# EQUATION SOLVER


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# PROBLEM STATEMENT

It is very difficult to solve complicated equations in one variable. Hence we decided to create an equation solver which will give solutions to the equation $f(x) = 0$.

**Our goals were :**

1) To get the solutions of the equation given by user.
2) Learning new methods to find the roots of an equation.
3) Learning how to make a GUI (Graphical User Interface) using Qt creator.
4) And of course to get good grades in CS.

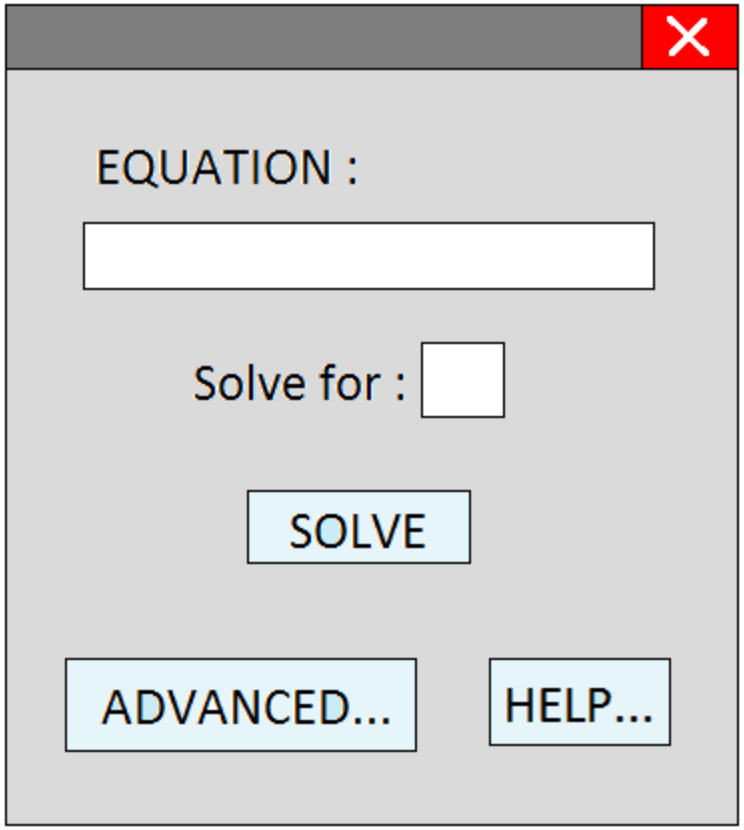
# THE MAIN WINDOW

When the program starts the main window appears. The user can enter the equation and the variable in the provided boxes.

There are three buttons provided in the main window.

1) Solve : as the name suggests, it will solve the given equation for the domain (-inf, +inf) and will give up to certain number of solutions.

2) Advanced : this will button will open a new window with more options known as ‘advanced window’.



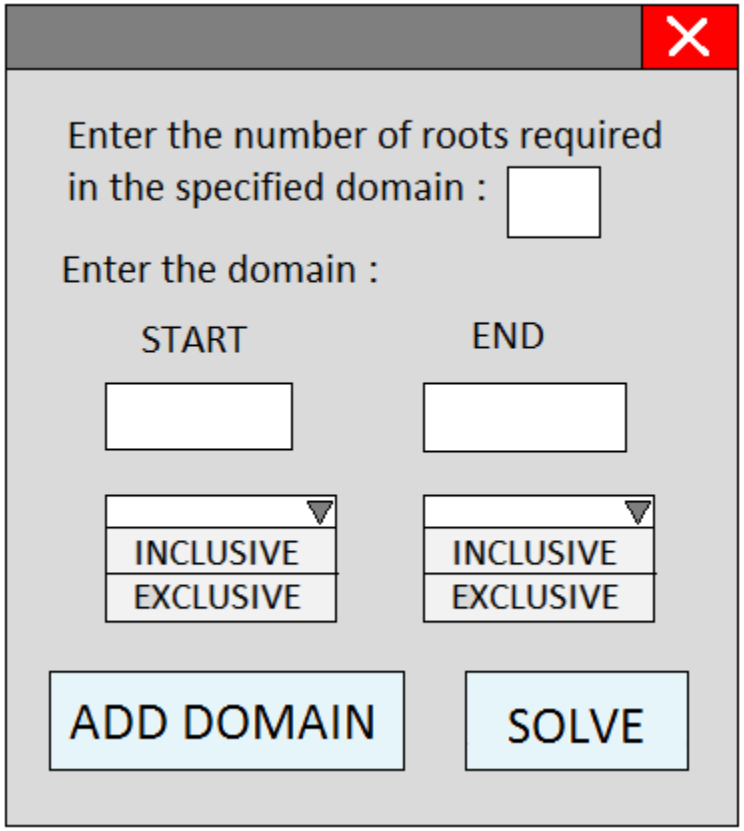
# THE ADVANCED WINDOW

**This window appears on when advanced button is clicked. This window gives you an option of specifying the domain and the number of roots required in that domain.**

1) Inclusive & exclusive : User can choose whether to take the start and end point values in the domain or not.

2) Add domain : This option allows user to add another domain in which user wants to have solutions. A blank advanced window reappears on clicking add domain.

3) Solve : use of solve button is same as that in main window.



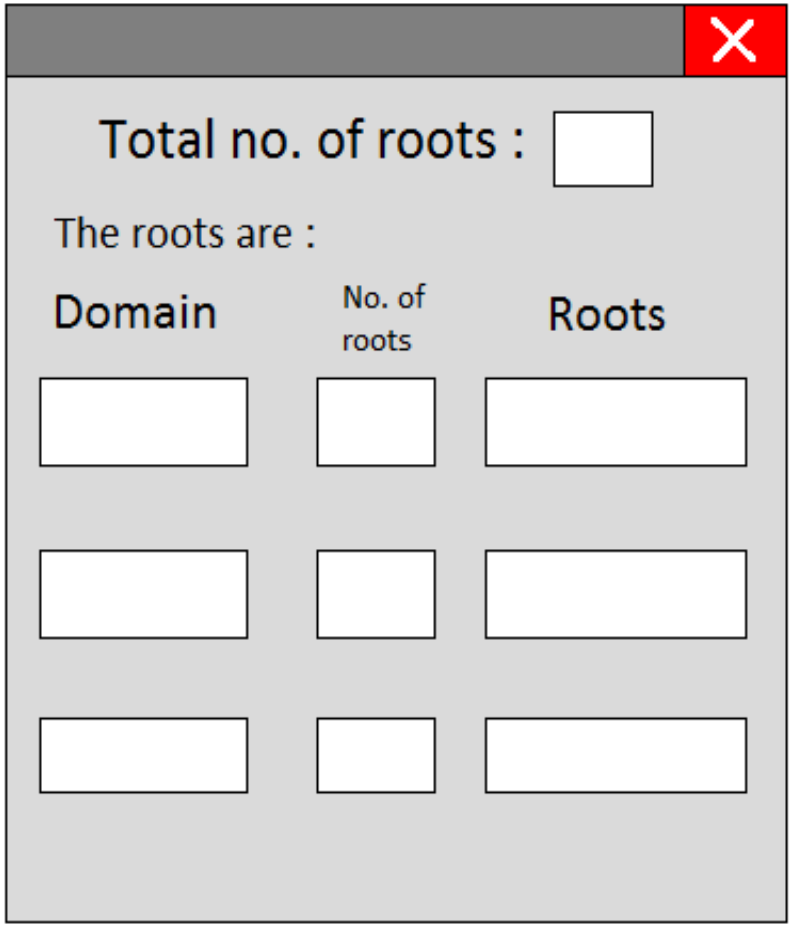
# THE OUTPUT WINDOW

**The output window appears after clicking solve button in main or advanced window.**

1) Roots : This window shows the total number of roots for the given equation in all the domains entered (if entered).

2) Domain wise display : It even shows no. of roots and roots in each domain separately in a tabular form as shown in the figure.

3) If no domain is entered (i.e. solve button is clicked from main window), then domain in which root will be shown is (-inf, +inf).



# THE HELP WINDOW & ERROR MESSAGES

The user can always refer to help window by clicking the help button provided in the main and advanced window.
The help window has help sections regarding valid inputs, allowed functions, syntax for writing equation in the input box and even a video showing how to use this software.
User is requested to read instructions given in help window at least once before using the software.

Error messages will be shown if there is some error in syntax or input.
Some examples of possible errors :

1) Entering the equation in x, variable box as y.
2) Using brackets improperly.
3) Using wrong operators.
4) Entering functions that are not allowed (refer help window).

**Have a look at a short video summarizing all the things.**

# CHALLENGE FACED AND ITS SOLUTION

1) **Parsing** :

Problem : Creating an expression tree for evaluating the expression. First of all, we had to learn about trees, and then expression trees, and so on. But it was still very difficult to parse the given input into the expression tree.

Solution : Converting the given expression into RPN (Reverse Polish Notation) to evaluate the expression. We found the shunting yard algorithm that converts the expression into RPN form.

# Extending the current project

1) Graph plotter.

2) Solving discontinuous and non – differentiable functions.

3) Solving implicit functions.