MSc: Computational & Software Techniques in Engineering
Java Programming Assignment 2012/2013

The assignment consists of writing a *Java applet* to enter and then display the solution to a system of linear equations.

The applet should provide the following functionality

1) Allow input of the matrix system and right hand side vector in two side by side scrollable areas in the top part of the applet.

2) Provide four buttons in the middle section of the applet with the following functionality:

Button	**Functionality**
`LU`	computes the L and U factorization of the matrix without pivoting.
`LU Pivot`	computes the L and U factorization of the matrix with pivoting
`Inverse`	compute the inverse of the matrix system
`Clear`	clears the output display area in the bottom part of the applet (see below)

3) Display the results of the button presses in 2) in a scrollable area in the bottom part of the applet as follows:

Button	**Output**
`LU`	the original matrix and vector and the lower and upper matrices, solution vector and determinant are displayed (as below)

```
LU Decomposition with scaled partial pivoting
Original matrix
   1.0000000   2.0000000   1.0000000   3.0000000
   2.0000000   3.0000000   1.0000000   4.0000000
   1.0000000   4.0000000   3.0000000   2.0000000
   2.0000000   4.0000000   1.0000000   5.0000000

Original vector
   4.0000000   1.0000000  -3.0000000   4.0000000

Lower matrix
   1.0000000   0.0000000   0.0000000   0.0000000
   0.5000000   1.0000000   0.0000000   0.0000000
   1.0000000   0.4000000   1.0000000   0.0000000
   0.5000000   0.2000000   0.0000000   1.0000000

Upper matrix
   2.0000000   3.0000000   1.0000000   4.0000000
   0.0000000   2.5000000   2.5000000   0.0000000
   0.0000000   0.0000000  -1.0000000   1.0000000
   0.0000000   0.0000000   0.0000000   1.0000000

Solution
  -6.0000000  -1.2000000  -0.2000000   4.2000000

Determinant = 5.0
```

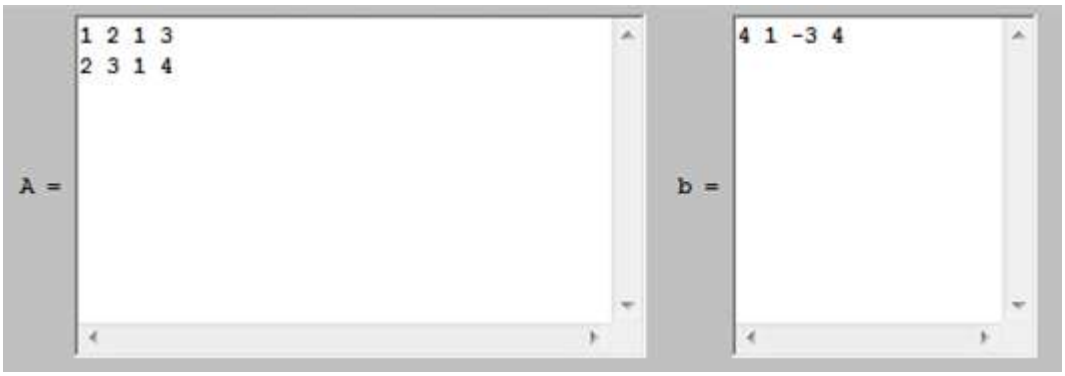
`LU Pivot`	As above but with the pivot vector also displayed
`Inverse`	the original matrix and vector, inverse matrix and determinant and pivot vector are displayed (as below)

```
Matrix Inversion
Original matrix
   1.0000000   2.0000000   1.0000000   3.0000000
   2.0000000   3.0000000   1.0000000   4.0000000
   1.0000000   4.0000000   3.0000000   2.0000000
   2.0000000   4.0000000   1.0000000   5.0000000

Lower matrix
   1.0000000   0.0000000   0.0000000   0.0000000
   0.5000000   1.0000000   0.0000000   0.0000000
   1.0000000   0.4000000   1.0000000   0.0000000
   0.5000000   0.2000000   0.0000000   1.0000000

Upper matrix
   2.0000000   3.0000000   1.0000000   4.0000000
   0.0000000   2.5000000   2.5000000   0.0000000
   0.0000000   0.0000000  -1.0000000   1.0000000
   0.0000000   0.0000000   0.0000000   1.0000000

Inverse matrix
  -1.0000000   2.0000000   0.0000000  -1.0000000
  -1.0000000  -0.6000000   0.2000000   1.0000000
   1.0000000   0.4000000   0.2000000  -1.0000000
   1.0000000  -0.4000000  -0.2000000   0.0000000

Determinant = 5.0

Pivot array
  2  3  4  1
```

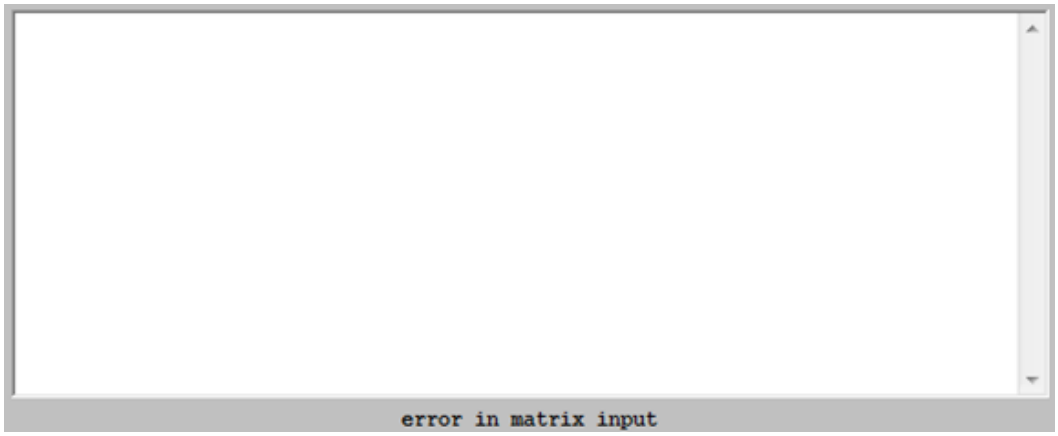
Exceptional conditions

1) If the matrix of data and/or right hand side vector entered in the top part of the applet is not correct in some way (i.e not enough data, size of matrix and rhs don't match, data has not real numbers), then the applet should simply display a message

   "error in matrix input"

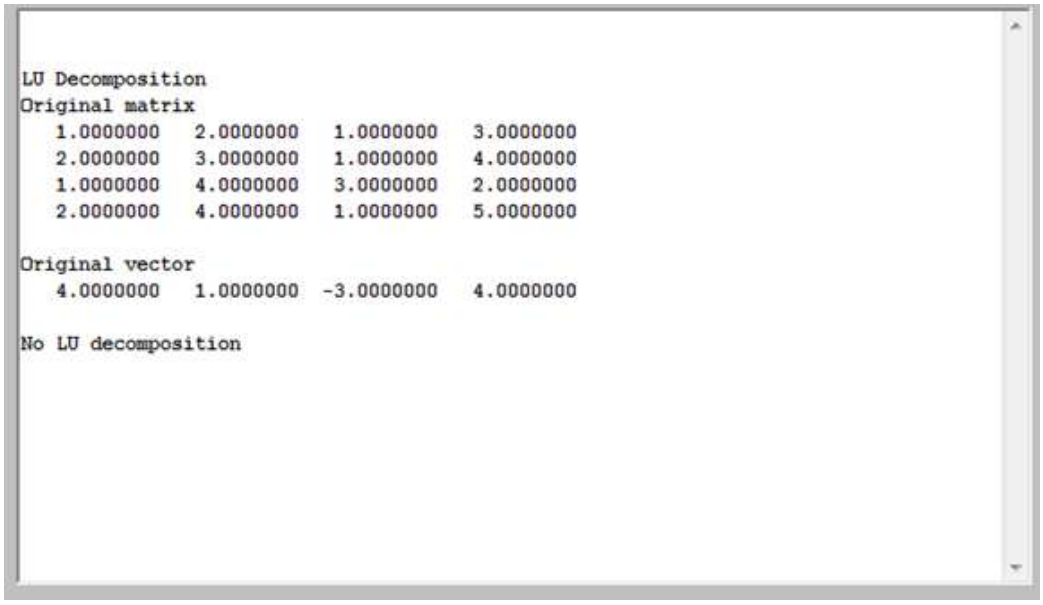


Display area



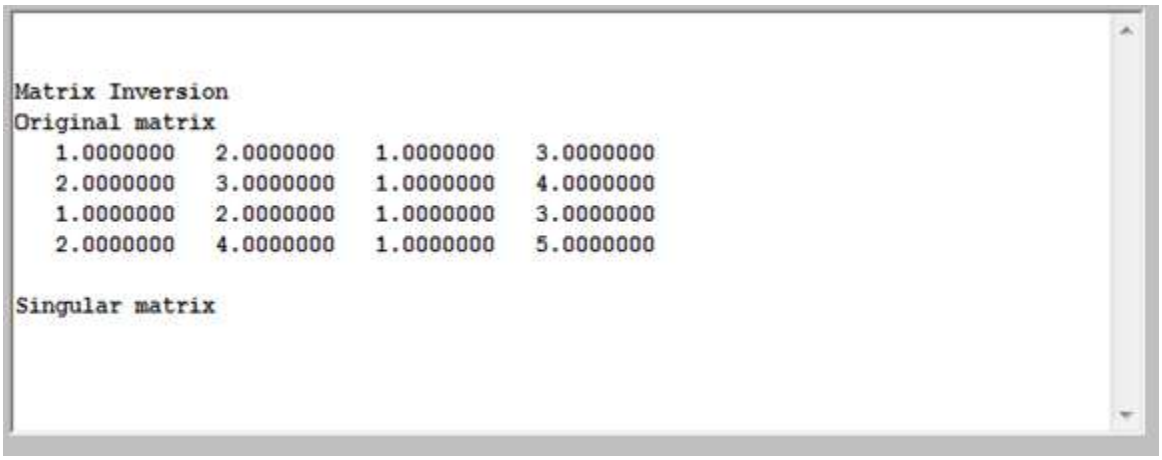
2) If the matrix is not singular but LU factorisation without pivoting is not possible (i.e LU factorisation can't be computed unless pivoting is used) then the result of the button press should be the display of the original matrix and right hand side vector followed by the text

   "no LU decomposition"



3) If the matrix is singular the result of pressing either LU, LU Pivot or Inverse should be the display of the original matrix and vector followed by the text

"singular matrix"



Notes:

- You can convert any of the code from exercise 3 of the C++ exercises that you feel would be useful.
- Your classes should be documented appropriately using javadoc.

Deliverables: to Pauline amac-mscadmin@cranfield.ac.uk by **Monday Feb 11** 2013

- A `jar` (Java Archive) file containing the compiled source code of your applet

- An `html` file containing an applet tag referencing the archive file. Loading the html file into a Java enabled browser should run the applet (see final exercise in `RainForest` application).

- A zip file containing the `.java` files and the accompanying javadoc documentation.

Marks will be awarded according to the following:

- Correctly functioning applet – **50%**
- Design of the code – **30%**
- Documentation – **20%**