

EECS708P Assignment 2 Report

Name: Bheki Maenetja

Student Number: 230382466

Assignment: No.2

Note: parameters are saved in .npy files inside the folder called “data”.

Question 1

Produce a plot of F1 against F2. Comment on the figure and the visible clusters.

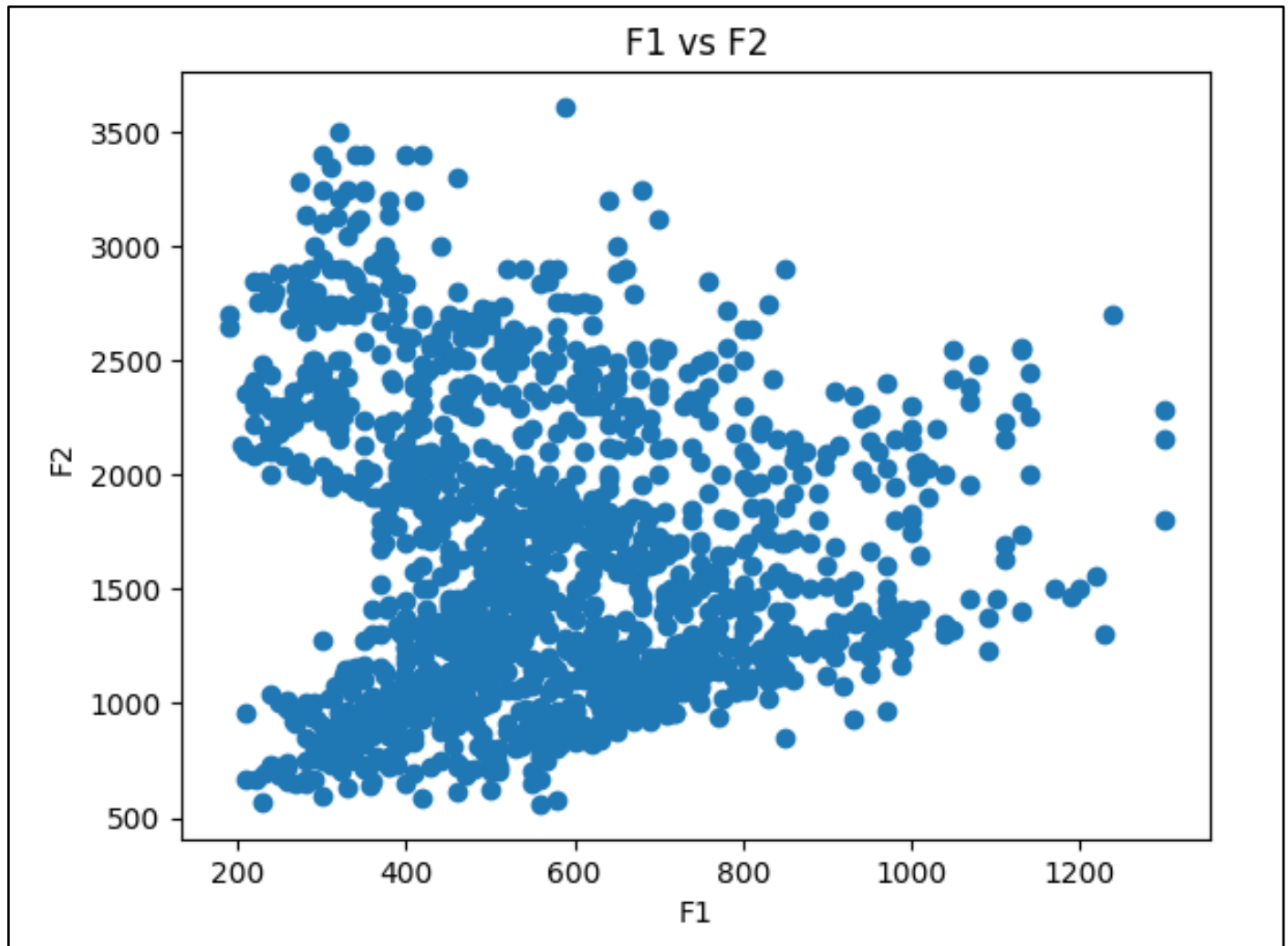


Figure 1 Scatter plot of F1 vs F2.

The scatter plot (see Figure 1 or code block 5 in the notebook) highlights the significant dispersion of data points as well as the variability in the relationship between F1 and F2. There is a noticeable clump of points around the lower F1 values that gradually thins out as F1 increases, indicating a potential cluster. Beyond this initial cluster, the points spread outwards and upwards, indicating that higher values of F1 yield a wider range of F2 values; as one moves to higher F1 values, the relationship between F1 and F2 becomes more variable. The lack of distinct, well-defined clusters could suggest overlapping groupings or a continuous spectrum of values rather than separate, distinct categories.

Question 5

Use the 2 MoGs ($K=3$) learnt in tasks 2 & 3 to build a classifier to discriminate between phonemes 1 and 2 and explain the process in the report.

For each phoneme, a GMM is trained to understand its distribution within the feature space. The ML estimation is used to determine the probability that each observed data point belongs to one of the $k=3$ clusters (or mixtures) defined in the model for each phoneme. During classification, the likelihood of each data point under the GMM parameters for phoneme 1 is compared to its likelihood under the GMM parameters for phoneme 2. The phoneme associated with the higher likelihood is the one the data point is most likely to belong to, according to the ML principle. After this comparison for all points, the model's predictions are aggregated, and the misclassification error is computed by contrasting these predictions with the actual labels. The accuracy, which inversely relates to the misclassification error, is then calculated to quantify the model's performance. This accuracy is a direct measure of the model's effectiveness in correctly classifying the phonemes, with higher accuracy indicating a better-performing model.

Question 6

Repeat for $K=6$ and compare the results in terms of accuracy.

When comparing the accuracy for $K=3$ (0.128) to the accuracy obtained with $K=6$ (approximately 0.181), it indicates that a model with more mixtures has a higher accuracy and thus performs better in classifying the phonemes. Having more mixtures allows the GMM to capture more complex patterns within the data, which can lead to a more detailed modelling of the phoneme distributions. This could be the reason for the improved accuracy when increasing the number of mixtures from 3 to 6. However, it may be important to reduce model complexity in order to avoid the risk of overfitting.