C:₩WINDOWS₩system32₩cmd.exe

```
---------- 1st A Matrix of Linear Equation Ax=b ----------

  4.000   2.000   3.000  -1.000
 -2.000  -1.000  -2.000   2.000
  5.000   3.000   4.000  -1.000
 11.000   4.000   6.000   1.000

---------- 1st b Matrix of Linear Equation Ax=b ----------

  4.000  -3.000   4.000  11.000

---------- About Matrix of Linear Equation 1 ----------

---------- Determinant ----------

0.000000

!!!!! Gauss-Jordan Elimination CAN NOT HANDLE A Singular Matirx !!!!!

!!!!! LU Decomposition CAN NOT HANDLE A Singular Matirx !!!!!

---------- Solution of Singular Value Decomposition ----------

  1.375000  -2.500000   1.250000  -0.625000

---------- Inverse Matrix using Singular Value Decomposition ----------

-809912.937500 -303717.343750 303717.437500 101239.218750
-1619824.750000 -607432.937500 607436.187500 202477.531250
2429737.250000 911150.500000 -911152.812500 -303716.812500
809912.875000 303717.562500 -303717.687500 -101238.960938

---------- 2nd A Matrix of Linear Equation Ax=b ----------

  2.000  -4.000  -5.000   5.000   0.000
 -1.000   1.000   2.000   0.000   4.000
 -1.000   6.000   0.000   3.000   2.000
  0.000   1.000   3.000   7.000   5.000
  5.000   0.000   8.000   7.000  -2.000
```

C:₩WINDOWS₩system32₩cmd.exe

```
---------- 2nd A Matrix of Linear Equation Ax=b ----------

  2.000  -4.000  -5.000   5.000   0.000
 -1.000   1.000   2.000   0.000   4.000
 -1.000   6.000   0.000   3.000   2.000
  0.000   1.000   3.000   7.000   5.000
  5.000   0.000   8.000   7.000  -2.000

---------- 2nd b Matrix of Linear Equation Ax=b ----------

 -5.000   2.000   0.000   4.000  -1.000

---------- About Matrix of Linear Equation 2 ----------

---------- Determinant ----------

3835.999512

---------- Solution of Gauss-Jordan Elimination ----------

 -2.873567  -0.612357   0.976277   0.635819  -0.553441

---------- Inverse Matrix using Gauss-Jordan Elimination ----------

  0.354536   0.766945   0.207769  -0.595412   0.253128
  0.035454   0.126695   0.195777  -0.159541   0.050313
 -0.138686  -0.098540  -0.096715   0.124088   0.016423
 -0.052138  -0.303963  -0.023201   0.234619  -0.044578
  0.149114   0.459333   0.051356  -0.171012   0.042492

---------- Solution of LU Decomposition ----------

 -2.873566  -0.612357   0.976277   0.635819  -0.553441

---------- Inverse Matrix using LU Decomposition ----------

  0.354536   0.766945   0.207769  -0.595412   0.253128
  0.035454   0.126695   0.195777  -0.159541   0.050313
 -0.138686  -0.098540  -0.096715   0.124088   0.016423
 -0.052138  -0.303962  -0.023201   0.234619  -0.044578
  0.000000   0.000000   0.000000   0.000000   0.000000

---------- Solution of Iterative Improvement ----------

 -2.873566  -0.612357   0.976277   0.635818  -0.553441

---------- Solution of Singular Value Decomposition ----------

 -2.873567  -0.612357   0.976278   0.635819  -0.553441

---------- Inverse Matrix using Singular Value Decomposition ----------

  0.354536   0.766945   0.207769  -0.595412   0.253128
  0.035454   0.126695   0.195777  -0.159541   0.050313
 -0.138686  -0.098540  -0.096715   0.124088   0.016423
 -0.052138  -0.303963  -0.023201   0.234620  -0.044578
  0.149114   0.459333   0.051356  -0.171012   0.042492
```

C:₩WINDOWS₩system32₩cmd.exe

```
---------- 3rd A Matrix of Linear Equation Ax=b ----------

  0.400   8.200   6.700   1.900   2.200   5.300
  7.800   8.300   7.700   3.300   1.900   4.800
  5.500   8.800   3.000   1.000   5.100   6.400
  5.100   5.100   3.600   5.800   5.700   4.900
  3.500   2.700   5.700   8.200   9.600   2.900
  3.000   5.300   5.600   3.500   6.800   5.700

---------- 3rd b Matrix of Linear Equation Ax=b ----------

 -2.900  -8.200   7.700  -1.000   5.700   3.000

---------- About Matrix of Linear Equation 3 ----------

---------- Determinant ----------

16178.401367

---------- Solution of Gauss-Jordan Elimination ----------

 -0.326608   1.532293  -1.044825  -1.587447   2.928480  -2.218931

---------- Inverse Matrix using Gauss-Jordan Elimination ----------

 -0.162205   0.122801   0.024068  -0.016431  -0.022840   0.046132
  0.169407  -0.041117   0.228313  -0.087624   0.180306  -0.395655
 -0.011636   0.122745  -0.117407  -0.180981   0.015910   0.186766
  0.105669  -0.051726  -0.108916   0.299774   0.000859  -0.190541
 -0.053026  -0.042361   0.160508  -0.224034   0.161811   0.015024
 -0.062341  -0.064694  -0.234216   0.351126  -0.364828   0.434633

---------- Solution of LU Decomposition ----------

 -0.326608   1.532292  -1.044826  -1.587447   2.928480  -2.218930

---------- Inverse Matrix using LU Decomposition ----------

 -0.162205   0.122801   0.024068  -0.016431  -0.022840   0.046132
  0.169407  -0.041117   0.228313  -0.087624   0.180306  -0.395655
 -0.011636   0.122745  -0.117407  -0.180981   0.015910   0.186766
  0.105669  -0.051726  -0.108916   0.299774   0.000859  -0.190541
 -0.053026  -0.042362   0.160508  -0.224034   0.161811   0.015024
  0.000000   0.000000   0.000000   0.000000   0.000000   0.000000

---------- Solution of Iterative Improvement ----------

 -0.326608   1.532292  -1.044825  -1.587448   2.928480  -2.218930

---------- Solution of Singular Value Decomposition ----------

 -0.326609   1.532292  -1.044824  -1.587447   2.928479  -2.218929

---------- Inverse Matrix using Singular Value Decomposition ----------

 -0.162205   0.122801   0.024068  -0.016431  -0.022840   0.046132
  0.169407  -0.041117   0.228313  -0.087624   0.180306  -0.395655
 -0.011636   0.122745  -0.117407  -0.180981   0.015910   0.186766
  0.105669  -0.051726  -0.108916   0.299774   0.000859  -0.190540
 -0.053026  -0.042361   0.160508  -0.224034   0.161811   0.015024
 -0.062341  -0.064694  -0.234216   0.351126  -0.364828   0.434633

계속하려면 아무 키나 누르십시오 . . .
```

1. Solve the equation and discuss empirically the advantage/disadvantage of each method.
    A. Solve the equation : There are solutions above the picture.
    B. discuss empirically the advantage/disadvantage of each method.
        i. Advantages
            1. Gauss-Jordan Elimination method is easy to use. (well-trained.)
            2. LU Decomposition method is efficient to use when I need many calculations about Ax=b, that A is fixed matrix while b is changed.
            3. SVD method can get (approximated) a solution even though the A matrix is singular one.
        ii. Disadvantages
            1. Gauss-Jordan Elimination method usually takes long time. And it won't work if matrix is singular one.
            2. LU Decomposition method can cause roundoff-error. To fix this, another sequence, Iterative Improvement, is needed.
            3. SVD method is hard to understand. And it also need a lot of calculations.

2. Apply the method of iterative improvement(mprove()) to the above problem and discuss the result
    A. There are changes on $10^{-6}$ decimal point. It is an unignorable difference compared to inverse matrix.
    B. This result from just one operation of mprove() function. The more operation I'll do, the more precision I can get.

3. Find the inverse and the determinant of the matrix $A_i$ in the above problem.
    A. There are inverse and the determinant of the matrix $A_i$ above the picture.