Pattern Recognition

CS6690

IIT Madras

Assignment 3

By:
Group 25:
Arun Baby (CS15S016)
Vishal Subbiah (MM12B035)

Gaussian Mixture Models

In this assignment we built a gaussian mixture model to to classify different data such as digits, images, handwriting and spiral. A gaussian mixture model is a weighted sum of gaussian density functions. Unlike the K-means which gives a hard clustering, GMM gives us a soft clustering. The initial values for the gaussian mixture model is obtained from k-means clustering.

Digits

In this dataset we have 5 classes with 39 features each. We have taken the data into 70 % for training and 30% for testing.

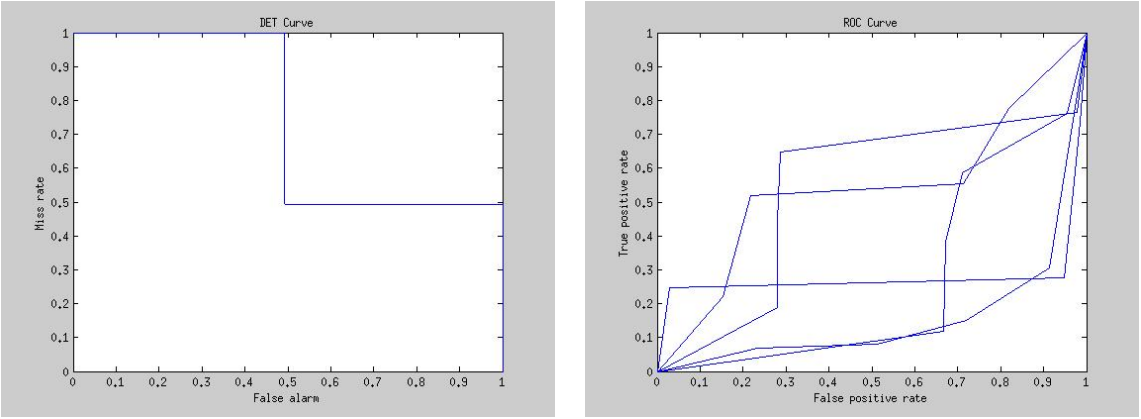


Figure 1: DET and ROC plots for Digits data for GMM

Images

In this dataset we have 3 classes with 23 features each. We have taken the data into 70 % for training and 30% for testing.

Handwriting

In this dataset we have 3 classes with 2 features each. We have taken the data into 70 % for training and 30% for testing.

Spiral

In this dataset we have 2 classes with 2 features each. We have taken the data into 70 % for training and 30% for testing.

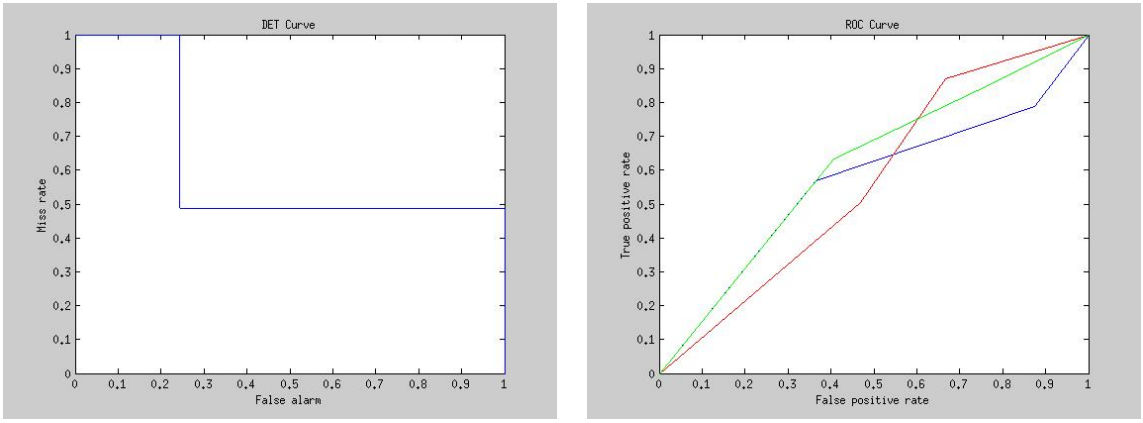


Figure 2: DET and ROC plots for Images data for GMM

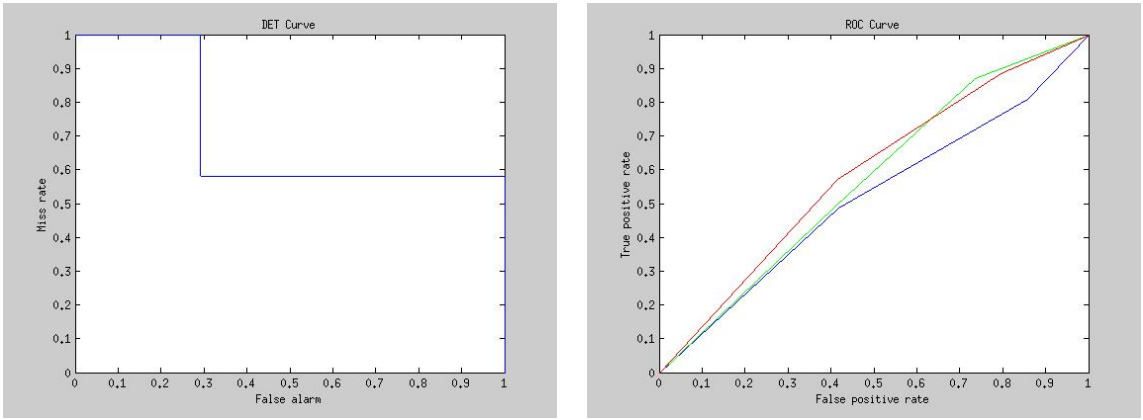


Figure 3: DET and ROC plots for Handwriting data for GMM

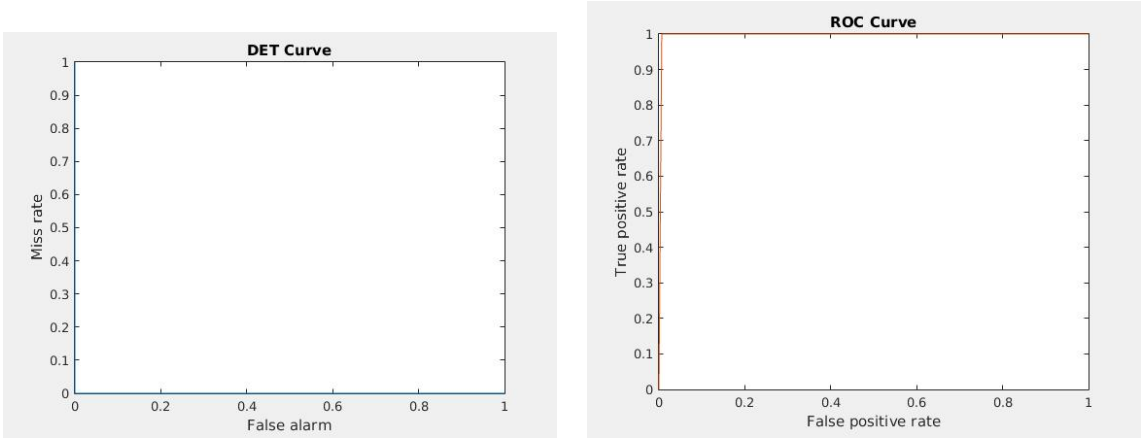


Figure 4: DET and ROC plots for Spiral data for GMM

Inference

- As the number of mixture increases the accuracy of classification increases till a certain number.
- After certain limit the number of Gaussian don't impact much on the accuracy of results.
- the number of mixtures of different classes affect the accuracy of classification. Different number of Gaussian per class gives better results in some cases.

Discrete Hidden Markov Models

In this assignment we built a discrete hidden Markov model to to classify different data such as digits, images, handwriting, spiral and video. A hidden Markov model is a Markov process where there exists some hidden states. The initial inputs are found using k-means clustering.

Digits

In this dataset we have 5 classes with 39 features each. We have taken the data into 70 % for training and 30% for testing.

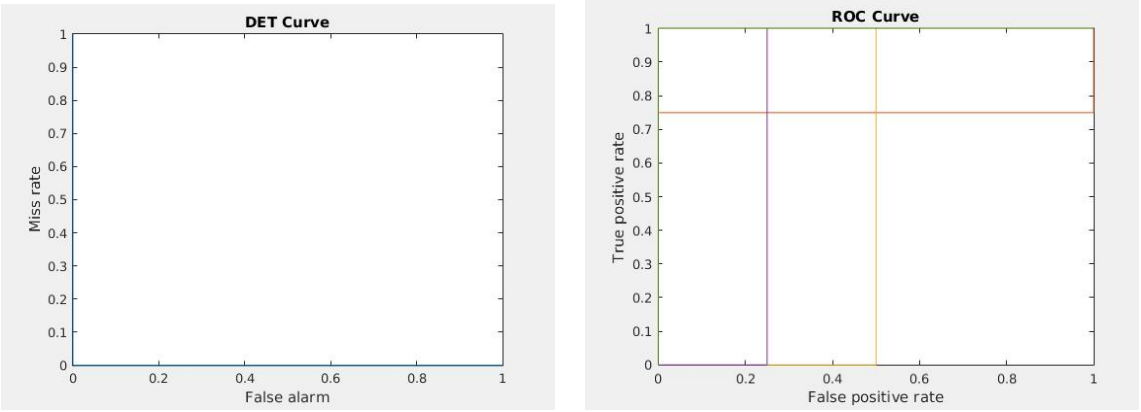


Figure 5: DET and ROC plots for Digits data for DHMM

Images

In this dataset we have 3 classes with 23 features each. We have taken the data into 70 % for training and 30% for testing.

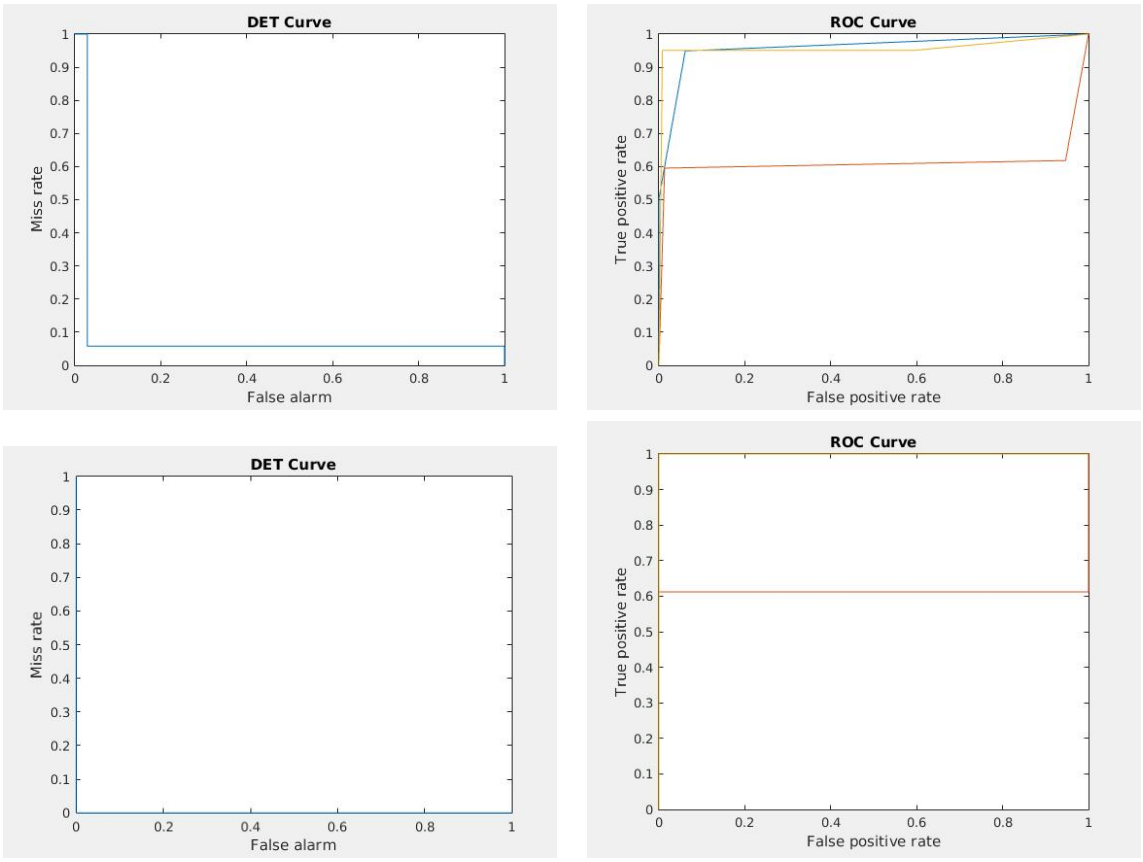


Figure 6: DET and ROC plots for Digits data for DHMM for with 8 and 64 k-means clusters

Handwriting

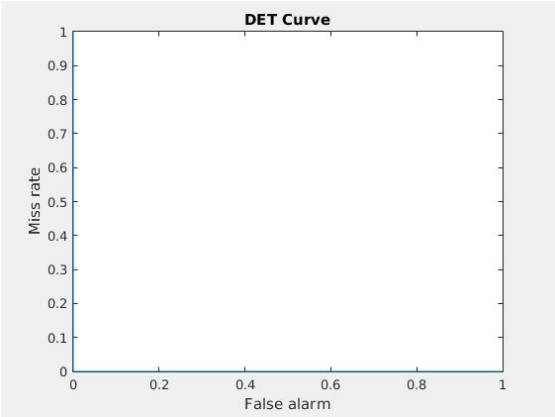
In this dataset we have 7 classes with 2 features each. We have taken the data into 70 % for training and 30% for testing.

Spiral

In this dataset we have 2 classes with 2 features each. We have taken the data into 70 % for training and 30% for testing.

Video

The frames are extracted from the videos(one every 3/25 sec). The features(hog) is extracted for each frames. Each feature is of size 4x5x31. A K means clustering is done to get discrete number of symbols. Using DHMM toolkit experiments(training and testing) are done. 80% of data is used for training and 20% for testing.



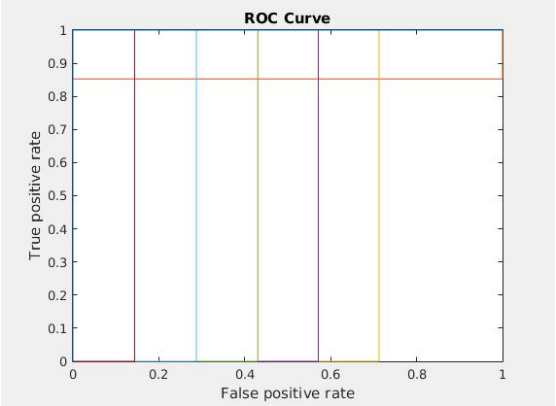
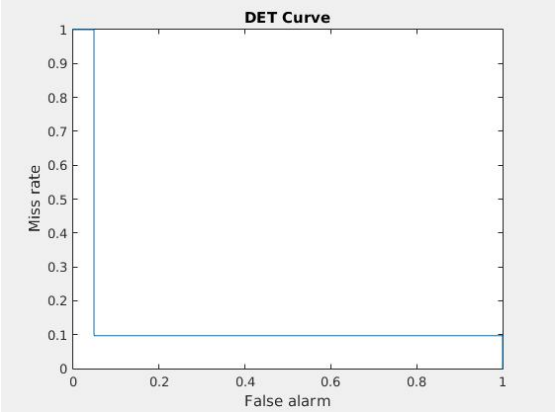


Figure 7: DET and ROC plots for Handwriting data for DHMM



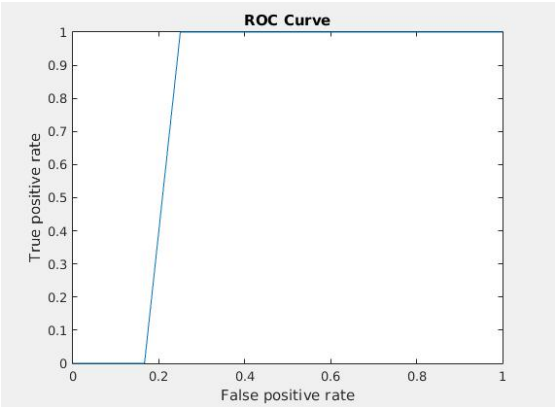
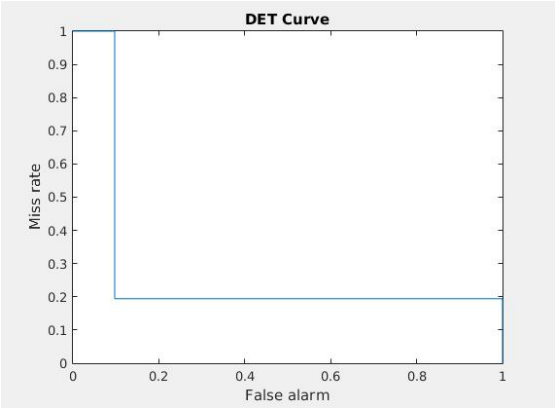


Figure 8: DET and ROC plots for Spiral data for DHMM



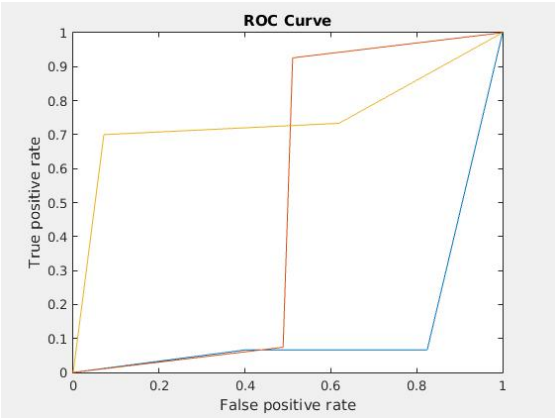


Figure 9: DET and ROC plots for Video data for DHMM

Inference

- DHMM gives better results if there is a sequence for the input data.
- So gives better accuracy for digits than for image data sets.
- DHMM is faster that DTW as DTW compares each file with all the template file.
- For handwritten dataset, normalising data and getting extra features increases the accuracy of classification.
- The initial k means clustering affect the accuracy.

Dynamic Time Warping

Dynamic time warping is an algorithm for measuring the similarity between two sequences which may vary in time.

Digits

In this dataset we have 5 classes with 39 features each. We have taken the data into 70 % for training and 30% for testing.

Inference

- The number of files(templates) representing the classes determines the accuracy.
- Runs very slow as the number of comparisons are more in this.

States	Accuracy
2	88.35
3	84.95
4	88.84
5	93.69
6	94.17
7	93.69
8	93.69
9	93.69

(a) K-means of 8 clusters

States	Accuracy
2	95.28
3	96.23
4	96.70
5	97.2
6	98.58
7	97.2
8	98.11
9	97.2

(b) K-means of 16 clusters

States	Accuracy
2	98.57
3	99.05
4	99.05
5	97.62
6	99.05
7	99.05
8	100
9	99.5

(c) K-means with 32 clusters

States	Accuracy
2	99.04
3	99.5
4	100
5	99.52
6	99.52
7	99.52
8	100
9	99.52

(d) K-means with 64 clusters

Table 1: Accuracy for different K-means for the images dataset for DHMM