

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

$$\begin{aligned}\sqrt{(0.5)^2 + (0.5)^2} &= \sqrt{0.25 + 0.25} \\ &= \sqrt{0.5} \\ &\approx 0.7071\end{aligned}$$

2. Multiple the following two vectors ($\vec{x} * \vec{w}^T$), where $\vec{x} = [0.5, 0.5]$ and $\vec{w} = [0.75, 1.25]$

$$\begin{aligned}&\begin{bmatrix} 0.5 \\ 0.5 \end{bmatrix} \cdot [0.75, 1.25] \\ &= \begin{bmatrix} 0.375 & 0.625 \\ 0.375 & 0.625 \end{bmatrix}\end{aligned}$$

3. Multiple the following two vectors ($\vec{x}^T * \vec{w}$) using the vectors from the previous problem.

$$[0.5, 0.5] \cdot \begin{bmatrix} 1.75 \\ 1.25 \end{bmatrix} = [1]$$

4. What is the dot product of \vec{x} and \vec{w} using the values from the previous problem?

$$\vec{x} \cdot \vec{w} = .5 \cdot .75 + .5 \cdot 1.25 = 1$$

5. What is the angle between \vec{x} and \vec{w} using the values from the previous problem? Draw the vectors and label the angle that you found.

$$\cos \theta = \frac{a \cdot b}{|\vec{a}| |\vec{b}|}$$

$$\cos \theta = \frac{1}{.7071 \cdot 1.4577}$$

$$\approx \frac{1}{1.03}$$

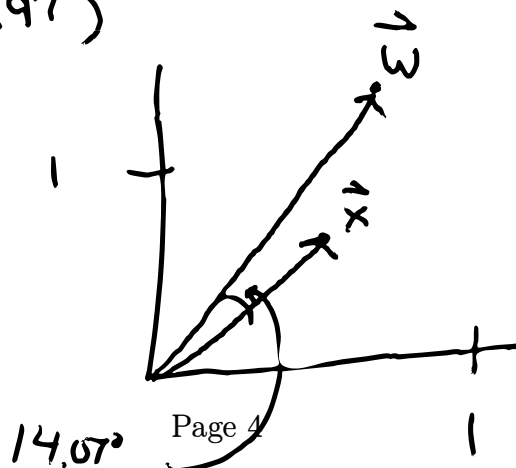
$$\sqrt{.75^2 + 1.25^2}$$

$$\sqrt{.5625 + 1.5625}$$

$$\approx 1.4577$$

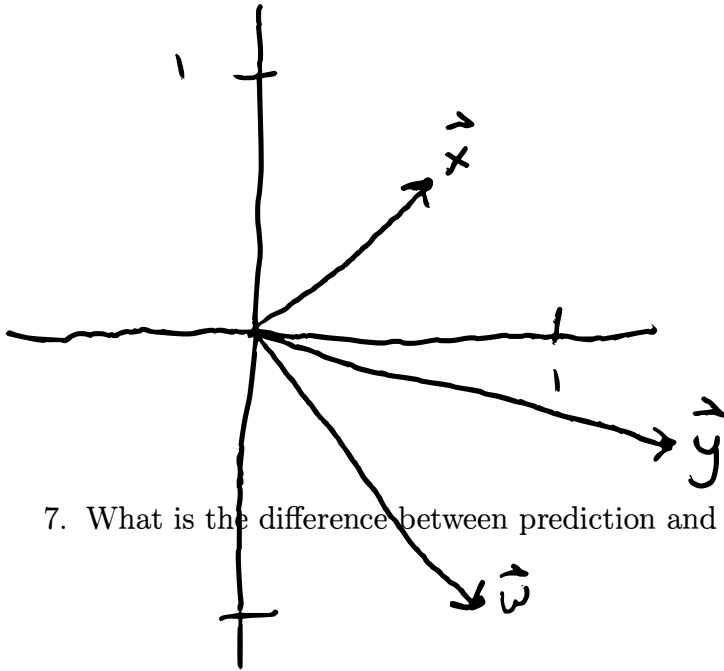
$$\theta = \cos^{-1}(.97)$$

$$\approx 14.07^\circ$$



6. Add the following vectors, and draw the resultant and the original vectors.
 $\vec{x} = [0.5, 0.5]$ and $\vec{w} = [0.75, -1]$

$$\vec{y} = \vec{x} + \vec{w} = \begin{bmatrix} 0.5 \\ 0.5 \end{bmatrix} + \begin{bmatrix} 0.75 \\ -1 \end{bmatrix} = \begin{bmatrix} 1.25 \\ -0.5 \end{bmatrix}$$



7. What is the difference between prediction and classification?

Prediction is used to get as close as possible to a specific value while classification is used to "classify" output by specific category

8. Using the perceptron learning algorithm and a single neuron, find the weights that correctly predict the "OR" function. Continue updating the weights using the algorithm discussed in class until you converge on a correct solution. Show all of your work. The initial weights are $w_0 = 0, w_1 = 0.5, w_2 = -0.5$ and the learning parameter $\nu = 0.25$. You may also assume that $x_0 = 1$.

x_1	x_2	OR
0	0	0
0	1	1
1	0	1
1	1	1

y_1

$$g(0 + 0 + 0) = 0 \quad \checkmark$$

$$g(0 + 0 - 0.5) = g(-0.5) = 0 \quad \times$$

$$g(1 + .5 + 0) = 1 \quad \checkmark$$

$$g(1 + .5 + .5) = 1 \quad \checkmark$$

correct?

y_2

$$g(1 + 0 + 0) = 1 \quad \times$$

$$g(0 + 0 + .5) = 1 \quad \checkmark$$

$$g(0 + .5 + 0) = 1 \quad \checkmark$$

$$g(0 + .5 + .5) = 1 \quad \checkmark$$

y_3

$$g(0 + 0 + 0) = 0 \quad \checkmark$$

$$g(0 + 0 + .5) = 1 \quad \checkmark$$

$$g(0 + .5 + 0) = 1 \quad \checkmark$$

$$g(0 + .5 + .5) = 1 \quad \checkmark$$

$$w_0 = 0 - (0 - 1)1 = 1$$

$$w_1 = .5 - (0 - 1)0 = .5$$

$$w_2 = -.5 - (0 - 1)1 = .5$$

$$w_0 = 1 - (1 - 0)1 = 0$$

$$w_1 = .5 - (1 - 0)0 = .5$$

$$w_2 = .5 - (1 - 0)0 = .5$$