

# NUMERICAL ANALYSIS REPORT 2

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## TABLE OF CONTENTSX

PSUEDOCODES .....	2
Gauss elimniation.....	2
Gauss seidel.....	3
Test runs.....	4
Gauss elimination (Example 1) .....	4
Gauss elimination (Example 2) .....	5
Gauss elimination (Example 3) .....	6
Gauss seidel (Example 1).....	7
Gauss Seidel (Example 2) .....	8
Gauss Seidel (Example 3) .....	9
THE GUI.....	10

# PSUEDOCODES

## GAUSS ELIMINATION

1. First step we read the equations from the user through the GUI, and store it in an array of strings then using MATLAB function 'equationsToMatrix(eqs)' we took the coefficients of the linear equation system and used it to create a matrix as shown down below

$$\begin{bmatrix} a_{11} & a_{12} & a_{13} & a_{14} \\ a_{21} & a_{22} & a_{23} & a_{24} \\ a_{31} & a_{32} & a_{33} & a_{34} \end{bmatrix}$$

2. Gauss elimination is applied on the matrix using the following pseudocode on matrix A shown above where N is the dimensions of matrix A (forward elimination)

---

```
    for j=1 to N-1
        for i=j+1 to N
            m = Ai,j / Aj,j
            Ai,: = Ai,: - m*Aj,: 
        end
    end
    X(N) = AN,N+1/AN,N
```

---

3. Solution now can be obtained by backward substitution which is the next step (Backward Substitution)

```
    for k=N-1 to 1
        X(k) = (Ak,N+1 - Ak,k+1:N*X(k+1:N))/Ak,k;
    End
```

## GAUSS SEIDEL

1. Indirect iterative method to be implemented to get gauss-seidel algorithm

$$x_i^{(k+1)} = \frac{b_i}{a_{i,i}} - \sum_{j=1}^{i-1} \frac{a_{i,j}}{a_{i,i}} x_j^{(k+1)} - \sum_{j=i+1}^n \frac{a_{i,j}}{a_{i,i}} x_j^k \quad \begin{matrix} i = 1, 2, 3, \dots, n \\ k = 0, 1, 2, \dots \end{matrix}$$

Where for  $k = 0, X^0$  is to be known and  $|a_{i,i}| \geq \sum |a_{i,j}|$

2. here we read the equations from the user through the GUI, and store it in an array of strings then using MATLAB function 'equationsToMatrix(eqs)' we took the coefficients of the linear equation system and used it to create a matrix as shown down below

$$\begin{bmatrix} a_{11} & a_{12} & a_{13} & b_{11} \\ a_{21} & a_{22} & a_{23} & b_{12} \\ a_{31} & a_{32} & a_{33} & b_{13} \end{bmatrix}$$

- 3- iterations are applied next after receiving guesses (g), also let b be the results and a be the equation system, N will be the dimensions of the matrix and itr will be number of iterations before stopping.

---

```
for j=1:itr
    for i=1:N
        X(i)=b(i,:)/A(i,i)-(A(i,[1:i-1,i+1:N])*g([1:i-1,1,i+1:N]))/A(i,i)
        g(i)=X(i);
    end
```

---

- 4- Print results in the GUI

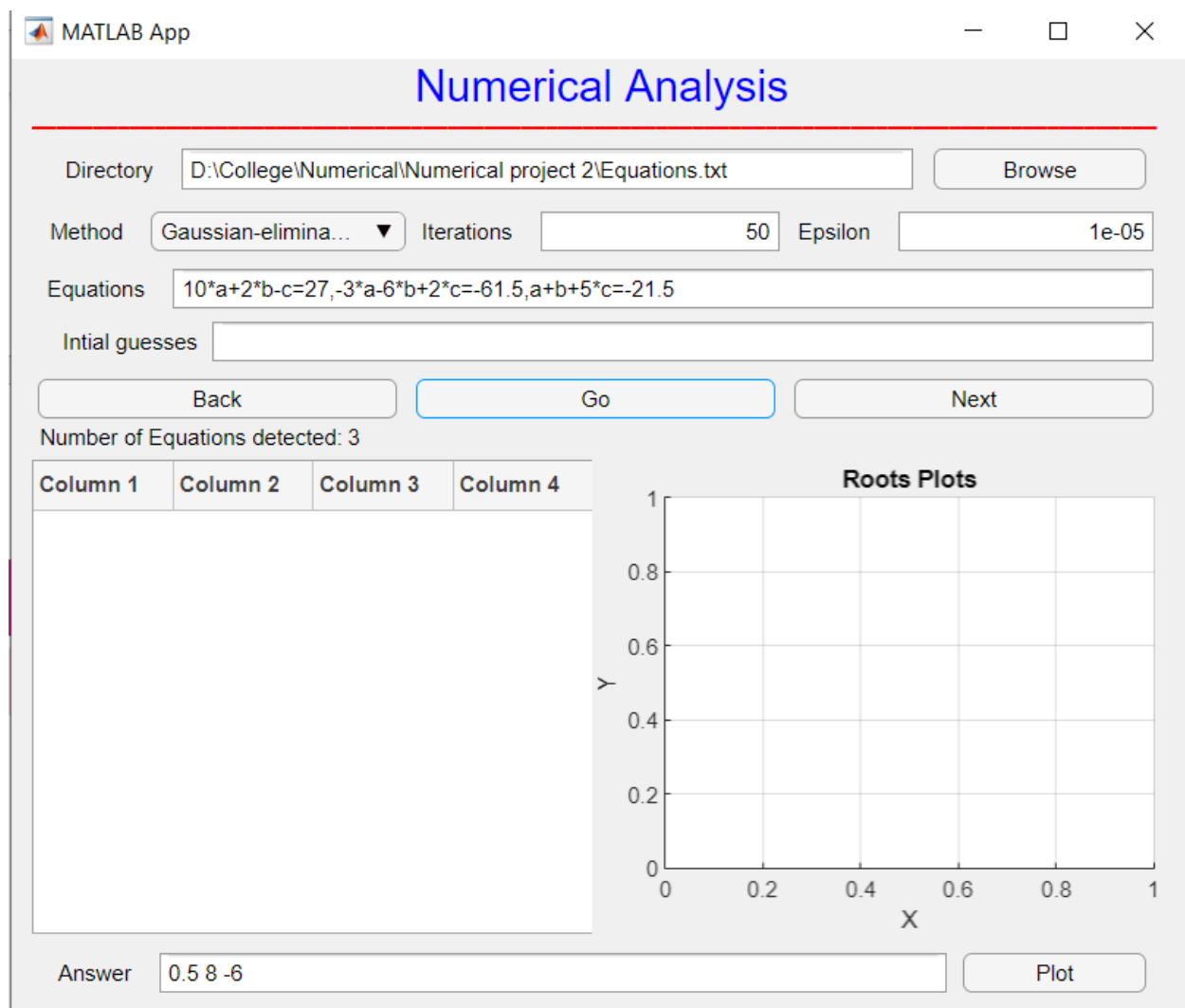
## TEST RUNS

### GAUSS ELIMINATION (EXAMPLE 1)

Equations to be inserted

- $8x + 4y - z = 11$
- $-2x + 3y + z = 4$
- $2x - y + 6z = 7$

No initial guesses, no number of iterations needed, or epsilon needed



The image shows a MATLAB App window titled "Numerical Analysis". The interface includes a "Directory" field with the path "D:\College\Numerical\Numerical project 2\Equations.txt" and a "Browse" button. The "Method" is set to "Gaussian-elimina..." with a dropdown arrow. The "Iterations" field is set to "50" and the "Epsilon" field is set to "1e-05". The "Equations" field contains the text "10\*a+2\*b-c=27,-3\*a-6\*b+2\*c=-61.5,a+b+5\*c=-21.5". The "Initial guesses" field is empty. Below these fields are three buttons: "Back", "Go" (highlighted with a blue border), and "Next". A label "Number of Equations detected: 3" is displayed above a table with four columns: "Column 1", "Column 2", "Column 3", and "Column 4". The table is currently empty. To the right of the table is a plot area titled "Roots Plots" with a grid. The x-axis is labeled "X" and ranges from 0 to 1. The y-axis is labeled "Y" and ranges from 0 to 1. At the bottom, there is an "Answer" field containing the text "0.5 8 -6" and a "Plot" button.

Column 1	Column 2	Column 3	Column 4
----------	----------	----------	----------

$a = 0.5$   $b = 8$   $c = -6$

## GAUSS ELIMINATION (EXAMPLE 2)

Equations to be inserted

- $8x + 4y - 1 = 11$
- $-2x + 3y + z = 4$
- $2x + y + 6z = 7$

No initial guesses, no number of iterations needed, or epsilon needed

The image shows a MATLAB App window titled "Numerical Analysis". The interface includes a "Directory" field with the path "D:\College\Numerical\Numerical project 2\Equation2.txt" and a "Browse" button. The "Method" is set to "Gaussian-elimina..." with a dropdown arrow. The "Iterations" field is set to "50" and the "Epsilon" field is set to "1e-05". The "Equations" field contains the text "8\*x+4\*y-1\*z=11,-2\*x+3\*y+1\*z=4,2\*x-1\*y+6\*z=7". There is an "Initial guesses" field. Below these are "Back", "Go", and "Next" buttons. A status bar indicates "Number of Equations detected: 3". On the left, there is a table with 4 columns labeled "Column 1", "Column 2", "Column 3", and "Column 4", which is currently empty. On the right, there is a "Roots Plots" area with a graph of y versus x, showing a grid from 0 to 1 on both axes. At the bottom, the "Answer" field displays "0.78302 1.4717 1.1509" and there is a "Plot" button.

Column 1	Column 2	Column 3	Column 4
----------	----------	----------	----------

Roots Plots

Answer: 0.78302 1.4717 1.1509

$$x = 0.783 \quad y = 1.4717 \quad z = 1.1509$$

## GAUSS ELIMINATION (EXAMPLE 3)

Equation to be inserted

- $a + b + c = 2$
- $2 * a + b - c + d = 1$
- $4 * a - b - 2 * c + 2 * d = 0$
- $3 * a - b - c + 2 * d = 3$

No initial guesses, no number of iterations needed, or epsilon needed

MATLAB App

### Numerical Analysis

Directory:

Method:  Iterations:  Epsilon:

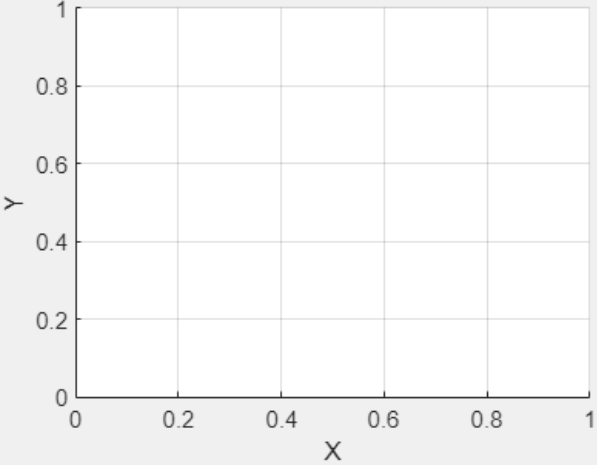
Equations:

Initial guesses:

Number of Equations detected: 4

Column 1	Column 2	Column 3	Column 4

Roots Plots



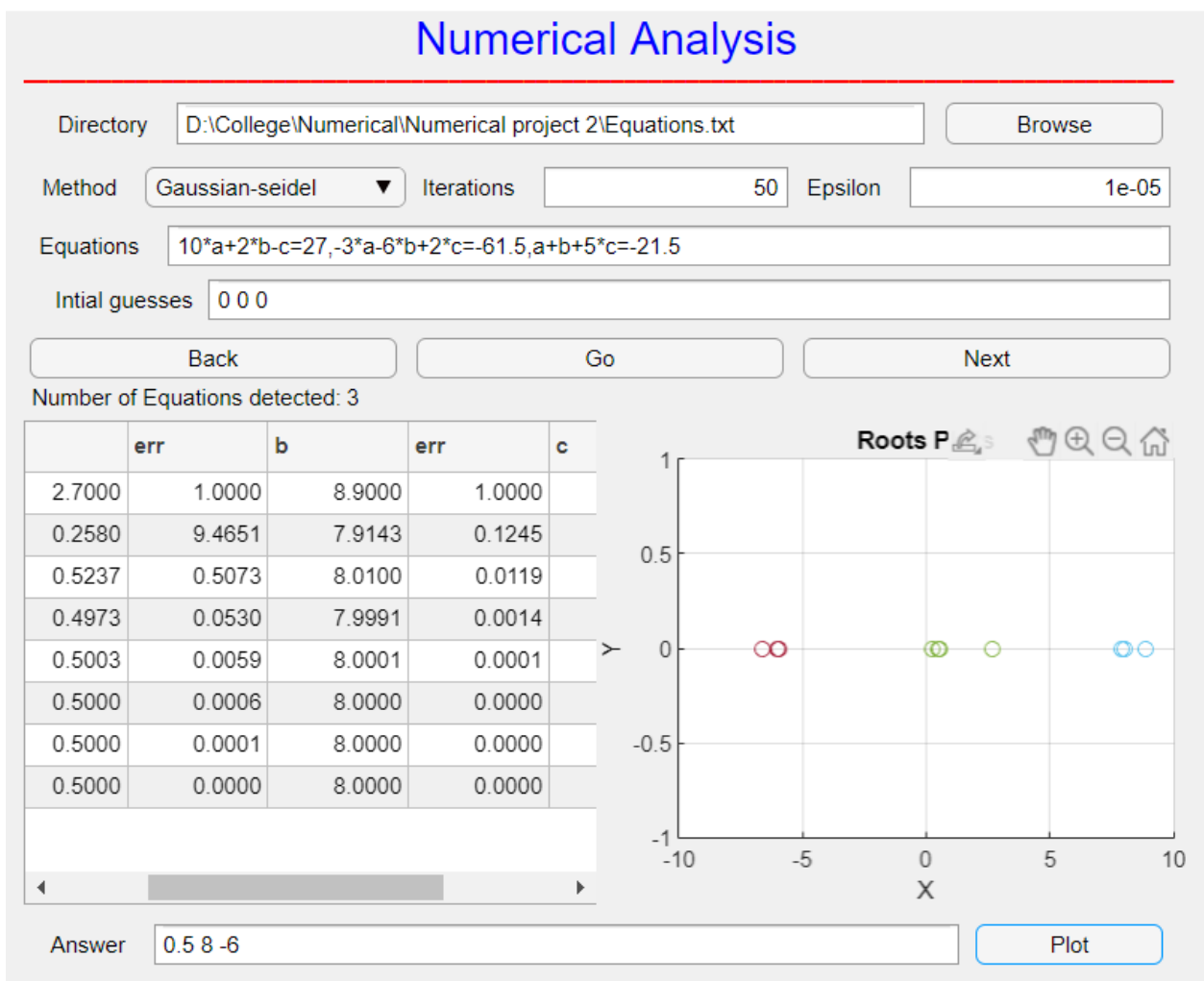
Answer:

## GAUSS SEIDEL (EXAMPLE 1)

Equations to be inserted

- $10a + 2b - c = 27$
- $-3a - 6b + 2c = -61.5$
- $a + b + 5c = -21.5$

Initial guess  $a=b=c=0$ , iterations = 50 epsilon = 0.00001



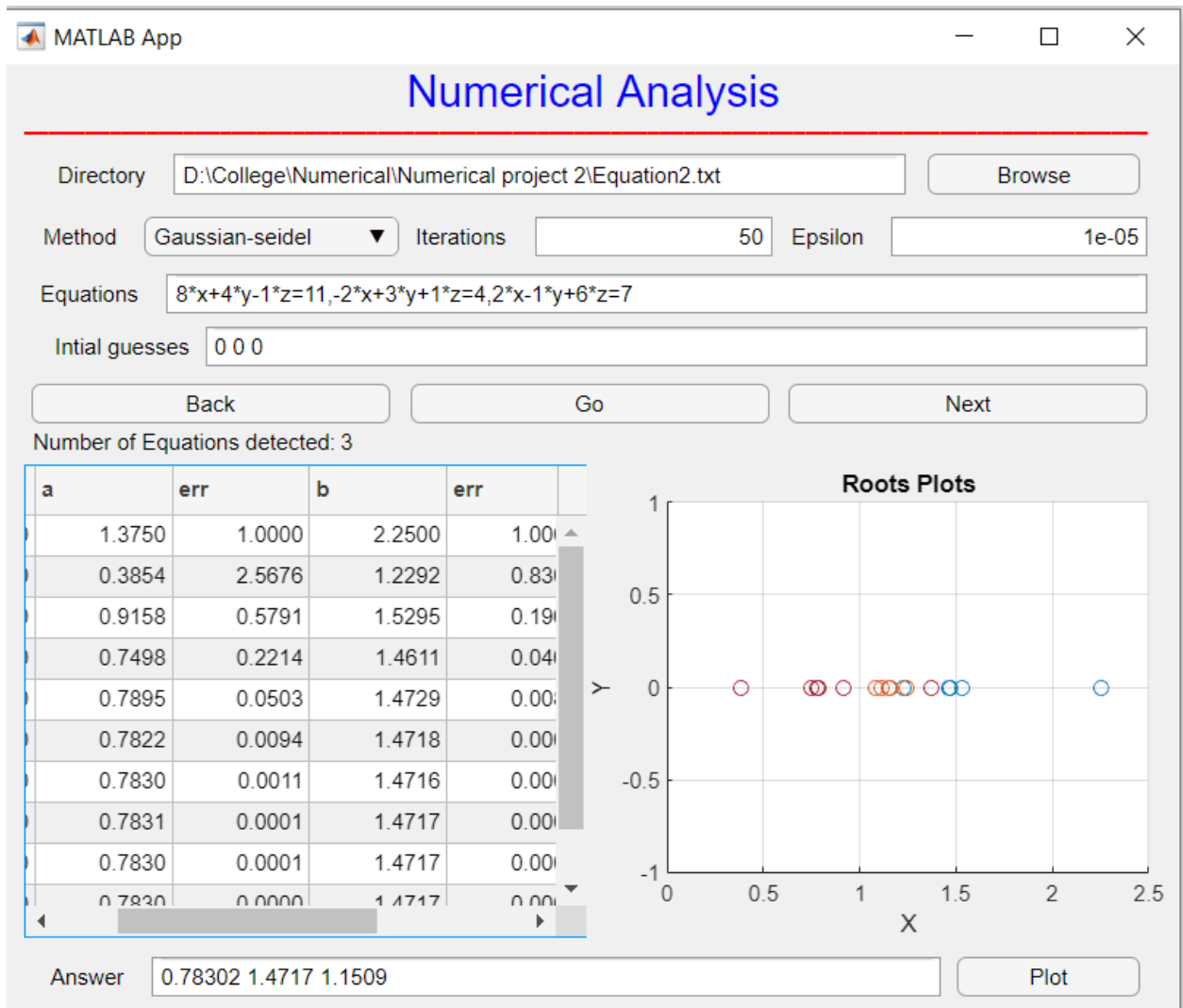
$a=0.5$   $b=8$   $c=-6$



## GAUSS SEIDEL (EXAMPLE 2)

Equations to be inserted

- $8x + 4y - 1 = 11$
- $-2x + 3y + z = 4$
- $2x + y + 6z = 7$
- Initial guess  $a=b=c=0$ , iterations = 50 epsilon = 0.00001



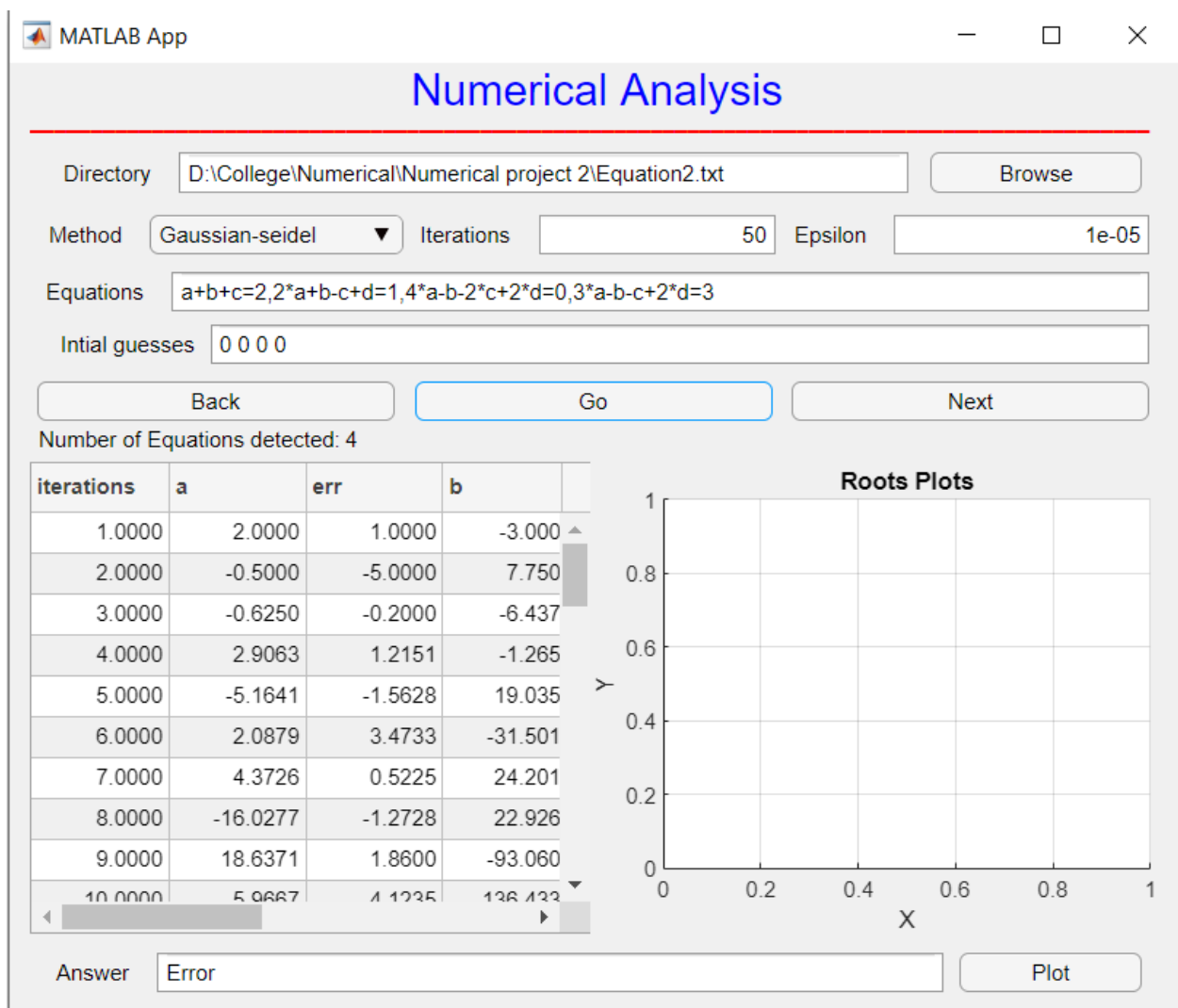
$x = 0.783$   $y=1.4717$   $z=1.1509$

## GAUSS SEIDEL (EXAMPLE 3)

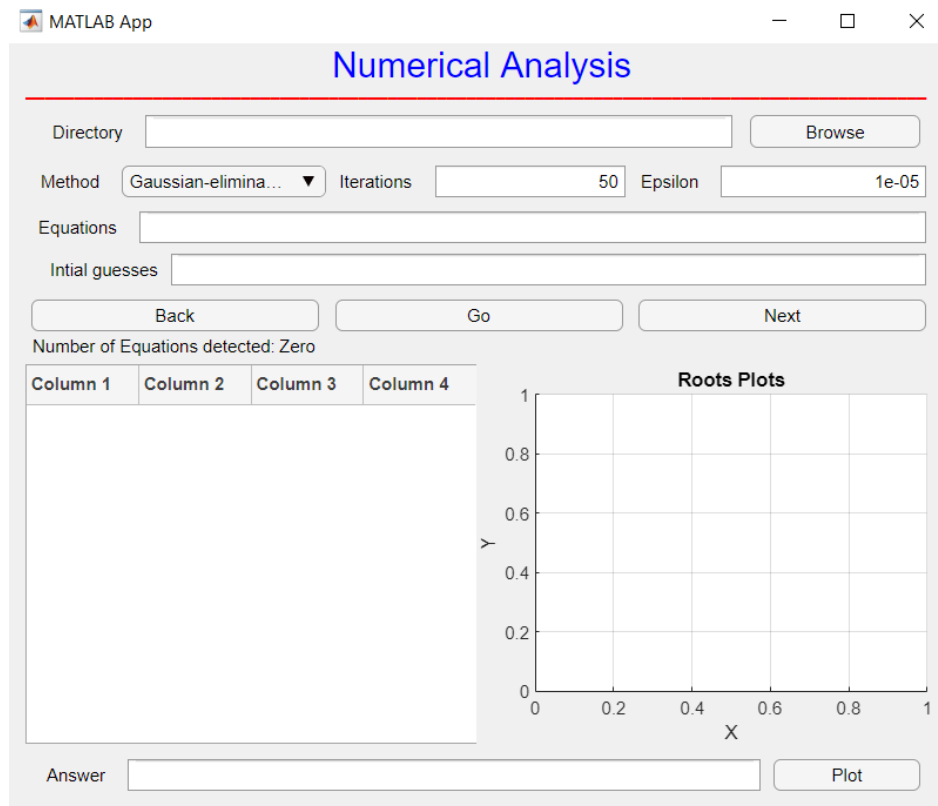
Equations to be inserted

- $a + b + c = 2$
- $2 * a + b - c + d = 1$
- $4 * a - b - 2 * c + 2 * d = 0$
- $3 * a - b - c + 2 * d = 3$

Initial guess  $a=b=c=d=0$ , iterations = 50 epsilon = 0.00001



# THE GUI



- Browse button is used to browse for text file containing equations. In the text file first the number of equation then the name of the method is written Gaussian-elimination as shown or gauss-seidel then the equations are written each equation is separated by a newline
- Iterations has max number of iterations used only in gauss seidel
- Epsilon is the precision that the iteration will stop before
- Equation where equation will be written separated by a comma
- Initial guesses are written there separated by a space
- Next and back is used to traverse between equations in the text file selected using browse
- Go to run the equations and show the answers
- Answers are shown in the answer text field
- Plot is used only with gauss seidel and to plot the next root the plot is clicked until it has reached number of iteration specified