Adamson University
College of Engineering
Computer Engineering Department

Linear Algebra

Laboratory Activity No. 3

# Linear Combinations and Vector Spaces

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# I. Objectives

This laboratory aims to understand how linear equations work as it visualizes its representation using the functions of Numpy and python by which it gives definition as a graph or plot.

# II. Methods

This laboratory activity introduces the method of plotting vectors with linear combinations that is a first-degree type of polynomial. The plot will be depending on its linear term or rank when described on matrix. Numpy here was used to define and plot the given or created linear combinations or equations and different functions here was defined as well in order to process the plotting of equation.

This activity also intends to represent linear combinations by its plot and see the relation to it as a vector in order to visualize its dimension or plot as it being represented as a code and with the use of different function from the Numpy library. The Numpy and Matplot library will give definition and methods of functions to run all necessary codes to have the final output as a graph or plot within the manipulation of linear combinations.

# III. Results

The first task is just simply depicting a simple type of linear combination as shown in the figure two that also should be shown first its equation as latex then matrix type and its final equation when it is going to be a code. The actual code consist of the vectors which as shown below, there are two which is the x and y that is described as an array as function, then the next on the coding is the spaces which was described and defined by the function ‘np.arange’ that has three parts which the first one is the start which was on the key zero, end for the value of key one and step for the value of key two. The function ‘plt.scatter’ defines the graph or the plot of the given linear equation where the key of the array vector was called and can add color for it to distinguish where it belong. All the necessary elements and functions was called and defined for it to run the show function then the final output and the graph is being represented.

$$X = (8x + 7y)\ ,\ Y = (2x + 8y)$$

$$X = \begin{bmatrix} 8 \\ 7 \end{bmatrix}, Y = \begin{bmatrix} 2 \\ 8 \end{bmatrix}$$

$$X = c \cdot \begin{bmatrix} 8 \\ 7 \end{bmatrix},\ Y = c \cdot \begin{bmatrix} 2 \\ 8 \end{bmatrix}$$

Figure 1 Task 1 Equation

```
#vectors
vectX = np.array([8,7])
vectY = np.array([2,8])

#spaces
c = np.arange(-10,10,0.2)

plt.scatter(c*vectX[0],c*vectX[1], color='green')
plt.scatter(c*vectY[0],c*vectY[1], color='orange')

plt.xlim(-10,10)
plt.ylim(-10,10)
plt.axhline(y=0, color='red')
plt.axvline(x=0, color='blue')

plt.grid()
plt.show()
```

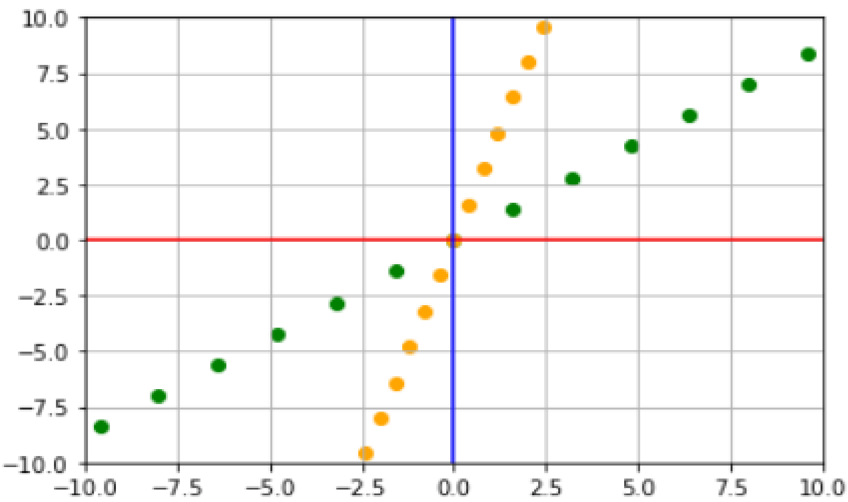


Figure 2 Task 1

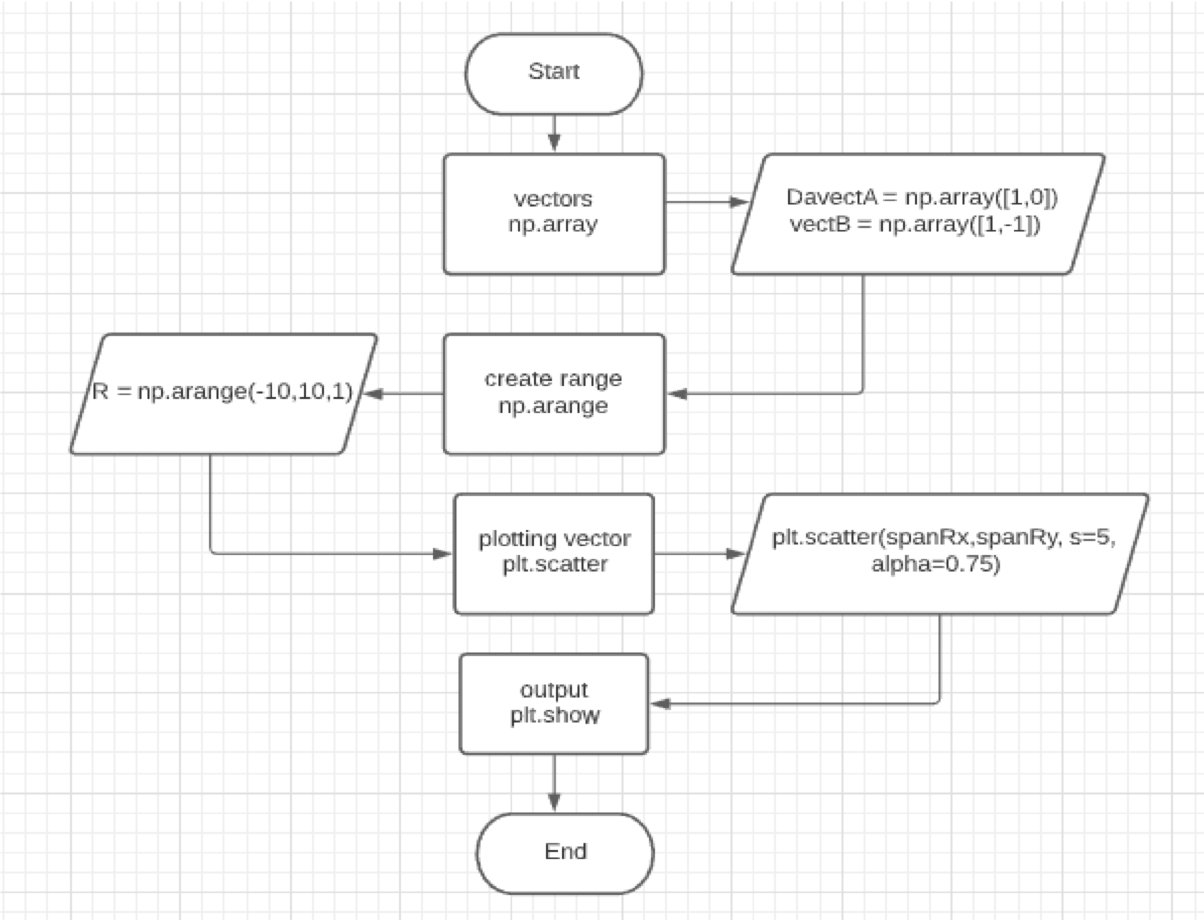


Figure 3 Task 1 Flowchart

The task two is kind of the same in task one as shown on the codes below in the figure five but it gives more definition to its graph. Other functions are defined to create a rectangular grid that gives more definition to the representation of the graphing of the linear equations. The function scatter from the task is kind of the same as the function or the method of variable that is called as span, and there, the vectors were called and its corresponding keys for it to perform the operation of the given equation then call also the other different aspects needed for the graph, then lastly, the final output is to be performed that gives a final outcome that is a plane.

$$X = (-3x + 5y)\ ,\ Y = (-6x + 2y)$$

$$X = \begin{bmatrix} -3 \\ 5 \end{bmatrix}, Y = \begin{bmatrix} -6 \\ 2 \end{bmatrix}$$

$$S = \left\{ c_1 \cdot \begin{bmatrix} -3 \\ 5 \end{bmatrix}, c_2 \cdot \begin{bmatrix} -6 \\ 2 \end{bmatrix} \right\}$$

Figure 4 Task 2 Equation

```
#vectors
vectX = np.array([-3,5])
vectY = np.array([-6,2])

#range
C = np.arange(-10,10,0.5)
c1, c2 = np.meshgrid(C,C)

vectZ = vectX + vectY
spanRx = c1*vectX[0] + c2*vectY[0]
spanRy = c1*vectX[1] + c2*vectY[1]
plt.scatter(spanRx,spanRy, s=5, alpha=0.75, color='red')

plt.axhline(y=0, color='blue')
plt.axvline(x=0, color='green')
plt.grid()

plt.show()
```

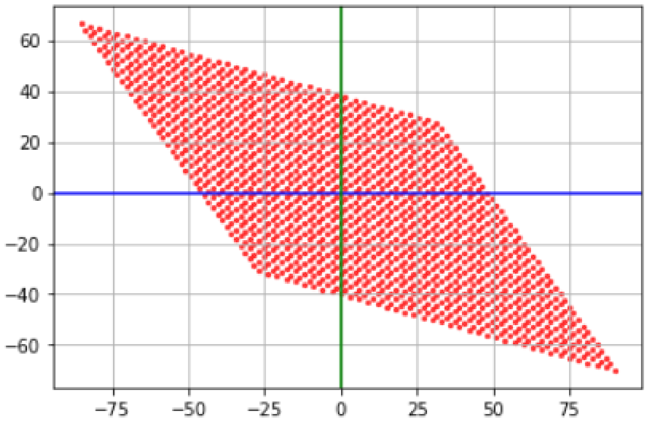


Figure 5 Task 2

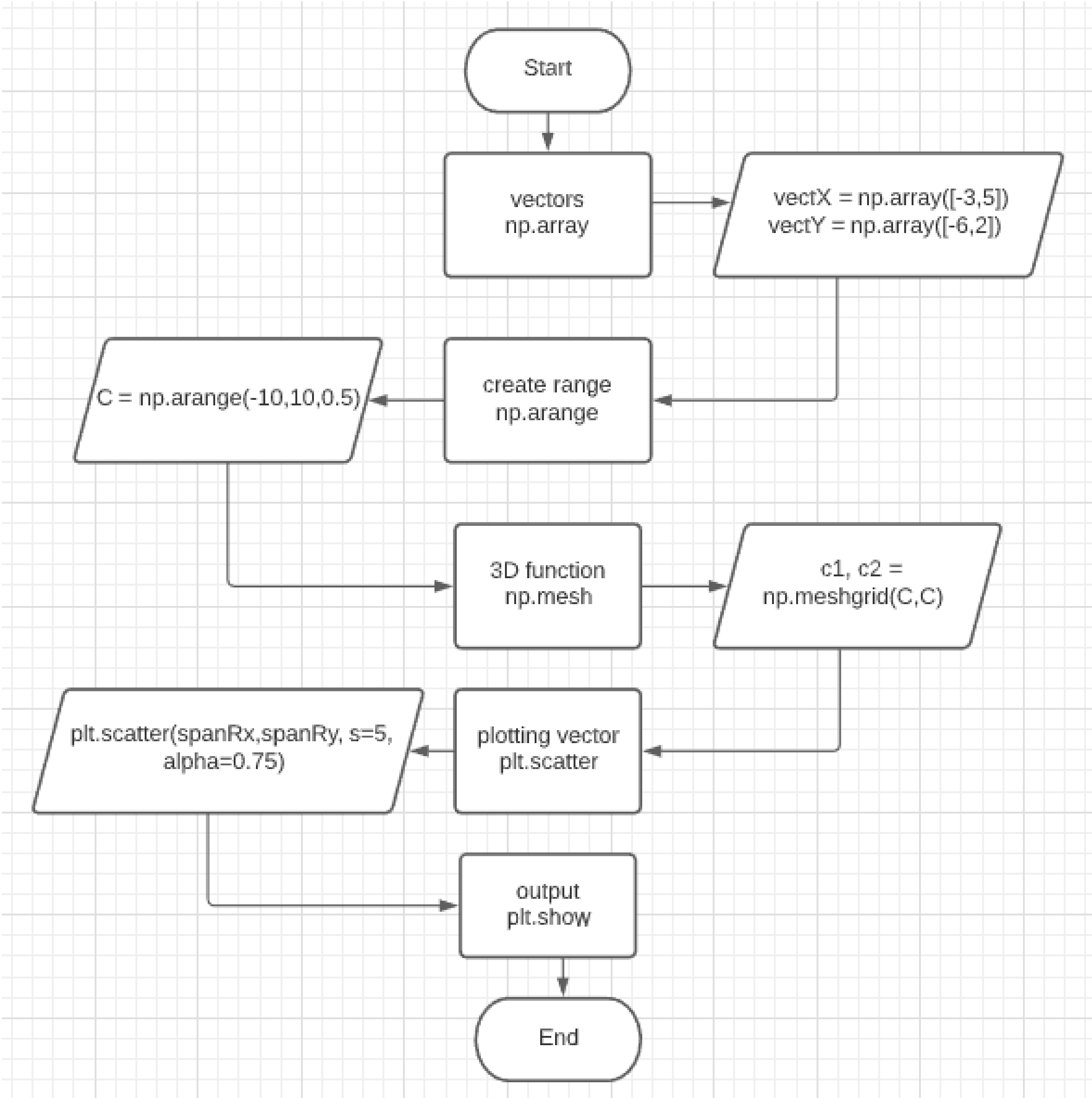


Figure 6 Task 2 Flowchart

# IV. Conclusion

Linear combinations and vector spaces are related to each other in a sense that it can be represented as a graph or plot in order to visualize its outcome or how the way it is. These two are actually can be related to the real-life application which is very wide when it comes to its usefulness to the society. It visualizes different dimension such, shapes and 3D objects such as the furniture at home like tables, chair and cabinets since these have shapes and dimension that can be actually computed or manipulated by linear combinations. This is something important to analyze and learn most especially for engineering students since they must have a broad mind by which they must see objects with equations and its representation and with the use of vector spaces and linear equations, it can be now be easily understood how things work in real-life situation.

# References

[1] D.J.D. Lopez. "Adamson University Computer Engineering Department Honor Code," AdU-CpE Departmental Policies, 2020.

# Code Link

**https://github.com/cherrylyncanoza/Linear-Algebra/tree/main/LinAlg_Lab3**