

$$1. w = \sum \lambda_i x_i y_i = \begin{pmatrix} 0.5 \\ 0.75 \\ 0.125 \end{pmatrix} + \begin{pmatrix} 0.4 \\ 0.15 \\ 0.225 \end{pmatrix} - \begin{pmatrix} 0.3 \\ 0.75 \\ 0.65 \end{pmatrix} - \begin{pmatrix} 0.2 \\ 0.65 \\ 0.425 \end{pmatrix} = \begin{pmatrix} 0.4 \\ -1 \\ -0.725 \end{pmatrix}$$

Then

$$w^T x + w_b = (0.4, -1, -0.725) \begin{pmatrix} 1 \\ 1 \\ 0 \end{pmatrix} + 1 = 0.4$$

2. The two gutters are

$$\begin{cases} w^T x + w_b = 1 \\ w^T x + w_b = -1 \end{cases} \Rightarrow \begin{cases} 0.4x_a - 1 - 0.725x_c = 0 \\ 0.4x_a - 1 - 0.725x_c + 2 = 0 \end{cases}$$

3. The inequalities is

$$y_k (w^T x_k + w_b) \geq 1 \quad \forall x_k \in C_+ \cup C_-$$

Applied it to 4 samples, we get

$$\text{Sample 1: } y_1 (w^T x_1 + 1) = \frac{0.8594}{-0.1406}$$

Fall into margin

$$\text{Sample 2: } y_2 (w^T x_2 + 1) = \frac{-0.1531}{0.8469}$$

Fall into margin

$$\text{Sample 3: } y_3 (w^T x_3 + 1) = -0.1344$$

Fall into margin

$$\text{Sample 4: } y_4 (w^T x_4 + 1) = -0.1219$$

Fall into margin

4. Answer is (2) $y_i (w^T x_i + w_b) \leq -1$

Proof: There are 2 cases.

① $y_i = 1$, Based on the question, it belongs in the opposing class, so

$$w^T x_i + w_b \leq -1$$

$$\Rightarrow y_i (w^T x_i + w_b) \leq -1$$

② $y_i = -1$, the same process as ①

$$w^T x_i + w_b \geq 1$$

$$\Rightarrow y_i (w^T x_i + w_b) \leq -1$$

$$\text{So } y_i (w^T x_i + w_b) \leq -1$$