

Homework 1

Instructor: Forrest Bao

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1 question 1:

$$X = [1.1, 2.2, 3.3, 1]$$

2 question 2:

$$W^T = \begin{bmatrix} 1 \\ 0 \\ 1 \\ 0 \end{bmatrix} \cdot [1.1, 2.2, 3.3, 1]$$

$$= 4.4 > 0$$

Hence, x is in class 1

3 question 3:

Loss function in terms of augmented feature vector -

$$J(W) = \sum_{i=1}^N (x_i W^T - y_i)^2$$

Let us consider x_i is the normalized augmented feature vector.

$$J(W) = \sum_{i=1}^N (x_i y_i W^T - y_i)^2$$

$$= \sum_{i=1}^N ((x_i y_i)^T W - y_i)^2$$

4 question 4:

Taking differentiation of $J(W)$ with respect to W :

$$\frac{\partial J(W)}{\partial W} = 2 \sum_{i=1}^N (x_i y_i) ((x_i y_i)^T W - y_i) = 0$$

$$\sum_{i=1}^N (x_i y_i) ((x_i y_i)^T W) = \sum_{i=1}^N y_i (x_i y_i)$$

Considering X as a matrix and replacing element wise expression.

$$\sum_{i=1}^N (x_i y_i) ((x_i y_i) = (Xy)^T (Xy)$$

Same way -

$$\sum_{i=1}^N (x_i y_i) (y_i) = (XY)^T (y)$$

Combining those -

$$((Xy)^T (Xy)) W = (XY).y$$

$$W = [(Xy)^T (Xy)]^{-1} (XY).y$$