Homework 1 - Linear Algebra

1. **Normalize the vector $\mathbf{v} = [1, 2, 3]$. Round your answer to 2 decimal points.**

2. **Simplify and Find the Length of the Vector**

   (a) **3 * [1, 1] + 2 * [-1, 1]**

   (b) **Find the length of the vector calculated in (a)**

3. **Calculate the Cross Product**

   (a) $[\mathbf{0, 1, 1}] \times [\mathbf{1, 1, 0}]$

   (b) $[\mathbf{2, 3, 4}] \times [\mathbf{1, 0, 0}]$

   (c) $[\mathbf{0, 3, 4}] \times [\mathbf{2, 2, 2}]$

4. **Calculate the Dot Product**

   (a) $[\mathbf{1, 0, 1}] \cdot [\mathbf{0, 1, 1}]$

   (b) $[\mathbf{0, 3, 4}] \cdot [\mathbf{1, 0, 0}]$

   (c) $[\mathbf{2, 3, 4}] \cdot [\mathbf{6, 4, 3}]$

5. **Consider a triangle formed by connecting the three points $\mathbf{p_1} = (0, 0, 0)$, $\mathbf{p_2} = (1, 0, 0)$ and $\mathbf{p_3} = (1, 1, 1)$.**

   (a) **Find the area of the surface of this triangle.**

   (b) **Find the vector which is perpendicular to the surface of this triangle, AND has a positive z-direction.**

6. **Calculate the Matrix**

   (a) $\begin{bmatrix} 1 & 2 & 5 \\ -1 & -1 & 1 \\ 4 & 4 & -2 \end{bmatrix} \cdot \begin{bmatrix} 1 \\ 2 \\ 3 \end{bmatrix}$

   (b) $\begin{bmatrix} 2 & 0 & 3 \\ 0 & -1 & 2 \\ 3 & 2 & -2 \end{bmatrix} \cdot \begin{bmatrix} -1 & -4 & 1 \\ 1 & -1 & 4 \\ 0 & 0 & 5 \end{bmatrix}$

7. **Consider two lines $\mathbf{y} = \frac{4}{3}\mathbf{x} - \mathbf{1}$ and $y = 0$:**

   (a) **Find the intersection point between the two lines (Draw the lines on a graph if stuck).**

   (b) **Are these lines perpendicular?**