

1. The perceptron is a model and an algorithm. True or False. Circle one and explain. (2 points)

Model: neuron

Algorithm: perceptron

2. You are training a perceptron with a set of data that has F features, how many parameters does your model have? Explain. (2 points)

$F + 1$
weights + bias.
one weight for every feature.

3. We have trained a neuron using the perceptron algorithm until convergence. Our resulting weights are $w = [5, -4, 2, -6, 12, 1]$ and $b = 0$. Which feature, $x_1, x_2, x_3, x_4, x_5, x_6$ would you say is the most important? Why? (2 points)

x_5 has the highest weight
 \therefore will have the highest impact
on the activation.

4. Given a perceptron model with parameters $w = [1, 2, 3, 4, 5]$, $b = 1$. How would the model classify the following samples? (4 points)

- (a) $x = [4, 1, 5, 2, 3]$ $+1$
(b) $x = [-1, 1, -1, 1, -1]$ -1
(c) $x = [1, 4, 3, 4, 1]$ $+1$
(d) $x = [-5, -2, 0, 1, 1]$ either.

1. Given the following activation $a = \sum w_i x_i$, our neuron "fires" if $a > 0$. How do we change the threshold from 0 to some value θ ? (2 points)

add a bias b

$$b = \theta$$

2. Given a neuron with parameters $w = [1, 1, 0]$ and $b = -1$, which of the following points are on the decision boundary for the neuron? How do you know? (3 points)

$$p_1 = (1, 2, 3)$$

$$p_2 = (1, 2, -3)$$

$$p_3 = (8, -1, 0)$$

$$p_4 = (2, 6, -8)$$

$$p_5 = (3, -2, 1)$$

$$1 + 2 - 1 \neq 0$$

$$1 + 2 - 1 \neq 0$$

$$8 - 1 - 1 \neq 0$$

$$2 + 6 - 1 \neq 0$$

$$3 - 2 - 1 = 0$$

activation = 0
if on decision boundary.

3. We are training a perceptron model. We have one feature, x_1 . For some sample, s , with label $y = -1$, we get $a > 0$. Using the update rules for the perceptron, show that we will do better on sample s after we update w and b . (3 points)

$$w_{old} x_1 + b_{old} > 0$$

$$w_{new} = w_{old} + x_1, y = w_{old} - x_1$$

$$b_{new} = b_{old} + y = b_{old} - 1$$

$$a_{new} = (w_{old} - x_1) x_1 + b_{old} - 1$$

$$w_{old} x_1 - x_1^2 + b_{old} - 1 < w_{old} x_1 + b_{old}$$

4. Given a perceptron model with parameters $w = [1, 2, 3, 4, 5]$, $b = 1$. How would the model classify the following samples? (3 points)

(a) $x = [-2, -4, 3, 1, 1] + 1$

(b) $x = [-5, -2, 0, 1, 1]$

either

$$-2 - 8 + 9 + 4 + 5 > 0$$

$$-5 - 4 + 0 + 4 + 5 = 0$$