**Ensemble Classifiers**

1. Bagging:
   1. I implemented a bagging routine using my existing SoftMax regression implementation([link](https://github.com/biraaj/ML_project1/blob/main/codes/functions.py)).
   2. The results can be obtained by running **run\_1\_2.py**.
   3. I got an accuracy for single classifier as **37.5%.**
   4. Using bagging routine, the accuracy obtained for each estimator is as follows:
      1. **62.5%** with **10** estimator which is a big improvement over single classification with same number of epochs and alpha value.
      2. **66.5%** with **50** estimators.
      3. **75%** with **100** estimators which is huge change from previous estimator and also from single classification.
2. Boosting:
   1. I implemented a boosting routine using my existing SoftMax regression implementation([link](https://github.com/biraaj/ML_project1/blob/main/codes/functions.py)).
   2. The boosting routine uses algorithm from the given paper ([link](https://hastie.su.domains/Papers/samme.pdf)).
   3. The results can be obtained by running run\_1\_2.py.
   4. I got an accuracy for single classifier as 37.5%.
   5. Using boosting routine, the accuracy obtained for each estimator is as follows:
      1. **41.66%** with **10** estimator which is a small improvement over single classification.
      2. **70.83%** with **50** estimators which is a huge improvement compared to previous 10 estimators as well as single classifier which was only 37.5%.
      3. **79.16%** with **100** estimators which is an observable change from previous estimator and huge improvement from single classification.

**K-Means Clustering:**

1. Implemented the K-Means clustering referring to the [link](https://anderfernandez.com/en/blog/kmeans-algorithm-python/).
2. The Accuracies obtained with different k values are given below:
   1. K=3:
      1. We obtained the overall accuracy as 43.33% with cluster no 1 having the maximum accuracy of 46.66% which predicts label 1.
   2. K=6:
      1. We obtained the overall accuracy as 47.5% which is better than k=3. Cluster no 5 having the maximum accuracy of 55% which predicts label 1.
      2. Here we have multiple clusters for a single label.
   3. K=9:
      1. We obtained the overall accuracy as 52.5% which is better than k=3,6. Cluster no 5 having the maximum accuracy of 66.66% which predicts label 1.
      2. Here we have multiple clusters for a single label.