CS5691: Assignment 3

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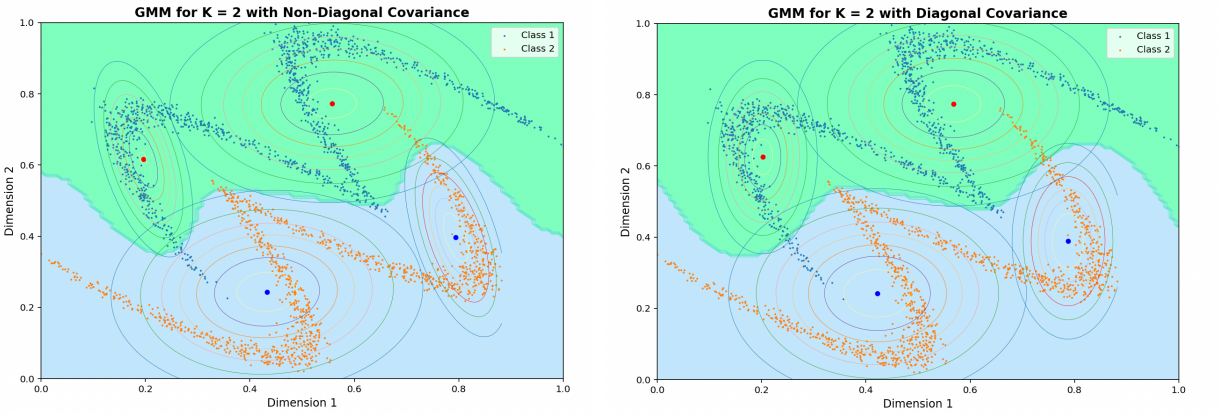
A. K-means, GMM

1. **Synthetic Dataset**

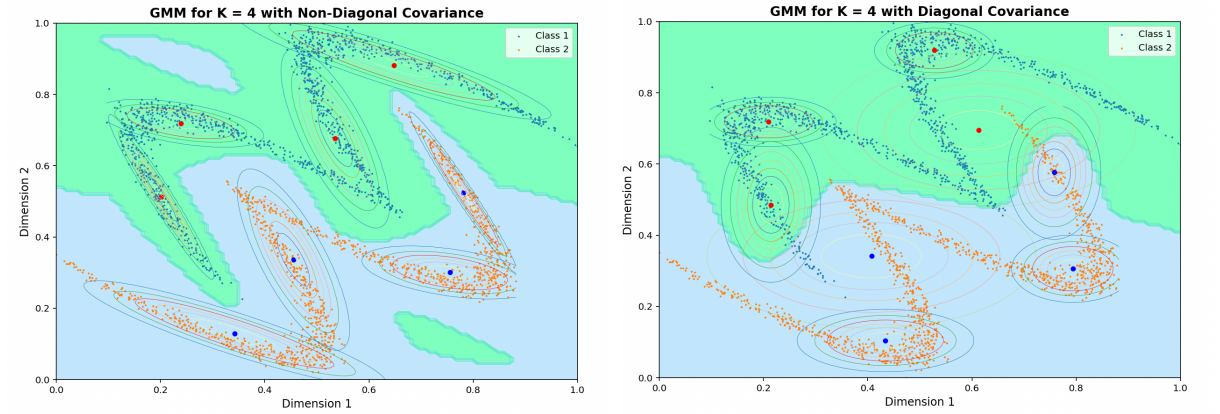
- First we do the observations for different number of clusters (K=2,4,8,16) for both diagonal and non diagonal covariance matrices.
- We start with plotting the GMMs for K=2, we observe that there is not much difference in the decision surface for both the covariance matrices. For Diagonal matrix it is a little smoother.

Figure 1: GMMs for synthetic data for K = 2 and Non-Diagonal and Diagonal Covariance for each class



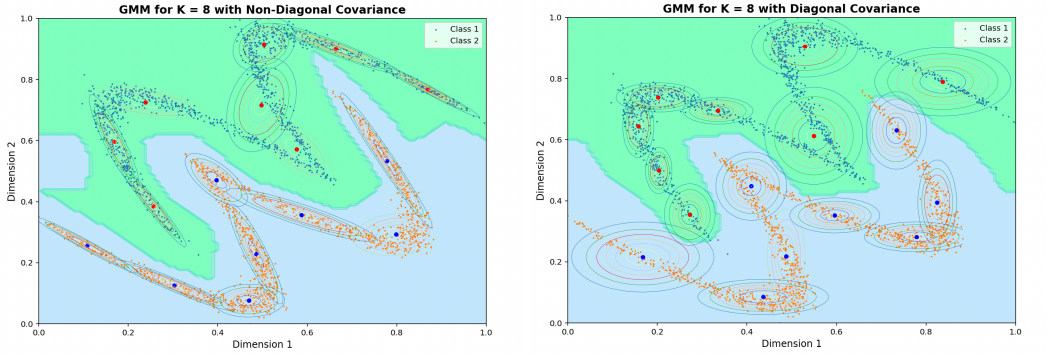
- Next we plot for K = 4. We observe that the decision plot for diagonal covariance matrix is better than non-diagonal.
- We observe that the decision surface starts taking better shape.

Figure 2: GMMs for synthetic data for K = 4 and Non-Diagonal and Diagonal Covariance for each class



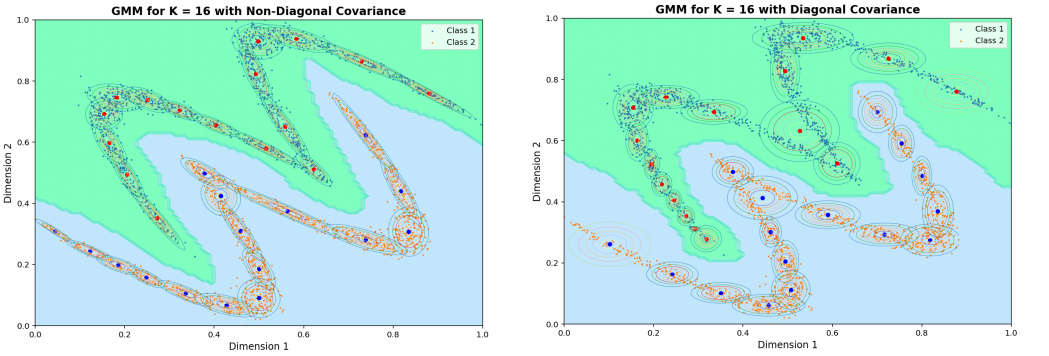
- For K = 8, we see the contour of the Gaussian fitting each branch in the entire model properly. The contours of the branches are aligned with the the branch's alignment and each branch completely fit in case of non-diagonal covariance matrix

Figure 3: GMMs for synthetic data for K = 8 and Non-Diagonal and Diagonal Covariance for each class



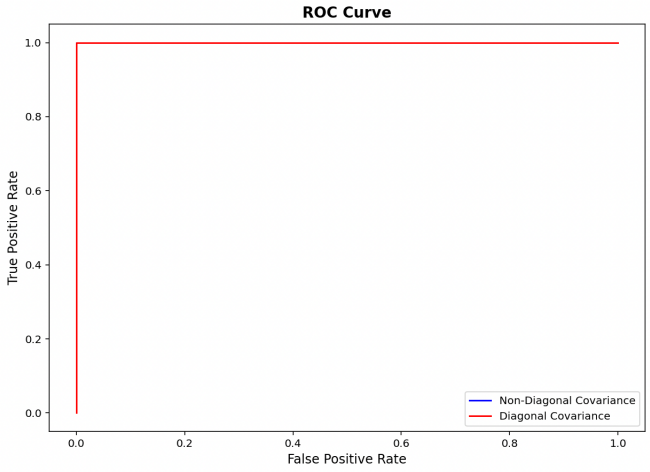
- When we choose K = 16, we see that the data starts getting overfitted, more in case of non-diagonal covariance matrix. We also see that the decision surface does very exact classification.

Figure 4: GMMs for synthetic data for K = 16 and Non-Diagonal and Diagonal Covariance for each class



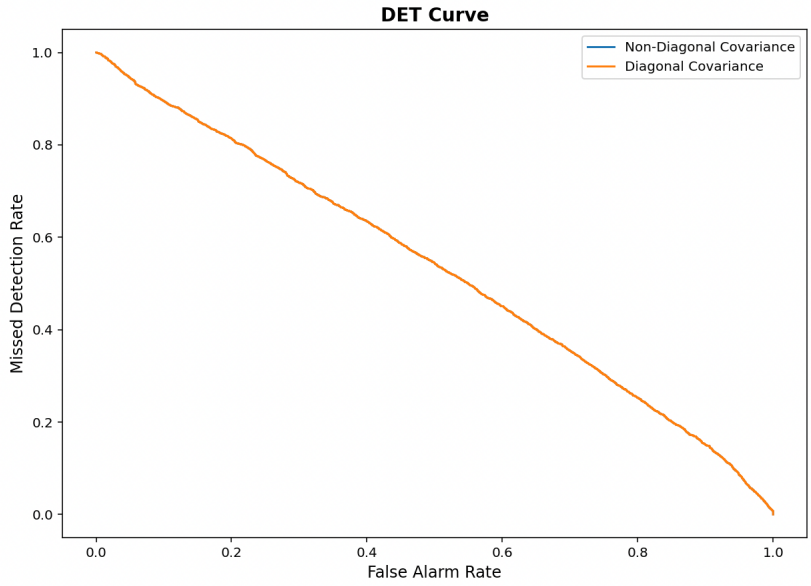
- **ROC Curve**

Figure 5: ROC Curve for Synthetic Data



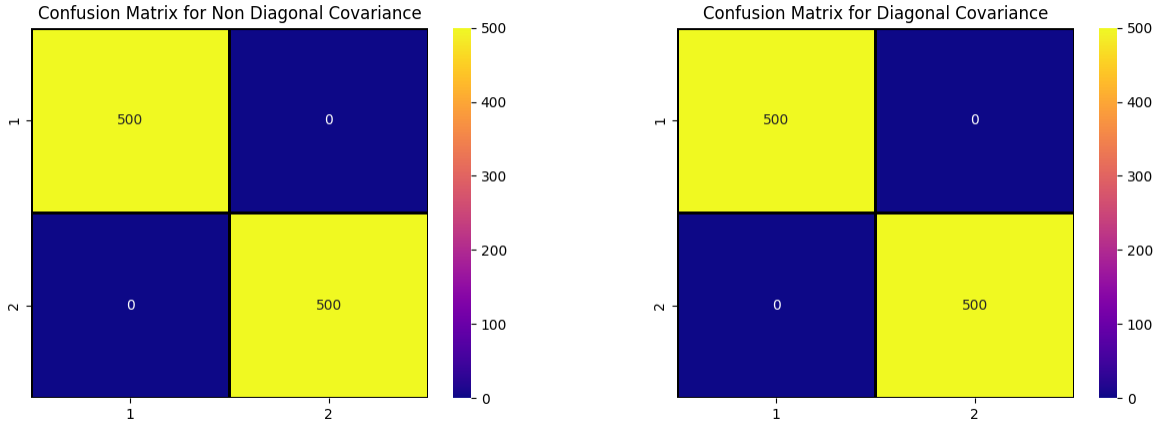
- **DET Curve**

Figure 6: DET Curve for Synthetic Data



- **Confusion Matrix**

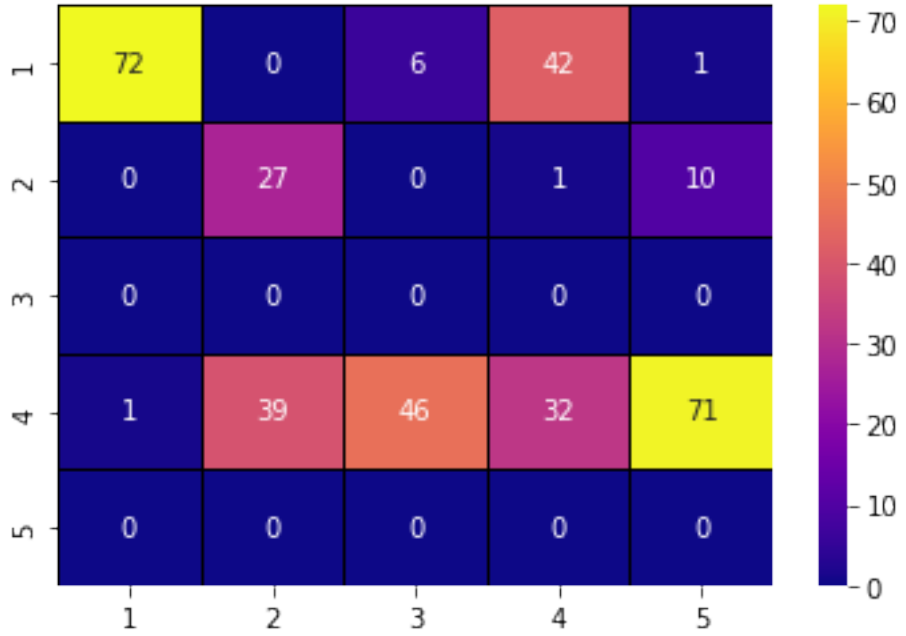
Figure 7: Confusion Matrix for both Non Diagonal and Diagonal Matrix and K = 16



2. **Image Dataset**

- For Diagonal Covariance Matrix we get accuracy of **37.64%**

Figure 8: Confusion Matrix for K = 4 and 10 iterations for Diagonal Covariance



- We observe that classification is better with diagonal covariance than non diagonal

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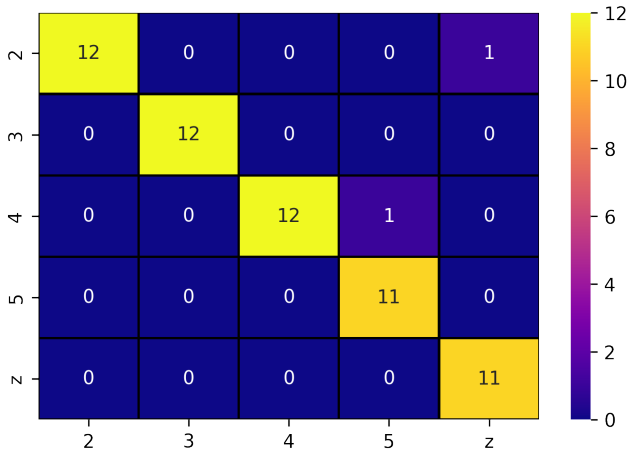
A. DTW

1. Isolated Spoken-Digit

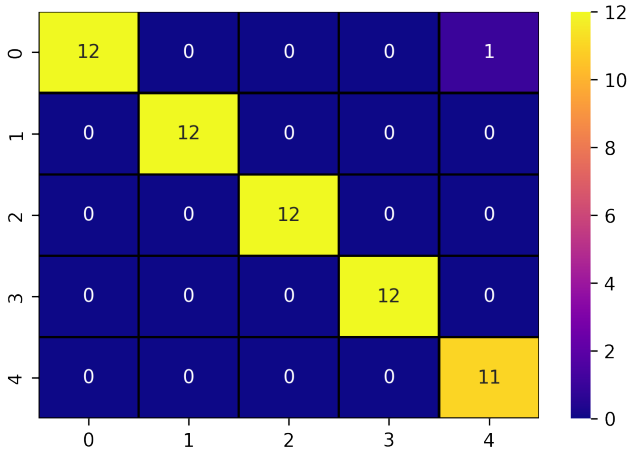
- From the confusion matrix we see that the accuracy is **96.7%** when DTW is applied on the spoken digit data for 20 nearest neighbours.

Figure 1: Confusion matrix for DTW applied on spoken digit data for 20 nearest neighbours



- For the 10 nearest neighbours the accuracy increased to **98.3%**.

Figure 2: Confusion matrix for DTW applied on spoken digit data for 10 nearest neighbours

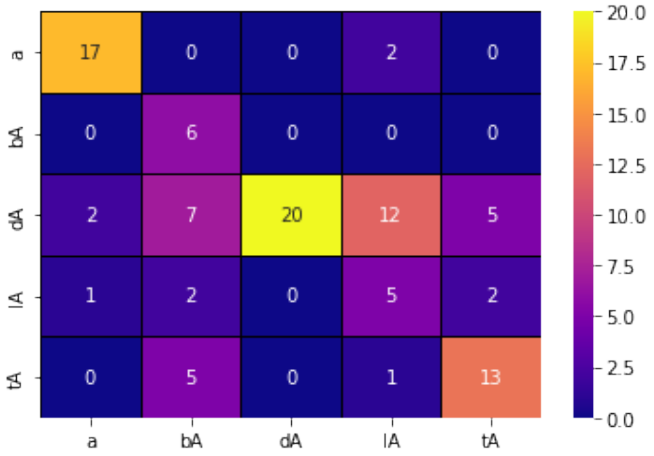


- By experimenting with different k-nearest neighbours we observed that the model was having most problem in recognizing the data of 'z' dataset as was confusing it with '2' dataset. And '5' was confused with '4' sometimes.

2. Online Handwritten-Character

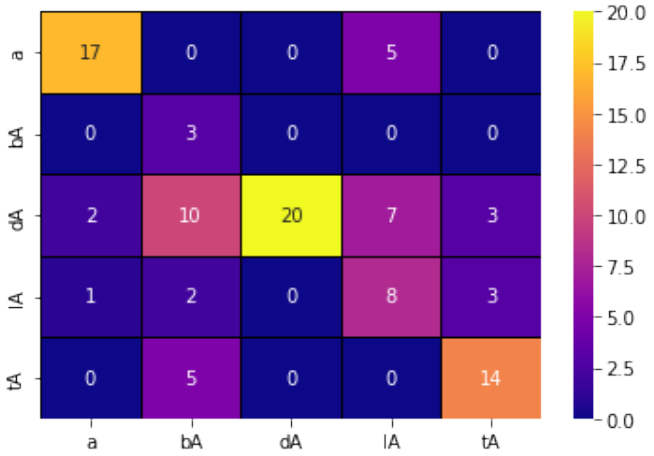
- When DTW is applied on the handwritten character data for 20 nearest neighbours, we get accuracy of **60%**.
- we get **100%** accuracy for 'dA'. And **85%** accuracy for 'a'.

Figure 3: Confusion matrix for DTW applied on handwritten character data for 20 nearest neighbours



- When DTW is applied on the handwritten character data for 60 nearest neighbours, We get accuracy of **62%**.
- We get better accuracy for 'lA' and 'tA' but lesser for 'bA'.

Figure 4: Confusion matrix for DTW applied on handwritten character data for 60 nearest neighbours



- Most of the confusion happens for 'bA' with 'dA' and 'tA'. And 'lA' with 'dA'.
- We also observed that when we choose 3 feature vectors (x,y,slope) we were getting lesser accuracy but after using one more feature vector of distance between consecutive points, the accuracy increased slightly.
- If we increase the number of significant feature vectors like curvature and other possible then we can get better accuracy.