# Introduction to Pattern Recognition Homework 2 Report

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## 1 Coding

### 1.1 Compute the mean vectors $m_i, (i = 1, 2)$ of each 2 classes on training data

### 1.2 Compute the within-class scatter matrix $S_W$ on training data.

### 1.3 Compute the between-class scatter matrix $S_B$ on training data.

### 1.4 Compute the Fisher's linear discriminant $W$ on training data.

### 1.5 Project the testing data by linear discriminant to get the class prediction by nearest-neighbor rule and calculate your accuracy score on testing data.

### 1.6 Plot the 1) best projection line on the training data and slow the slope and intercept on the title 2)colorize the data with each class 3) project all data points on your projection line.

## 2 Questions

### 2.1 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 $w \propto (m_2 - m_1)$.

### 2.2 Using eq 1 and eq 2, derive the result eq 3 for the posterior class probability in the two-class generative model with Gaussian densities, and verify the results eq 4 and eq 5 for the parameters w and $w_0$.

$$\frac{1}{1 + exp(-\alpha) = \phi(\alpha)} \tag{1}$$

$$a = ln\frac{p(x|C_1)p(C_1)}{p(x|C_2)p(C_2)} \tag{2}$$

$$p(C_1|x) = \phi(w^T x + w_0) \tag{3}$$

$$w = \sum^{-1}(\mu_1 - \mu_2) \tag{4}$$

$$w_0 = -\frac{1}{2}\mu_1^T \sum{}^{-1}\mu_1 + \frac{1}{2}\mu_2^T \sum{}^{-1}\mu_2 + ln\frac{p(C_1)}{p(C_2)} \tag{5}$$