Assignment 1
Linear Algebra

Swati Mohanty (EE20RESCH11007)

September 2020

1 Problem

Find the area of a rectangle $ABCD$ with vertices $A = \begin{pmatrix} -1 \\ \frac{1}{2} \\ 4 \end{pmatrix}$, $B = \begin{pmatrix} 1 \\ \frac{1}{2} \\ 4 \end{pmatrix}$, $C = \begin{pmatrix} 1 \\ -\frac{1}{2} \\ 4 \end{pmatrix}$, $D = \begin{pmatrix} -1 \\ -\frac{1}{2} \\ 4 \end{pmatrix}$.

2 Solution

Method 1: The adjacent sides of the rectangle are BA and AD (i.e. length and breadth). Area of a rectangle = length * breadth = AD*BA.
AD = $\mathbf{A} - \mathbf{D}$
$= \begin{pmatrix} -1 \\ \frac{1}{2} \\ 4 \end{pmatrix}$ - $\begin{pmatrix} -1 \\ -\frac{1}{2} \\ 4 \end{pmatrix} = 1$
Similarly, BA = $\mathbf{B} - \mathbf{A} = 2$. Thus, area = 1*2 = 2 sq.units

Method 2: Area of rectangle = cross product of vectors of adjacent sides
Side $\mathbf{AD} = \mathbf{A}$ - $\mathbf{D} = \begin{pmatrix} 0 \\ -1 \\ 0 \end{pmatrix}$ Side $\mathbf{BA} = \mathbf{B}$ - $\mathbf{A} = \begin{pmatrix} 2 \\ 0 \\ 0 \end{pmatrix}$
Area = $\mathbf{AD}$ X $\mathbf{BA} = \begin{pmatrix} 0 \\ -1 \\ 0 \end{pmatrix}$ X $\begin{pmatrix} 2 \\ 0 \\ 0 \end{pmatrix}$
$= \begin{pmatrix} 0 & -0 & 1 \\ 0 & 0 & 0 \\ -1 & 0 & 0 \end{pmatrix} \mathrm{X} \begin{pmatrix} 2 \\ 0 \\ 0 \end{pmatrix} = 2$
Python code link

https://github.com/Swati-Mohanty/EE5600/blob/master/Assignment1/Code/quad_area.py