NUMERICAL ANALYSIS REPORT 2

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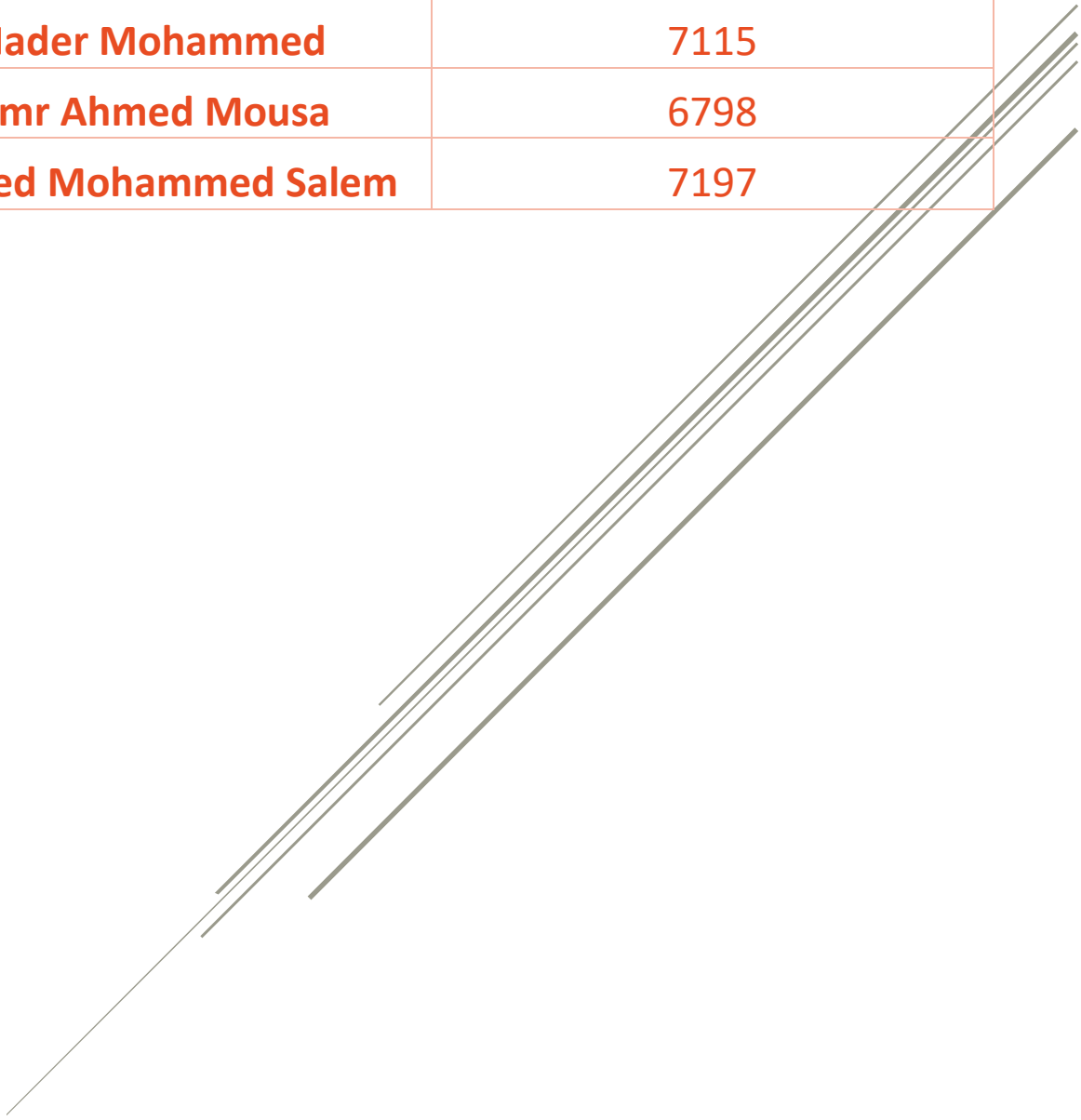


TABLE OF CONTENTSX

PSUEDOCODES

GAUSS ELIMNIATION

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 = $A_{i,j}$ / $A_{j,j}$
    $A_{i,:}$= $A_{i,:}$ - m*$A_{j,:}$
  end
end
X(N) = $A_{N,N+1}$/$A_{N,N}$

---

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

for k=N-1 to 1
X(k) = ($A_{k,N+1}$ - $A_{k,k+1:N}$*X(k+1:N))/$A_{k,k}$;
End

GAUSS SEIDEL

1. Indirect iterative method to be implemented to get gauss-sediel algorothm

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

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

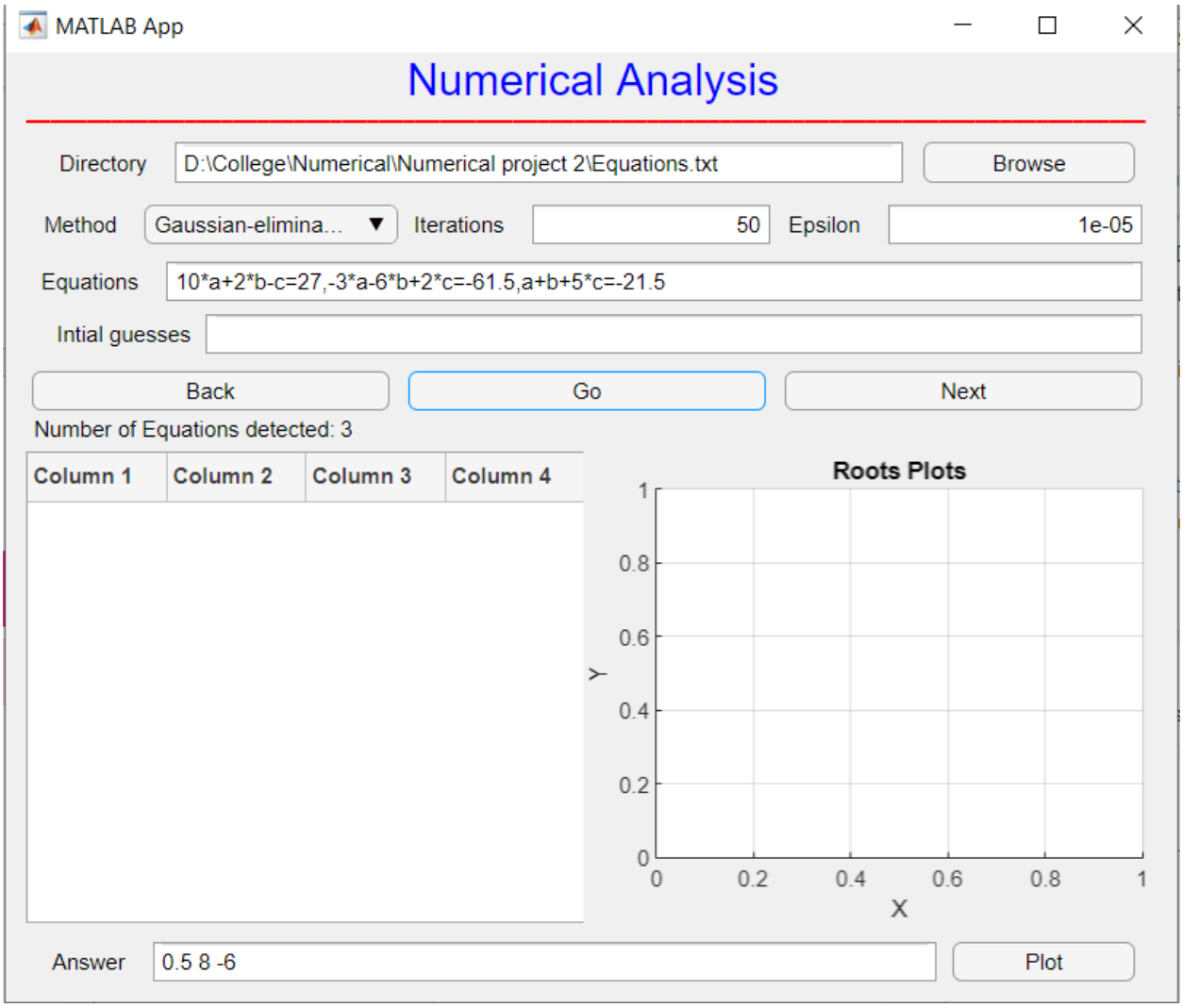
TEST RUNS

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



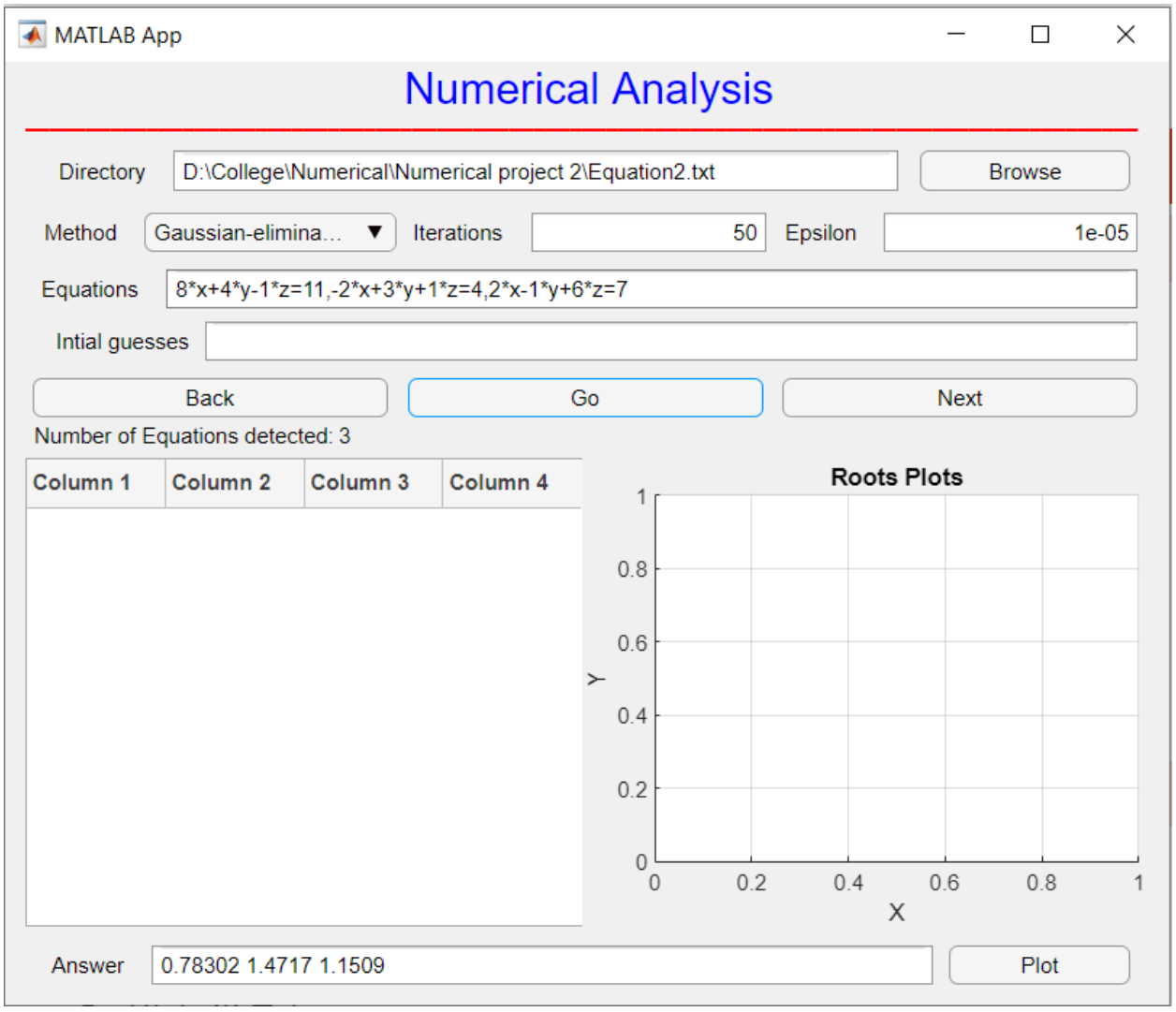
a= 0.5 b=8 c=-6

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



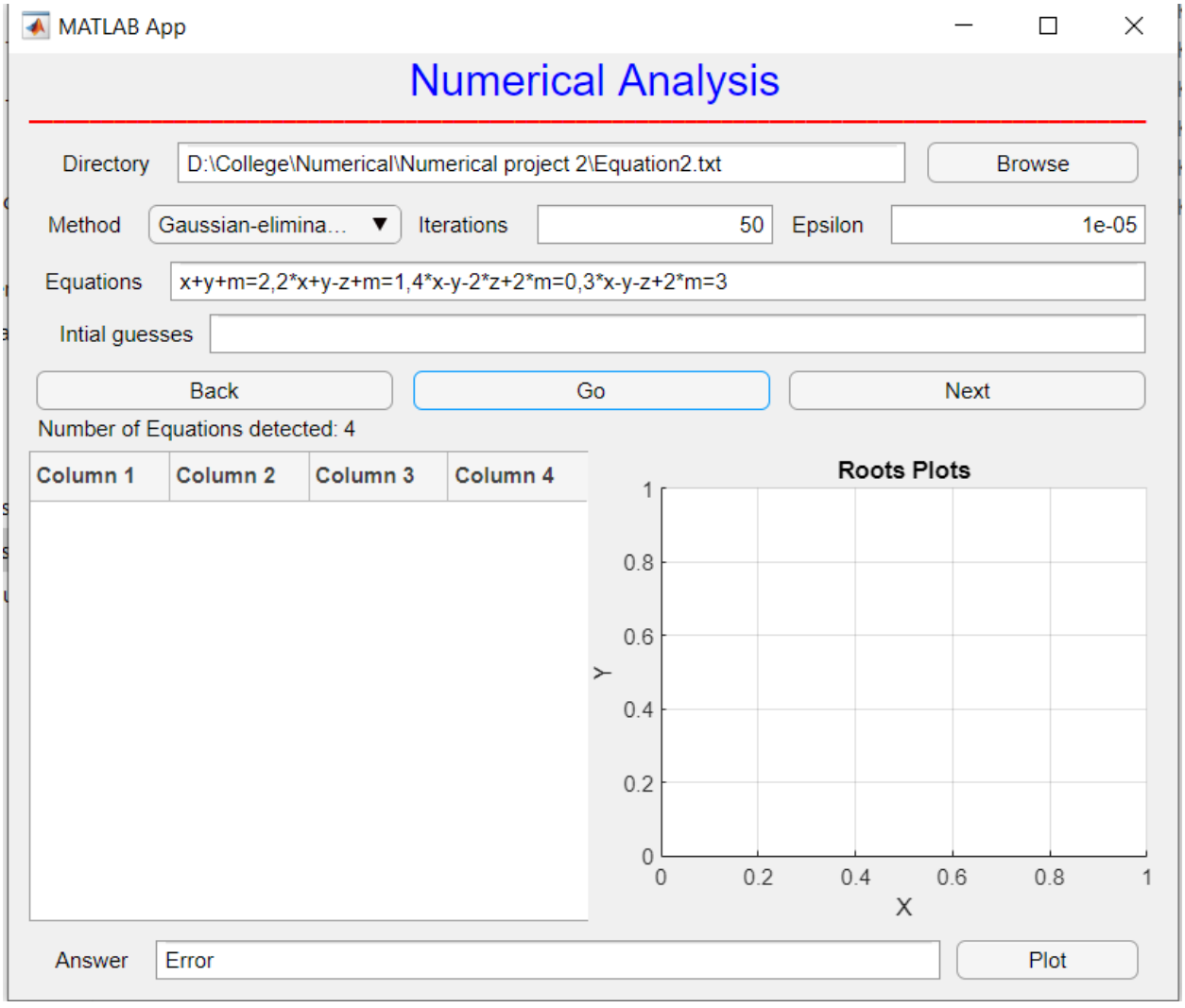
x = 0.783 y=1.4717 z=1.1509

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

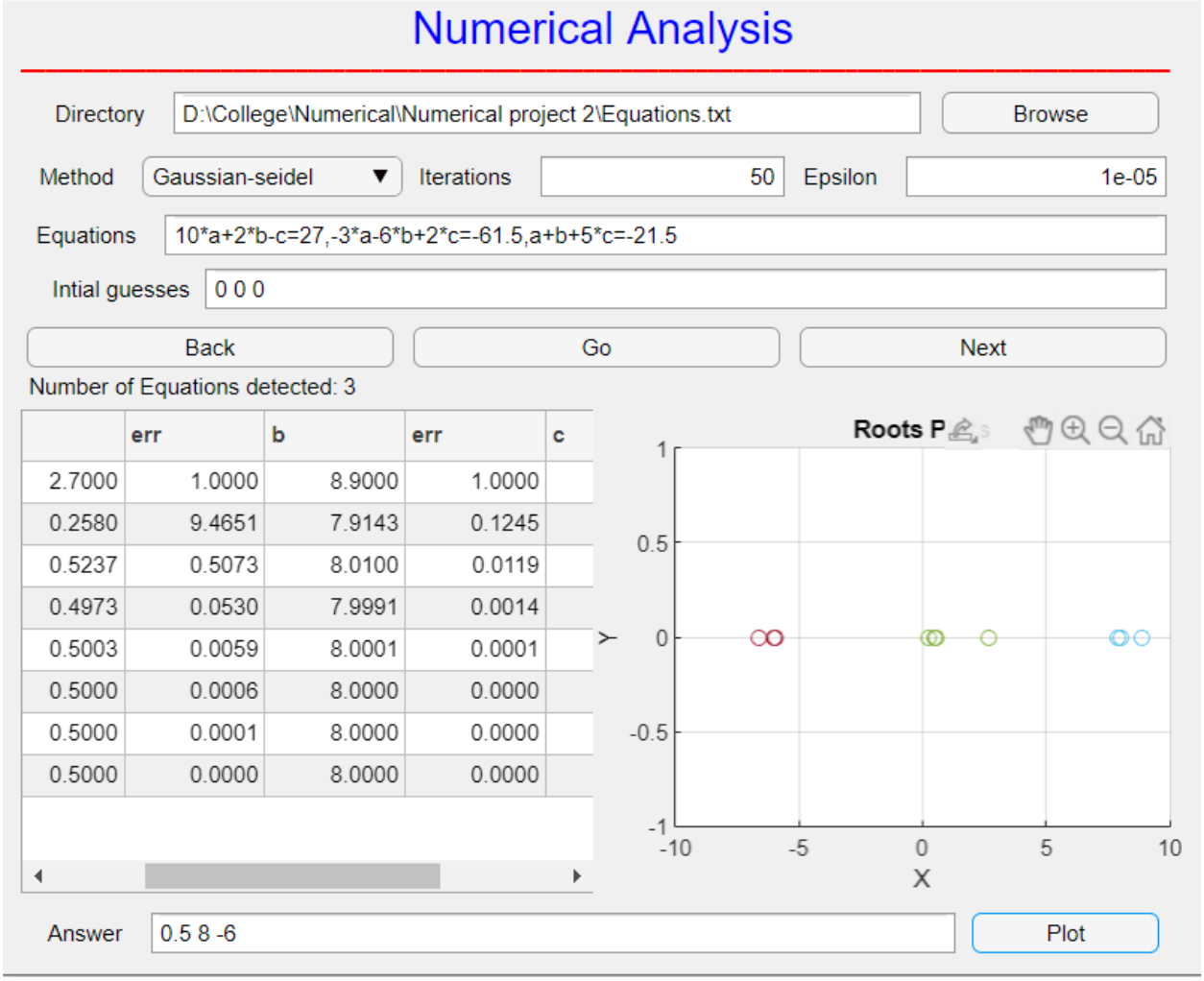


GAUSS SEIDEL (EXAMPLE 1)

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

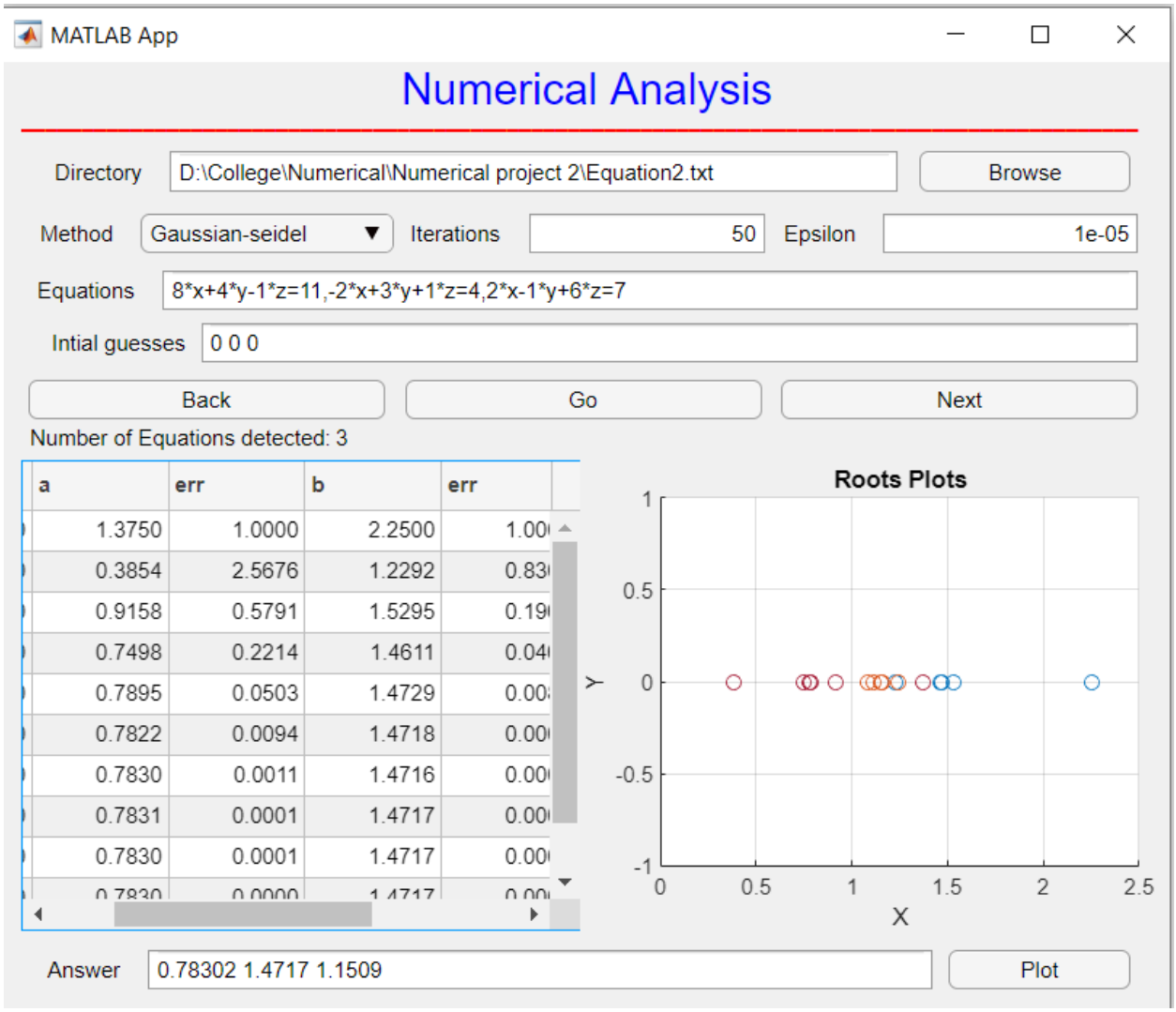


a= 0.5 b=8 c= -6

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



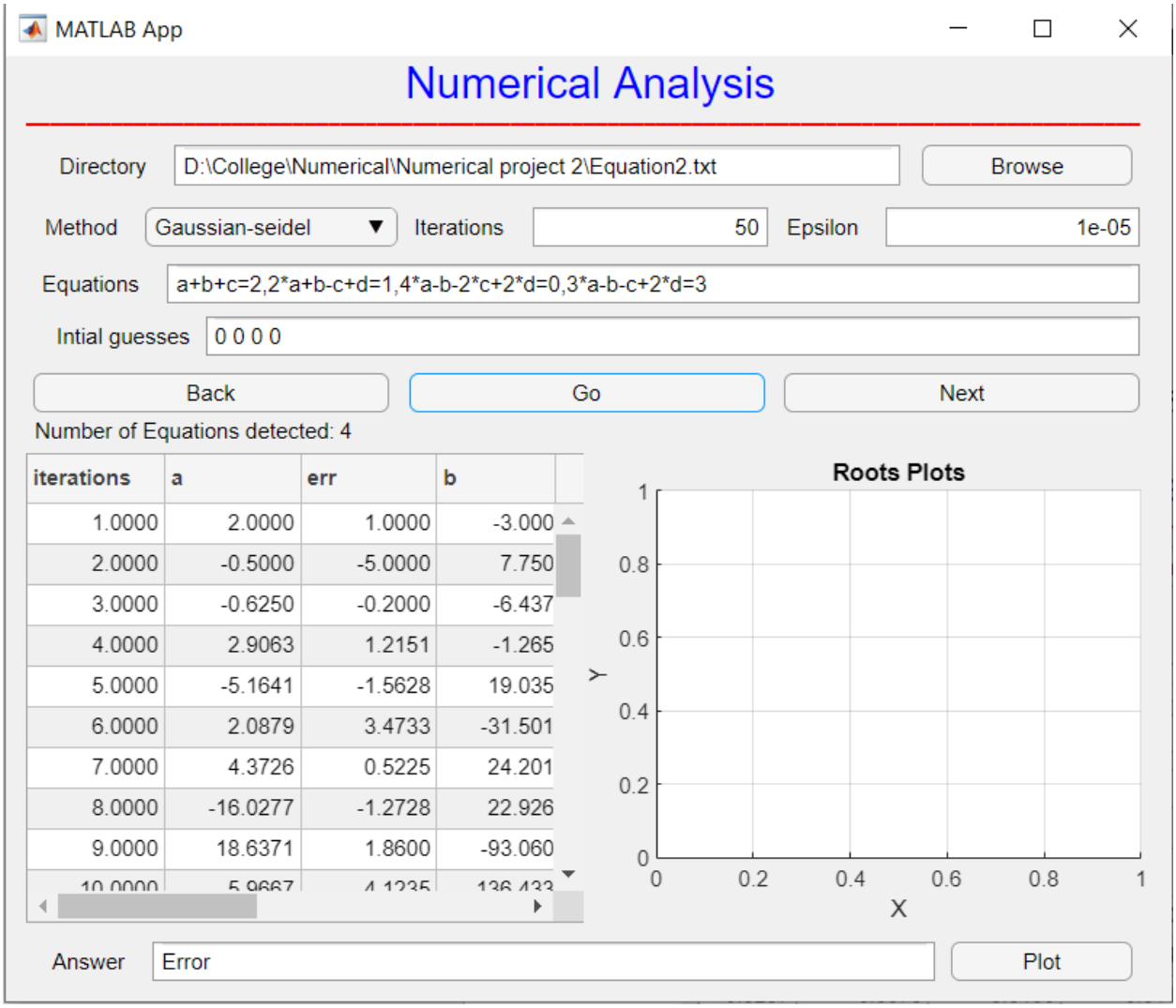
x = 0.783 y=1.4717 z=1.1509

GAUSS SEIDEL (EXAMPLE 3)

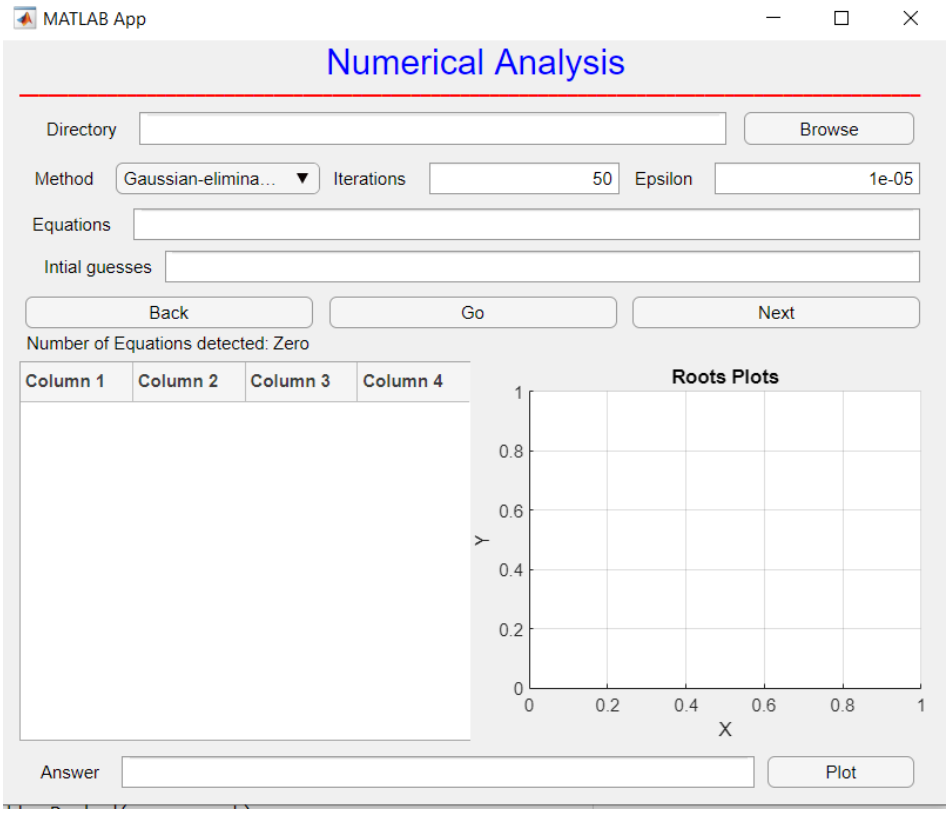
Equations to be inserted

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

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 specfied