MATH 3940 Problem Set 2 Solutions - Matlab

Question 1: **:** (b) >> A=[2 -7 0; 5 10 4; 0 5 2];

>> [V D]=eig(A)

V = 0.7035 0.7683 -0.6247

-0.5025 -0.3293 -0.0000

-0.5025 -0.5488 0.7809

D = 7.0000 0 0

0 5.0000 0

0 0 2.0000

(d) M-file for power method is

```
function [lambda, V]=power2(A,X,tol, max1 )
lambda=0;
cnt=0;
err=1;
state=1;
while ((cnt<=max1)&(state==1))
   Y=A*X;
   %normalize Y
   [m j]=max(abs(Y));
   mu1=Y(j);
   dc=abs(lambda-c1);
   Y=(1/mu1)*Y;
   %update X and lambda and check for convergence
   dv=norm(X-Y);
   err=max(dc,dv);
   X=Y;
   lambda=mu1;
   state=0;
```

```
   if(err>tol)
      state=1;
   end
   cnt=cnt+1;
end
V=X;
```

```
>> A=[2 -7 0; 5 10 4; 0 5 2];
>> [lambda V]=power2(A,[1 1 1]',10^(-5),35)
lambda =    7.0000
V =    1.0000
       -0.7143
       -0.7143
```

Question 2: (c) Using power method from Question 1, we have

```
>> A=[2 1 3; 0 -3 1; 0 0 1];
>> X=[1; 1; 1];
>> [lambda V]=power2(A,X,10^-5,30)
lambda =   -3.0000
V =   -0.2000
       1.0000
      -0.0000
```

Question 3: (b) Using Matlab builtin command, we obtain

```
 >> C=[4 -1 1; 0 2 -1; 0 0 -4];
>> [V D]=eig(C)
V =   1.0000    0.4472   -0.1022
      0         0.8944    0.1635
      0              0    0.9812
D =  4.000     0          0
          0    2.000      0
          0         0    -4.000
```

(c) Using power method from Question 1, we have

```
>> A=[4 -1 1; 0 2 -1; 0 0 -4];

>> X=[1; 1; 1];

>> [lambda V]=power2(A,X,10^-5,15)

lambda =    -4

V =    0.5833

       0.1667

       1.0000

>> [lambda V]=power2(A,X,10^-5,16)

lambda =    -4

V =    -0.7917

        0.1667

        1.0000

>> [lambda V]=power2(A,X,10^-5,17)

lambda =    -4

V =    0.5833

       0.1667

       1.0000

>> [lambda V]=power2(A,X,10^-5,18)

lambda =    -4

V =    -0.7917

        0.1667

        1.0000
```

We see that the values are going back and forth between two eigenvectors, and we are not getting any convergence, so the power method diverges.

The reason of the failure of the power method is that A does not have a single dominant eigenvalue, both 4 and -4 have largest magnitude. Thus the power method works good in the case of a single dominant eigenvalue.