CF Linear Equations.Net
User Manual
V 1.0.0.1

1. The ***CF Linear Equations.Net*** application is a Windows Form app for solving systems of linear equations of the form **Ax** = **B** where:
    A is a square matrix.
    B is a vector of the same length as the rows and columns of **A.**
    x is the calculated vector.

    The user supplies the values for **A** and **B**, the app solves for **x.** In addition, upon a successful calculation, the **Ax** will be calculated and displayed so that the user may detect any inaccuracies in the computer calculations.

2. When the application is started, the initial screen appears with a zeroized two-dimensional matrix and vector. ([Figure 1](#)). The user can:
    a. Manually enter values into the matrix (**A**) and vector (**b**).
    b. Add or delete rows and columns.
    c. Load a matrix or a vector from a .csv file.
    d. Save a matrix or a vector to a .csv file.
    e. Zeroize a matrix or a vector.
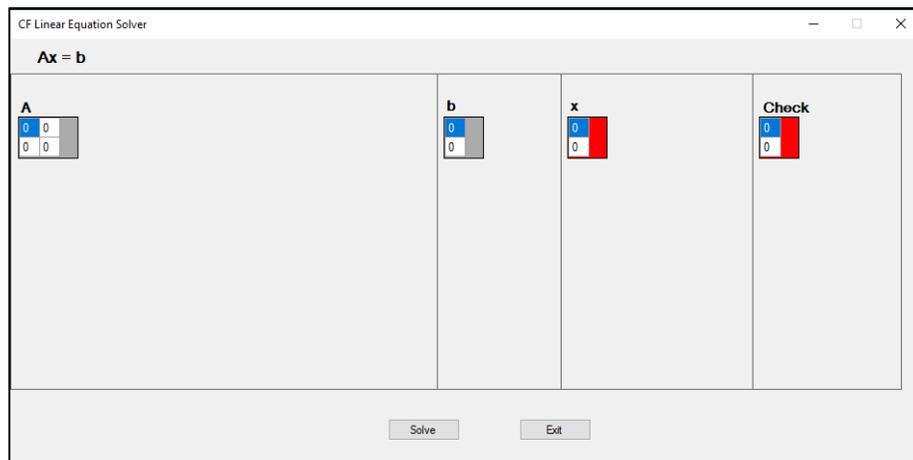   f. Solve the system of linear equations (if a solution exists).

Figure 1- Initial Screen

3. **Manually Entering Values**.

You may enter values in both the **A** matrix and the **b** vector using the keyboard. All entries must properly formatted double values (<u>Figure 2</u>). Examples are:
   a. 1.0
   b. 1.0E10
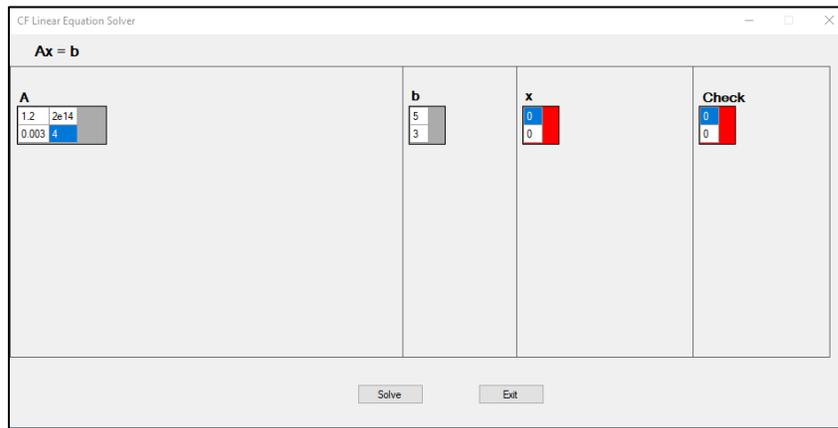   c. -1.5E-2
   d. 5
   e. -1.0

Figure 2-Entering Values Manually

4. **Add/Deleting rows and columns**.

You can add or delete rows and columns for the **A** matrix using the matrix popup menu (<u>Figure 3</u>). The matrix popup menu is displayed when you right click on the **A** matrix. Simply select ***Add Row*** or ***Delete Row*** from the menu. A row and column will be added to the matrix, and all the vector sizes will be updated to match the matrix. Note: if there are only two rows in the matrix, the ***Delete Row*** item will not be shown in the context menu.
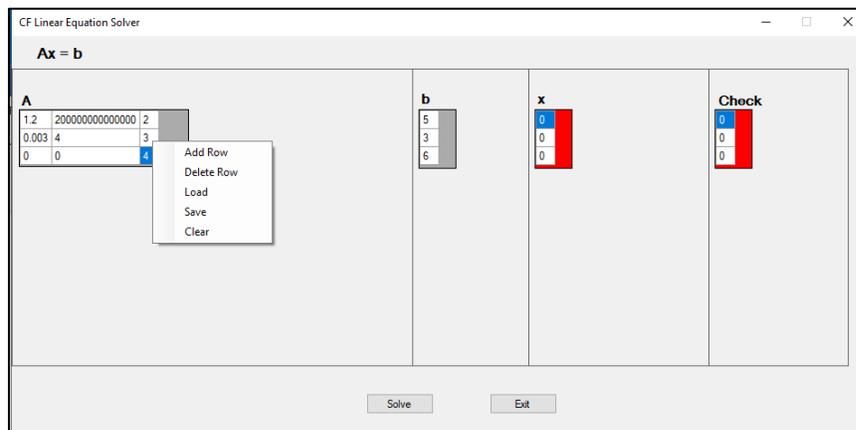

Figure 3 - Adding/Deleting Rows and Columns

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5. **Loading a Matrix from a .csv File**.

Instead of typing in values, you can load the **A** matrix from a comma-delimited file. The file must consist of comma-delimited double values in square matrix form. To see an example of a properly formatted file, just save the **A** matrix to a .csv file (see paragraph 7) and inspect it.

To load a file, just select **Load** from the matrix context menu (Figure 3) and select the file to load (Figure 4).

Figure 4 - Loading a Matrix from a File

6. **Loading the b Vector from a .csv File**.

Instead of typing in values you can load the **b** vector from a comma-delimited file. The file will consist of comma-delimited double values in vector form. The size of the vector must equal the number of rows in the current matrix.   To see an example of a properly formatted file, just save a vector to a .csv file (see paragraph 8).

To load a file, just select **Load** from the vector context menu (Figure 5) and select the file to load from the popup dialog.
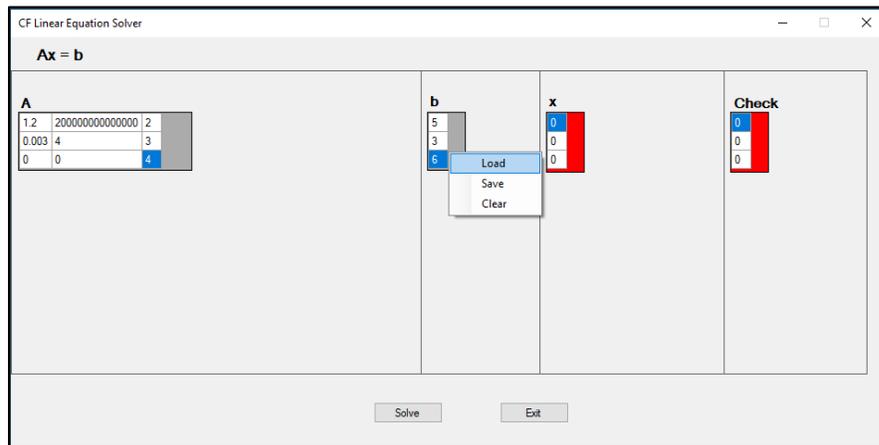
Figure 5 - Loading the Vector from a File

7. **Saving a Matrix to a .csv File**.

To save the **A** matrix to a .csv file, select *Save* from the matrix popup menu (Figure 3) and either select the file name from the file list or type in a new file name (Figure 6).
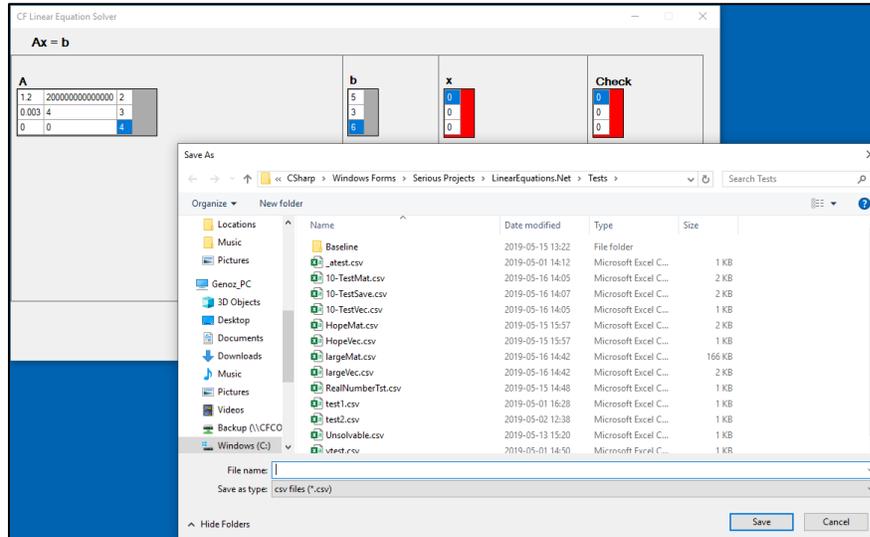

Figure 6-Saving the Matrix to a File

8. **Saving the Vector to a .csv File**.
To save the **b** vector to a .csv file, select *Save* from the vector popup menu (Figure 5) and either select the file name from the dialog or type in a new name (Figure 7).
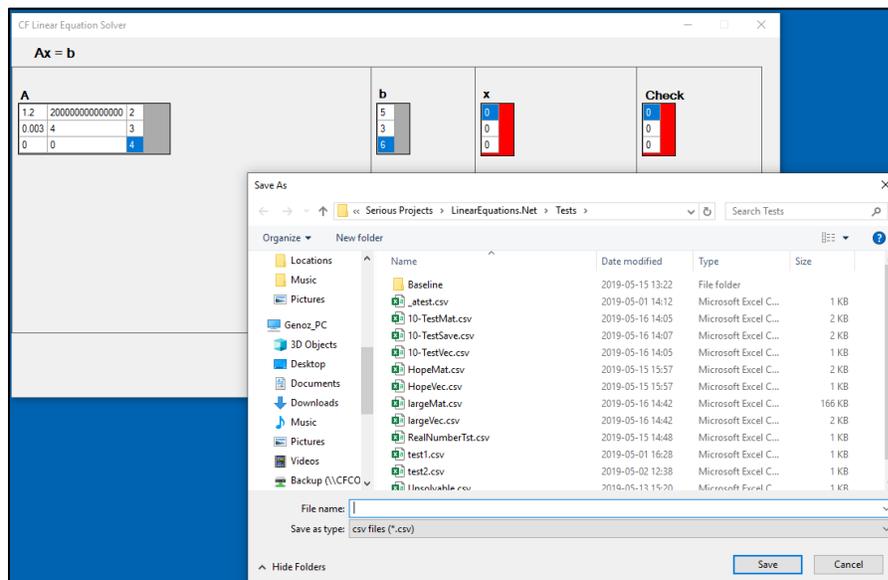

Figure 7- Saving the Vector to a File

9. **Zeroizing a Matrix**.

You can zeroize the **A** matrix by selecting **_Clear_** from the matrix popup menu ([Figure 8](#)). This will set all cells in the matrix to zero, as well as resetting the **x** and **Check** vectors.
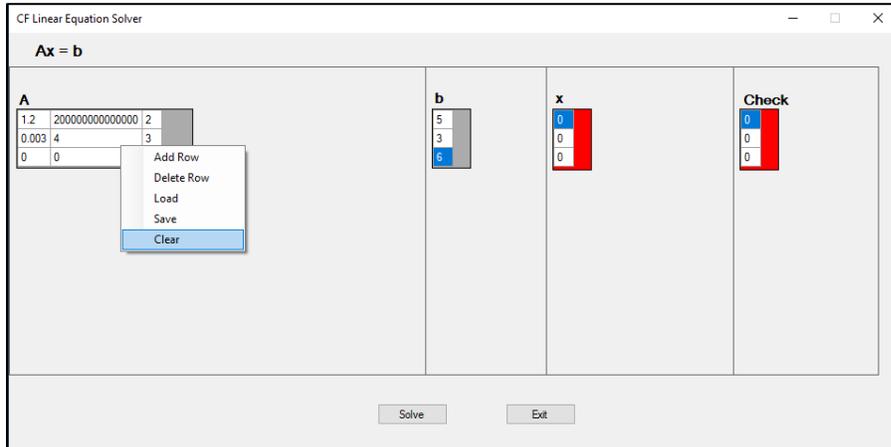

Figure 8-Zeroizing a Matrix

10. **Zeroizing a Vector**.

You can zeroize the **b** vector by selecting **_Clear_** from the vector popup menu ([Figure 9](#)). This will set all cells in the **b** vector to zero, as well as resetting the **x** and **Check** vectors.
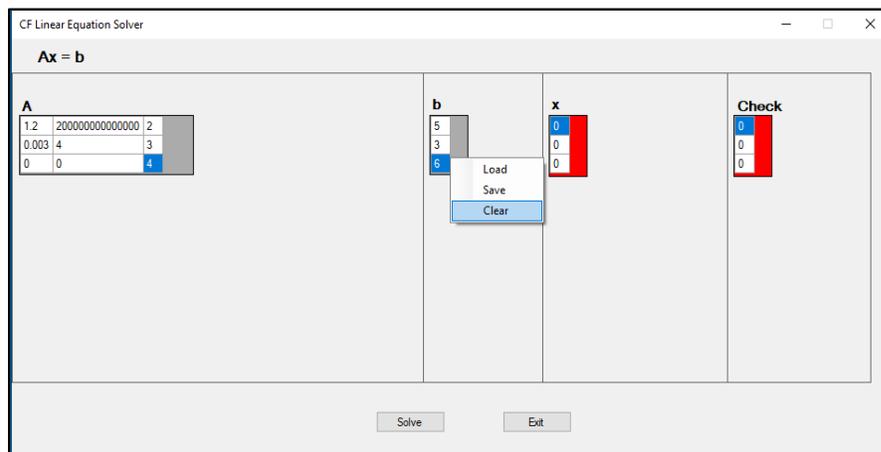

Figure 9-Zeroizing a Vector

11. **Solving the System of Linear Equations**.

Once the **A** matrix and **b** vector are filled you can attempt to solve the system by clicking on the *Solve* button. If the system can be solved, the result will be displayed in the **x** vector. In addition, the app will multiply the matrix by the x vector and display the result in the **Check** vector (Figure 10). The values in the Check vector should match the values in the b vector. A small difference might result from computer arithmetic rounding errors.

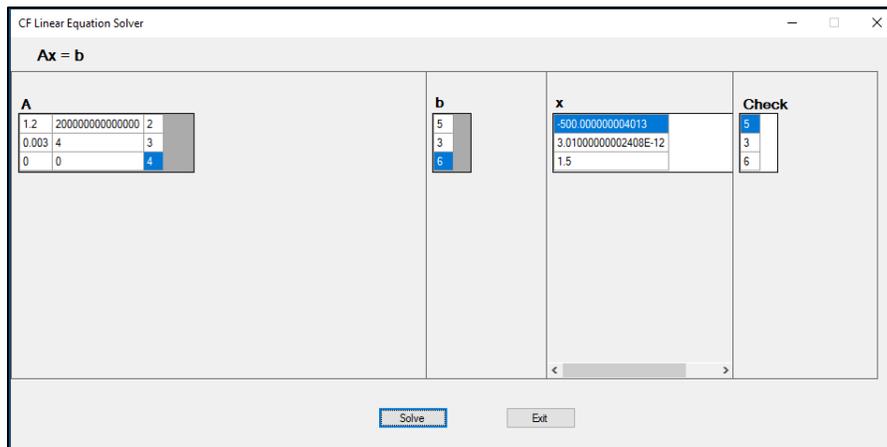If the system cannot be solved, a message will appear (Figure 11).

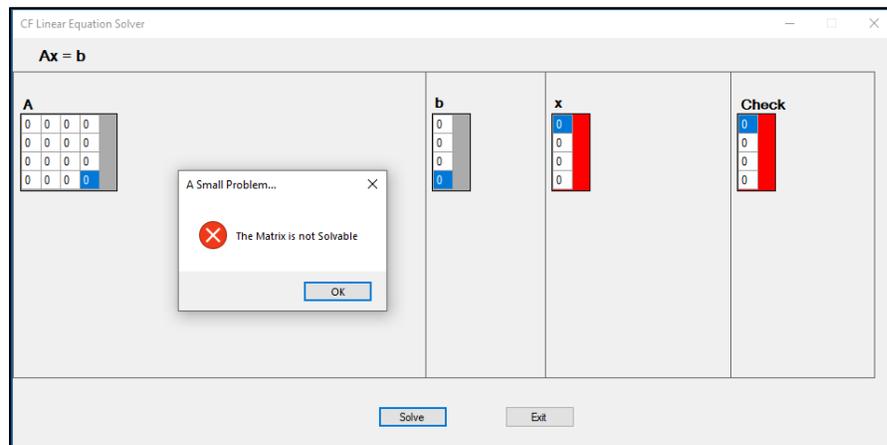*Figure 10-Solving the System of Linear Equations*

Figure 11 – An un-solvable System

12. **Errors** – If an input error occurs, a message box will popup. Normally, the error message will be self-explanatory. If an unexpected error happens, please email the text of the error to:

    corporate@cfsw.biz

13. Please email any problem descriptions or improvement suggestions to:

    corporate@cfsw.biz