



Homework5

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|------|---------------|
| 과목명. | 수치해석 |
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HANYANG UNIVERSITY

1. gauss-jordan

```
Microsoft Visual Studio 디버그 콘솔
which method?
=====
1. gauss-jordan
2. LU decomposition
3. Singular Value Decomposition
0. exit
=====
1
Matrix A
  4.000000    2.000000    3.000000   -1.000000
 -2.000000   -1.000000   -2.000000    2.000000
  5.000000    3.000000    4.000000   -1.000000
 11.000000    4.000000    6.000000    1.000000

Numerical Recipes run-time error...
gaussj: Singular Matrix
...now exiting to system...

C:\Users#gjawi\source\repos\HW5\Debug\HW5.exe (프로세스 9812개)이(가) 종료되었습니다(코드: 1개).
디버깅이 중지될 때 콘솔을 자동으로 닫으려면 [도구] -> [옵션] -> [디버깅] > [디버깅이 중지되면 자동으로 콘솔 닫기]를 사용
하도록 설정합니다.
이 창을 닫으려면 아무 키나 누르세요...
```

첫 번째 data는 singular matrix이기 때문에 gauss-jordan method로 inverse와 해를 구할 수 없었다.

```
C:\Users#gjawi\source\repos\HW5\Debug\HW5.exe
which method?
=====
1. gauss-jordan
2. LU decomposition
3. Singular Value Decomposition
0. exit
=====
1
Matrix A
  2.000000   -4.000000   -5.000000    5.000000    0.000000
 -1.000000    1.000000    2.000000    0.000000    4.000000
 -1.000000    6.000000    0.000000    3.000000    2.000000
  0.000000    1.000000    3.000000    7.000000    5.000000
  5.000000    0.000000    8.000000    7.000000   -2.000000

inverse of A
  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   -0.308963   -0.023201    0.234619   -0.044578
  0.149114    0.459333    0.051356   -0.171012    0.042492

solution x:
 -2.873567   -0.612357    0.976277    0.635819   -0.553441

Matrix A
  0.400000    8.200000    6.700000    1.900000    2.200000    5.300000
  7.800000    8.300000    7.700000    3.300000    1.900000    4.800000
  5.500000    8.800000    3.000000    1.000000    5.100000    6.400000
  5.100000    5.100000    3.600000    5.800000    5.700000    4.900000
  3.500000    2.700000    5.700000    8.200000    9.600000    2.900000
  3.000000    5.300000    5.600000    3.500000    6.800000    5.700000

inverse of A
 -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    0.151811    0.015024
 -0.062341   -0.064694   -0.234216    0.351126   -0.364828    0.434633

solution x:
 -0.326608    1.532293   -1.044825   -1.587447    2.928480   -2.218931
which method?
=====
```

2번째와 3번째 data에 대해서는 inverse와 해를 구할 수 있었고 gauss-jordan method를 이용하면 inverse를 바로 구할 수 있는 점이 장점이었다.

2. LU Decomposition

```
C:\Users#gjawn\source\repos\HW5\Debug\HW5.exe
2. LU decomposition
3. Singular Value Decomposition
0. exit
=====
2
lineq1.dat
original matrix:
 4.000000  2.000000  3.000000 -1.000000
-2.000000 -1.000000 -2.000000  2.000000
 5.000000  3.000000  4.000000 -1.000000
11.000000  4.000000  6.000000  1.000000
inverse of A:
-1.00000002004087734272.000000-37500000751532900352.00000037500000751532900352.00000012500001350022594560.000000
-2.000000066784733601792.000000-75000019095251845120.00000075000010299158822312.00000025000004899068444672.000000
300000041196535291648.000000112500015448738234368.000000-112500006652645212160.000000-37500005149579411456.000000
100000002004087734272.00000037500000751532900352.000000-37499996353466389248.000000-12500001350022594560.000000
solution:
 1.000000 -3.000000  2.000000  0.000000
determinant: -0.000000
*****
lineq2.dat
original matrix:
 2.000000 -4.000000 -5.000000  5.000000  0.000000
-1.000000  1.000000  2.000000  0.000000  4.000000
-1.000000  6.000000  0.000000  3.000000  2.000000
 0.000000  1.000000  3.000000  7.000000  5.000000
 5.000000  0.000000  8.000000  7.000000 -2.000000
inverse of A:
 0.354536  0.766945  0.207769 -0.595412  0.253128
 0.035454  0.126895  0.186777 -0.159541  0.060819
-0.138686 -0.088540 -0.086715  0.124088  0.016423
-0.052138 -0.303952 -0.023201  0.234619 -0.044578
 0.149114  0.459333  0.051356 -0.171011  0.042492
solution:
-2.873566 -0.612357  0.976277  0.635819 -0.553441
determinant: 3835.999512
*****
lineq3.dat
original matrix:
 0.400000  8.200000  6.700000  1.900000  2.200000  5.300000
 7.800000  8.300000  7.700000  3.300000  1.900000  4.800000
 5.500000  8.800000  3.000000  1.000000  5.100000  6.400000
 5.100000  5.100000  3.600000  5.800000  5.700000  4.900000
 3.500000  2.700000  5.700000  8.200000  9.600000  2.900000
 3.000000  5.300000  5.600000  3.500000  6.800000  5.700000
inverse of A:
-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  0.180508 -0.224034  0.161811  0.015024
-0.062341 -0.064694 -0.234216  0.351126 -0.364828  0.434533
solution:
-0.326608  1.532292 -1.044826 -1.587447  2.928480 -2.218930
determinant: 16178.401367
```

LU decomposition 역시 첫번째 data에 대해서는 singular matrix이기 때문에 inverse를 구할 때 쓰레기 값이 나오게 되었다.

하지만 solution은 근사값을 구할 수 있었고

2,3번째 data에 대해서는 gauss-jordan과 마찬가지로 inverse와 solution을 구할 수 있었고 determinant도 손쉽게 구할 수 있었다.

다만 inverse를 구할 때 약간의 계산이 필요하였다.

3. Singular Value Decomposition

```
C:\Users#gjawi\source\repos\HW5\Debug\HW5.exe
=====
3
line1.dat
Original matrix:
 4.000000  2.000000  3.000000 -1.000000
-2.000000 -1.000000 -2.000000  2.000000
 5.000000  3.000000  4.000000 -1.000000
11.000000  4.000000  6.000000  1.000000
inverse of A:
-0.020081  -0.332530  -0.467470  0.244177
 0.032129  0.612048  0.787952  -0.270683
 0.048183  0.118072  0.281928  -0.106024
-0.100401  0.537349  0.262650  0.020883
solution:
 1.733334  -1.533334  -0.200000  -0.733334
=====
line2.dat
Original matrix:
 2.000000 -4.000000 -5.000000  5.000000  0.000000
-1.000000  1.000000  2.000000  0.000000  4.000000
-1.000000  6.000000  0.000000  3.000000  2.000000
 0.000000  1.000000  3.000000  7.000000  5.000000
 5.000000  0.000000  8.000000  7.000000  -2.000000
inverse of A:
 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  -0.309963  -0.023201  0.234620  -0.044578
 0.149114  0.459333  0.051356  -0.171012  0.042492
solution:
-2.679566  -0.612357  0.976278  0.635819  -0.553441
=====
line3.dat
Original matrix:
 0.400000  8.200000  6.700000  1.900000  2.200000  5.300000
 7.800000  8.300000  7.700000  3.300000  1.900000  4.800000
 5.500000  8.800000  3.000000  1.000000  5.100000  6.400000
 5.100000  5.100000  3.600000  5.800000  5.700000  4.900000
 3.500000  2.700000  5.700000  8.200000  9.600000  2.900000
 3.000000  5.300000  5.600000  3.500000  6.800000  5.700000
inverse of A:
-0.162205  0.122801  0.024068  -0.016431  -0.022840  0.046132
 0.169407  -0.041117  0.228319  -0.087624  0.180806  -0.395855
-0.011636  0.122745  -0.117407  -0.180381  0.015910  0.188766
 0.106669  -0.051726  -0.106916  0.289774  0.000859  -0.190541
-0.053026  -0.042361  0.160608  -0.224034  0.161811  0.015024
-0.062341  -0.064694  -0.234216  0.351126  -0.364828  0.434633
solution:
-0.326609  1.532292  -1.044825  -1.587447  2.928480  -2.218930
=====
which method?
=====
1. gauss-jordan
2. LU decomposition
3. Singular Value Decomposition
0. exit
=====
```

SVD method 는 singular matrix인 1번째 data에 대해서도 정확한 inverse와 solution을 구할 수 있었다. 계산량이 많지만 정확하게 inverse와 solution을 구할 수 있다는 점이 svd의 장점이다.