Project 02: Linear Equations Systems

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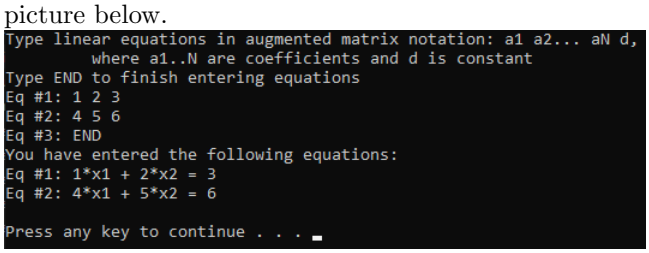
Your task is to write a linear equations systems solver. On pictures you have my take on this tasks, but if you have your own (probably better) idea, go with it!

1. (4 points) Let the user input the equations in the augmented matrix form and then display them as equations systems - with variables, equal sign etc. At this point assume, that there will always be only two equations with two variables each. In the end you should get something like on the picture below.



2. (4 points) Implement the forward elimination algorithm, (for now without the pivot procedure), still assuming, that there will only be two equations with two variables each. Below you will find some examples, on how should the matrix look like after the forward elimination procedure

$$\left[\begin{array}{cc|c} 1 & 2 & 3 \\ 4 & 5 & 6 \end{array}\right] \rightarrow \left[\begin{array}{cc|c} 1 & 2 & 3 \\ 0 & -3 & -6 \end{array}\right]$$

$$\left[\begin{array}{cc|c} -1 & 3 & 7 \\ 2 & -5 & 10 \end{array}\right] \rightarrow \left[\begin{array}{cc|c} -1 & 3 & 7 \\ 0 & 1 & 24 \end{array}\right]$$

3. (4 points) Implement backwards substitution algorithm and show the answers to the user. In the end you should obtain something like on the picture below

```
Type linear equations in augmented matrix notation: a1 a2... aN d,
        where a1..N are coefficients and d is constant
Type END to finish entering equations
Eq #1: 1 2 3
Eq #2: 4 5 6
Eq #3: END
You have entered the following equations:
Eq #1: 1*x1 + 2*x2 = 3
Eq #2: 4*x1 + 5*x2 = 6

Result is:
x1 = -1
x2 = 2

Press any key to continue . . .
```

4. (6 points) Expand your program, so that the user can input any number of equations/variables. For simplicity display an error, if the number of equations is not equal to the number of variables.

```
Type linear equations in augmented matrix notation: a1 a2... aN d,
        where a1..N are coefficients and d is constant
Type END to finish entering equations
Eq #1: 6 -2 2 4 16
Eq #2: 12 -8 6 10 26
Eq #3: 3 -13 9 3 -19
Eq #4: -6 4 1 -18 -34
Eq #5: END
You have entered the following equations:
Eq #1: 6*x1 - 2*x2 + 2*x3 + 4*x4 = 16
Eq #2: 12*x1 - 8*x2 + 6*x3 + 10*x4 = 26
Eq #3: 3*x1 - 13*x2 + 9*x3 + 3*x4 = -19
Eq #4: -6*x1 + 4*x2 + 1*x3 - 18*x4 = -34

Result is:
x1 = 3
x2 = 1
x3 = -2
x4 = 1

Press any key to continue . . .
```

5. (2 points) Implement the pivot procedure inside the forward elimination method, so that linear equations systems with coefficients equal to zero can be calculated.

```
Type linear equations in augmented matrix notation: a1 a2... aN d,
        where a1..N are coefficients and d is constant
Type END to finish entering equations
Eq #1: 0 2 4
Eq #2: 1 -3 3
Eq #3: END
You have entered the following equations:
Eq #1: 0*x1 + 2*x2 = 4
Eq #2: 1*x1 - 3*x2 = 3

Result is:
x1 = 9
x2 = 2

Press any key to continue . . .
```