

SOFTWARE PROJECT LAB-1

Project name :

Equation Mastermind

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Overview

Mainly this project will solve two types of problems

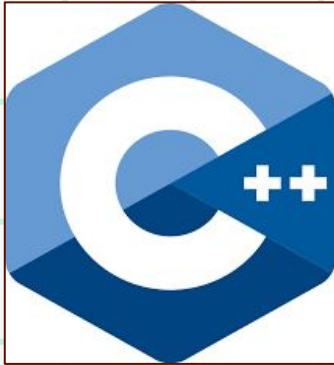
**Linear
Equation**

**Polynomial
Equation**

Tools used

Tool used

- Language: C++



Github link: <https://github.com/Jihad011/SPL-1>

Project Description

- Generally this program will take linear and polynomial equation as input.
- Shows step by step solution process .
- Finally shows output with plotting graph.

Flashback of Equation to Solution

```
int input_controller(string str[])
{
    unsigned int number_of_variable;

    cout<<"\n Number of variables : ";
    cin>>number_of_variable;
    getchar();    //for consume ENTER

    cout<<" \nInput expression like (ax+by+cz.....=c)\nINPUT "<<number_of_variable<<" EQUATIONS \n "<<endl;

    for(size_t i=0;i<number_of_variable;i++)
    {
        getline(cin,str[i]);
    }
    return number_of_variable;
}
```

Here I take equation as a line of string.

Flashback of Equation to Solution

Then tokenizing and parsing the expression , we can extract variables ,coefficient , operator,power,fractional point value.

**After that I solve this equations using matrix method.
Lets see how the method do solve,,,,,**

Output After tokenizing

```
x^4 + 3x^3 +4x^2 - 2x - 7=0
Term type: Cx^n.      Term: 1  x^4
Term type: operator.  Term: +
Term type: Cx^n.      Term: 3  x^3
Term type: operator.  Term: +
Term type: Cx^n.      Term: 4  x^2
Term type: operator.  Term: -
Term type: Cx^n.      Term: 2  x^1
Term type: operator.  Term: -
Term type: constant.  Term: 7
Term type: eqaul_sign. Term: =
Term type: constant.  Term: 0
```


Linear Equation solve

Input linear equation

Create Matrix

Find determinant of matrix
(row reduction method)

Det = 0

yes

Infinite / No solution

no

Unique Solution
(Cramer's rule)

$$\left[\begin{array}{ccc|c} x & y & z & \\ \hline a & b & c & m \\ d & e & f & n \\ g & h & i & o \end{array} \right]$$

Coefficient
Matrix

Column Vector

$$D = \begin{vmatrix} a & b & c \\ d & e & f \\ g & h & i \end{vmatrix}$$

$$D_x = \begin{vmatrix} m & b & c \\ n & e & f \\ o & h & i \end{vmatrix}$$

$$D_y = \begin{vmatrix} a & m & c \\ d & n & f \\ g & o & i \end{vmatrix}$$

$$D_z = \begin{vmatrix} a & b & m \\ d & e & n \\ g & h & o \end{vmatrix}$$

$$x = \frac{D_x}{D}$$

$$y = \frac{D_y}{D}$$

$$z = \frac{D_z}{D}$$

Find Determinant

```

21 //find determinant of matrix
22 double determinant_matrix(double array[][SIZE], unsigned int number)
23 {
24     for(size_t i=0;i<number;i++)
25     {
26         for (size_t j=number-1;j>i;j--)
27         {
28             if(array[j][i]==0)
29             {
30                 continue;
31             }
32             else{
33                 if(array[j-1][i]==0)
34                 {
35                     //exchanging rows
36                     for(size_t p=0;p<number;p++){
37                         double temp = array[j][p];
38                         array[j][p] = array[j-1][p];
39                         array[j-1][p]=temp;
40                     }
41                     continue;

```

```

42                 }
43                 double required_ratio = array[j][i] / array[j-1][i];
44
45                 for(size_t k=0;k<number ;k++)
46                 {
47                     array[j][k] = array[j][k] - required_ratio*array[j-1][k];
48                 }
49             }
50         }
51     }
52
53     //calculate determinant of matrix required portion of matrix
54
55     double sum=-1;
56     for(size_t i=0;i<number;i++)
57     {
58         sum*=array[i][i];
59     }

```

Sample Input -Output

3 variable

2 variable

```
Number of variables : 3

Input expression like (ax+by+cz.....=c)
INPUT 3 EQUATIONS

x + 3y + 4z = 4
-x + 3y + 2z = 2
3x + 9y + 6z = -6

Solution is:
x = -2
y = -2
z = 3
```

```
Number of variables : 2

Input expression like (ax+by+cz.....=c)
INPUT 2 EQUATIONS

2x + 3y = 5
-3x + 4y = -3

Solution is:
x = 0.822222
y = -0.244444
```

What are the challenges?

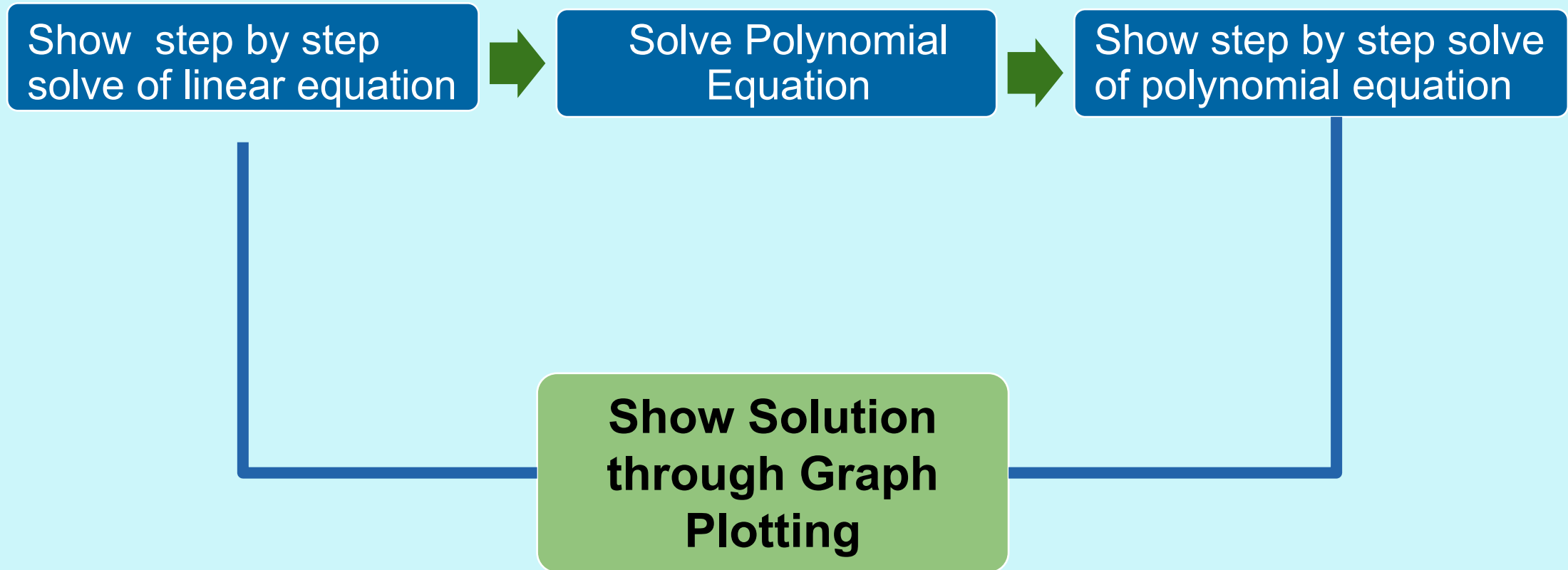
Separate variable and number

Create matrix from equations

Implementing tokenizer, parser, matrix algorithm



Next Target



Solving Polynomial Equations

Solve $x^3 + 2x^2 - 9x = 18$

Set equation equal to zero.

$$x^3 + 2x^2 - 9x - 18 = 0$$

Factor.

$$(x^3 + 2x^2) + (-9x - 18) = 0$$

$$x^2(x + 2) + (-9)(x + 2) = 0$$

$$(x^2 - 9)(x + 2) = 0$$

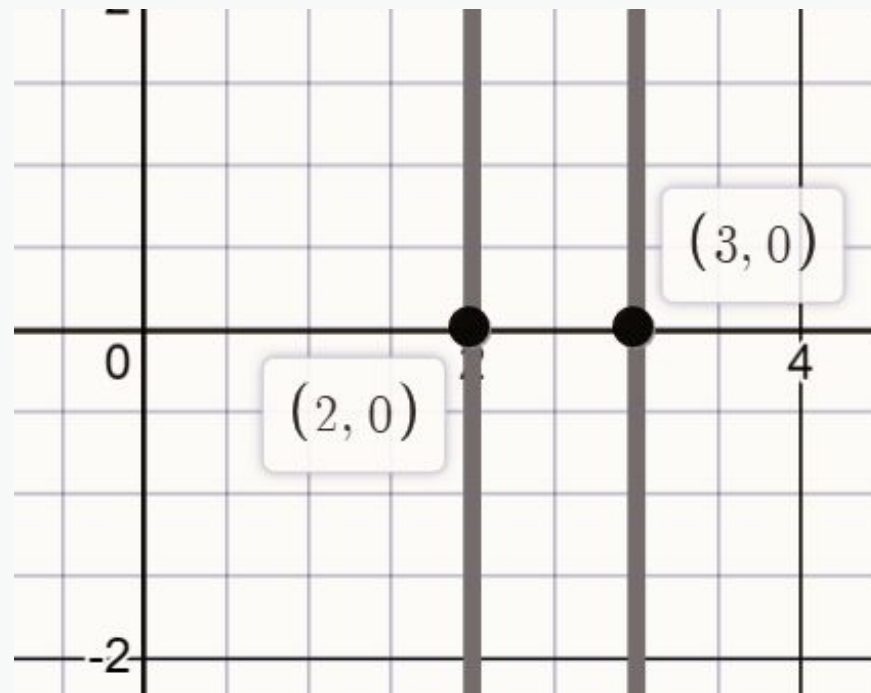
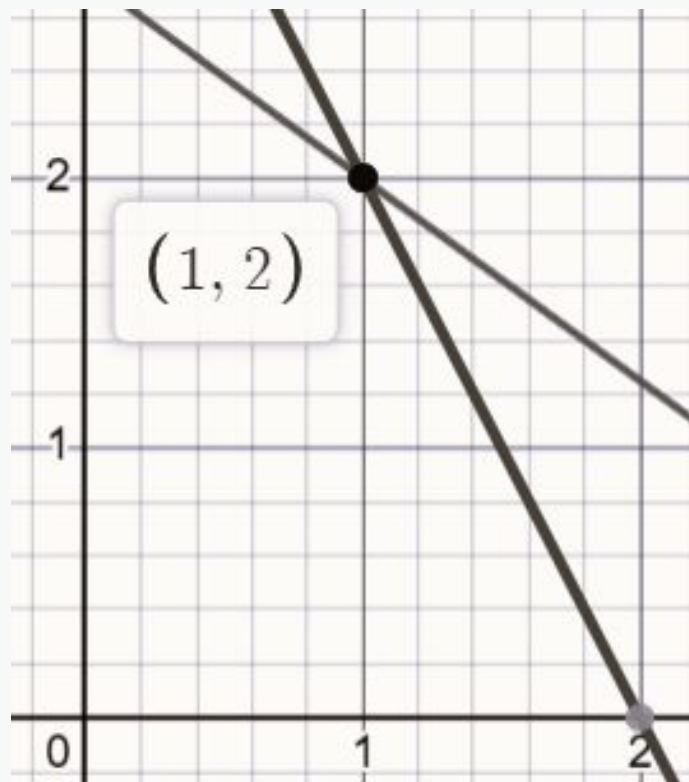
$$(x + 3)(x - 3)(x + 2) = 0$$

Set each factor equal to zero and solve.

$$(x + 3) = 0 \quad (x - 3) = 0 \quad (x + 2) = 0$$

$$x = -3 \quad x = 3 \quad x = -2$$

sample Graph Plotting



Thank you!