1

Suppose you train a soft-margin SVM and formulate the dual problem using the data in the table below. The lambda values in the table are the Lagrangian parameters obtained through SMO (Sequential Minimal Optimization) with $C = 1$. Based on the table, you will compute the decision boundary and margins for a soft-margin SVM. The bias is -0.6

$$\lambda*_{n=1}^{4} = \underset{\lambda_{n=1}^{4}}{\arg\max} -\frac{1}{2}\sum_{n=1}^{4}\sum_{m=1}^{4}\lambda_n\lambda_m \cdot t_n \cdot t_m \cdot \kappa(x_n, x_m) + \sum_{n=1}^{4}\lambda_n$$

$$\text{subject to} \quad 0 \le \lambda_n \le C \quad n = 1,2,3,4$$

$$\sum_{n=1}^{4}\lambda_n \cdot t_n = 0$$

$$** \text{ kernel function} \quad \kappa(x_n, x_m) = x^t \cdot x$$

.

data num	$\vec{x} = (x_0, x_1)$	class	λ
d_1	$(+1, -1)$	$t_1 = +1$	$\lambda_1 = 0.64$
d_2	$(+2, -2)$	$t_2 = +1$	$\lambda_2 = 0$
d_3	$(-2, +2)$	$t_3 = -1$	$\lambda_3 = 0$
d_4	$(-1/4, +1/4)$	$t_4 = -1$	$\lambda_4 = 0.64$

1.1

3 pts

When the computed decision boundary is $A \cdot x_0 + B \cdot x_1 - 3 = 0$, what is the value of A (integer)?

4 (with margin: 0.01)

1.2

3 pts

When the computed decision boundary is $A \cdot x_0 + B \cdot x_1 - 3 = 0$, what is the value of B (integer)?

-4 (with margin: 0.01)

1.3

3 pts

When the positive and negative margin is $A \cdot x_0 + B \cdot x_1 + C = \pm 1$, what is A (one digit decimal)?

0.8 (with margin: 0.01)

1.4

3 pts

When the positive and negative margin is $A \cdot x_0 + B \cdot x_1 + C = \pm 1$, what is B (one digit decimal)?

-0.8 (with margin: 0.01)

1.5

3 pts

When the positive and negative margin is $A \cdot x_0 + B \cdot x_1 + C = \pm 1$, what is C (one digit decimal)?

-0.6 (with margin: 0.01)

1.6

d1 and d4 are within the margin.. This was the correct answer.

5 pts

Suppose you trained SMO with $C << 1$, where C is much smaller than 1. Check all possible situations with the small C.

- ➔ ☐ margins get larger.
- ➔ ☐ d1 and d4 are within the margin.
- ➔ ☐ all data points become support vectors.
- ☐ d2 and d3 are never within the margin.