MATH 4610 w/ Joe Koebbe

Fall 2021

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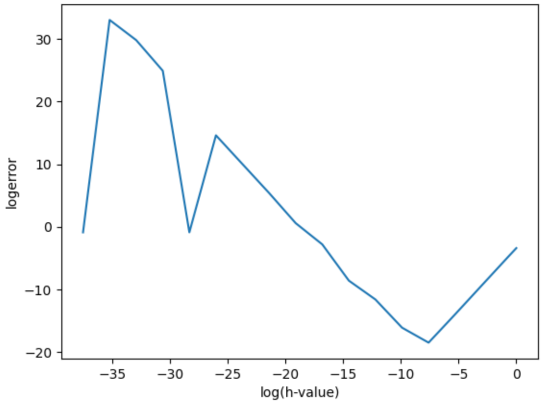
1. $f'(a) = \frac{f(a+h)-f(a-h)}{2h} \approx \frac{1}{2h}(f(a)+f'(a)h+\frac{1}{2}f''(a)h^2+\frac{1}{6}f'''(\xi_1)h^3-f(a)+f'(a)h-\frac{1}{2}f''(a)h^2+\frac{1}{6}f'''(\xi_2)h^3$
   $= \frac{1}{2h}(2f'(a)h+\frac{1}{6}f'''(\xi_3)h^3) = f'(a)+\frac{1}{12}f'''(\xi_3)h^2$
   error $= |f'(a)-(f'(a)+\frac{1}{12}f'''(\xi_3)h^2)| = \frac{1}{12}f'''(\xi_3)h^2$
   error $\leqslant ch^2$

```
    h-value   error
1e-0       0.03354335418516324
1e-1       0.00034667345475336564
1e-2       3.467876013296678e-06
1e-3       3.4640095514237856e-08
1e-4       1.9541062379335727e-08
1e-5       2.802191542139454e-07
1e-6       0.00014626922009641774
1e-7       0.022391258179794205
1e-8       0.6940761880780137
1e-9       55.09500439471066
1e-10      5550.698976289233
1e-11      555111.0961657414
1e-12      0.4161468365471424
1e-13      5551115122.709634
1e-14      1665334536938.1506
1e-15      277555756156288.72
1e-16      0.4161468365471424
```

   This was taken from what I did for task sheet 2, as this is practically asking us to do the same thing as before.

2. The code I used to create the table from task 1, and what used to create the graph below can be found in my gitHub repository using this link. `https://github.com/spencerwheeler2077/math4610/blob/main/SecDerivative.py`



   We can see from this plot that the approximation begins to fail after log(h-value) -7.5

3. I wrote a program to find the machine epsilon in python. Since python only uses double precision floating point numbers, imported a single precision floating point from the numpy library. These codes can be found in this directory in my repository for this class.

   `https://github.com/spencerwheeler2077/math4610/tree/main/Percision`

4. I put the two files in one folder, that can be easily accessed, and imported into other projects. This file can be found at this url. (This is the same url form task 3)

   `https://github.com/spencerwheeler2077/math4610/tree/main/Percision`

5. A shared Library is a file or place that you put several routines. Routines are programs or lines or code that you might reuse often, in many different projects. There are many advantages for shared libraries, some listed on this site are saving disk storage space, saving memory, and making executable files easier to maintain.

   `http://osr507doc.sco.com/en/tools/ShLib_WhatIs.html`