Practicum Case	
MATH6183 | MATH6183001 | MATH6183016 | MATH6183049 Scientific Computing	
Mathematics & Statistics	**E231-MATH6183-JJ01-02**
Valid on *Even Semester Year 2022/2023*	**Revision 00**

Learning Outcomes

- LO2 – solve the systems of linear algebraic equations, eigenvalues, eigenvectors, regression and interpolation through scientific computation

Topic

- Session 02 – System of Linear Equation

Subtopics

- Gauss-Seidel Linear Equation
- NumPy

Soal
Case

Solving Linear Equation

Solve the following **system of linear equations** with the following **requirements**:

- You must determine whether the **equations** are **diagonally dominant programmatically**. If the equation is **not diagonal**, then **print error message.**
- If the equations are **diagonally dominant**, use **Gauss-Seidel method** and the number **15** as the **maximum iterations**. **Otherwise**, show a **message** telling the equations are **not diagonally dominant**.
- Use a **pre-defined threshold** $\epsilon = 0.022$
- Use the **value 0** as the **initial value** of x_1, x_2, x_3, and x_4.

Then, **show the result** for each equations and check whether the equations below are **convergent or not** and print the value of x1, x2, x3, and x4 in each iteration.

Below are the **systems of linear equations** that you need to solve:

$$\begin{aligned} 4x_1 + 2x_2 - x_3 &= 41 \\ x_1 - 5x_2 + 2x_3 &= -10 \\ 2x_1 - x_2 - 4x_3 &= 1 \end{aligned}$$

$$\begin{aligned} 3x_1 + 4x_2 + 5x_3 &= 34 \\ -3x_1 + 7x_2 - 4x_3 &= -32 \\ x_1 - 4x_2 - 2x_3 &= 62 \end{aligned}$$

$$\begin{aligned} 9x_1 - 2x_2 + 3x_3 + 2x_4 &= 55 \\ 2x_1 + 8x_2 - 2x_3 + 3x_4 &= -14 \\ -3x_1 + 2x_2 + 11x_3 - 4x_4 &= 12 \\ -2x_1 + 3x_2 + 2x_3 + 10x_4 &= -21 \end{aligned}$$

Below are the **snippet code** for the equations above:

```
Xs = [
    [
      [4, 2, -1],
      [1, -5, 2],
      [2, -1, -4]
    ],
    [
      [3, 4, 5],
      [-3, 7, -4],
      [1, -4, -2]
    ],
    [
      [9, -2, 3, 2],
      [2, 8, -2, 3],
      [-3, 2, 11, -4],
      [-2, 3, 2, 10]
    ]
]
Ys = [
    [41, -10, 1],
    [34, -32, 62],
    [55, -14, 12, -21]
]
```

```
A: [[4, 2, -1], [1, -5, 2], [2, -1, -4]], y = [41, -10, 1]
iter:  1 [10.25    4.05    3.8625]
iter:  2 [9.190625   5.383125   2.99953125]
iter:  3 [8.30832031 4.86147656 2.68879102]
iter:  4 [8.49145947 4.7738083  2.80227766]
iter:  5 [8.56366526 4.83364412 2.8234216 ]
iter:  6 [8.53903334 4.83717531 2.81022284]
iter:  7 [8.53396806 4.83088275 2.80926334]
convergen

A: [[3, 4, 5], [-3, 7, -4], [1, -4, -2]], y = [34, -32, 62]
not diagonally dominant

A: [[9, -2, 3, 2], [2, 8, -2, 3], [-3, 2, 11, -4], [-2, 3, 2, 10]], y = [55, -14, 12, -21]
iter:  1 [ 6.11111111 -3.27777778  3.35353535 -0.56515152]
iter:  2 [ 4.39046016 -1.79729938  2.40957938 -1.16463403]
iter:  3 [ 5.16732568 -2.00269881  2.44080351 -0.95388592]
iter:  4 [ 5.06444041 -2.04820201  2.49765287 -0.97218189]
iter:  5 [ 5.03944457 -2.02087972  2.47921505 -0.98169018]
iter:  6 [ 5.05377509 -2.02550619  2.48050699 -0.97769452]
convergen
```

Figure 1. Gauss Seidel Result with Epsilon 0.022