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Numerical Methods

2/24/20

Numerical Methods Midterm Part 2

13.

- a. There are 5 solutions
- b. Solutions are:
  - i. -2.0536798999
  - ii. -1.1375432023
  - iii. -0.3423790088
  - iv. 1.2416595497
  - v. 2.2505111651
- c. I calculated these solutions with The Secant Method, because this method is efficient at calculating values of roots efficiently, and I realized after plotting the function that the 5 solutions all cross the x-axis, meaning if I chose my endpoints properly it will succeed at finding the solutions since the signs will be opposite on each side of each solution respectively.
- d. See secant.m code attached in canvas submission

14.

- The solution if I stop when  $h = 0.025$  is approximately  $-1.2925406006e-10$ , but if we keep going using the suggested size of 4 for  $n$ , the final solution comes out as  $-1.0711444098e-10$ , which is more precise, but not a huge amount more so. See the Output screenshot on the following page.

15.

- See Richardson.m, the algorithm successfully outputs the matrix, and the last number in it is the final solution. I had it printing the h-value as well to find which value was the one which fits the location where  $h = 0.025$ , as requested in problem 14. I removed the printing of the h-value from the submitted code.

Octave

File Edit Debug Window Help News

Current Directory: /home/jonny

File Browser

/home/jonny

Workspace

Name	Class	Dimen
a	double	1x1
ans	double	9x9
b	double	1x1
e	double	1x1
f	function_h...	1x1
h	double	1x1
nmax	double	1x1
x	double	1x1

Command History

Richardson(f, x, 8, h)  
 Richardson  
 Richardson(f, x, 8, h)  
 Richardson  
 Richardson(f, x, 8, h)  
 Richardson(f, x, 8, h)  
 Richardson(f, x, 8, h)  
 Richardson(f, x, 4, h)  
 Richardson(f, x, 4, h)  
 Richardson(f, x, 8, h)

Command Window

```
>> Richardson(f, x, 8, h)
n = 9
h = 0.050000000000
h = 0.025000000000
h = 0.012500000000
h = 0.006250000000
h = 0.003125000000
h = 0.001562500000
h = 0.000781250000
h = 0.000390625000
h = 0.000195312500
ans =

Columns 1 through 3:

-2.6258112963e-10    0.0000000000e+00    0.0000000000e+00
-1.3758700191e-10    -1.2925406006e-10    0.0000000000e+00
-1.1403932571e-10    -1.1246948063e-10    -1.1220305873e-10
-1.0856849857e-10    -1.0820377676e-10    -1.0813606718e-10
-1.0722586229e-10    -1.0713635321e-10    -1.0711940998e-10
-1.0689175583e-10    -1.0686948206e-10    -1.0686524601e-10
-1.0680832603e-10    -1.0680276404e-10    -1.0680170502e-10
-1.0678747462e-10    -1.0678608453e-10    -1.0678581978e-10
-1.0678226215e-10    -1.0678191465e-10    -1.0678184846e-10

Columns 4 through 6:

0.0000000000e+00    0.0000000000e+00    0.0000000000e+00
0.0000000000e+00    0.0000000000e+00    0.0000000000e+00
0.0000000000e+00    0.0000000000e+00    0.0000000000e+00
-1.0812011819e-10    0.0000000000e+00    0.0000000000e+00
-1.0711542309e-10    -1.0711444098e-10    0.0000000000e+00
-1.0686424929e-10    -1.0686400377e-10    -1.0686394261e-10
-1.0680145584e-10    -1.0680139446e-10    -1.0680137917e-10
-1.0678575748e-10    -1.0678574214e-10    -1.0678573831e-10
-1.0678183289e-10    -1.0678182905e-10    -1.0678182810e-10

Columns 7 through 9:

0.0000000000e+00    0.0000000000e+00    0.0000000000e+00
0.0000000000e+00    0.0000000000e+00    0.0000000000e+00
0.0000000000e+00    0.0000000000e+00    0.0000000000e+00
0.0000000000e+00    0.0000000000e+00    0.0000000000e+00
0.0000000000e+00    0.0000000000e+00    0.0000000000e+00
-1.0680137535e-10    0.0000000000e+00    0.0000000000e+00
-1.0678573736e-10    -1.0678573712e-10    0.0000000000e+00
-1.0678182786e-10    -1.0678182780e-10    -1.0678182778e-10

>>
```

Variable Editor

Command Window Editor Documentation