Solve System of Algebraic Equations

1. Given the following matrices:

$$A = \begin{bmatrix} 3 & 2 & 1 \\ 0 & 5 & 2 \\ 1 & 0 & 3 \end{bmatrix} \quad B = \begin{bmatrix} 2 \\ 1 \\ 3 \end{bmatrix} \quad I = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

Perform the following MATLAB operations, if they can be done. If not, explain why.

```
1 + A
A .* I
trace(A)
```

2. Analyzing electric circuits can be accomplished by solving sets of equations. For a particular circuit, the voltages V1, V2, and V3 are found through the system:

$$\begin{cases} V1 = 5 \\ -6V1 + 10V2 - 3V3 = 0 \\ -V2 + 51V3 = 0 \end{cases}$$

Put these equations in matrix form and solve in MATLAB.

3. Re-write the following system of equations in matrix form:

$$\begin{cases} 4x_1 - x_2 + 3x_3 = 10 \\ -1x_1 + 3x_2 + x_3 - 5x_4 = -3 \\ 2x_1 + x_2 - x_3 + 2x_4 = 2 \\ 3x_1 + 2x_2 - 4x_3 = 4 \end{cases}$$

Set it up in MATLAB and use any method to solve

4. For a 2x2system of equations, Cramer's rule states that the unknowns x are fractions of determinants. The numerator is found by replacing the column of coefficients of the unknown by constants b. So:

$$x_1 = \frac{\begin{vmatrix} b_1 & a_{12} \\ b_2 & a_{22} \end{vmatrix}}{D} \qquad and, \quad x_2 = \frac{\begin{vmatrix} a_{11} & b_1 \\ a_{21} & b_2 \end{vmatrix}}{D}$$

Use Cramer's rule to solve the following 2x2system of equations:

$$\begin{cases} 4x_1 - 2x_2 = -2 \\ -3x_1 + 2x_2 = -1 \end{cases}$$

5. use

```
>> help lu
```

or look for `lu` in MATLAB documentation. Read Entire the article and solve examples :-)

6. solve question number 2 in this homework using `solve` function .

7. solve question number 3 in this homework using `solve` function .

Attention, attention:

```
% You can solve non-linear equations via
% solve function, look at this example:

>> MyEquation = solve('y= x^2', 'y=cos(x)')

MyEquation =

    x: [1x1 sym]
    y: [1x1 sym]

>> MyEquation.x
ans =
-0.82413231230252242296095678577199

>> MyEquation.y
ans =
0.67919406818110235182483021957489
```

7. To analyze electric circuits, it is often necessary to solve simultaneous equations. To find the voltages Va, Vb, and Vc at nodes a, b, and c, the equations are

```
2(Va-Vb) + 5(Va-Vc) - exp(-t) = 0
2(Vb - Va) + 2Vb + 3(Vb - Vc) = 0
Vc = 2 sin(t)
```

Find out how to use the **`solve`** function to solve for Va, Vb, and Vc so that the solution will be returned in terms of t.

8. The reproduction of cells in a bacterial colony is important for many environmental engineering applications such as wastewater treatments. The formula

```
log(N) = log(N0) + t/T log(2)
```

can be used to simulate this, where N is the original population, N is the population at time t, and T is the time it takes for the population to double. Use the **`solve`** function to determine the following: if $N_0 = 10^2$, $N = 10^8$, and t= 8 hours, what will be the doubling time T? Use **`double`** to get your result in hours.