What is your decision on a new requirement?

Gauss-Jordon Elimination

- Solve a set of linear equations
  - Gauss-Jordon Elimination (http://en.wikipedia.org/wiki/Gauss%E2%80%93Jordan_elimination)

$$L_1\text{: } 2x + y - z = 8$$

$$L_2\text{: } -3x - y + 2z = -11$$

$$L_3\text{: } -2x + y + 2z = -3$$

  - Basic algorithm:
    - eliminate x from all equations except L_1, then
    - eliminate y from all equations except L_2, and
    - eliminate z from all equations except L_3.

    This will put the system into reduced row-echelon form.

    Each unknown variables can be solved.

Gauss-Jordon Elimination (cont'd)

- In matrix notation:

$$\left(\begin{array}{ccc|c} 2 & 1 & -1 & 8 \\ -3 & -1 & 2 & -11 \\ -2 & 1 & 2 & -3 \end{array}\right) \Rightarrow \left(\begin{array}{ccc|c} 1 & 0.5 & -0.5 & 4 \\ 0 & 0.5 & 0.5 & 1 \\ 0 & 2 & 1 & 5 \end{array}\right)$$

Normalize 1st row
Multiply 3 and add to 2nd row
Multiply 2 and add to 3rd row

$$\Rightarrow \left(\begin{array}{ccc|c} 1 & 0 & -1 & 3 \\ 0 & 1 & 1 & 2 \\ 0 & 0 & -1 & 1 \end{array}\right)$$

Normalize 2nd row
Multiply -0.5 and add to 1st row
Multiply -2 and add to 3rd row

$$\Rightarrow \left(\begin{array}{ccc|c} 1 & 0 & 0 & \mathbf{2} \\ 0 & 1 & 0 & \mathbf{3} \\ 0 & 0 & 1 & \mathbf{-1} \end{array}\right)$$

Normalize 3rd row
Multiply 1 and add to 1st row
Multiply -1 and add to 2nd row

x=2, y=3, z = -1 are the result.

Write a C program to do this!

Matrix Inverse

$$\left(\begin{array}{ccc|ccc} 2 & 1 & -1 & 1 & 0 & 0 \\ -3 & -1 & 2 & 0 & 1 & 0 \\ -2 & 1 & 2 & 0 & 0 & 1 \end{array}\right) \Rightarrow \left(\begin{array}{ccc|ccc} 1 & 0.5 & -0.5 & 0.5 & 0 & 0 \\ 0 & 0.5 & 0.5 & 1.5 & 1 & 0 \\ 0 & 2 & 1 & 1 & 0 & 1 \end{array}\right)$$

$$\Rightarrow \left(\begin{array}{ccc|ccc} 1 & 0 & -1 & -1 & -1 & 0 \\ 0 & 1 & 1 & 3 & 2 & 0 \\ 0 & 0 & -1 & -5 & -4 & 1 \end{array}\right)$$

$$\Rightarrow \left(\begin{array}{ccc|ccc} 1 & 0 & 0 & 4 & 3 & -1 \\ 0 & 1 & 0 & -2 & -2 & 1 \\ 0 & 0 & 1 & 5 & 4 & -1 \end{array}\right)$$

$$\begin{pmatrix} 2 & 1 & -1 \\ -3 & -1 & 2 \\ -2 & 1 & 2 \end{pmatrix} \begin{pmatrix} 4 & 3 & -1 \\ -2 & -2 & 1 \\ 5 & 4 & -1 \end{pmatrix} = \begin{pmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{pmatrix}$$

Assume you have the previous program,
write another C program to do this!

How would you do it?

How would you do it?

1. Write a totally new program to do it?
    - Old program might still have bugs, write a new one might avoid that at all.
    - Old program is difficult to read and modify. Even if old program does not have bugs, there will be some bugs after the modification.

or

2. Adapt the old program to satisfy the new requirement?

or

3. Modularize suitably each components in the old program, test the modularized old program, and extract useful components from it to compose the new program?