Math128a - PJ2

March 21, 2020

[ ]:
```
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P1.

t = [0, 1, 2, 3, 4, 5];
x = [1.0, 1.5, 2.0, 2.0, 2.5, 2.5];
y = [1.0, 0.5, 1.0, 1.5, 1.5, 1.0];
[b1, c1, d1] = ncspline(t, x);
[b2, c2, d2] = ncspline(t, y);
tt = linspace(t(1), t(end), 1000);
xx = splineeval(t, x, b1, c1, d1, tt);
yy = splineeval(t, y, b2, c2, d2, tt);
plot(xx, yy, x, y, 'o'), axis equal, grid on

b1 =

    0.4522    0.5957    0.1651    0.2440    0.3589
c1 =

         0    0.1435   -0.5742    0.6531   -0.5383
d1 =

    0.0478   -0.2392    0.4091   -0.3971    0.1794
b2 =

   -0.7608    0.0215    0.6746    0.2799   -0.2943
c2 =

         0    0.7823   -0.1292   -0.2656   -0.3086
d2 =

    0.2608   -0.3038   -0.0455   -0.0144    0.1029
```
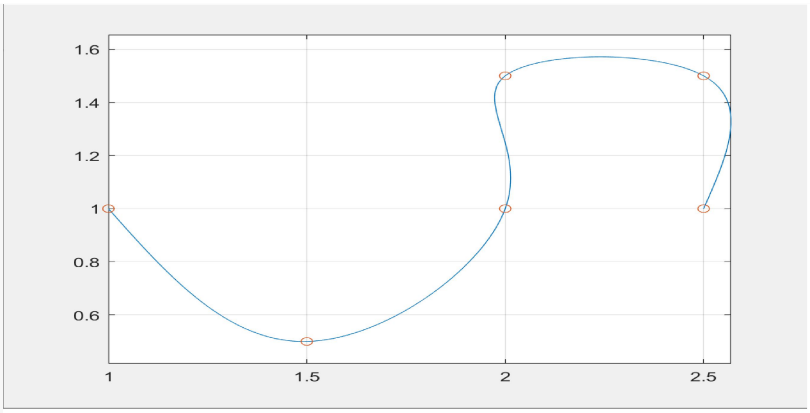



P2.

I modified the Newton Matlab code in course webpage.

```
function p = newton(x, a, b, c, d, p0, tol)

while 1
    p = p0 - (splineeval(x, a, b, c, d, p0) - 1.2)/diffsplineeval(x, a, b, c,␣
 ↪d, p0);
    if abs(p-p0) < tol, break; end
    p0 = p;
end
```

Command :

```
t1 = newton(t, y, b2, c2, d2, 2, 10^(-8));
t2 = newton(t, y, b2, c2, d2, 5, 10^(-8));
x1 = splineeval(t, x, b1, c1, d1, p1);
x2 = splineeval(t, x, b1, c1, d1, p2);

t1 =

   2.317982170678300

t2 =

   4.661644158641097

splineeval(t, y, b2, c2, d2, t1)

ans =

   1.200000000000000
```

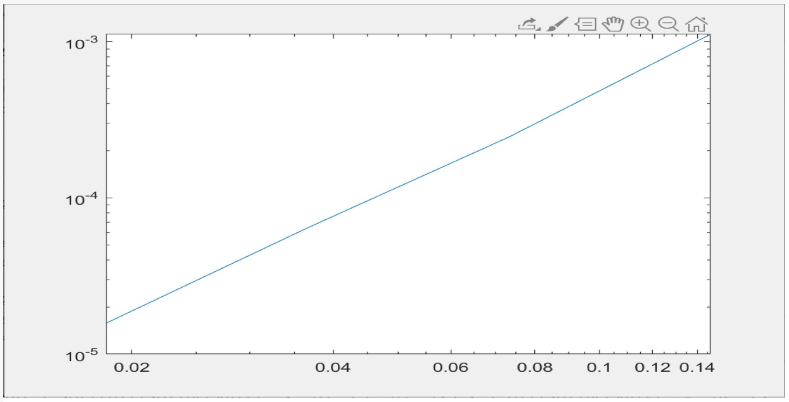
```
splineeval(t, y, b2, c2, d2, t2)

ans =

   1.200000000000000

x1 =

   2.007587864036430

x2 =

   2.553759440675376
```

P3.
I wrote the Matlab function for this problem.

```
function val = trapezoid(n)
t = [0, 1, 2, 3, 4, 5];
x = [1.0, 1.5, 2.0, 2.0, 2.5, 2.5];
y = [1.0, 0.5, 1.0, 1.5, 1.5, 1.0];
[b1, c1, d1] = ncspline(t, x);
[b2, c2, d2] = ncspline(t, y);

t1 = newton(t, y, b2, c2, d2, 2, 10^(-8));
t2 = newton(t, y, b2, c2, d2, 5, 10^(-8));

h = (t2 - t1)/n;
val = sqrt(diffsplineeval(t, x, b1, c1, d1, t1)^2 + diffsplineeval(t, y, b2,␣
 ↪c2, d2, t1)^2);
for i = 1:(n-1)
    val = val + 2*sqrt(diffsplineeval(t, x, b1, c1, d1, t1+(i*h))^2 +␣
 ↪diffsplineeval(t, y, b2, c2, d2, t1+(i*h))^2);
end
val = val + sqrt(diffsplineeval(t, x, b1, c1, d1, t2)^2 + diffsplineeval(t, y,␣
 ↪b2, c2, d2, t2)^2);
val = (h * (0.5)) * val;
end

Command :

L16 = trapezoid(16); L32 = trapezoid(32); L64 = trapezoid(64);
L128 = trapezoid(128); L10000 = trapezoid(10000);
```

```
L16 =

   1.162654862462450

L32 =

   1.161785809250850

L64 =

   1.161604753231802

L128 =

   1.161556258136053

L10000 =

   1.161540504195514
```

```
error(1) = abs(L10000 - L16);
error(2) = abs(L10000 - L32);
error(3) = abs(L10000 - L64);
error(4) = abs(L10000 - L128);

h(1) = (t2 - t1)/16;
h(2) = (t2 - t1)/32;
h(3) = (t2 - t1)/64;
h(4) = (t2 - t1)/128;
loglog(h, error)
```



```
logh = log(h);
logerror = log(error);
slope = (logerror(4) - logerror(1))/(logh(4) - logh(1));
slope =

   2.048118862941069
```