

# NCTU Pattern Recognition, Homework 2

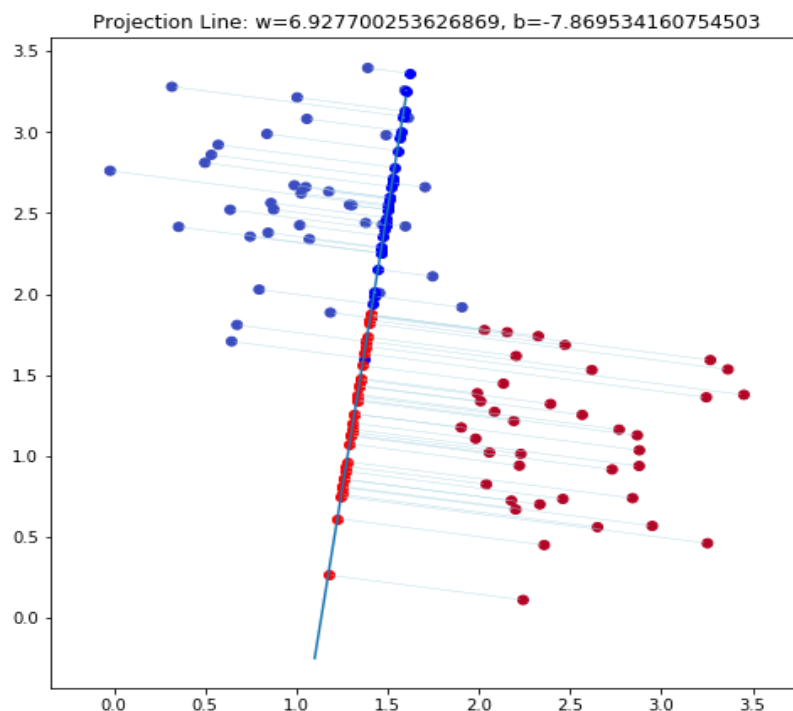
**Deadline: April 21, 23:59**

## Part. 1, Coding (60%):

In this coding assignment, you are required to implement Fisher's linear discriminant by using only [NumPy](#), then train your model on the provided dataset, and evaluate the performance on testing data. Find the sample code and data on the GitHub page [https://github.com/NCTU-VRDL/CS\\_ILE5065/tree/main/HW2](https://github.com/NCTU-VRDL/CS_ILE5065/tree/main/HW2)

**Please note that only NumPy can be used to implement your model, you will get 0 point by calling `sklearn.discriminant_analysis.LinearDiscriminantAnalysis`.**

1. (5%) Compute the mean vectors  $m_i$  ( $i=1, 2$ ) of each 2 classes on **training data**
2. (5%) Compute the within-class scatter matrix  $S_w$  on **training data**
3. (5%) Compute the between-class scatter matrix  $S_b$  on **training data**
4. (5%) Compute the Fisher's linear discriminant  $w$  on **training data**
5. (20%) Project the **testing data** by Fisher's linear discriminant to get the class prediction by nearest-neighbor rule and calculate your accuracy score on **testing data** (you should get accuracy over 0.9)
6. (20%) Plot the **1) best projection line** on the **training data** and show the slope and intercept on the title (you can choose any value of **intercept** for better visualization) **2) colorize the data** with each class **3) project all data points on your projection line**. Your result should look like the below image (This image is for reference, not the answer)



**Part. 2, Questions (40%):**

1. (20%) Show that maximization of the class separation criterion given by  $L(\lambda, w) = w^T (m_2 - m_1) + \lambda(w^T w - 1)$  with respect to  $w$ , using a Lagrange multiplier to enforce the constraint  $w^T w = 1$ , leads to the result that  $w \propto (m_2 - m_1)$ .
2. (20%) Show that the logistic sigmoid function satisfies the property  $\sigma(-a) = 1 - \sigma(a)$  and its inverse is given by  $\sigma^{-1}(y) = \ln\{y/(1 - y)\}$ .