Math 527 Homework 5

Mathew Houser

CE 5.4.1

Write a function to compute $\int_a^b f(x)\,dx$ using formula (8).

```
function int = Quad(f,a,b)
dx = (b-a)/2;
x1 = (1/2).*((b-a)*(-sqrt(3/5))+a+b);
x2 = (1/2).*(a+b+(b-a).*0);
x3 = (1/2).*((b-a).*(sqrt(3/5))+b+a);
f1 = f(x1);
f2 = f(x2);
f3 = f(x3);
sum = (5/9).*(f1)+(8/9).*(f2)+(5/9).*(f3);
int = dx.*sum;
end
```

CE 5.4.2

Use the function above to approximate the integrals:

```
>> Quad('1/sqrt(x)',0,1)
      x1 = 0.1127
      x2 = 0.5000
      x3 = 0.8873
      f1 = 2.9788
      f2 = 1.4142
      f3 = 1.0616
      sum = 3.5017
      int = 1.7509
      ans = 1.7509
```

```
>> Quad('exp(-(cos(x1)^2))',0,2)
      x1 = 0.2254
      x2 = 1
      x3 = 1.7746
      f1 = 2.1063
      f2 = 1
      f3 = 0.7507
      sum = 2.4761
      int = 2.4761
      ans = 2.4761
```

CE 6.2.4

Command Window

```
t = zeros(1,41);
y = zeros(1,41);
z = zeros(1,41);
for i = 1:41
   t(i) = -5.25+(0.25).*i;
   y(i) = (t(i).^2+1)^(-1);
end
```

```
Spline3_Coef(t,y);
x = zeros(1,101);
x(1)=0;
f = zeros(1,101);
SS = zeros(1,101);
diff=zeros(1,101);
for i = 2:101
   x(i) = ((i-1)./20);
   f(i) = (x(i).^2+1)^(-1);
   SS(i) = Spline3_Eval(t,y,z,x(i));
   diff(i) = SS(i)-f(i);
end
```

Spline3_Coef(t,y)

```
function [z] = Spline3_Coef(t,y)
h = zeros (1,40);
b = zeros (1,40);
u = zeros (1,39);
v = zeros (1,39);
for i = 1:40
   h(i) = t(i+1)-t(i);
   b(i) = (y(i+1)-y(i))/h(i);
end
u(1) = 2.*(h(1)+h(2));
v(1) = 6.*(b(2)-b(1));
for i = 2:40
   u(i) = 2.*(h(i)+h(i-1))-((h(i-1)).^2./u(i-1));
   v(i) = 6.*(b(i)-b(i-1))-((h(i-1)).*(v(i-1))./(u(i-1)));
end
z(41) = 0;
for i = 40:-1:1
   z(i) = (v(i)-h(i).*z(i+1))./u(i);
end
z(1)=0;
end
```

Spline3_Eval(t,y,z,x)

```
function [S] = Spline3_Eval(t,y,z,x)
for i = 40:-1:1
   if x-t(i)>=0
       h = t(i+1)-t(i);
       tmp = (z(i)./2)+(x-t(i)).*(z(i+1)-z(1))./(6.*h);
       tmp = -(h./6).*(z(i+1)+2.*z(i))+(y(i+1)-y(i))./h+(x-t(i)).*(tmp);
       S = y(i)+(x-t(i)).*(tmp);
   end
end
end
```

Answer

```
diff = S(x)-f(x)

 Columns 1 through 22

      0   -0.8787   -0.8705   -0.8576   -0.8403   -0.8192   -0.7946
-0.7673   -0.7377   -0.7064   -0.6740   -0.6410   -0.6077   -0.5746
-0.5420   -0.5100   -0.4790   -0.4490   -0.4201   -0.3925   -0.3660
-0.3409

 Columns 23 through 44

-0.3169   -0.2942   -0.2727   -0.2523   -0.2330   -0.2148   -0.1975
-0.1812   -0.1658   -0.1512   -0.1374   -0.1243   -0.1120   -0.1003
-0.0892   -0.0786   -0.0686   -0.0592   -0.0501   -0.0416   -0.0334
-0.0256

 Columns 45 through 66

-0.0182   -0.0111   -0.0043    0.0021    0.0083    0.0142    0.0199
0.0253    0.0306    0.0356    0.0404    0.0450    0.0495    0.0538
0.0579    0.0619    0.0658    0.0695    0.0731    0.0766    0.0800
0.0833

 Columns 67 through 88

0.0865    0.0895    0.0925    0.0954    0.0983    0.1010    0.1037
0.1063    0.1088    0.1113    0.1137    0.1161    0.1184    0.1207
0.1229    0.1250    0.1271    0.1292    0.1312    0.1332    0.1352
0.1371

 Columns 89 through 101

0.1389    0.1408    0.1426    0.1444    0.1461    0.1478    0.1495
0.1512    0.1528    0.1544    0.1560    0.1576    0.1592
```

```
function [z] = Spline3_Coef(t,y)
h = zeros (1,40);
b = zeros (1,40);
u = zeros (1,39);
v = zeros (1,39);
for i = 1:40
   h(i) = t(i+1)-t(i);
   b(i) = (y(i+1)-y(i))/h(i);
end
u(1) = 2.*(h(1)+h(2));
v(1) = 6.*(b(2)-b(1));
for i = 2:40
   u(i) = 2.*(h(i)+h(i-1))-((h(i-1)).^2./u(i-1));
   v(i) = 6.*(b(i)-b(i-1))-((h(i-1)).*(v(i-1))./(u(i-1)));
end
z(41) = 0;
for i = 40:-1:1
   z(i) = (v(i)-h(i).*z(i+1))./u(i);
end
z(1)=0
end

function [S] = Spline3_Eval(t,y,z,x)
for i = 40:-1:1
   if x-t(i)>=0
       h = t(i+1)-t(i);
       tmp = (z(i)./2)+(x-t(i)).*(z(i+1)-z(1))./(6.*h);
       tmp = -(h./6).*(z(i+1)+2.*z(i))+(y(i+1)-y(i))./h+(x-t(i)).*(tmp);
       S = y(i)+(x-t(i)).*(tmp);
   end
end
end

t = zeros(1,41);
y = zeros(1,41);
z = zeros(1,41);
for i = 1:41
   t(i) = -5.25+(0.25).*i;
   y(i) = (t(i).^2+1)^(-1);
end
```

```
function [z] = Spline3_Coef(t,y)
h = zeros (1,40);
b = zeros (1,40);
u = zeros (1,39);
v = zeros (1,39);
for i = 1:40
   h(i) = t(i+1)-t(i);
   b(i) = (y(i+1)-y(i))/h(i);
end
u(1) = 2.*(h(1)+h(2));
v(1) = 6.*(b(2)-b(1));
for i = 2:40
   u(i) = 2.*(h(i)+h(i-1))-((h(i-1)).^2./u(i-1));
   v(i) = 6.*(b(i)-b(i-1))-((h(i-1)).*(v(i-1))./(u(i-1)));
end
z(41) = 0;
for i = 40:-1:1
   z(i) = (v(i)-h(i).*z(i+1))./u(i);
end
z(1)=0
end
function [S] = Spline3_Eval(t,y,z,x)
for i = 40:-1:1
   if x-t(i)>=0
       h = t(i+1)-t(i);
       tmp = (z(i)./2)+(x-t(i)).*(z(i+1)-z(1))./(6.*h);
       tmp = -(h./6).*(z(i+1)+2.*z(i))+(y(i+1)-y(i))./h+(x-t(i)).*(tmp);
       S = y(i)+(x-t(i)).*(tmp);
   end
end
end
x = zeros(1,101);
x(1)=0;
f = zeros(1,101);
SS = zeros(1,101);
diff=zeros(1,101);
for i = 2:101
   x(i) = ((i-1)./20);
   f(i) = (x(i).^2+1)^(-1);
   SS(i) = Spline3_Eval(t,y,z,x(i));
   diff(i) = f(i)-SS(i);
end
```