we discussed in the class. To this goal, you are given training images of 3 characters in a folder named **TrainCharacters.rar**. Each of the 200 training images of each class are of size 128×128. You are given 300 test images (100 in each class) of size 128×128 in a separate folder **TestCharacters.rar**.

Assume the samples to be generated from a multi dimensional Gaussian distribution, having class specific mean vectors $\boldsymbol{\mu_i}$. Consider each of the modelling schemes for computing the covariance matrix.

(i) The samples of a given character class are modelled by a separate covariance matrix $\boldsymbol{\Sigma_i}$.

(ii) The samples across all the characters are pooled to generate a common diagonal covariance matrix $\boldsymbol{\Sigma}$. The diagonal entries correspond to the variances of the individual features, that are considered to be independent.

(iii) The covariance matrix of each class is forced to be identity matrix.

For each scenario, build a generative Bayesian classifier using the training images and categorize the characters contained in the test folder. The mean and the covariance matrices are to be estimated from the training data using the Maximum Likelihood techniques, as discussed in class. Report the individual character accuracies as well as the averaged accuracy for each of the models.

Employ the 128×128 pixel intensity values directly as features in this task. If you happen to encounter memory storage issues during simulation, you may consider resizing

the images to a more manageable size (say 32×32) for the feature computation. However, note that in order to beat the curse of dimensionality, you have to add a regularization term of the form $\lambda \mathbf{I}$ in the computation of the covariance matrix.

1(b)

Give 4 examples of images from the test set that are misclassified by each of the classifiers designed in Task 1(a). You need to display both the state of nature (true label) and the predicted class for each image.

(2)

You are provided with 2 different data-sets- **TrainingSet.mat** and **TestSet.mat**. In this task, you are required to build a regression function and evaluate its performance on the testing set.

(i) Learn the weights of a polynomial regressor by adopting a three-fold cross validation strategy on the data-set **TrainingSet.mat**. You may consider orders of polynomial between one to nine . Accordingly, select the order of polynomial(M) that gives the lowest average error.

(ii) Using the order(M) obtained from (i), test the regression function on the **TestSet.mat** and calculate the mean square error.