HW 1 - Vectors and Perceptron Worksheet

1) What is the magnitude of $\vec{w} = [0.5, 0.5]$?

$$|\vec{w}| = \sqrt{0.5^2 + 0.5^2} = \sqrt{0.5} = \boxed{0.05\sqrt{2}}$$

2) Multiply the following $(\vec{x} * \vec{w}^T)$, where

$\vec{x} = [0.5, 0.5]$ and $\vec{w} = [0.75, 1.25]$

$$\vec{w}^T = \begin{bmatrix} 0.75 \\ 1.25 \end{bmatrix}$$

$$\vec{x} * \vec{w}^T = [0.5 \quad 0.5] * \begin{bmatrix} 0.75 \\ 1.25 \end{bmatrix}$$

$$= 0.5 \cdot 0.75 + 0.5 \cdot 1.25 = 0.375 + 0.75 = [1.125]$$

3) Multiply the following two vectors $(\vec{x}^T * \vec{w})$ Using the vectors

$$\vec{x}^T = \begin{bmatrix} 0.5 \\ 0.5 \end{bmatrix} \quad \vec{x}^T * \vec{w} =$$

$$\begin{bmatrix} 0.5 \\ 0.5 \end{bmatrix} * [0.75 \quad 1.25]$$

$$= \begin{bmatrix} 0.375 & 0.75 \\ 0.75 & 0.75 \end{bmatrix}$$

4.) What is the dot product of $\vec{x}$ and $\vec{w}$?

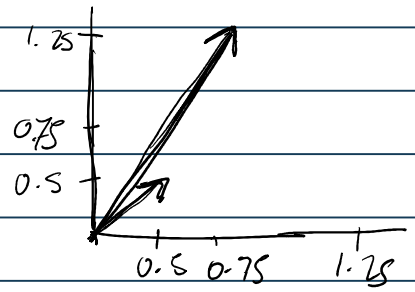
$\vec{x} = [0.5, 0.5]$ and $\vec{w} = [.75, 1.25]$

$\vec{x} \cdot \vec{w} = 0.75 \cdot 0.5 + 1.25 + 0.5$

$= 0.375 + 0.75$

$= 1.125$

5.) Angle between $\vec{x}$ and $\vec{w}$ using the values from the previous problem?



$|\vec{w}| = \sqrt{0.75^2 + 1.25^2}$

$=$

$\cos\theta = \frac{\vec{x} \cdot \vec{w}}{|\vec{x}| \cdot |\vec{w}|} \Rightarrow \theta = \cos^{-1}\left(\frac{\vec{x} \cdot \vec{w}}{|\vec{x}| \cdot |\vec{w}|}\right)$

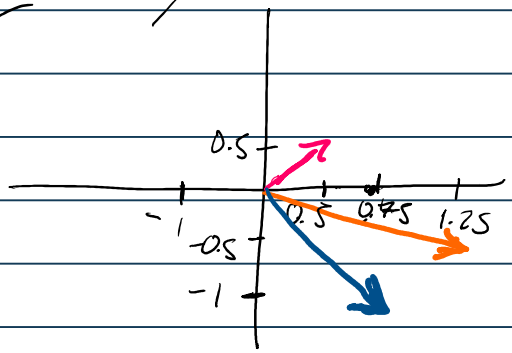
$\theta = \cos^{-1}\left(\frac{1.125}{0.005\sqrt{2} \cdot \sqrt{2.125}}\right)$

$\boxed{\theta = 104.19^\circ}$

6.) Add the following vectors and draw the resultant and the original vectors.

$\vec{x} = [0.5, 0.5]$ $\vec{w} = [0.75, -1]$

$\vec{x} + \vec{w} = [1.25, -0.5] = \vec{c}$



7.)

Classification is about categorizing the given data, usually based on similarities & given attributes.

Prediction is about attempting to predict missing or unavailable values in a dataset. Often through models that attempt to fit a shape that gets as close to the data as possible.

Wednesday, April 12, 2023 5:09 PM

Can't sure if x_0 represented bias weight.

6.) $w_0 = 0$, $w_1 = 0.5$, $w_2 = -0.5$, $\gamma = 0.25$, $x_0 = 1$

	x_1	x_2	OR
1.	0	0	0 ✓
2.	0	1	1 ✓
3.	1	0	1 ✓
4.	1	1	1 ✓

1.) (0,0)

function: $(1)(0) + 0(0.5) + 0(-0.5) = 0$

So, the neuron doesn't fire & is in agreement with the output.

(0,1)

2.) function: $(1)(0) + 0(0.5) + 1(-0.5) = -0.5$

So the value is less than zero, so the neuron doesn't fire, $= 0$, which is incorrect as the output is 1.

$w_0 = 0 - 0.25(0 - 1) \times 1 = 0.25$

$w_1 = 0.5 - 0.25(0 - 1) \times 0 = 0.5$

$w_2 = 0.5 - 0.25(0 - 1) \times 1 = 0.75$

(1,0) 3.) function: $(1)(0.25) + 1(0.5) + 0(0.75) = 0.75$

So, the value is greater than zero, so the neuron fires = 1 This matches the output. So no changes.

(1,1) 4.) function: $(1)(0.25) + 1(0.5) + 1(0.75) = 1.5$

Since the value is greater than zero, the neuron fires = 1, This matches the output, So no changes are made.

(continued) →

5. (Input 1 again) (0, 0)

Function: $= (1)(0.25) + 0(0.5) + 0(0.75) = 0.25$

- Since the value is greater than zero, the neuron fires, so it returns 1. Then, the output = 0.

w_0: $0.25 - 0.25(0.25 - 0) \times 1 = 0.0625$

w_1: $0.5 - 0.25(0.25 - 0) \times 0 = 0.5$

w_2: $0.75 - 0.25(0.25 - 0) \times 0 = 0.75$

6.) (0, 1)

Function $= (1)0.0625 + 0(0.5) + 1(0.75) = 0.8125 > 0.$

So, the neuron fires and returns 1, which matches the output. So no changes are made.

- We can probably conclude at this point that the process will repeat until w_0 is modified to approximate 0, or be less than zero.

The main difficulty here is that 0 = 0, doesn't allow the weight of w_0 to go below zero quickly if at all.