Faculty of Engineering
Computer and Systems Engineering Dept.

Project

Due Date for Project Submission:

Level 1: Saturday May 12th, 2018 (till 11:59PM)

Level 2 and Level 3: Thursday June 28th, 2018 (till 11:59PM)

Teams: No Groups, Work is individual based (Each Student submit a project).

Notes:

- Automatic Grading will be applied over an online system at (**cseasu.com**).
- The online system can automatically detect copied submissions with intelligent comparison (plagiarism detection). All detected copies of students submissions will take **zero** grade.

Project Description

It is required to develop a program to solve linear equations. The programs reads first an integer n which is the number of equations.

Then the program reads n lines containing the equations.

For example the input to the program is like:

3
2x1+3x2+4x3=16
1x1+2x2+1x3=8
3x1+1x2+2x3=13

Equation proper form: Any operation should first convert every equation to the proper form. The equation proper should have the following properties

1. variables are ordered alphabetically from left to right

   3x2+2x1+4x3=16
   Should be
   2x1+3x2+4x3=16

2. Any variable should appears only one time

   4x1+3x2-2x1+4x3=16
   Should be
   2x1+3x2+4x3=16

3. Only one constant term should appear in the equation and it should be on the right hand side

   2x1+3x2+5+4x3-11=10
   Should be
   2x1+3x2+4x3=16

4. Coefficient when equals to one or -1 the digit 1 is optional

   1x1+3x2-1x3=10
   Can be input as be
   x1+3x2-x3=10

In the program, after reading the equations the program reads one or more commands from user and program should print the results of each operations and read another operation till the program read the operation quit which ends the program. **Any result printed should be based on the proper form of equations.**

Level	operation	Meaning	Action Required from the Program
1	num_vars	Print the number of variables	Print the number of variables in the equations.
	equation i	Print equation number i (i is integer)	Print equation of the equation number i
	column x2	Print the column of coefficients of variable (x2)	Print the vector of coefficients of the given variable name. (x2 can be replaced by any variable name)
2	add 1 3	Add equation 1 and equation 3 and print the result equation	Print the result equation from adding equation 1 and equation 3. (1 and 3 can be any integer numbers from 1 to n).
	subtract 1 3	Subtract equation 1 minus equation 3 and print the result equation	Print the result equation from subtracting equation 1 and equation 3. (1 and 3 can be any integer numbers from 1 to n).

	substitute x2 1 3	Substitutes the variable x2 in equation 1 by its equation in equation 3 and print the result equation	Remove the variable x2 from equation 1 by substituting it with equation 3 and print the result equation
3	D	Cramer's Coefficient matrix	Prints the Cramer's coefficients matrix.
	D x1	Cramer's Coefficient matrix of variable x1	Prints the Cramer's coefficients matrix with answer-column values in x1 columns values
	D_value	Cramer's coefficient matrix determinant value	Prints the value of the determinant of the Coefficient matrix.
	solve	Print the solution of the equations	Prints the value of each variable that solves the solution I no solution, the program should print "No Solution"

Project Marks Distribution:

30% to support operators in Level 1

10% for input given in the proper form (1 digit coefficient, 2 digits var name)

10% input is not in the proper form (1 digit coefficient, 2 digits var name)

5% coefficients can be of any length and including float values

5% variable names can be of any length

40% to support operators in Level 2

15% for input given in the proper form (1 digit coefficient, 2 digits var name)

15% input is not in the proper form (1 digit coefficient, 2 digits var name)
5% coefficients can be of any length and including float values
5% variable names can be of any length

30% to support operators in Level 3
10% for input given in the proper form (1 digit coefficient, 2 digits var name)
10% input is not in the proper form (1 digit coefficient, 2 digits var name)
5% coefficients can be of any length and including float values
5% variable names can be of any length

General Constraints:

1- User can input equations can be up to 100 equations.
2- All values are of float data types in general case.
3- Do not prompt user to enter anything , just read the input directly.
4- Output should not include any extra white spaces or any extra texts more than the results.

Hints:

1. While parsing the equations, you will need to convert from string to float and from float to string. Use the following example as a guide:

```
#include<iostream>
#include<string>
#include<cstdlib>
#include<sstream>

using namespace std;

int main() {
// To convert from string to float use atof function
// atof needs #include<cstdlib>

string s = "1.5";
float v;
v = atof(s.c_str());


// To convert float-to string use ostringstream variable
// ostringstream needs #include<sstream>
// ostringstream variables are used in a similar way to cout
// Then get the string from the ostringstream using .str

float d = 1.55;
string str;
ostringstream ss;
ss << d;
str = ss.str();


return 0;
}
```

Input / Output Samples

User Input in Blue, Program Output in Red (Just for Clarification, not required in the program)

Example 1 (num_vars operation)

```
3
2x1+3x2+4x3=16
1x1+2x2+1x3=8
3x1+1x2+2x3+x4=13
num_vars
4
```

Example 2 (equation i operation)

```
3
2x1+3x2+4x3=16
1x1+2x2+1x3=8
3x1+1x2+2x3+x4=13
equation 2
1x1+2x2+1x3=8
```

Example 3 (column operation)

```
3
2x1+3x2+4x3=16
1x1+2x2+1x3=8
3x1+1x2+2x3+x4=13
column x2
3
2
1
```

Example 4 (Add operation)

```
3
2x1+3x2+4x3=16
1x1+2x2+1x3=8
3x1+1x2+2x3+x4=13
add 1 3
4x1+4x2+6x3+x4=29
```

Example 5 (subtract operation)

```
3
2x1+3x2+4x3=16
1x1+2x2+1x3=8
3x1+1x2+2x3+x4=13
subtract 3 1
2x1-1x2+1x3+x4=5
```

Example 6 (substitute operation)

```
3
2x1+3x2+4x3=16
1x1+2x2+1x3=8
3x1+1x2+2x3+x4=13
substitute x2 1 3
-7x1-2x3-3x4=-23                    or        7x1+2x3+3x4=23
```

Example 7 (D operation)

```
3
2x1+3x2+4x3=16
1x1+2x2+1x3=8
3x1+1x2+2x3=13
D
2     3     4
1     2     1
3     1     2
```

Example 7 (D x2 operation)

```
3
2x1+3x2+4x3=16
1x1+2x2+1x3=8
3x1+1x2+2x3=13
D x2
2     16     4
1     8      1
3     13     2
```

Example 8 (D_value operation)

```
3
2x1+3x2+4x3=16
1x1+2x2+1x3=8
3x1+1x2+2x3=13
D_value
-11
```

Example 9 (solve operation) note that the solution of xi = (D xi)value/D_value

```
3
2x1+3x2+4x3=16
1x1+2x2+1x3=8
3x1+1x2+2x3=13
solve
x1=3
x2=2
x3=1
```