1 K-Means and GMM

1.1 MOTIVATION

To perform classification using clustering using K-means and GMM

1.2 EXPERIMENTAL RESULTS

1.2.1 SYNTHETIC DATA

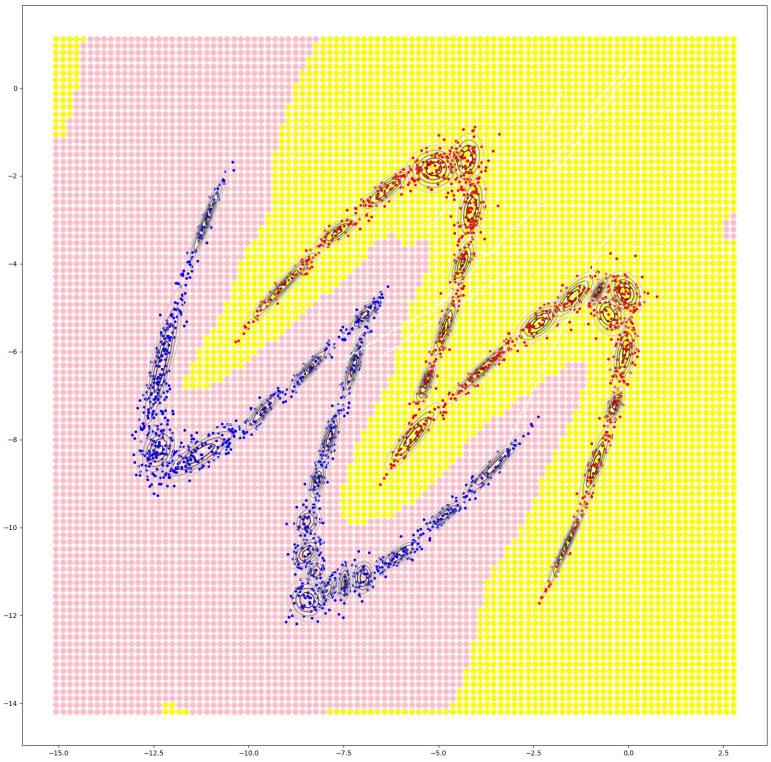

Figure 1: contour plots of the mixtures , k=20 and non diagonal covariance

k values vs accuracy for synthetic data		
K1(for class 1)	K2(for class 2)	Accuracy
2	2	96.4
2	10	99.1
4	4	98.9
4	10	99.4
6	6	99.6
6	10	99.9
10	6	100
10	10	100

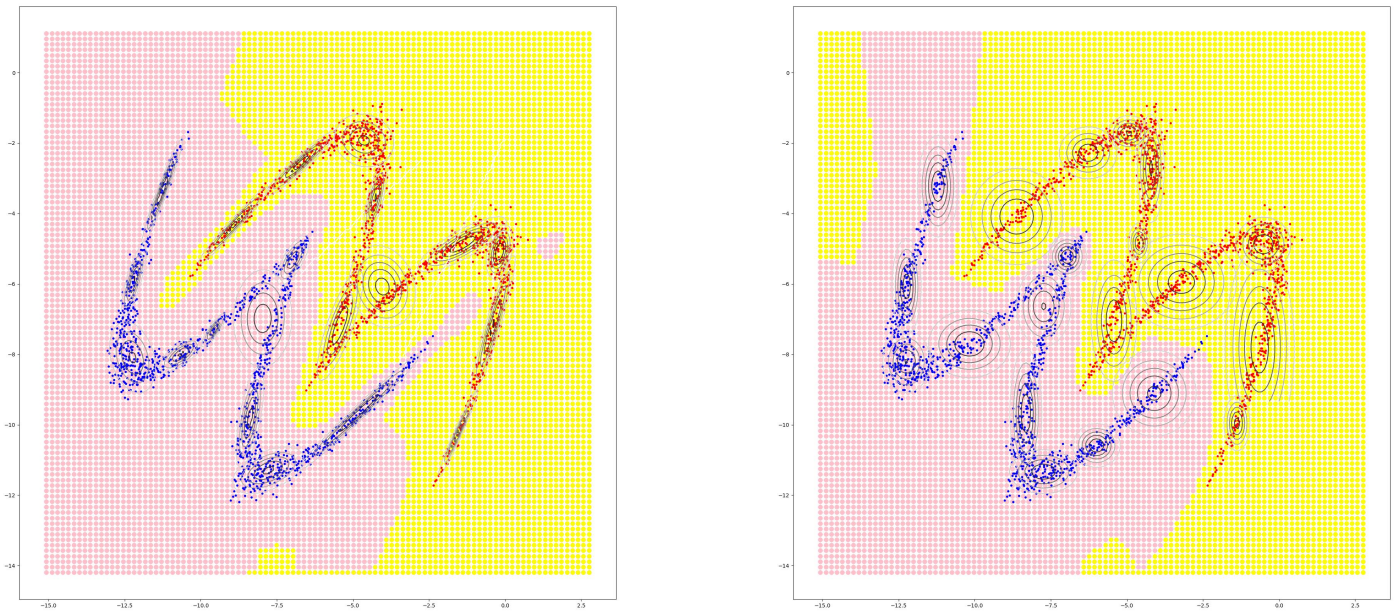

Figure 2: k=10 and non diagonal covariance on the left side and diagonal covariance on the right side

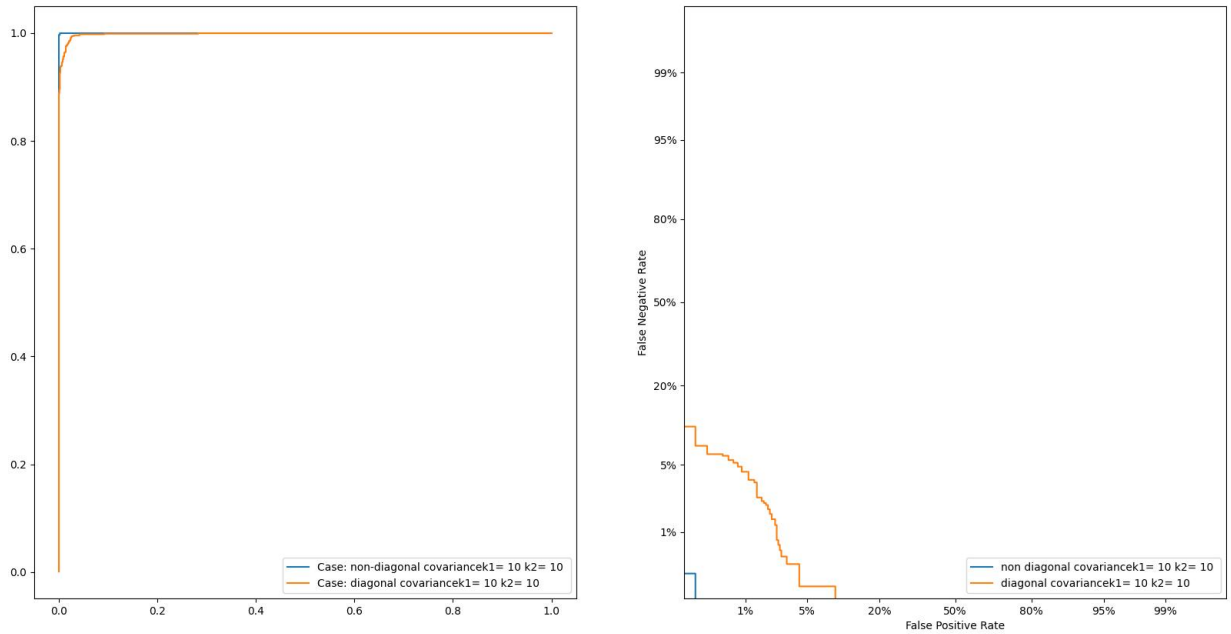

Figure 3: roc and det curves for k=10

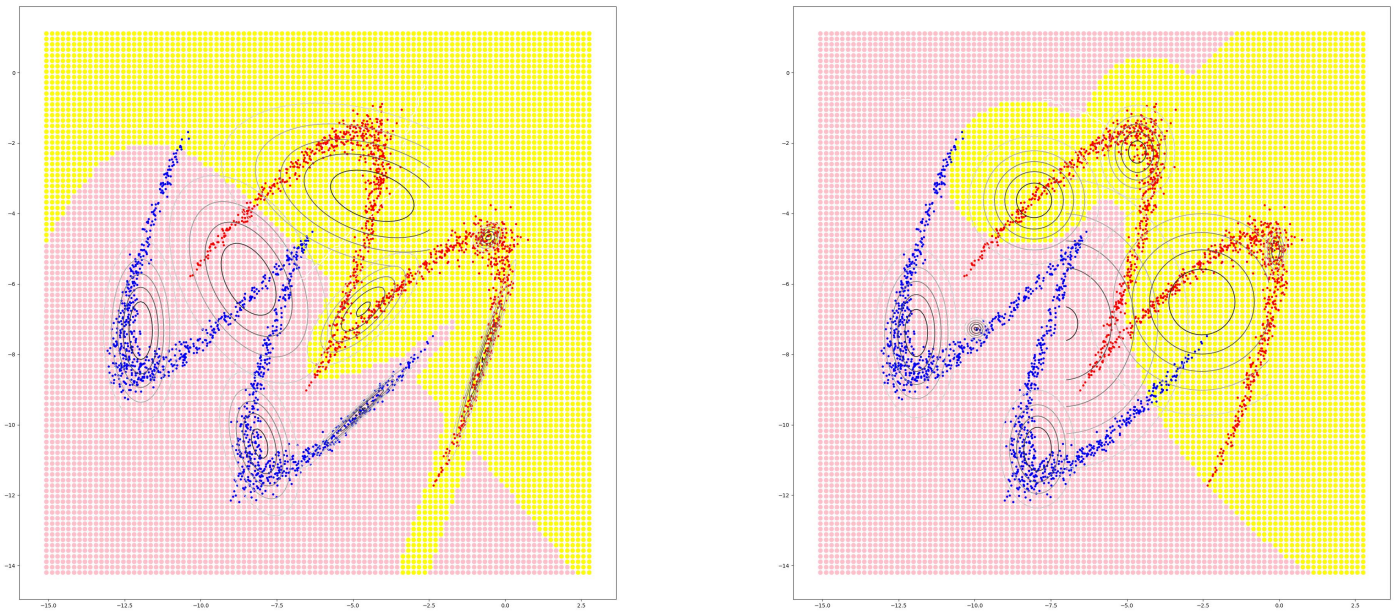

Figure 4: k=4 and non diagonal covariance on the left side and diagonal covariance on the right side

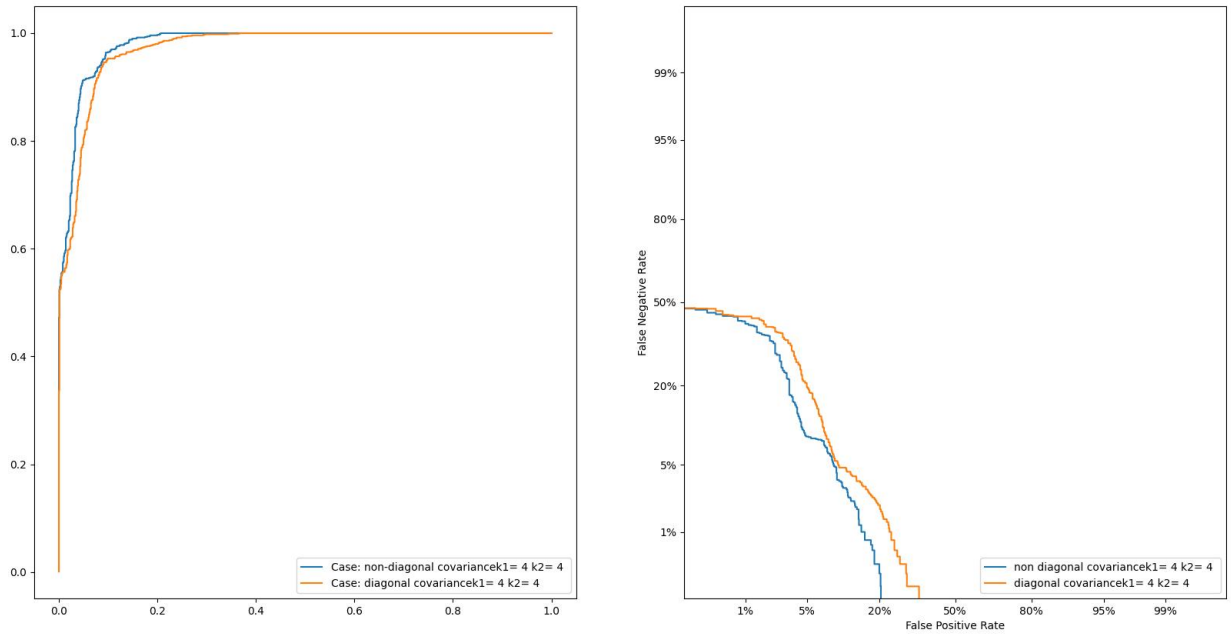

Figure 5: roc and det curves for k=4

1.2.2 IMAGE DATA

The image is divided into 36 blocks of 23 dimensional vector each and every block is treated independently for training a class (i.e forest or coast etc) . and then for classification we use the joint probability to classify the given image into a class

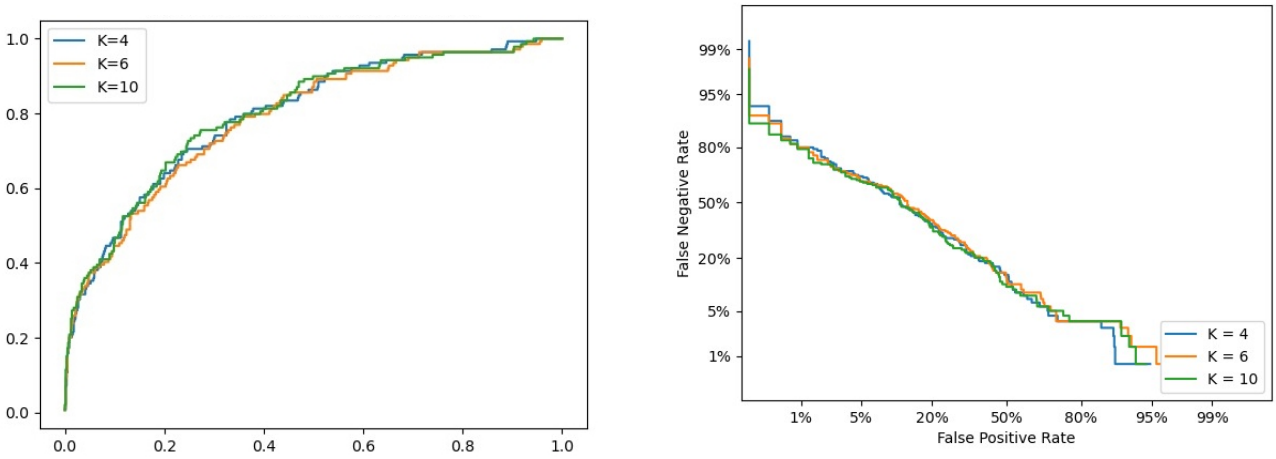

Figure 6: roc and det curves for image data

1.3 INFERENCES

1)as we increase k value , or the number of iterations we get more classification accuracy
2)For a non diagonal covariance matrix , we get more accuracy than a diagonal matrix

2 DTW

2.1 MOTIVATION

Perform Dynamic time warping on Isolated spoken digit data set and hand written character data set.

2.2 Results

The ROC and DET for DTW when varying k(Top k best distances average is used as score) on spoken digit data set:

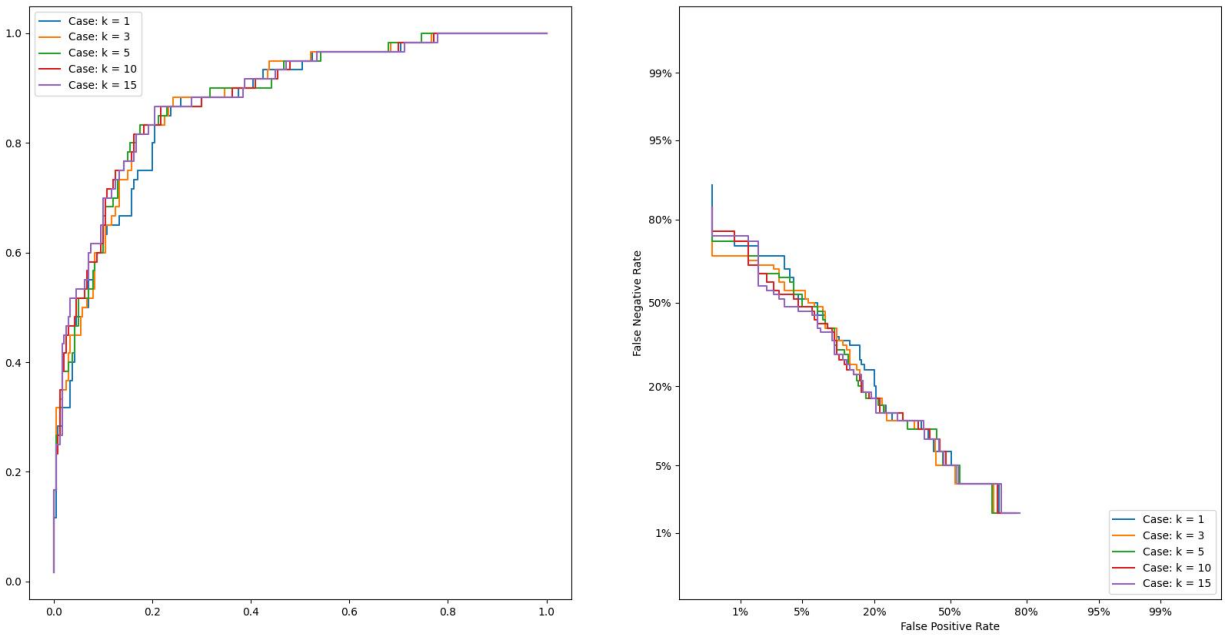

Figure 7

Confusion Matrix for all the ks was same:

	1	2	3	4	5	total % correct
1	12.0	0.0	0.0	0.0	0.0	100.0
2	0.0	12.0	0.0	0.0	0.0	100.0
3	0.0	0.0	12.0	0.0	0.0	100.0
4	0.0	0.0	0.0	12.0	0.0	100.0
5	1.0	0.0	0.0	0.0	11.0	91.66666666666666
total % correct	92.3076923076923	100.0	100.0	100.0	100.0	98.33333333333333

Figure 8: Confusion Matrix for DTW on spoken digits

The ROC and DET curves for DTW when varying k for handwritten data:

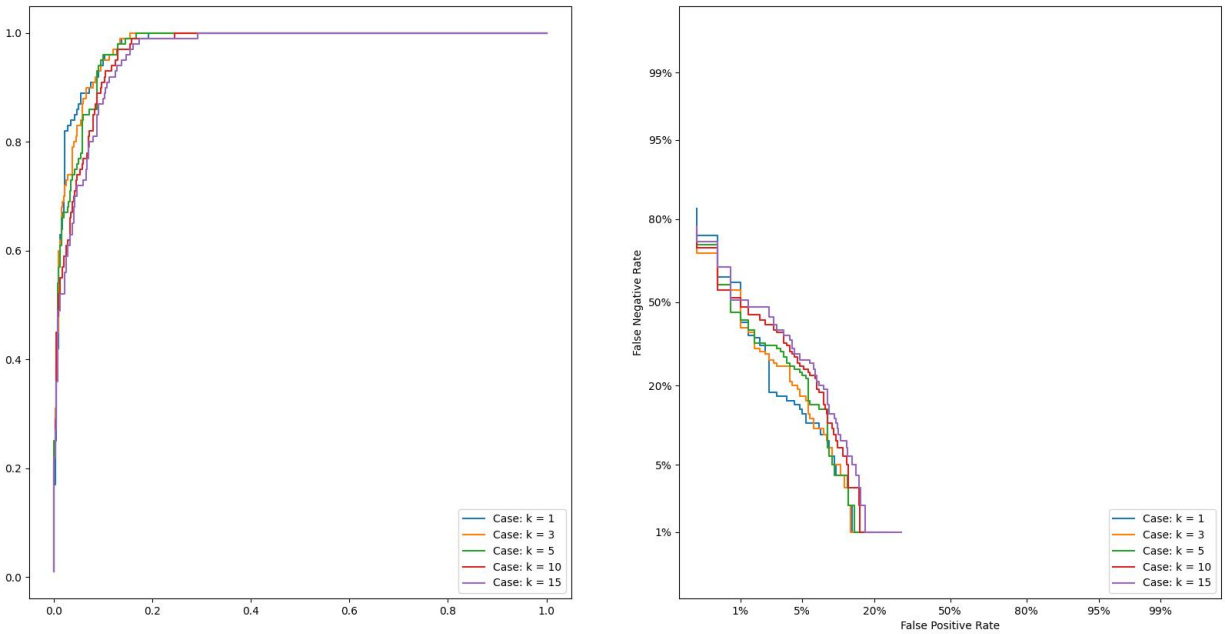

Figure 9

The confusion matrices for k = 3 to 15 were all same:

	1	2	3	4	5	total % correct
1	20.0	0.0	0.0	0.0	0.0	100.0
2	0.0	19.0	1.0	0.0	0.0	95.0
3	0.0	1.0	19.0	0.0	0.0	95.0
4	0.0	0.0	0.0	20.0	0.0	100.0
5	0.0	0.0	0.0	0.0	20.0	100.0
total % correct	100.0	95.0	95.0	100.0	100.0	98.0

Figure 10

3 HMM

3.1 MOTIVATION

Train Discrete HMM on Isolated spoken digit data set and hand written character data set.

3.2 Results

The best performing model on spoken digits for HMM has symbol count = 20 and number of states = 3.
Confusion Matrix of it is:

	1	2	3	4	5	total % correct
1	12.0	0.0	0.0	0.0	0.0	100.0
2	0.0	12.0	0.0	0.0	0.0	100.0
3	0.0	0.0	12.0	0.0	0.0	100.0
4	0.0	0.0	0.0	12.0	0.0	100.0
5	0.0	1.0	0.0	0.0	11.0	91.66666666666666
total % correct	100.0	92.30769230769231	100.0	100.0	100.0	98.33333333333333

Figure 11

The ROC and DET curve for it is:

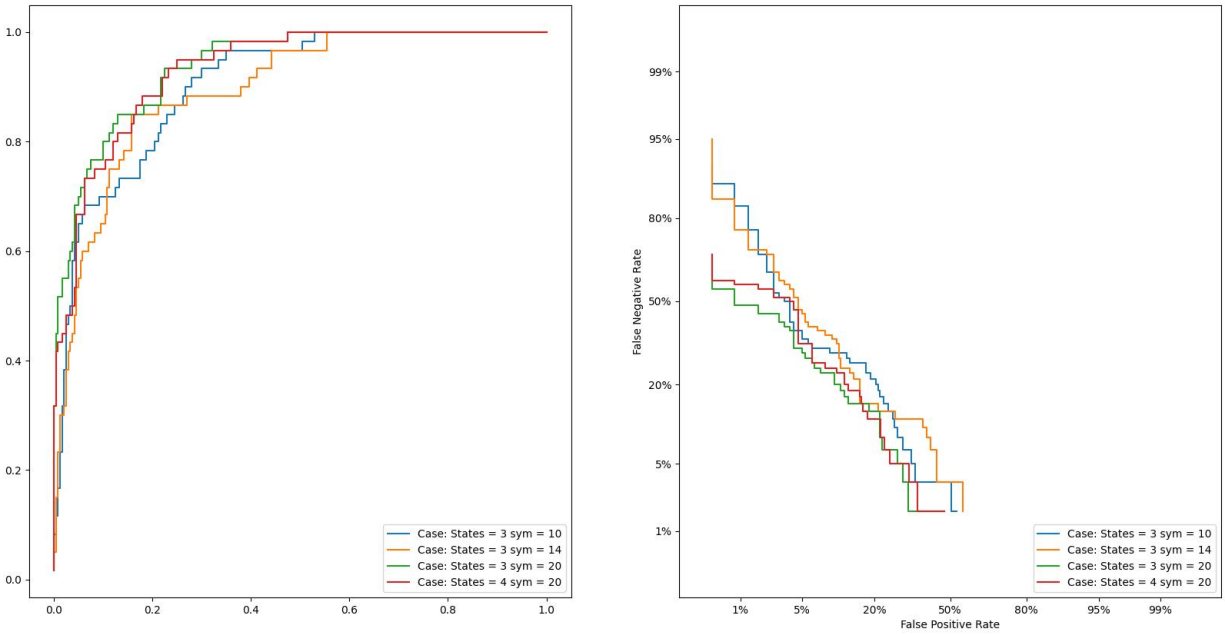

Figure 12

The best performing model on handwritten digits was when symbols are 30 and k = 3 with accuracy of 98. The confusion matrix for it is :

	1	2	3	4	5	total % correct
1	20.0	0.0	0.0	0.0	0.0	100.0
2	0.0	20.0	0.0	0.0	0.0	100.0
3	0.0	1.0	19.0	0.0	0.0	95.0
4	0.0	0.0	0.0	20.0	0.0	100.0
5	0.0	1.0	0.0	0.0	19.0	95.0
total % correct	100.0	90.9090909090909	100.0	100.0	100.0	98.0

Figure 13

The ROC and DET curves for various model parameters:

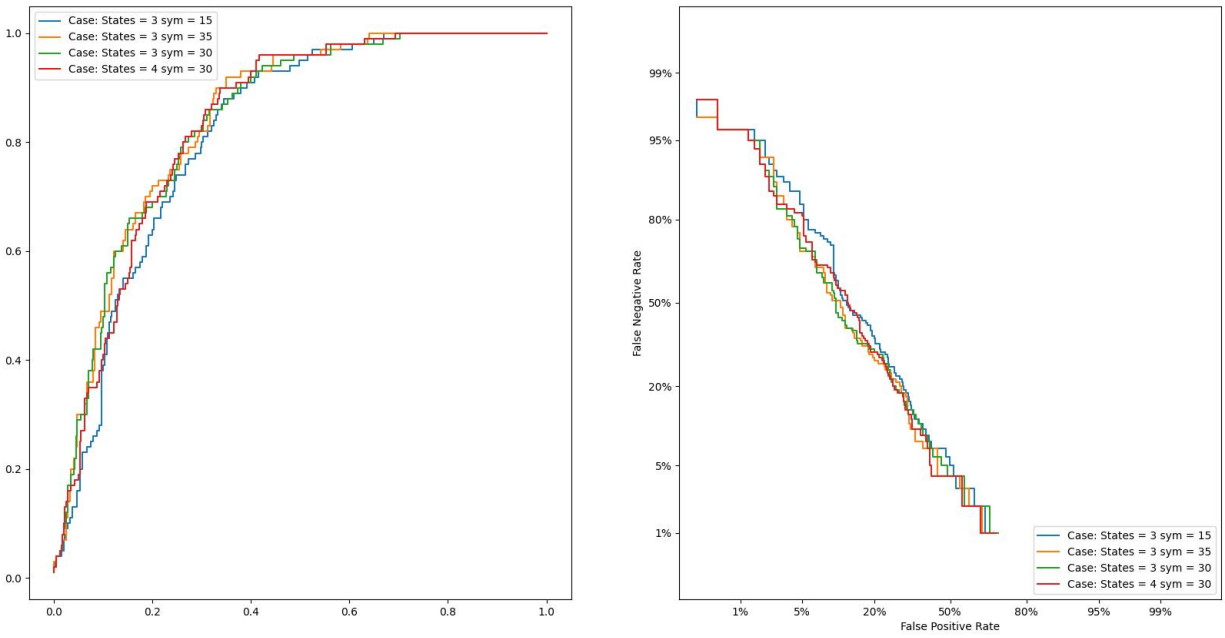

Figure 14

4 Inferences

1)Both DTW and HMM performed well on the data sets with accuracy greater than 96 on all data sets.
2)DTW took higher time than HMM.
3)Feature Scaling was required for Handwritten Data because the characters were displaced in space.
4)The errors performed by DTW in handwritten data were in bha and cha which when manually checked was also difficult to differentiate.
5)HMM was highly dependent on seed values for accuracy.
6)Based on ROC curves DTW did really good on handwritten character more than spoken digits.