수치해석 HW7

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HW7의 목표는 gaussian distribution을 이용한 random number generator를 이용해서 9X9 symmetric matrix A를 생성한 후, A의 모든 eigenvector들과 eigenvalue들을 구하는 것이다.

우선 gasdev(평균, 표준편차)를 이용해서 random number를 생성하고 symmetric matrix를 만든다.

<9X9 matrix>

```
#define NP 9
```

<main함수 내부에서 symmetric matrix를 생성하는 코드>

```
srand(time(NULL));

//input random number by using gaussian distribution
for (int i = 0; i < NP; i++)
{
    for (int j = i; j < NP; j++)
    {
        c[i][j] = c[j][i] = gasdev(0, 1);
        //
    }

}
```

<gasdev 함수>

```
float gasdev(float average, float stdev)
{
    float gset;
    float fac,rsq,v1,v2;


    do {
        v1 = 2.0*((float)rand()/RAND_MAX)-1.0;
        v2 = 2.0*((float)rand()/RAND_MAX)-1.0;
        rsq=v1*v1+v2*v2;
    } while (rsq >= 1.0 || rsq <= -1.0);

    fac=sqrt(-2.0*log(rsq)/rsq);
    gset=v1*fac;
    gset = (stdev*gset) + average;
    return gset;
}
```

<jacobi tranformation을 이용해서 eigenvalue를 구한다.>

```
d=vector(1,NP);
v=matrix(1,NP,1,NP);
e=convert_matrix(&c[0][0],1,NP,1,NP);
printf("****** Finding Eigenvectors ******₩n");
jacobi(e,NP,d,v,&nrot);
printf("unsorted eigenvectors:₩n");
for (i=1;i<=NP;i++) {
    printf("eigenvalue %3d = %12.6f₩n",i,d[i]);
    printf("eigenvector:₩n");
    for (j=1;j<=NP;j++) {
        printf("%12.6f",v[j][i]);
        if ((j % 5) == 0) printf("₩n");
    }
    printf("₩n");
}
```

<eigsrt를 이용해서 jacobi의 결과를 descending order로 sorting한다>

```
 printf("₩n****** Sorting Eigenvectors ******₩n₩n");
 eigsrt(d,v,NP);
 printf("sorted eigenvectors:₩n");
 for (i=1;i<=NP;i++) {
     printf("eigenvalue %3d = %12.6f₩n",i,d[i]);
     printf("eigenvector:₩n");
     for (j=1;j<=NP;j++) {
         printf("%12.6f",v[j][i]);
         if ((j % 5) == 0) printf("₩n");
     }
     printf("₩n");
 }
```

<실행결과>

```
print matrix
-0.857703 -0.603839 -0.020380 -0.853552 -0.596639 0.695650 -0.872708 -0.076591 0
.790961
-0.603839 -0.335602 -0.499656 2.133528 0.883417 -2.663428 -1.001892 0.314116 0.1
51394
-0.020380 -0.499656 2.559304 -0.453271 0.059032 -2.261580 -1.351129 0.316195 1.3
98274
-0.853552 2.133528 -0.453271 1.021159 -0.216262 -0.457905 -0.774405 0.627749 -0.
727452
-0.596639 0.883417 0.059032 -0.216262 -0.002029 0.011816 -0.042914 0.672509 1.20
9687
0.695650 -2.663428 -2.261580 -0.457905 0.011816 1.222574 1.544797 2.427207 -0.85
0834
-0.872708 -1.001892 -1.351129 -0.774405 -0.042914 1.544797 0.444218 1.429637 -0.
562433
-0.076591 0.314116 0.316195 0.627749 0.672509 2.427207 1.429637 0.473596 0.15902
7
0.790961 0.151394 1.398274 -0.727452 1.209687 -0.850834 -0.562433 0.159027 0.694
158
```

```
****** Finding Eigenvectors ******
unsorted eigenvectors:
eigenvalue   1 =    -2.588469
eigenvector:
    0.604588   -0.088624    0.182919    0.338013    0.375507
   -0.067313    0.451519   -0.293045   -0.208869
eigenvalue   2 =    -3.986226
eigenvector:
   -0.052094    0.619092    0.274861   -0.124577   -0.105408
    0.586483    0.118067   -0.389322    0.048575
eigenvalue   3 =     6.705753
eigenvector:
   -0.027561    0.296070    0.476509    0.119986    0.057644
   -0.620119   -0.396588   -0.268891    0.229502
eigenvalue   4 =     3.915728
eigenvector:
   -0.234188    0.464534   -0.482117    0.600248   -0.007826
   -0.130214   -0.026540   -0.007515   -0.344749
eigenvalue   5 =     2.376805
eigenvector:
   -0.134478    0.215384    0.271098    0.245558    0.454442
    0.145682    0.156962    0.659530    0.338195
eigenvalue   6 =    -1.661443
eigenvector:
   -0.411723   -0.451667    0.021805    0.487744    0.020713
    0.225925    0.029751   -0.408829    0.410627
eigenvalue   7 =     0.436545
eigenvector:
   -0.575731    0.013188    0.093208   -0.316226    0.176560
   -0.337818    0.599777   -0.133731   -0.191738
eigenvalue   8 =     1.054846
eigenvector:
   -0.124552   -0.176504    0.577775    0.293812   -0.493115
    0.071397    0.037648    0.243273   -0.473630
eigenvalue   9 =    -1.033864
eigenvector:
    0.203905    0.153954   -0.122531    0.104958   -0.602675
   -0.241907    0.487374    0.104920    0.488275
```

```
****** Sorting Eigenvectors ******

sorted eigenvectors:
eigenvalue   1 =     6.705753
eigenvector:
   -0.027561    0.296070    0.476509    0.119986    0.057644
   -0.620119   -0.396588   -0.268891    0.229502
eigenvalue   2 =     3.915728
eigenvector:
   -0.234188    0.464534   -0.482117    0.600248   -0.007826
   -0.130214   -0.026540   -0.007515   -0.344749
eigenvalue   3 =     2.376805
eigenvector:
   -0.134478    0.215384    0.271098    0.245558    0.454442
    0.145682    0.156962    0.659530    0.338195
eigenvalue   4 =     1.054846
eigenvector:
   -0.124552   -0.176504    0.577775    0.293812   -0.493115
    0.071397    0.037648    0.243273   -0.473630
eigenvalue   5 =     0.436545
eigenvector:
   -0.575731    0.013188    0.093208   -0.316226    0.176560
   -0.337818    0.599777   -0.133731   -0.191738
eigenvalue   6 =    -1.033864
eigenvector:
    0.203905    0.153954   -0.122531    0.104958   -0.602675
   -0.241907    0.487374    0.104920    0.488275
eigenvalue   7 =    -1.661443
eigenvector:
   -0.411723   -0.451667    0.021805    0.487744    0.020713
    0.225925    0.029751   -0.408829    0.410627
eigenvalue   8 =    -2.588469
eigenvector:
    0.604588   -0.088624    0.182919    0.338013    0.375507
   -0.067313    0.451519   -0.293045   -0.208869
eigenvalue   9 =    -3.986226
eigenvector:
   -0.052094    0.619092    0.274861   -0.124577   -0.105408
    0.586483    0.118067   -0.389322    0.048575
```