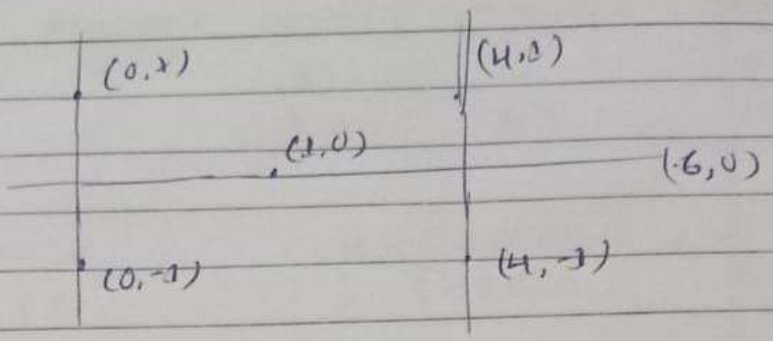
LAB-6 Support vector Machine

9) Points (4,1), (4,-1), and (6,0) belong to positive class and points (1,0), (0,1), and (0,-1) belong to negative class. Draw an optimal hyperplane



$$s_1 = \begin{pmatrix} 1 \\ 0 \end{pmatrix} \quad s_2 = \begin{pmatrix} 4 \\ 1 \end{pmatrix} \quad s_3 = \begin{pmatrix} 4 \\ -1 \end{pmatrix}$$

$$\tilde{s}_1 = \begin{pmatrix} 1 \\ 0 \\ 1 \end{pmatrix} \quad \tilde{s}_2 = \begin{pmatrix} 4 \\ 1 \\ 1 \end{pmatrix} \quad \tilde{s}_3 = \begin{pmatrix} 4 \\ -1 \\ 1 \end{pmatrix}$$

$$\alpha_1 \tilde{s}_1 \tilde{s}_1 + \alpha_2 \tilde{s}_1 \tilde{s}_2 + \alpha_3 \tilde{s}_1 \tilde{s}_3 = 0$$
$$\alpha_1 \tilde{s}_2 \tilde{s}_1 + \alpha_2 \tilde{s}_2 \tilde{s}_2 + \alpha_3 \tilde{s}_2 \tilde{s}_3 = 0$$
$$\alpha_1 \tilde{s}_3 \tilde{s}_1 + \alpha_2 \tilde{s}_3 \tilde{s}_2 + \alpha_3 \tilde{s}_3 \tilde{s}_3 = 0$$

$$2\alpha_1 + 5\alpha_2 + 5\alpha_3 = 0$$
$$5\alpha_1 + 18\alpha_2 + 16\alpha_3 = 0$$
$$5\alpha_1 + 16\alpha_2 + 18\alpha_3 = 0$$

$$\alpha_1 = -\frac{22}{9}$$

$$\alpha_2 = \frac{7}{18}$$

$$\alpha_3 = \frac{7}{18}$$

$$w = \sum \alpha_i s_i = \alpha_1 \tilde{s}_1 + \alpha_2 \tilde{s}_2 + \alpha_3 \tilde{s}_3$$

$$= \begin{pmatrix} -\frac{22}{9} \\ 0 \\ -\frac{22}{9} \end{pmatrix} + \begin{pmatrix} \frac{28}{18} \\ \frac{7}{18} \\ \frac{7}{18} \end{pmatrix} + \begin{pmatrix} \frac{28}{18} \\ -\frac{7}{18} \\ -\frac{7}{18} \end{pmatrix} = w = \begin{pmatrix} 2/3 \\ 0 \\ -5/5 \end{pmatrix}$$

$$\frac{2}{3}x_1 + 0x_2 + \left(-\frac{5}{3}\right) = 0$$

$$2x_1 - 5 = 0$$

$$x_1 = 5/2$$

$$x_1 = 2.5$$

Equation of boundary $\Rightarrow$ ~~$x_1 = 2.5 = 2.5$~~ $x_1 = 2.5$