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

$$|\vec{w}| = \sqrt{0.5^2 + 0.5^2} = \boxed{0.707}$$

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

$$[0.5, 0.5] \times \begin{bmatrix} 0.75 \\ 1.25 \end{bmatrix} = [0.5 \cdot 0.75 + 0.5 \cdot 1.25]$$

$$= \boxed{[1]}$$

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

$$\begin{bmatrix} 0.5 \\ 0.5 \end{bmatrix} \times \begin{bmatrix} 0.75, 1.25 \end{bmatrix} = \boxed{\begin{bmatrix} 0.375 & 0.625 \\ 0.375 & 0.625 \end{bmatrix}}$$

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

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

$$= \boxed{1}$$

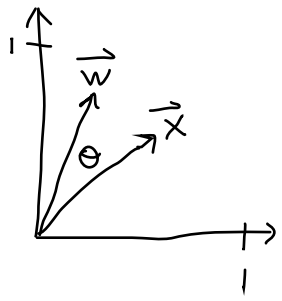
5. What is the angle between $\vec{x}$ and $\vec{w}$ using the values from the previous problem? Draw the vectors and label the angle that you found.

$$|\vec{x}||\vec{w}|\cos\theta = \vec{x} \cdot \vec{w}$$

$$\cos\theta = \frac{1}{|\vec{x}||\vec{w}|}$$

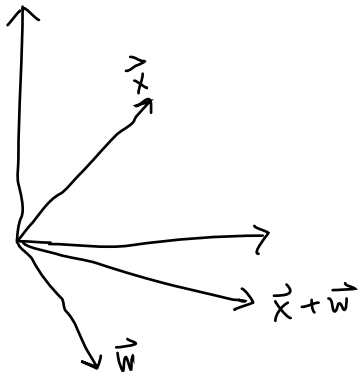
$$\cos\theta = \frac{1}{1.03}$$

$$\boxed{\theta = 14.036^\circ}$$



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

$\vec{x} + \vec{w} = [0.5 + 0.75, 0.5 - 1] = \boxed{[1.25, -0.5]}$




7. What is the difference between prediction and classification?

Prediction refers to predicting missing values for a dataset.
Classification is a type of prediction, where categorical variables are predicted to split the data into groups.

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 |

First iteration:

Input: [0,0], y: 0, t: 0
No update since y = t

Input: [0,1], y: 0, t: 1
w0 = 0 − 0.25(0 − 1) • 1 = 0.25
w1 = 0.5 − 0.25(0 − 1) • 0 = 0.5
w2 = −0.5 − 0.25(0 − 1) • 1 = −0.25

Input: [1,0], y: 1, t: 1
No update since y = t

Input: [1,1], y: 0, t: 1
w0 = 0.25 − 0.25(0 − 1) • 1 = 0.5
w1 = 0.5 − 0.25(0 − 1) • 1 = 0.75
w2 = −0.25 − 0.25(0 − 1) • 1 = 0

---

Second iteration:

Input: [0,0], y: 0, t: 0
No update since y = t

Input: [0,1], y: 1, t: 1
No update since y = t

Input: [1,0], y: 1, t: 1
No update since y = t

Input: [1,1], y: 1, t: 1
No update since y = t

w0=0.5, w1 = 0.75, w2 = 0