# August-December 2024 Semester
# CS616: Statistical Pattern Recognition
# CS612: Statistical Pattern Recognition Laboratory
# Programming Assignment 4

**Date:** 04 November 2024

**Deadline for submission of code and report**: **Sunday, Nov. 18, 2023, 10:00 PM**

## Datasets:

**Dataset 1:** 2-dimensional artificial data:

(a) Linearly separable dataset used in Assignment1

(b) Nonlinearly separable data set used in Assignment1

**Dataset 2:** 3 class scene image datasets: Consider the 32-dimensional BoVW representation from Assignment-2.

## Classifiers to be built:

1. Build Bayes classifier using Gaussian mixture model (GMM) with 1, 2, 4 and 8 mixtures on the reduced dimensional representations of Dataset-2 obtained using PCA.
   - Perform the experiments on different values of $l$ *(including* $l$=1*),* the reduced dimensions in PCA.
2. Build Bayes classifier using the density estimated from K-nearest neighbour (KNN) method for Dataset-1 and Dataset-2
   - Perform the experiments on different values of $K$ *(including* $K$=1*),* the number of neighbours in KNN method of density estimation.
3. Apply Fisher linear discriminant analysis (FDA) on Dataset-1 and Dataset-2. Use Bayes classifier using both unimodal Gaussian and GMM.
4. Perceptron-based classifier on Dataset-1 and Dataset-2.
5. Logistic regression classifier on Dataset-1 and Dataset-2.
6. SVM-based classifier using (a) linear kernel, (b) polynomial kernel and (c) Gaussian/RBF kernel on Dataset-1 and Dataset-2.
   - Perform experiments on different values of SVM parameters and kernel parameters.

**Report should include following:**

1. Classification accuracy, precision for every class, mean precision, recall for every class, mean recall, F-measure for every class and mean F-measure on test data.
2. Confusion matrix based on the performance for test data.
3. **Decision region plots**: Observation on the nature of decision boundary obtained for Dataset-1 for **Bayes classifier using the density estimated from KNN method** (for different values of K), **Logistic regression**, **perceptron-based classifier** and **SVM** (for different values of kernel and SVM parameters)
4. Observation on the nature of decision boundary obtained for Dataset-1 (a) for **Bayes classifier using FDA** (This plot is superimposed by the of 1-dimensional reduced dimensional representation of training data for each pair of classes using FDA).
5. Comparison of decision region plots obtained for the best KNN-based Bayes classier, logistic regression, perceptron-based classifier and best SVM (for each kernel) with that of best models from Assignment-1, 2 and 3 on Dataset-1.
6. Comparison of decision region plots obtained for the perceptron-based classier and linear kernel based SVM on Dataset-1 (a).
7. Plot of eigen values in ascending order during PCA.
8. Plot of 2-dimensional reduced dimensional representations using PCA.

9. Plot of 1-dimensional reduced dimensional representation for each pair of classes using FDA
10. Comparison of accuracy with all the classifiers for each dataset (comparison from all classifiers from all assignments).

**Report by a team should include the plots and observations about the results of studies.**

**Each group of students must use the dataset identified for that group only.**

**The expectation of the assignment is to implement from scratch using Python or MATLAB or any other programming language.**
**Note: You are free to use libraries.**

**Report should be in PDF form and report by a team should also include the observations about the results of studies.**

## *Instruction:*

**Upload in Moodle all your codes in a single zip file.**

- **Give the name of the code folder as Group<*number*>_Assignment4_code**
  **Example: Group01_Assignment4_code.**
- **Give the name of the zip file as Group<*number*>_Assignment4_code.zip**
  **Example: Group01_Assignment4_code.zip**

**Upload the report as PDF file.**

- **Give the name to the report file as Group<*number*>_Assignment4_report.pdf**
  **Example: Group01_Assignment4_report.pdf**

**We will not accept the submission if you don't follow the above instructions.**