Adamson University
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Linear Algebra

Laboratory Activity No. 8

System of Linear Equations

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I. Objectives

This laboratory activity aims to implement the principles and techniques of systems of linear equations. The objective of this activity is learning how to solve a system of linear equations. It also aims to implement the learnings of Cramer's rule, Gauss-Jordan, and Gaussian rule.

II. Methods

- The practices in this laboratory activity are to understand the linear equation system and do it in codes.
    - The laboratory activity implies that researchers were learning how to find the variables' values in a linear equation system.
- The laboratory activity provides the researchers with a knowledge of how to determine the real-world problem that can be solved by a system of linear equations like business and circuits.
    - The researchers achieved to solve a system of linear equations by using python and the NumPy libraries. The researchers also achieved it by studying Cramer's rule, Gauss-Jordan, and Gaussian rule.

Example of linear Equation:

At a store you purchase 2 bottle water & 3 candy bars for 5.25 dollars. Your friend purchase 5 bottle waters & 1 candy bar for 8.25 dollars. What is the cost of a bottle water and a candy bar?

Figure 1. Created system of linear equation problem

Figure 1 shows that the researchers created a world problem; it is a linear equation that needs to find one bottled water and candy bar value.

$$A = \begin{cases} 2b + 3c = 5.25 \\ 5b + c = 8.25 \end{cases}$$

$$\begin{bmatrix} 2 & 3 \\ 5 & 1 \end{bmatrix} \cdot \begin{bmatrix} b \\ c \end{bmatrix} = \begin{bmatrix} 5.25 \\ 8.25 \end{bmatrix}$$

Figure 2. Created Matrix

Figure 2 shows the created system of linear equation and matrix in the world problem of Figure 1. Let variable B as bottled water and variable C as a candy bar.

III. Results

```
foods = np.array([
    [2, 3],
    [5, 1]
])
cost_all = np.array([
    [5.25],
    [8.25]
])
```

Figure 3. Initialization of matrix

Figure 3 shows that to compute linear equations, the researchers need to create two matrices. The first matrix created is $\begin{matrix} 2b + 3c \\ 5b + c \end{matrix}$ it represents the gathered information in the word problem created by the researcher. The second matrix cost_all = $\begin{matrix} 5.25 \\ 8.25 \end{matrix}$ The first element of the matrix is the amount of 2 bottles of water & 3 candy bar. The next element in the matrix is the amount of 5 bottles of water & 1 candy bar.

```
prices = np.linalg.inv(foods) @ cost_all
print('The price of one bottle water is: $ {:.2f}'.format(float(prices[0])))
print('The price of one candy bar is: $ {:.2f}'.format(float(prices[1])))
```

```
The price of one bottle water is: $ 1.50
The price of one candy bar is: $ 0.75
```

Figure 4. Input and Output using np.linalg.inv()

Figure 4 shows that the np.linalg.inv() function create an inverse matrix on the given parameter. Solving for a linear equation system needs the second matrix to multiply the first given matrix's inverse. This process results from a (2,1) matrix. The first element is the variable B/ bottled water, and the second element is the variable C/ candy bar.

```
price_linalg = np.linalg.solve(foods, cost_all)
print('The price of one bottle water is: $ {:.2f}'.format(float(price_linalg[0])))
print('The price of one candy bar is: $ {:.2f}'.format(float(price_linalg[1])))
```

```
The price of one bottle water is: $ 1.50
The price of one candy bar is: $ 0.75
```

Figure 5. Input and Output using np.linalg.solve()

Figure 5 shows that the NumPy library has a function that computes the system of linear equations. In this case, it is the same as the result of Figure 4. The only difference in this method is that it uses a function called np.linalg.solve(). It automatically computes for the linear matrix equation. This function's difference is that the first matrix does not need to find the matrix's inverse.

IV. Conclusion

The use of a system of linear equations in robotics is the movement of the robot. The first is using the inverse kinematics of a robot, implementing the law of sine and cosine. Lastly, the linear equation system in robotics is the robotic motion and orthogonal matrices, wherein it computes the robot's movement using matrices.

References

[1] "numpy.linalg.solve," *numpy.linalg.solve - NumPy v1.19 Manual*. [Online]. Available: https://numpy.org/doc/stable/reference/generated/numpy.linalg.solve.html. [Accessed: 14-Dec-2020].

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Github source:

https://github.com/Zofserif/Linear-Algebra/blob/master/Lab8/LinAlg%20Lab%208.ipynb