Exercise 2

Part 1

```
type givens.m
```

```
function G=givens(m,i,j,theta)
format
G=[];
if 1 <= i  && i < j && j <= m && m >= 2
    G=eye(m);
    c=cos(theta);
    s=sin(theta);
    G(i,i)=c; G(i,j)=-s; G(j,i)=s; G(j,j)=c;
    disp('the Givens rotation matrix G is')
    disp(G)
else
    disp('a Givens rotation matrix cannot be constructed')
end
```

```
%(a)
m=1;i=1;j=2;theta=pi
```

```
theta = 3.1416
```

```
G=givens(m,i,j,theta);
```

```
a Givens rotation matrix cannot be constructed
```

```
%(b)
m=4;i=3;j=2;theta=pi/2
```

```
theta = 1.5708
```

```
G=givens(m,i,j,theta);
```

```
a Givens rotation matrix cannot be constructed
```

```
%(c)
m=5;i=2;j=4;theta=pi/4
```

```
theta = 0.7854
```

```
G=givens(m,i,j,theta);
```

```
the Givens rotation matrix G is
    1.0000         0         0         0         0
         0    0.7071         0   -0.7071         0
         0         0    1.0000         0         0
         0    0.7071         0    0.7071         0
         0         0         0         0    1.0000
```

```
%(d)
m=2;i=1;j=2;theta=-pi/2
```

```
theta = -1.5708
```

```
G=givens(m,i,j,theta);
```

```
the Givens rotation matrix G is
    0.0000    1.0000
   -1.0000    0.0000
```

```
%(e)
m=3;i=1;j=2;theta=pi
```

```
theta = 3.1416
```

```
G=givens(m,i,j,theta);
```

```
the Givens rotation matrix G is
   -1.0000   -0.0000         0
    0.0000   -1.0000         0
         0         0    1.0000
```

```
A=[1 -1 1; 1 1 0; 0 0 1]
```

```
A = 3×3
     1    -1     1
     1     1     0
     0     0     1
```

```
GA=[-1 1 -1; -1 -1 0; 0 0 1]
```

```
GA = 3×3
    -1     1    -1
    -1    -1     0
     0     0     1
```

```
GpA=G*A
```

```
GpA = 3×3
   -1.0000    1.0000   -1.0000
   -1.0000   -1.0000    0.0000
         0         0    1.0000
```

```
if closetozeroroundoff(GpA-GA,7)==0
    disp('The predicted matrix and the observed matrix match')
end
```

```
The predicted matrix and the observed matrix match
```

```
type closetozeroroundoff.m
```

```
function B=closetozeroroundoff(A,p)
A(abs(A)<10^-p)=0;
B=A;
end
```

Part 2

```
type givensrot.m
```

```
function G=givensrot(m,i,j,a,b)
G=eye(m);
r=hypot(a,b);
c=a/r;
s=b/r;
G(i,i)=c; G(i,j)=-s; G(j,i)=s; G(j,j)=c;
end
```

```
type uppertrian.m
```

```
function R = uppertrian(A)
format
[m,n]=size(A);
R=A;
k=min(m,n)
for i=1:k
    for j=m:-1:i+1
        while j>i
            if R(j,i)~=0
                b=R(j,i);
                a=R(i,i);
                G=givensrot(m,i,j,a,b);
                R=G'*R;
            end
            break
          end
    end
end
R=closetozeroroundoff(R,12);
disp('the output matrix R is')
disp(R)
test1=1;
test2=1;
if ~istriu(R)==1
    test1=0;
end
for i=1:n
    if closetozeroroundoff(norm(A(:,i))-norm(R(:,i)),7)~=0
        test2=0;
        break
    end
end
if test1 & test2
    disp('A has been reduced correctly to an uppertriangular matrix R')
else
    disp('the output matrix R is not what was expected?!')
end
end
```

```
%(a)
A=ones(2)
```

```
A = 2×2
     1     1
     1     1
```

```
R = uppertrian(A);
```

```
k = 2
the output matrix R is
    1.4142    1.4142
         0         0

A has been reduced correctly to an uppertriangular matrix R
```

```
%(b)
A=magic(3)
```

```
A = 3×3
     8     1     6
```

```
     3     5     7
     4     9     2
```

```
R = uppertrian(A);
```

```
k = 3
the output matrix R is
    9.4340    6.2540    8.1620
         0    8.2394    0.9655
         0         0   -4.6314

A has been reduced correctly to an uppertriangular matrix R
```

```
%(c)
A=magic(4)
```

```
A = 4×4
    16     2     3    13
     5    11    10     8
     9     7     6    12
     4    14    15     1
```

```
R = uppertrian(A);
```

```
k = 4
the output matrix R is
   19.4422   10.5955   10.9041   18.5164
         0   16.0541   15.7259    0.9848
         0         0    1.9486   -5.8458
         0         0         0         0

A has been reduced correctly to an uppertriangular matrix R
```

```
%(d)
A=[magic(3),ones(3,2)]
```

```
A = 3×5
     8     1     6     1     1
     3     5     7     1     1
     4     9     2     1     1
```

```
R = uppertrian(A);
```

```
k = 3
the output matrix R is
    9.4340    6.2540    8.1620    1.5900    1.5900
         0    8.2394    0.9655    0.6137    0.6137
         0         0   -4.6314   -0.3088   -0.3088

A has been reduced correctly to an uppertriangular matrix R
```

```
%(e)
A=[magic(2),ones(2,3)]
```

```
A = 2×5
     1     3     1     1     1
     4     2     1     1     1
```

```
R = uppertrian(A);
```

```
k = 2
```

```
the output matrix R is
    4.1231    2.6679    1.2127    1.2127    1.2127
         0   -2.4254   -0.7276   -0.7276   -0.7276

A has been reduced correctly to an uppertriangular matrix R
```

```
%(f)
A=triu(magic(5))
```

```
A = 5×5
    17    24     1     8    15
     0     5     7    14    16
     0     0    13    20    22
     0     0     0    21     3
     0     0     0     0     9
```

```
R = uppertrian(A);
```

```
k = 5
the output matrix R is
    17    24     1     8    15
     0     5     7    14    16
     0     0    13    20    22
     0     0     0    21     3
     0     0     0     0     9

A has been reduced correctly to an uppertriangular matrix R
```

```
%(g)
A=tril(magic(3))
```

```
A = 3×3
     8     0     0
     3     5     0
     4     9     2
```

```
R = uppertrian(A);
```

```
k = 3
the output matrix R is
    9.4340    5.4060    0.8480
         0    8.7622    1.5311
         0         0    0.9678

A has been reduced correctly to an uppertriangular matrix R
```

```
%(h)
A=[1 1 2 0;0 0 1 3;0 0 2 4;0 0 3 5;1 0 -2 3]
```

```
A = 5×4
     1     1     2     0
     0     0     1     3
     0     0     2     4
     0     0     3     5
     1     0    -2     3
```

```
R = uppertrian(A);
```

```
k = 4
the output matrix R is
    1.4142    0.7071         0    2.1213
```

```
         0    0.7071    2.8284   -2.1213
         0         0    3.7417    6.9488
         0         0         0    1.3093
         0         0         0         0
```

A has been reduced correctly to an uppertriangular matrix R

```
%(i)
A=hilb(4)
```

```
A = 4×4
    1.0000    0.5000    0.3333    0.2500
    0.5000    0.3333    0.2500    0.2000
    0.3333    0.2500    0.2000    0.1667
    0.2500    0.2000    0.1667    0.1429
```

```
R = uppertrian(A);
```

```
k = 4
the output matrix R is
    1.1932    0.6705    0.4749    0.3698
         0    0.1185    0.1257    0.1175
         0         0    0.0062    0.0096
         0         0         0    0.0002
```

A has been reduced correctly to an uppertriangular matrix R

```
%(j)
A=[1 3 4 -1 2;2 6 6 0 -3;1 3 1 2 -1;1 3 0 3 0]
```

```
A = 4×5
     1     3     4    -1     2
     2     6     6     0    -3
     1     3     1     2    -1
     1     3     0     3     0
```

```
R = uppertrian(A);
```

```
k = 4
the output matrix R is
    2.6458    7.9373    6.4254    1.5119   -1.8898
         0         0    0.8165   -0.8165    1.6330
         0         0    3.3238   -3.3238   -0.0573
         0         0         0         0   -2.7854
```

A has been reduced correctly to an uppertriangular matrix R