MATH 3940 Problem Set 4 Solutions - Matlab

Question 1: (d) M-file for Jacobi method for system of nonlinear equations is:

```
function [P, iter] = jacobinl(G,P0,tol, maxite)
N=length(P0) ;
for k=1 :maxite
   for j=1:N
    X=feval(G,P0);
   end
err=norm(X-P0);
relerr=err/norm(X);
P0=X;
iter=k;
if(err<tol)|(relerr<tol)
   break
end
end
P=P0';
```

M-file for the function is:

```
function Z=GQ5(X)
x=X(1); y=X(2);
Z=zeros(1,2);
Z(1)=(-2*y+3)/2;
Z(2)=(-3*x^2+4)/2;
```

```
>> [P iter] = jacobinl('GQ5',[0 0],10^-5, 10)
P = 1.0e+009 *
  -0.00000000046192      -6.79918443878832
k = 10
```

The iterations are diverging because the values are very large after 10 iterations.

(e) M-file for Gauss-Seidel method for system of nonlinear equations is:

```
function [P, k] = seidel(G,P0,tol, maxite)
for k=1 :maxite
   X=P0;
 for j=1:N
   A=feval(G,X);
    X(j)=A(j);
   end
err=norm(X-P0);
relerr=err/norm(X);
P0=X;
iter=k;
if(err<delta)|(relerr<delta)
   break
end
end
P=P0';
>> [P iter] = seidel('GQ5',[0 0],10^-5, 10)
P = 1.0e+159 *  9.13435831329221      -Inf
k = 10
```

The iterations are diverging because the values are very large after 10 iterations.

Question 3: (a)

```
>> x=[-2 -1 0 1 2 3];
>> y=[1 4 11 16 13 -4];
>> p=polyfit(x,y,5)
p = -0.0000    0.0000   -1.0000   -1.0000    7.0000   11.0000
>> Value=polyval(p,-1.5)
Value = 1.6250
```

(c) M-file for Lagrange polynomial is

```
function [C]=lagran(X,Y)
w=length(X) ;
```

```
n=w-1;
L=zeros (w,w) ;
for k=1:n+1
   V=1;
   for j=1:n+1
      if k~=j
         V=conv (V,poly(X(j)))/(X(k)-X(j));
      end
   end
   L(k,:)=V;
end
C=Y*L;
>> X=[-2 -1 0];
>> Y=[1 4 11];
>> [C]=lagran(X,Y)
C =     2     9    11
```

The Lagrange polynomial is P_2(x)=2x^2+9x+11

(e) M-file for Newton polynomial is

```
function [C,D]=newtonpoly(X,Y)
n=length(X);
D=zeros(n,n);
D(:,1)=Y';
for j=2:n
   for k=j:n
      D(k,j)=(D(k,j-1)-D(k-1,j-1))/(X(k)-X(k-j+1));
   end
end
C=D(n,n);
for k=(n-1):-1:1
```

```
   C=conv(C,poly(X(k)));
   m=length(C);
   C(m)=C(m)+D(k,k);
end
>> X=[-2 -1 0 1 2 3];
>> Y=[1 4 11 16 13 -4];
>> [C D]=newtonpoly(X,Y)
C =    0    0   -1   -1    7   11
D =  1     0     0     0     0    0
      4     3     0     0     0    0
     11     7     2     0     0    0
     16     5    -1    -1     0    0
     13    -3    -4    -1     0    0
     -4   -17   -7    -1     0    0
```

The Newton polynomial is P_3(x)=-x^3-x^2+7x+11

Question 4: (a)

```
X=[0 0.5 1 1.5];
>> Y=[1   1.1065   1.3679   1.7231];
>> [C]=lagran(X,Y)
C =  -0.0815    0.4320    0.0174    1.0000
```

The Lagrange polynomial is -0.0815x^3+ 0.432x^2+ 0.0174x+1

(b)

```
>>  X=[0 0.5 1 1.5];
>> Y=[1 1.1065 1.3679 1.7231];
>> [C D]=newtonpoly(X,Y)
C =   -0.0815    0.4320    0.0174    1.0000
D =  1.0000         0         0         0
      1.1065    0.2130         0         0
      1.3679    0.5228    0.3098         0
      1.7231    0.7104    0.1876   -0.0815
```

The Newton polynomial is -0.0815x^3+ 0.432x^2+ 0.0174x+1