

## SVM-Example

### Question 1

An SVM is trained with the following data:

$i$	1	2	3
$x_i$	$(-1, -1)$	$(1, 1)$	$(0, 2)$
$y_i$	-1	1	1

Let  $\alpha_1, \alpha_2, \alpha_3$  be the Lagrangian multipliers associated with this data. ( $\alpha_i$  is associated with  $(x_i, y_i)$ .)

**A**

Using the polynomial kernel of degree 2, what (dual) optimization problem needs to be solved in terms of the  $\alpha_i$  in order to determine their values?

Reminder: the polynomial kernel of degree 2 is:

$$K(x_i, x_j) = (x_i'x_j + 1)^2$$

**Answer**

**B**

The solution to the optimization problem is:

$$\alpha_1 = 1/8, \quad \alpha_2 = 1/8, \quad \alpha_3 = 0$$

a. What are the indexes of the support vectors? Circle them below.

**Answer:** 1   2   3

b. This SVM classifies the example  $x$  according to the sign of  $w'\phi(x) + b$ , where the transformation  $\phi$  is implicitly defined by the kernel. Compute the value of the constant  $b$ . (This can be done without explicit computation of  $\phi$  or  $w$ .)

**Answer:** The value of  $b$  is:

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c. What computation needs to be carried out to determine the classification of the point  $x = (-1, 0)$  by this SVM?

**Answer:**

.

d. What computation needs to be carried out to determine the classification of the point  $x = (1, 0)$  by this SVM?

**Answer:**

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