EIGEN VALUES AND EIGEN VECTORS

1. Create a 3x3 matrix with rank 2, find eigenvectors. Show with Matlab, that eigenvectors correspond to non-zero eigenvalues lie in column space.

```
% Generate a random 3x3 A matrix with rank 2
A= randi(9,3,2)*randi(9,2,3)
```

```
A = 3×3
   105   102    52
    54    60    28
    21    30    12
```

```
% Generate eigen vectors
[eigen_vectors,eigen_values]=eig(A)
```

```
eigen_vectors = 3×3
    0.8622    0.6631   -0.3123
    0.4653   -0.3015   -0.1562
    0.2003   -0.6852    0.9370
eigen_values = 3×3
  172.1197         0         0
         0    4.8803         0
         0         0    0.0000
```

```
% check ranks
rank(A)
```

```
ans = 2
```

```
check =[A eigen_vectors(:,1)];
rank(check)
```

```
ans = 2
```

```
check2=[A eigen_vectors(:,3)];
rank(check2)
```

```
ans = 3
```

```
check3=[A eigen_vectors(:,2)];
rank(check3)
```

```
ans = 2
```

```
fprintf("Since the rank of non zero eigen value's corresponding \n eigen vector
didn't change, the eigen vectors \n with non zero eigen values lie in the
columnspace of A ");
```

```
Since the rank of non zero eigen value's corresponding
 eigen vector didn't change, the eigen vectors
 with non zero eigen values lie in the columnspace of A
```

2. Construct a symmetric 3 by 3 matrix - rank 1 matrix

```
% Generate a random matrix
A=randi(5,3,1)*randi(5,1,3);

% Make it symmetric since AA' or A'A matrices are symmetric
A=A*A'
```

```
A = 3×3
    45   135    45
   135   405   135
    45   135    45
```

```
rank(A)
```

```
ans = 1
```

3. Construct a random 3 by 3 matrix A of rank 3 and show that AAT is symmetric.

```
% Generate a random matrix
A=randi(5,3,3)*randi(5,3,3)
```

```
A = 3×3
    23    34    30
    16    24    16
    10    18    23
```

```
A=A*A';

A
```

```
A = 3×3
        2585        1664        1532
        1664        1088         960
        1532         960         953
```

```
A'
```

```
ans = 3×3
        2585        1664        1532
        1664        1088         960
        1532         960         953
```

4. Construct a random 3 by 3 matrix A of rank 3 and show that the eigen values of A and AT are the same

```
% Generate random matrix
A=randi(5,3,3)*randi(5,3,3);

% Compute Eigen values
eig(A)
```

```
ans = 3×1
   98.8025
    0.5323
   -4.3348
```

```
eig(A')
```

```
ans = 3×1
   98.8025
    0.5323
   -4.3348
```

5. Construct a 3x3 matrix with all elements non-zero and one eigen value as zero

```
% Generate a non zero 3x3 matrix with rank 2
A = randi([1,5],3,2) * randi([2,4],2,3)
```

```
A = 3×3
    17    16    20
    22    16    24
    24    22    28
```

```
% Compute the eigen values
eig(A)
```

```
ans = 3×1
   63.5794
   -0.0000
   -2.5794
```