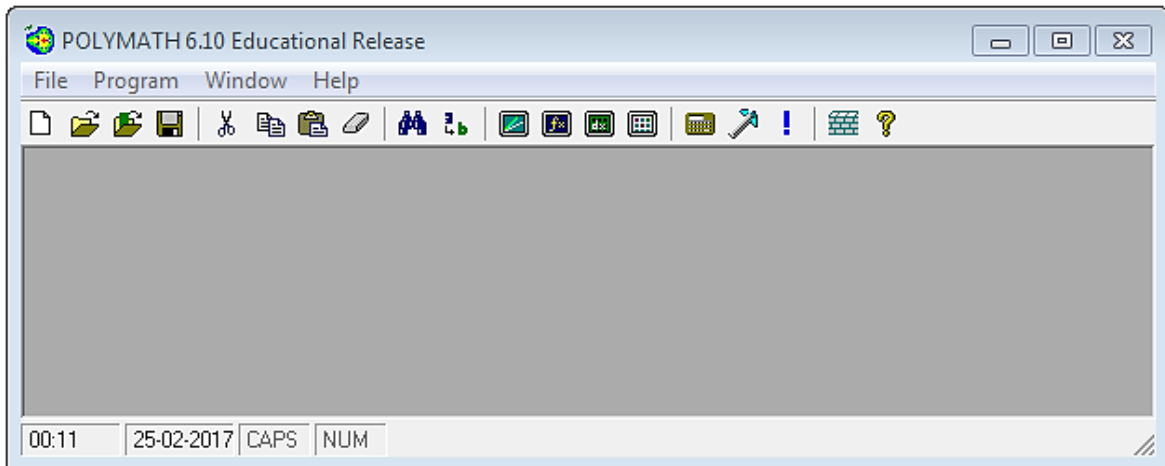## Polymath tutorial on Non-Linear Equation Solver
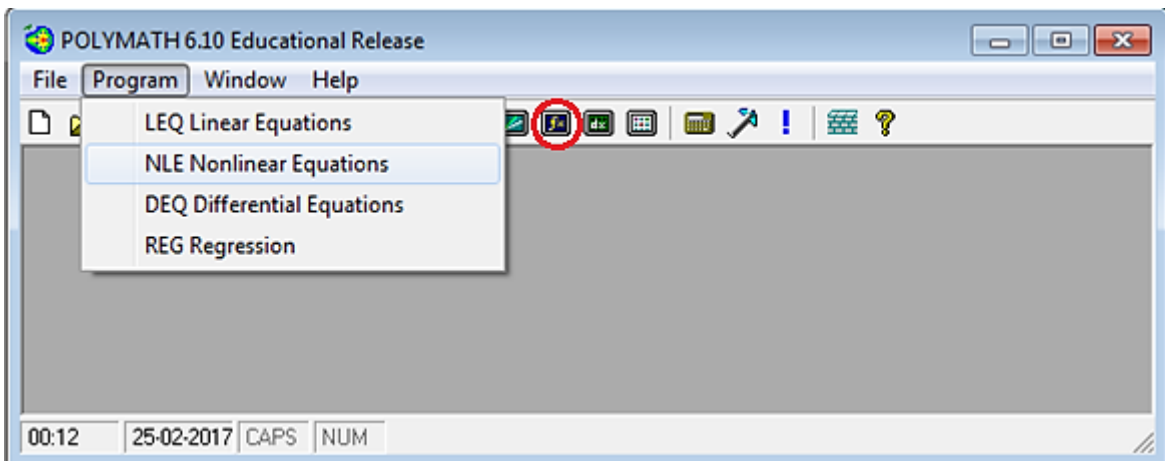
Solve the following nonlinear equation to find x & y using Polymath

$$x + y^2 = 0$$
$$2y - x^2 - 2 = 0$$

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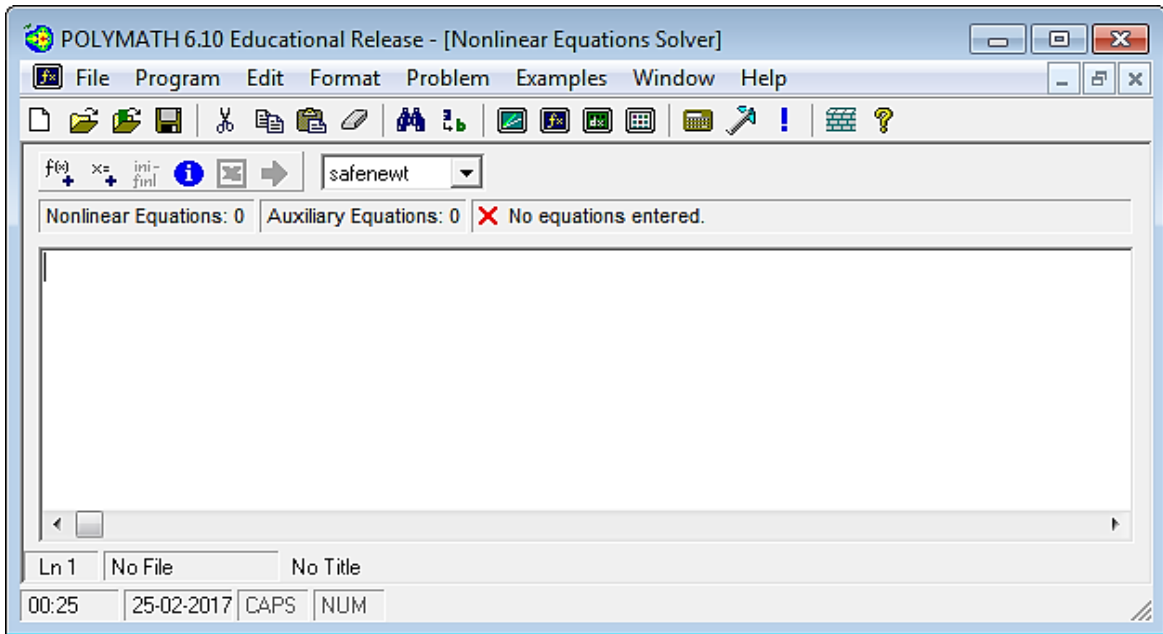First, launch Polymath which you can download from http://www.polymath-software.com
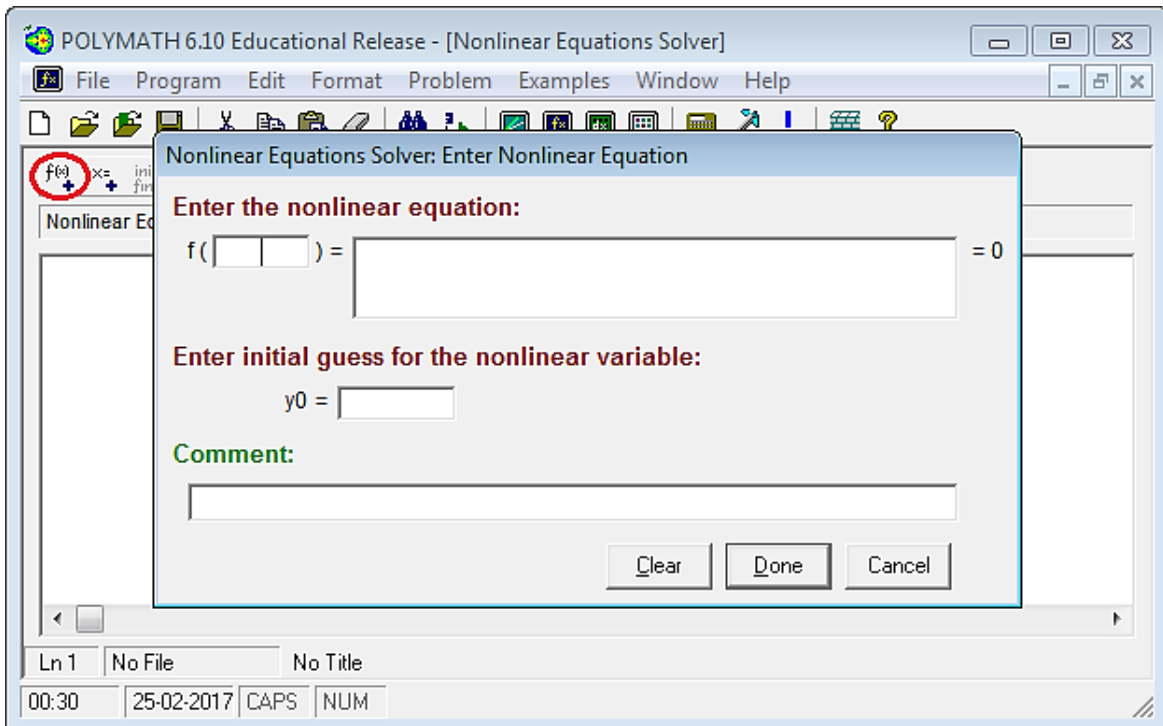You will see a window that looks like this.

To use the nonlinear solver in Polymath, first click on the "Program" tab present on the toolbar. This will bring up a list of options from which you need to select. In this case we need to solve nonlinear equations so select "NLE Nonlinear Equations". The shortcut button "fx" for differential equation solver is also present on the menu bar ( ) as shown by red circle in below screenshot

This will open up another window, which looks like this.

To enter the nonlinear equations, press the "$f(\mathbf{x})_+$" button present on the menu bar (shown by red circle in the below screenshot). This will bring up a dialogue box in which you can enter your nonlinear equation. Polymath also ask you to specify an initial guess value for the variable.
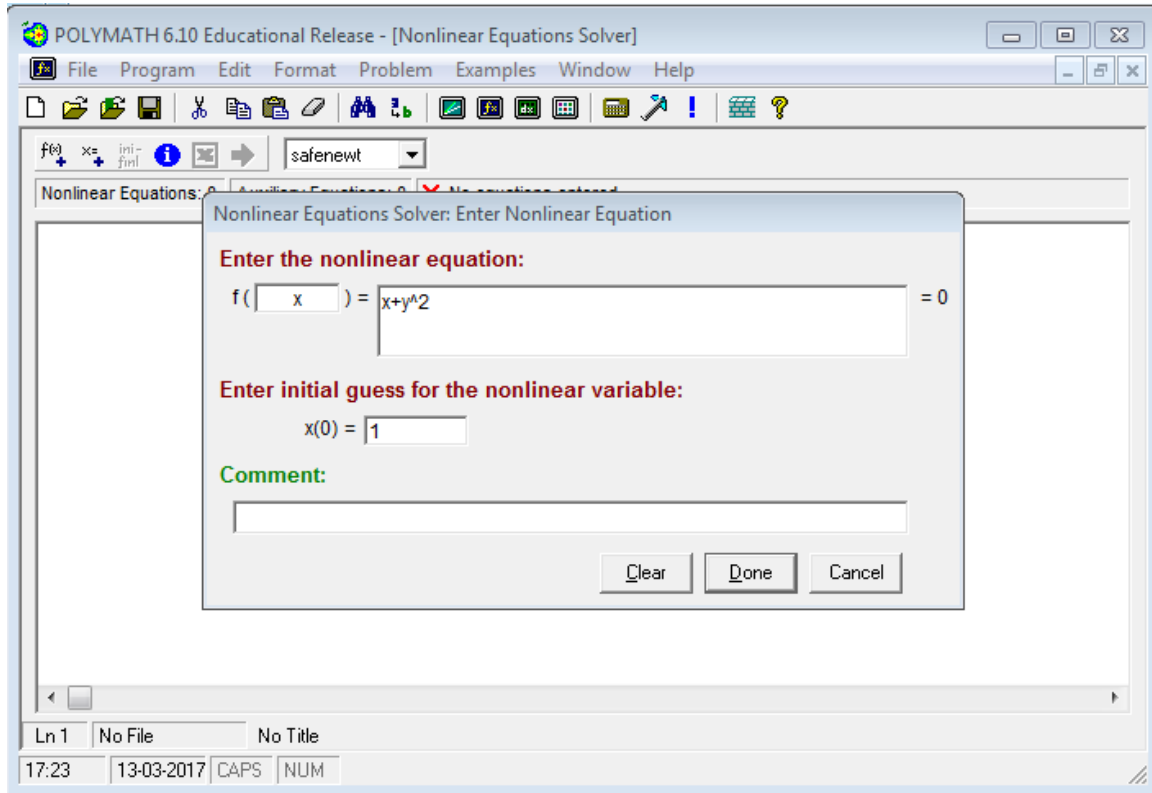

In the above dialogue box, only one nonlinear equation can be entered at one time

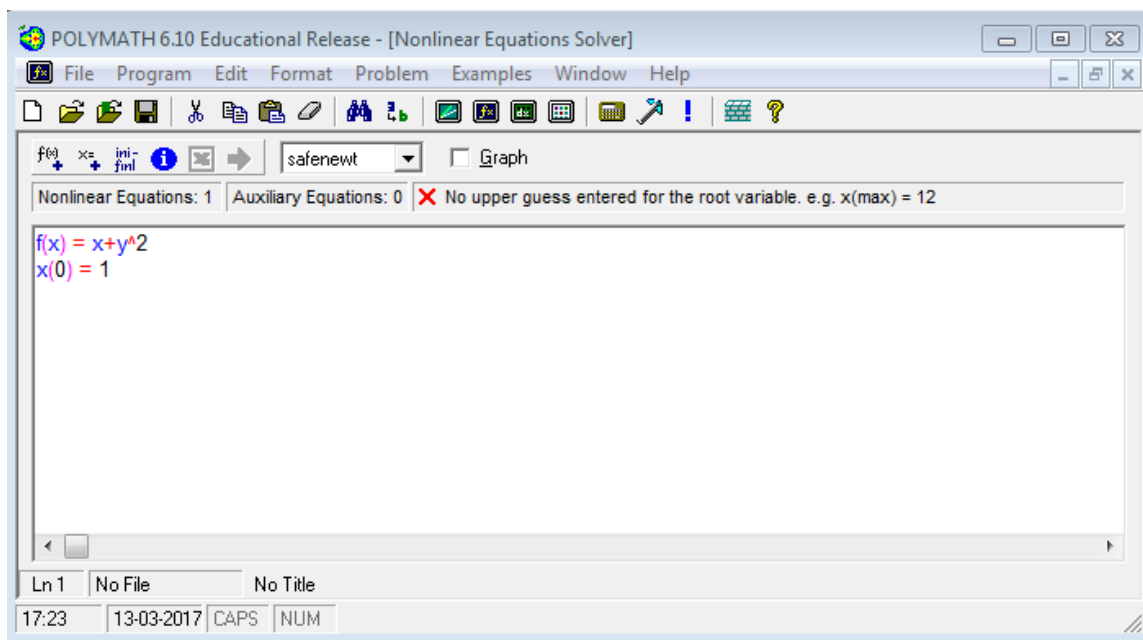First nonlinear equation in polymath form is

$$x + y^2 = 0$$

Let's take initial guess value of x =1

Enter the above equation and initial value in the space provided in the rectangular box as shown below

Note that the no matter what variable you enter in the "f( )" box, the equation that you input will be solved to find when it equals 0. Make sure that the variable you do enter into the "f( )" box is one of the variables that you want Polymath to vary in searching for a solution to the NLE.

Now, click Done. You will find that your 1st equation is entered in the main window
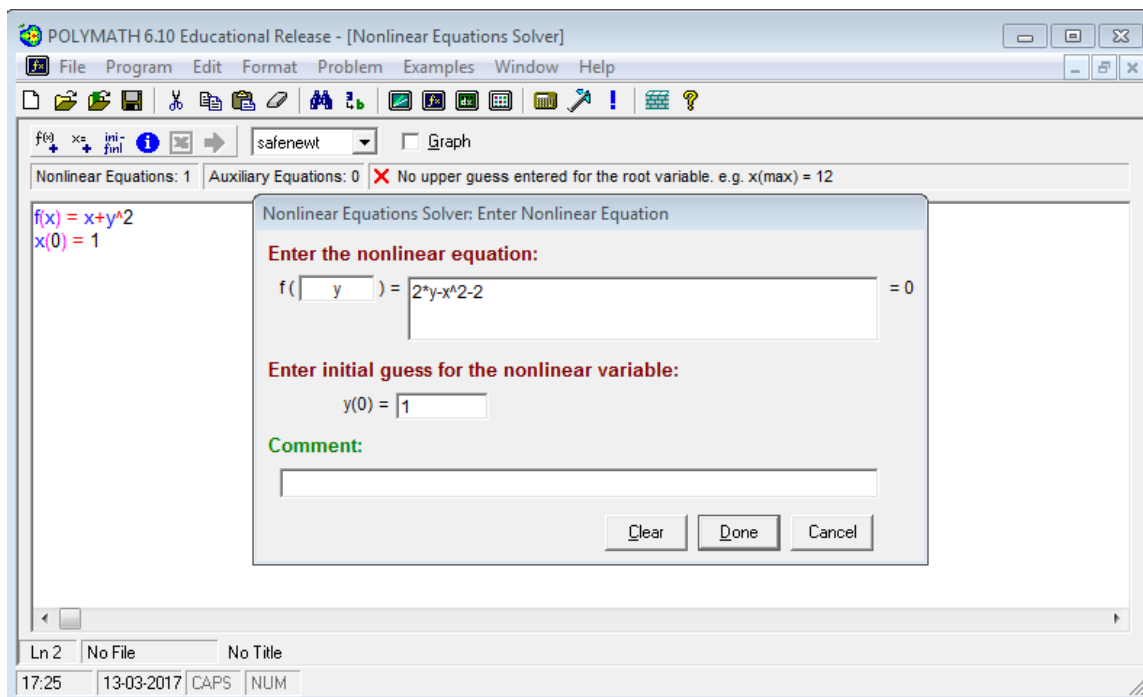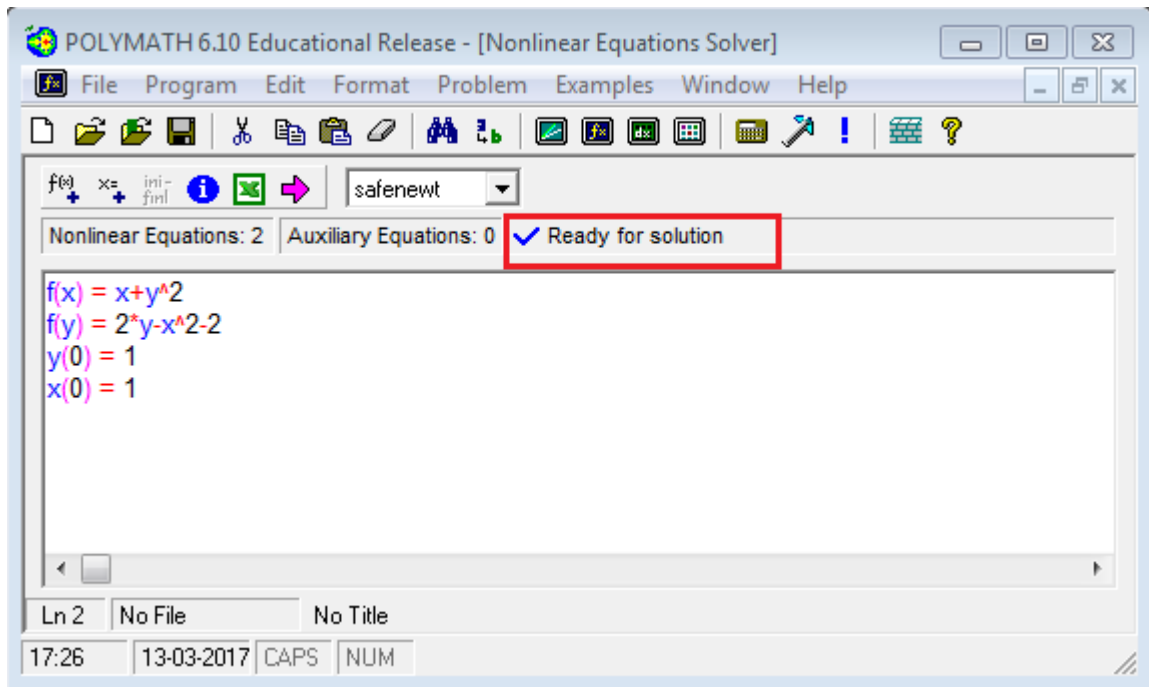

Second equation in polymath form is
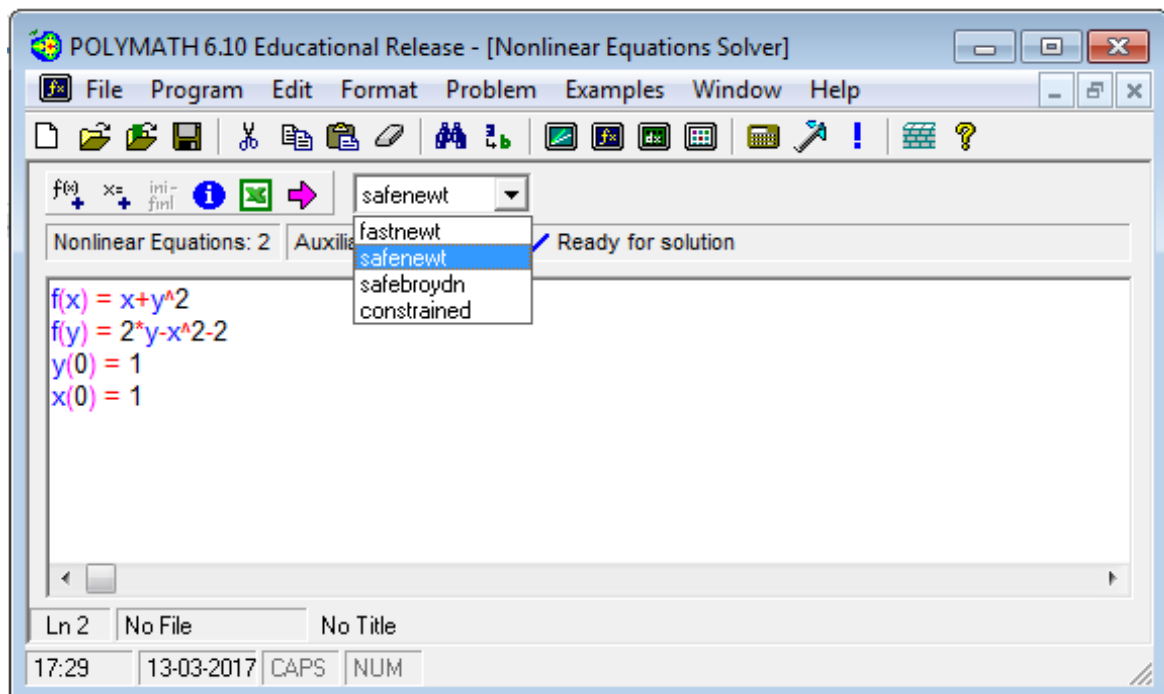
$$2*y - x^2 - 2 = 0$$

Let's take initial guess of y =1

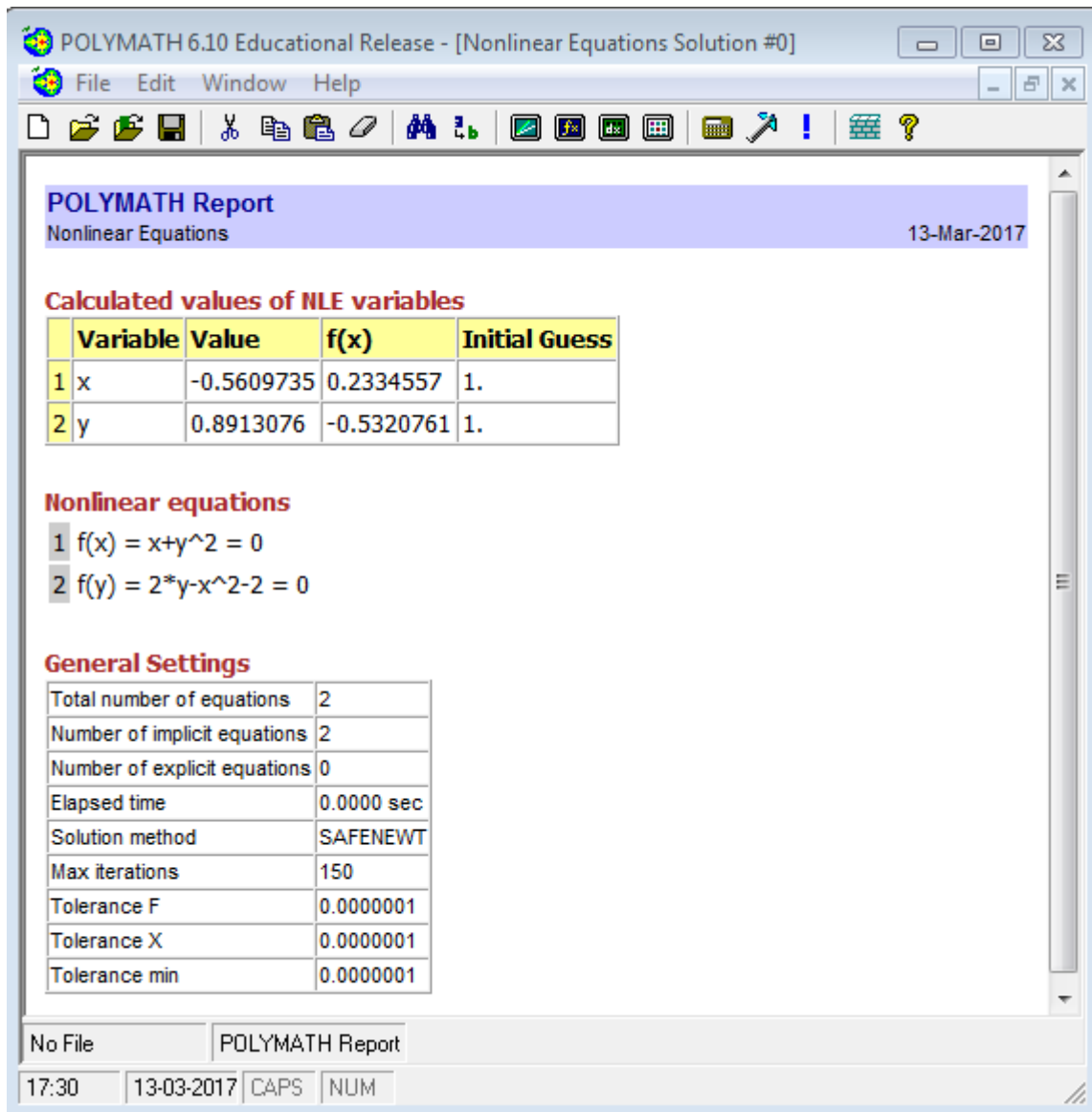To add more equation, again click on "*f*(**x**)₊" button and enter the above equation and initial guess

After you press done, your main window will have 2nd equation as well. When all of the necessary information has been specified, the screen will look like this. You are now ready to run the program as shown by ✔ "Ready for solution" (indicated by red rectangle)

You can choose the method of nonlinear equation solver you would like to use by selecting the option from the drop down menu present next to "safenewt". By default, polymath uses safenewt method. In this case, we will choose safenewt

When you are ready to run the solver, just click the pink arrow ➡. You should get a report window that looks like this. In the report, you can find the final value of the variables, function value and other statistical details

From the above report, value of x & y are

$$x = -0.56 \ and \ y = 0.89$$

If the window says something about the solver not converging, one of two things is happening. Either your guesses for the variables are too far off from their true values, which means you need to enter better guesses, or the system you have entered is insolvable, so you should check your equations for errors.

This is basically all you need to get started using Polymath to solve NLEs.