

```

format long

clc
clear
clf
syms x
fun=@(x)(1+25.*x.^2).^(-1);
df1 = matlabFunction( diff(fun(x)) );
df2 = matlabFunction( diff(diff(fun(x))) );
a=-1;
b=1;
%tol=input('Enter a tolerance: ');

tol=[0.1,0.001,0.0001,0.00001,0.000001,0.000001];
frm=ceil(length(tol)/2);

for j=1:length(tol)
[myarea,plst,theError,theExactError,fevals]=adaptInt(fun,a,b,tol(j),df2);
Iexact=integral(@(x)abs(fun(x)),a,b);
flst=fun(plst);
diff=abs(Iexact-myarea);
vec=zeros(length(plst),1);

subplot(2,frm,j)
hold on
fplot(fun,[a,b])
stem(plst,flst,'filled','r')
scatter(plst,vec,'filled','b')
ylim([0 1.25])
for k=1:1:length(plst)-1
    rx = [plst(k) plst(k) plst(k+1) plst(k+1)];
    ry = [flst(k) 0 flst(k+1) 0];
    k = convhull(rx, ry);
    fill (rx(k), ry(k), 'g','facealpha', 0.23);
end
fprintf('For a tolerance of %f the approx area = %f.\n The exact area = %f.\n The
approximate error = %d.\n The exact error(comp) = %d.\n The difference in integrals is %
d.\n The number of function evaluations is %u.\n\n',tol(j), myarea,Iexact,theError,
theExactError,diff,fevals)
end

```

```
function [area,ptSet,errorTotal,error,fevals] = adaptInt(fun,xi, xf, tol,df2)
y1=fun(xi);
y2=fun(xf);
[area,error,errorTotal]=TrapezoidArea(xi,xf,y1,y2,fun,df2);
fevals=2;
ptSet=[xi xf];
if error>=tol
    m=(xi+xf)/2;
    [a1, S1,E1,Ex1,feval1]=adaptInt(fun,xi, m, tol,df2);
    [a2, S2,E2,Ex2,feval2]=adaptInt(fun,m,xf, tol,df2);
    area=a1+a2;
    errorTotal=E1+E2;
    error=Ex1+Ex2;
    fevals=feval1+feval2;
    ptSet=[ptSet S1 S2];
    ptSet=sort(ptSet);
    ptSet=unique(ptSet','rows').';
end
end
```

```
function [trapArea,OutTrueError,ErrorEst] = TrapezoidArea(x1,x2,y1,y2,fun,df2)
trapArea=(1/2)*abs(x2-x1)*(abs(y1)+abs(y2));
OutTrueError=abs(integral(@(x) fun(x),x1,x2)-trapArea);
ErrorEst=abs((x2-x1)^3/12*fminbnd(@(x) -1*df2(x),x1,x2));
end
```

For a tolerance of 0.100000 the approx area = 0.657162.
The exact area = 0.549360.
The approximate error = 1.458449e-02.
The exact error(comp) = 1.078015e-01.
The difference in integrals is 1.078015e-01.
The number of function evaluations is 8.
The number of points 5.

For a tolerance of 0.001000 the approx area = 0.551637.
The exact area = 0.549360.
The approximate error = 2.487841e-03.
The exact error(comp) = 6.510018e-03.
The difference in integrals is 2.276214e-03.
The number of function evaluations is 40.
The number of points 21.

For a tolerance of 0.000100 the approx area = 0.550120.
The exact area = 0.549360.
The approximate error = 6.700963e-04.
The exact error(comp) = 1.447460e-03.
The difference in integrals is 7.593906e-04.
The number of function evaluations is 84.
The number of points 43.

For a tolerance of 0.000010 the approx area = 0.549526.
The exact area = 0.549360.
The approximate error = 1.498758e-04.
The exact error(comp) = 3.190275e-04.
The difference in integrals is 1.657701e-04.
The number of function evaluations is 176.
The number of points 89.

For a tolerance of 0.000001 the approx area = 0.549401.
The exact area = 0.549360.
The approximate error = 3.431725e-05.
The exact error(comp) = 6.733533e-05.
The difference in integrals is 4.098522e-05.
The number of function evaluations is 380.
The number of points 191.

For a tolerance of 0.000001 the approx area = 0.549401.
The exact area = 0.549360.
The approximate error = 3.431725e-05.
The exact error(comp) = 6.733533e-05.
The difference in integrals is 4.098522e-05.
The number of function evaluations is 380.
The number of points 191.

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ADAPTIVE TRAPEZOID

