**EEL5840**

**Elements of Machine Intelligence**

**Assignment – 4**

**(**All the solutions have been programmed by me using MATLAB.**)**

**Section 1:** Implementing Bayes Classifier

* The dataset is split into 2 parts: 70% of data for training and 30% for testing
* The training data for the two classes is split into two parts, so as to calculate mean and covariance of features, for the two classes. The mean of the features of the two classes is denoted by and respectively. The covariance of the features of the two classes is denoted by and respectively.
* We use the following discriminant function:

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where *p(j)* is the probability of class j, is the mean of features samples in class j, and is the covariance of features of samples in class j

* The above discriminant function is used on each sample x from the testing data, to get g(x) for each class.
* For every sample x, we’ll get and , on the basis of the above formula.
* We classify whether a sample x refers to class 0 or class 1 by comparing and . If > , the sample is classified as belonging to class 0, else to class 1.
* On the basis of the classification of testing data, we get the following class confusion matrix:
* Following observations can be made from the class confusion matrix, taken for the 60 samples in the testing data:
  1. 28 samples belonging to class 0 have been correctly classified as class 0
  2. No sample of class 0 have been classified incorrectly as class 1
  3. 32 samples of class 1 have been correctly classified as class 1
  4. No sample of class 1 has been incorrectly classified as class 0
* We measure the accuracy classifier using the following formula:
* The accuracy of this classifier is 100%
* The time taken to classify the whole dataset using Bayes classifier came to an average of 0.0469 seconds over 10 observations of classifying the 200 samples

**Section 2**: Implementing Fisher’s Linear Discriminant

* The dataset is split into 2 parts: 70% of data for training and 30% for testing
* The training data for the two classes is split into two parts, so as to calculate mean and covariance of features, for the two classes. The mean of the features of the two classes is denoted by and respectively. The covariance of the features of the two classes is denoted by and respectively.
* We use the following discriminant function:

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* If the term on left side of the inequality is greater than that on the right side, the sample is classified to class 1, else to class 1
* The above discriminant function is used on each sample x from the testing data, to get g(x). The class of the sample is then decided as specified above.
* On the basis of the classification of testing data, using various values of T, we get the following class confusion matrix for the most accurate test results:
* Following observations can be made from the class confusion matrix, taken for the 60 samples in the testing data:
  1. No sample belonging to class 0 have been correctly classified as class 0
  2. 28 samples of class 0 have been classified incorrectly as class 1
  3. 32 samples of class 1 have been correctly classified as class 1
  4. No sample of class 1 has been incorrectly classified as class 0
* The accuracy of this classifier is 53.3%
* The time taken to classify the whole dataset using Bayes classifier came to an average of 0.0156 seconds over 10 observations of classifying the 200 samples. This is because in case of Fisher’s LDA, we have the complex terms in the equation already calculated while in Bayes Classification, the g(x) has to be calculated completely for each sample, as per the formula of Bayes Classifier in section 1.