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Linear Algebra

Laboratory Activity No. 10

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# Linear Transformations

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January 2, 2021

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## I. Objectives

At the end of this activity you will be able to:

1. Be familiar with the role of matrix operations.
2. Visualize matrix operations.
3. Justify the precedence of matrix operations through Python.

## II. Results

Try to implement the linear transformations using spans using the scatterplot view. Just do at least one example of linear transformation for a 2D space.

```
In [8]: def scatter_plot(x,t_mat=np.eye(2)):
        x_prime = x @ t_mat

        R = np.arange(-14,12,1)
        c1, c2 = np.meshgrid(R,R)

        spanRx = c1*x_prime[0][0] + c2*x_prime[1][0]
        spanRy = c1*x_prime[0][1] + c2*x_prime[1][1]
        plt.scatter(spanRx ,spanRy, s=5, alpha=1)

        plt.axhline(y=0, color='b')
        plt.axvline(x=0, color='b')
        plt.grid()
        plt.show()
```

```
In [9]: #Rotation
def matrix_rotation(theta):
    theta = np.deg2rad(theta)
    rot_matrix = np.array([
        [np.cos(theta), -np.sin(theta)],
        [np.sin(theta), np.cos(theta)]
    ])
    return rot_matrix
```

```
In [10]: scatter = np.eye(2)
scatter_plot(scatter)

rotate = matrix_rotation(45)
scatter_plot(scatter@rotate)
```

Figure 1 Input

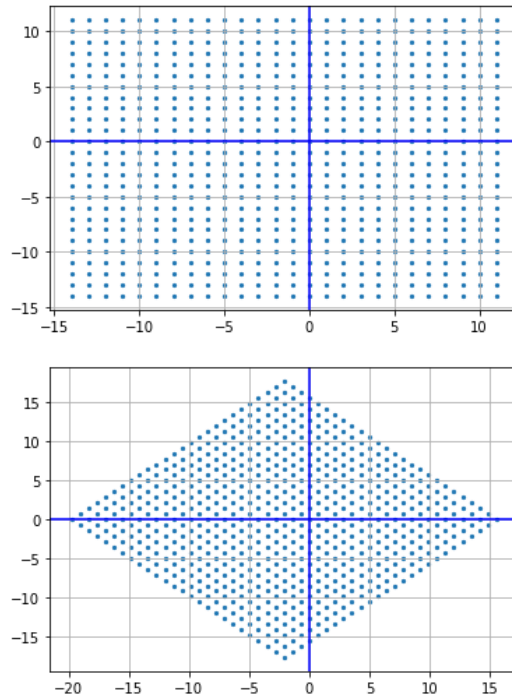


Figure 2 Output

## METHODOLOGY

The methods and functions that applied for this lab activity which is Linear Transformations was using of Python and NumPy. The `np.eye()` function is to return a 2- D array with ones on the diagonal and zeros as you can see in Figure 2 Output [1]. The `np.arange()` function, it creates an instance of ndarray with evenly spaced values and returns the references to it [2]. The `np.meshgrid()` function is used to create a rectangular grid out of two given one-dimensional arrays representing the Cartesian indexing or Matrix indexing and the results are in Figure 2 Output [3]. When it comes in modifications in the output, `plt.scatter()` function will be varying marker size and color and `plt.axhline()` function to add the position data coordinates of the horizontal line across the axis [4]. When it comes in code block of rotation, the `np.deg2rad()` function is to convert the angles from degree to radian with the arrays of `np.cos(theta)` and `np.sin(theta)` function [5]. These are the major functions that was used in the input program in order to display the desired output and

## My Github Repository Link

<https://github.com/martinliwag/Lin-Alg-Lab-10---Linear-Transformations-Martin-Liwag-.git>

## III. Conclusion

As a conclusion briefly explain the essence of linear transformations. Additionally, cite an example of using linear transformation in mechanics.

As we live in a society where automated information resources are increased and will continue to increase in importance as a security mechanism. Electronic networks for banking, shopping, inventory control, benefit and service delivery, information storage and retrieval, distributed processing, and government applications will need improved methods for access control and data security which applies the linear transformation in every aspect of these examples. The example that I cited of using linear transformation in mechanics are Annulus and Cylinder a surface created by projecting a closed two-dimensional curve along an axis intersecting the plane of the curve and that applies the linear transformations [6].

## IV. References

- [1] "NumPy," 29 June 2020. [Online]. Available: <https://numpy.org/doc/stable/reference/generated/numpy.eye.html>. [Accessed 1 January 2021].
- [2] M. Stojiljković, "NumPy arange(): How to Use np.arange()," [Online]. Available: <https://realpython.com/how-to-use-numpy-arange/>. [Accessed 01 January 2021].
- [3] 09 April 2019. [Online]. Available: <https://www.geeksforgeeks.org/numpy-meshgrid-function/>. [Accessed 01 January 2021].
- [4] "matplotlib.axes.Axes.axhline," [Online]. Available: [https://matplotlib.org/3.3.3/api/\\_as\\_gen/matplotlib.axes.Axes.axhline.html](https://matplotlib.org/3.3.3/api/_as_gen/matplotlib.axes.Axes.axhline.html). [Accessed 01 January 2021].

- [5] "NumPy deg2rad() Method," [Online]. Available: <https://www.javatpoint.com/numpy-deg2rad/>. [Accessed 01 January 2021].
- [6] "Cylinder vs Annulus - What's the difference?," [Online]. Available: <https://wikidiff.com/annulus/cylinder>. [Accessed 01 January 2021].