1．用Newton迭代法求方程 $\tan x = e^x$ 的第一个正根.

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```
newton.m:
function x1=newton(x0,eps)
format long
format compact
x1=x0-dao(x0);
while abs(x1-x0)>eps
        x0=x1;
        x1=x0-dao(x0);
end
```

```
dao.m:
function y=dao(x)
y=tan(x)-exp(x);
y1=tan(x)^2 - exp(x) + 1;
y=y/y1;
```

结果：

>> x1=newton(1,1e-6)

x1 =

   1.306326940423080

2．作矩阵 $A=\begin{bmatrix} 4 & 1 & 1 & 1 \\ 8 & 5 & 1 & 3 \\ 12 & -3 & 7 & 2 \\ 4 & 10 & 2 & 7 \end{bmatrix}$ 的LU分解.

```
lu12.m:
function [l,u]=lu12(a,n)
for k=1:n-1
    for i=k+1:n
        a(i,k)=a(i,k)/a(k,k);
        for j=k+1:n
            a(i,j)=a(i,j)-a(i,k)*a(k,j);
        end
```

```
    end
end
l=eye(n);
u=zeros(n,n);
for k=1:n
    for i=k:n
        u(k,i)=a(k,i);
    end
end
for k=1:n
    for j=1:k-1
        l(k,j)=a(k,j);
    end
end
```

结果:

```
>> a=[4 1 1 1;8 5 1 3;12 -3 7 2;4 10 2 7];
>> [l,u]=lu12(a,4)
l =
     1     0     0     0
     2     1     0     0
     3    -2     1     0
     1     3     2     1
u =
     4     1     1     1
     0     3    -1     1
     0     0     2     1
     0     0     0     1
```

3.用Jacobi迭代法求解方程组$\boldsymbol{Ax}=\boldsymbol{b}$，其中$\boldsymbol{A}=\begin{pmatrix}4 & 1 & -1 & 1\\ -1 & 4 & -1 & 1\\ 1 & 2 & 5 & -1\\ 3 & 2 & -1 & 7\end{pmatrix},\boldsymbol{b}=\begin{pmatrix}2\\ 8\\ 8\\ 10\end{pmatrix}$.

jacobi.m:

```
function x=jacobi(a,b,x0,n,tol,m)
x=zeros(n,1);
for k=0:m
    for i=1:n
        s=0;
        for j=1:n
            if j~=i
                s=s+a(i,j)*x0(j,1);
            end
        end
        x(i,1)=(b(i,1)-s)/a(i,i);
```

```
        if norm(x-x0,inf)<tol
            break;
        end
        x0(i,1)=x(i,1);
    end
end
```

结果：

```
>> a=[4 1 -1 1;-1 4 -1 1;1 2 5 -1;3 2 -1 7];
>> b=[2 8 8 10]';
>> x0=[0 0 0 0]';
>> x=jacobi(a,b,x0,4,1e-6,50)
x =
  -0.000000983453000
   2.000001278748222
   0.999997309599650
   0.999999964663427
```

4.用复化的辛甫生方法计算$\int_1^3 (e^{x^2} - \frac{\sin x}{x})dx \ (h=0.1)$.

simpson.m:

```
function [SI,Y,esp]=simpson(a,b,m)
%a,b为区间左右端点，xps(x)为求积公式，m*2等分区间长度
h=(b-a)/(2*m);
SI0=xps(a)+xps(b);
SI1=0;
SI2=0;
for i=1:((2*m)-1)
    x=a+i*h;
    if mod(i,2)==0
        SI2=SI2+xps(x);
    else
        SI1=SI1+xps(x);
    end
end
SI=vpa(h*(SI0+4*SI1+2*SI2)/3,10);
syms x
Y=vpa(int(xps(x),x,a,b),10);
esp=abs(Y-SI);
```

xps.m:

```
function y=xps(x)
y=exp(x^2)-sin(x)/x;
```

结果：

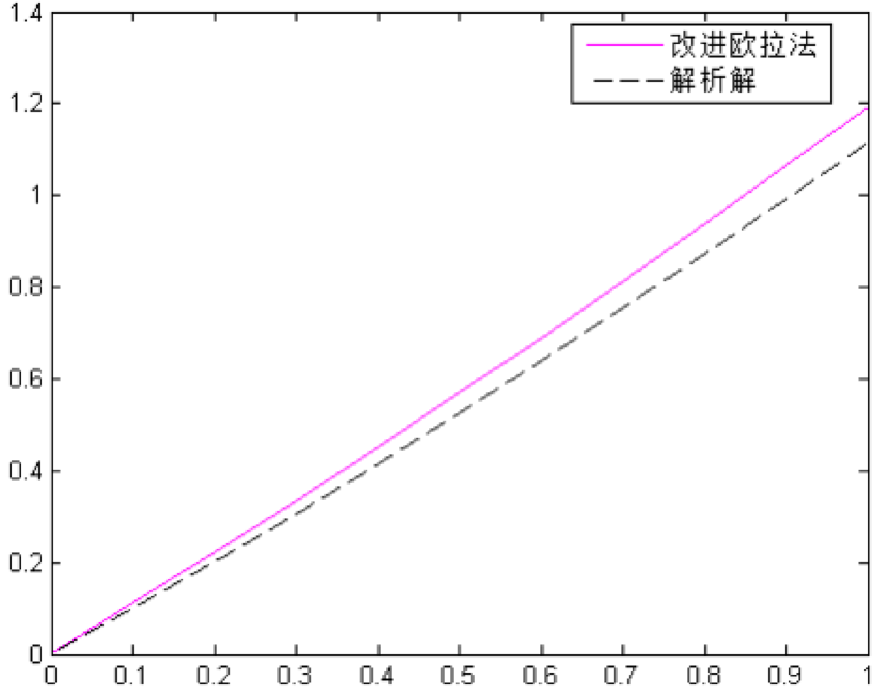
```
>> [SI,Y,esp]=simpson(1,3,10)
SI =
```

```
1443.251264
Y =
1442.179902
esp =
1.0713621257845176160117262043059
```

5.用改进的尤拉法解方程 $\begin{cases} \dfrac{dy}{dx} = e^{x-y} + x^2 e^{-y} \\ y|_{x=0} = 0 \end{cases}$

```
euler22.m:
function [B1,B2]=euler22(a,b,n,y0)
%欧拉法解一阶常微分方程
%初始条件y0
h = (b-a)/n; %步长h
%区域的左边界a
%区域的右边界b
x = a:h:b;
m=length(x);

%改进欧拉法
y = y0;
for i=2:m
    y(i)=y(i-1)+h/2*( oula2(x(i-1),y(i-1))+oula2(x(i),y(i-1))+h*(oula2(x(i-1),x(i-1))));
    B1(i)=x(i);
    B2(i)=y(i);
end
plot(x,y,'m-');
hold on;

%精确解用作图
xx = x;
f = dsolve('Dy=exp(x-y)+(x^2)*exp(-y)','y(0)=0','x');%求出解析解
y = subs(f,xx); %将xx代入解析解，得到解析解对应的数值

plot(xx,y,'k--');
legend('改进欧拉法','解析解');

oula2.m:
function f=oula2(x,y)
f=exp(x-y)+(x^2)*exp(-y);

结果：
>> [B1,B2]=euler22(0,1,10,0)
B1 =
  Columns 1 through 7
                   0   0.100000000000000   0.200000000000000   0.300000000000000   0.400000000000000   0.500000000000000   0.600000000000000
  Columns 8 through 11
```

```
   0.700000000000000    0.800000000000000    0.900000000000000    1.000000000000000
B2 =
  Columns 1 through 7
                   0    0.110758545903782    0.222173861791736    0.335492896789537    0.451351722029268    0.569931474513367    0.691088488902808
  Columns 8 through 11
   0.814464555075657    0.939577860819895    1.065894210026593    1.192879090561291
```



6.(1) 用$y=a+bx+cx^2$拟合下列数据:

x	2.36	3.73	5.951	8.283
f(x)	14.1	16.2	18.3	21.4

```
LSM1.m:
function [a,b,c]=LSM1(x,y,m)     %x,y为序列长度相等的数据向量，m为拟合多项式次数
format short;
A=zeros(m+1,m+1);
```

```
for i=0:m
    for j=0:m
        A(i+1,j+1)=sum(x.^(i+j));
    end
    b(i+1)=sum(x.^i.*y);
end
a=A\b';
p=fliplr(a');
%y=p[0]*x^m+p[1]*x^(m-1)+...+p[m-1]*x+p[m];
a=p(3);
b=p(2);
c=p(1);
```

```
结果：
>> x=[2.36      3.73    5.951   8.283];
>> y=[14.1      16.2    18.3    21.4];
>> [a,b,c]=LSM1(x,y,2)
a =
   11.4457
b =
    1.1866
c =
   8.1204e-04
```

(2) 按如下插值原则，求Newton插值多项式：

x	2.36	3.73	5.951	8.283
f(x)	14.1	16.2	18.3	21.4

说明：最后，一定给清楚各多项式的系数！

```
newploy.m:
function [A,C,L,wcgs,Cw]= newploy(X,Y)
n=length(X); A=zeros(n,n); A(:,1)=Y';
q=1.0; c1=1.0;
for  j=2:n
   for i=j:n
       A(i,j)=(A(i,j-1)- A(i-1,j-1))/(X(i)-X(i-j+1));
   end
   b=poly(X(j-1));q1=conv(q,b); c1=c1*j;  q=q1;
end
C=A(n,n); b=poly(X(n)); q1=conv(q1,b);
for k=(n-1):-1:1
  C=conv(C,poly(X(k))); d=length(C); C(d)=C(d)+A(k,k);
```

```
end
L(k,:)=poly2sym(C); Q=poly2sym(q1);
syms M
wcgs=M*Q/c1; Cw=q1/c1;
```

结果：

```
>> x=[2.36      3.73    5.951   8.283];
>> y=[14.1      16.2    18.3    21.4];
>>  [A,C,L,wcgs,Cw]= newploy(x,y)
A =
   14.1000         0         0         0
   16.2000    1.5328         0         0
   18.3000    0.9455   -0.1636         0
   21.4000    1.3293    0.0843    0.0418
C =
    0.0418   -0.6674    4.4138    6.8506
L =
(3015319848353441*x^3)/72057594037927936 - (3005803726105311*x^2)/4503599627370496 + (4969523982821561*x)/1125899906842624 + 7713109820116169/1125899906842624
wcgs =
(M*(x^4 - (5081*x^3)/250 + (1273498286182623*x^2)/8796093022208 - (7485266609524121*x)/17592186044416 + 7633404131354389/17592186044416))/24
Cw =
0.0417   -0.8468    6.0325  -17.7287   18.0795
```

newpoly2.m:

```
function y= newpoly2(X,Y,x)
n=length(X); m=length(x);
for t=1:m
   z=x(t); A=zeros(n,n);A(:,1)=Y';
   q1=1.0; c1=1.0;
   for  j=2:n
       for i=j:n
         A(i,j)=(A(i,j-1)- A(i-1,j-1))/(X(i)-X(i-j+1));
       end
       q1=abs(q1*(z-X(j-1)));c1=c1*j;
    end
    C=A(n,n);q1=abs(q1*(z-X(n)));
    for k=(n-1):-1:1
       C=conv(C,poly(X(k)));d=length(C); C(d)=C(d)+A(k,k);
    end
    y(k)= polyval(C, z);


end
```

结果：

```
>> y= newpoly2(x,y,15)
y =
   64.1181
```