TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING

PURWANCHAL CAMPUS
Dharan-8

A Lab Report On: To Solve The System Of Linear Algebraic Equation Using Gauss Elimination Method

Submitted By

Name: Dhiraj KC
Roll No. : PUR077BEI014
Faculty: Electronics, Communication and Information
Group: A

Submitted To

Department Of Electronics and Computer Engineering
Checked By: Pukar Karki

TITLE: TO SOLVE THE SYSTEM OF LINEAR ALGEBRAIC EQUATION USING GAUSS ELIMINATION METHOD

THEORY

In Gauss Elimination Method, the unknown values are eliminated successfully and the system is reduced to a triangular system from which these unknown values are determined using substitution. It can be done by using two methods.

1. Forward Elimination

   Given system is reduced to upper triangular matrix.

$$\begin{pmatrix} a_1 & b_1 & c_1 & : & d_1 \\ 0 & b_2' & c_2' & : & d_2' \\ 0 & 0 & c_3'' & : & d_3'' \end{pmatrix}$$

2. Backward Elimination

   Given system is reduced to lower triangular matrix.

$$\begin{pmatrix} a_1'' & 0 & 0 & : & d_1'' \\ a_2' & b_2' & 0 & : & d_2' \\ a_3 & b_3 & c_3 & : & d_3 \end{pmatrix}$$

Consider a system of linear equation,

$$a_1x + b_1y + c_1z = d_1$$
$$a_2x + b_2y + c_2z = d_2$$
$$a_3x + b_3y + c_3z = d_3$$

Step 1: The Argument Matrix is

$$\begin{pmatrix} a_1 & b_1 & c_1 & : & d_1 \\ a_2 & b_2 & c_2 & : & d_2 \\ a_3 & b_3 & c_3 & : & d_3 \end{pmatrix}$$

Step 2: Elimination of 'x' from second and third row, applying $R_2 \to R_2 - \frac{a_2}{a_1}R_1, R_3 \to R_3 - \frac{a_3}{a_1}R_1$

$$\begin{pmatrix} a_1 & b_1 & c_1 & : & d_1 \\ 0 & b_2' & c_2' & : & d_2' \\ 0 & b_3' & c_3' & : & d_3'' \end{pmatrix}$$

Step 3: Elimination of 'y' from third row. $R_3 \to R_3 - \frac{b_3'}{b_2'}R_2$

$$\begin{pmatrix} a_1 & b_1 & c_1 & : & d_1 \\ 0 & b_2' & c_2' & : & d_2' \\ 0 & 0 & c_3'' & : & d_3'' \end{pmatrix}$$

Step 4: Evaluate the unknown values using backward substitution.

$$c_3'z = d_3''$$
$$z = \frac{d_3''}{c_3''}$$
$$b_2'y + c_2'z = d_2'$$
$$y = \frac{d_2' - c_2'z}{b_2'}$$
$$a_1x + b_1y + c_1z = d_1$$
$$x = \frac{d_1 - b_1y - a_1z}{a_1}$$

ALGORITHM

1. Start
2. Read number of unknowns: n
3. Read argument matrix A of n by n+1 size
4. Transform argument matrix A to upper triangle matrix by row operation.
5. Obtain solution by Back Substitution
6. Display Result
7. Stop

PROGRAM

```
import numpy as np

a = np.array([[3, -2, 5, 0],
        [4, 5, 8, 1],
        [1, 1, 2, 1],
        [2, 7, 6, 5]], float)
b = np.array([2, 4, 5, 7], float)
n = len(b)
x = np.zeros(n, float)

# Elimination Stage
for i in range(n-1):
  for j in range(i+1, n):
    if a[j][i] == 0:
      continue
    factor = a[i][i]/a[j][i]
    for k in range(i, n):
      a[j][k] = a[i][k] - a[j][k]*factor
    b[j] = b[i]-b[j]*factor

# Back Substitution
x[n-1] = b[n-1] / a[n-1][n-1]
for i in range(n-2, -1, -1):
  sum = 0
  for j in range(i+1, n):
    sum += a[i][j]*x[j]
  x[i] = (b[i] - sum)/a[i][i]

print("The solution is ", x)
```

OUTPUT

```
The solution is  [ 28.77777778   2.16666667 -16.         6.05555556]
```