ML Problem Solving

Vector arithmetic and linear classifier inference

1. A linear model $\hat{y} = a_1 x_1 + a_2 x_2 + b$ has $a = [-1, 1]$ and $b = 2$. For the following x, determine the score $\hat{y}$ and the *associated prediction*. Recall that our linear classifier was trained on targets $t \in \{0, 1\}$.

a) $[[0], [0]]$

b) $[[-1], [1]]$

c) $[[1], [-1]]$

d) $[[1.5], [0]]$

e) $[[0], [-1.5]]$

2. Consider that we want to represent $a \cdot x + b$ as a single vector multiplication $a \cdot x$, without explicitly adding the bias b, where a and x are vectors and b is a scalar. What would be the values for a and x for each input?

a) $a = [\ \_\_\_\_\_\ ,\ \_\_\_\_\_\ ,\ \_\_\_\_\_\ ]$, $x = [\ \_\_\_\_\_\ ,\ \_\_\_\_\_\ ,\ \_\_\_\_\_\ ]^T$

b) $a = [\ \_\_\_\_\_\ ,\ \_\_\_\_\_\ ,\ \_\_\_\_\_\ ]$, $x = [\ \_\_\_\_\_\ ,\ \_\_\_\_\_\ ,\ \_\_\_\_\_\ ]^T$

c) $a = [\ \_\_\_\_\_\ ,\ \_\_\_\_\_\ ,\ \_\_\_\_\_\ ]$, $x = [\ \_\_\_\_\_\ ,\ \_\_\_\_\_\ ,\ \_\_\_\_\_\ ]^T$

d) $a = [\ \_\_\_\_\_\ ,\ \_\_\_\_\_\ ,\ \_\_\_\_\_\ ]$, $x = [\ \_\_\_\_\_\ ,\ \_\_\_\_\_\ ,\ \_\_\_\_\_\ ]^T$

e) $a = [\ \_\_\_\_\_\ ,\ \_\_\_\_\_\ ,\ \_\_\_\_\_\ ]$, $x = [\ \_\_\_\_\_\ ,\ \_\_\_\_\_\ ,\ \_\_\_\_\_\ ]^T$

3. Now assume we want to calculate all 5 scores in a single matrix multiplication. Is this possible? If it is, write down the matrices and vectors for this data and model. What do we need to change compared to our linear model $a \cdot x$?