

Problem 2:-

$$\text{class 1 :- } X_1 = \begin{bmatrix} -2 & 1 \\ -5 & -4 \\ -3 & 1 \\ 0 & -3 \\ -8 & -1 \end{bmatrix}$$

$$\text{class 2 :- } X_2 = \begin{bmatrix} 2 & 5 \\ 1 & 0 \\ 5 & -1 \\ -1 & -3 \\ 6 & 1 \end{bmatrix}$$

$$\text{Mean of class 1 :- } [-3.6 \quad -1.2] = \mu_1$$

$$\text{Mean of class 2 :- } [2.6 \quad 0.4] = \mu_2$$

$$\begin{aligned} \text{Scatter Matrix} &= (N-1) (X_1 - \mu_1) \\ &= 4 (X_1 - \mu_1) \end{aligned}$$

$$\text{Scatter Matrix } S_1 = \begin{bmatrix} 37.2 & 1.4 \\ 1.4 & 20.8 \end{bmatrix}$$

$$S_2 = \begin{bmatrix} 33.2 & 8.8 \\ 8.8 & 35.2 \end{bmatrix}$$

$$\text{Within class scatter} = \begin{bmatrix} 70.4 & 10.2 \\ 10.2 & 56 \end{bmatrix}$$

Optimal line direction

$$= \begin{bmatrix} 70.4 & 10.2 \\ 10.2 & 56 \end{bmatrix}^{-1} * [\mu_2 - \mu_1]$$

$$= \begin{bmatrix} -0.0862 \\ -0.0128 \end{bmatrix}$$



optimal direction:  $\begin{bmatrix} -0.086 \\ -0.013 \end{bmatrix}$

$\begin{bmatrix} -2 & 1 \\ -5 & -4 \\ -3 & 1 \\ 0 & -3 \\ -8 & -1 \end{bmatrix}$  project these samples onto  $\begin{bmatrix} -0.086 \\ -0.013 \end{bmatrix}$

Vector product of class 1 and  $\begin{bmatrix} -0.086 \\ -0.013 \end{bmatrix}$

$= \begin{bmatrix} -2 & 1 \\ -5 & -4 \\ -3 & 1 \\ 0 & -3 \\ -8 & -1 \end{bmatrix} \begin{bmatrix} -0.086 \\ -0.013 \end{bmatrix}$

class 1  $= \begin{bmatrix} 0.172 - 0.013 \\ 0.431 + 0.05 \\ 0.259 - 0.013 \\ 0 + 0.039 \\ 0.69 - 0.0129 \end{bmatrix} = \begin{bmatrix} 0.159 \\ 0.482 \\ 0.246 \\ 0.039 \\ 0.702 \end{bmatrix}$

similarly for class 2 we get:

class 2  $= \begin{bmatrix} -0.172 - 0.064 \\ -0.09 + 0 \\ -0.43 + 0.013 \\ -0.086 + 0.039 \\ -0.52 - 0.0129 \end{bmatrix} = \begin{bmatrix} -0.236 \\ -0.086 \\ -0.418 \\ 0.124 \\ -0.53 \end{bmatrix}$

4th sample from class 2 is misclassified.  
 $[-1, -3]$  is misclassified.