Assignment 2- Writeup

For this assignment, the problem that we faced was using Taylor Series to accurately approximate mathematical functions such as sin, cos, tan, e^x , and log to a point that it essentially replicates the same math functions in the math.h library.

In order to start constructing a solution for this problem, we have to look closely at the Taylor expansion for each function; specifically, determining the difference from one term(k) to the next term(k+1). By figuring out the difference between two terms, recursion can be used to approximate math functions within a certain period.

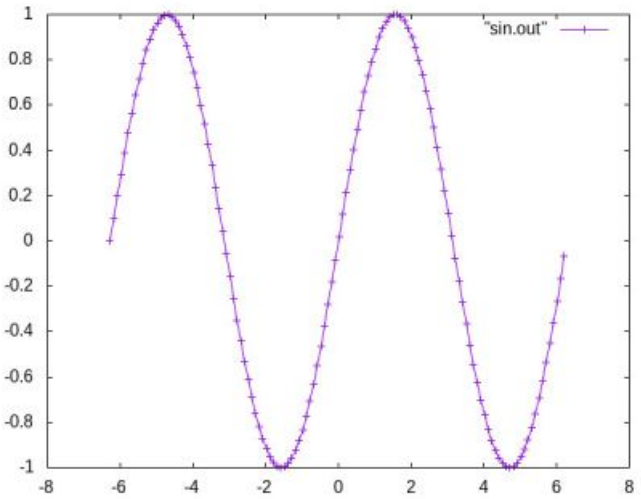
Once the difference is evaluated:

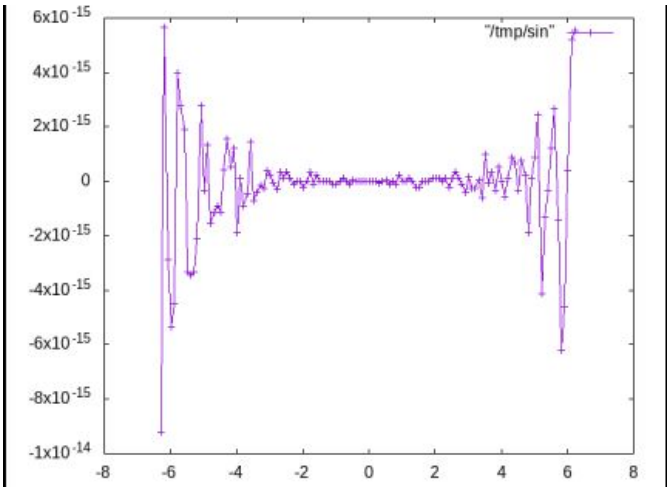
- set the difference to "term" and add it to the increasing "sum" value.
- return the value "sum"

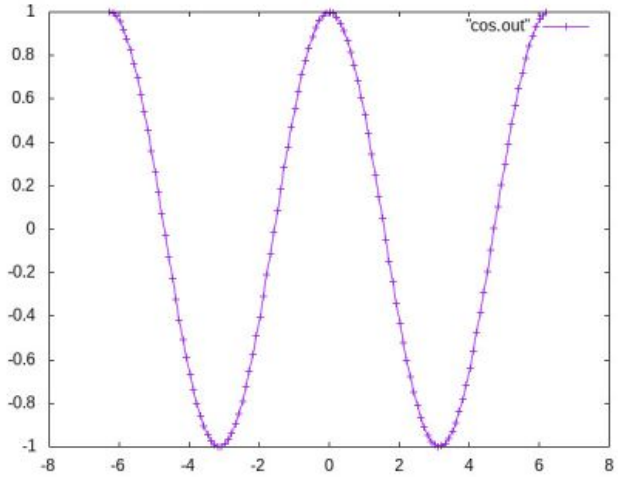
as long as each term is greater than the value defined for epsilon (10e-14)

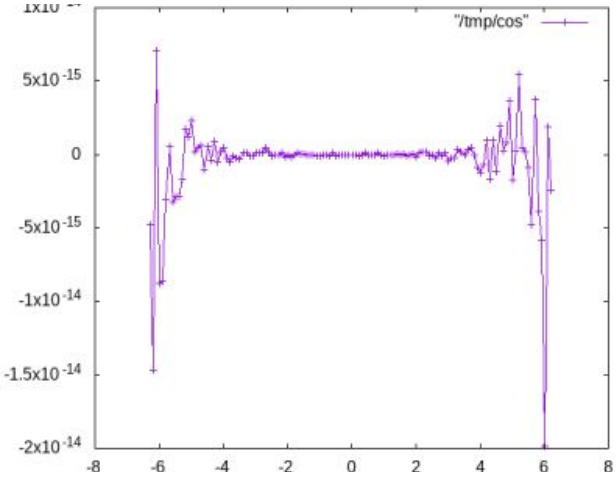
Then within the main method, set getopt() options— in this case 'asctel' — to call "all", "sin", "cos", "tan", "exp", or "log" functions. In the statements used to call these functions, the periods for each function can be specified i.e, for sin and cos [-2pi, 2pi]. Before the outputs of the created function, the library function, and the difference between the created and library functions are printed, each function should be prefaced with the header clarifying which column has x values, the respective outputs, and the difference, with necessary spacing.

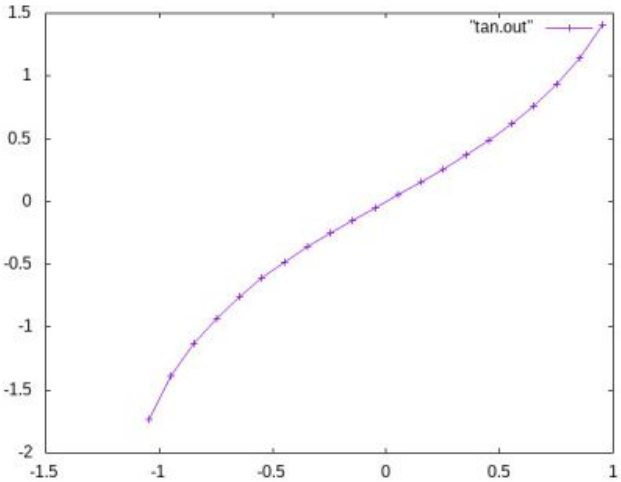
Outputs:

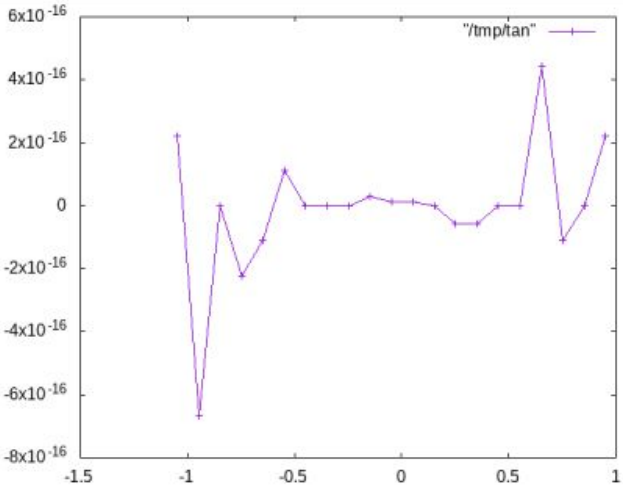


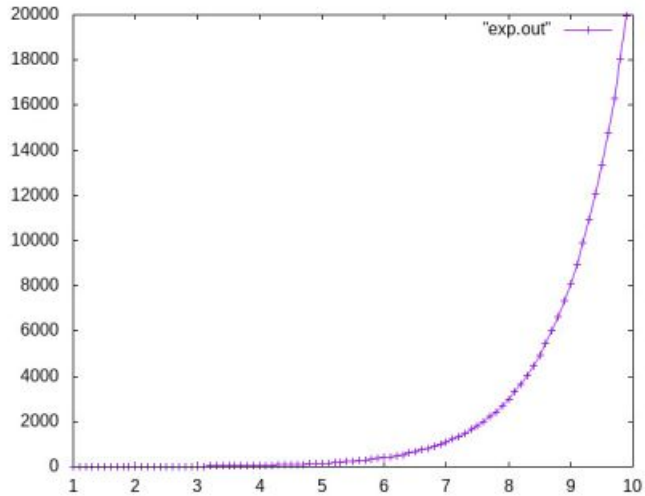


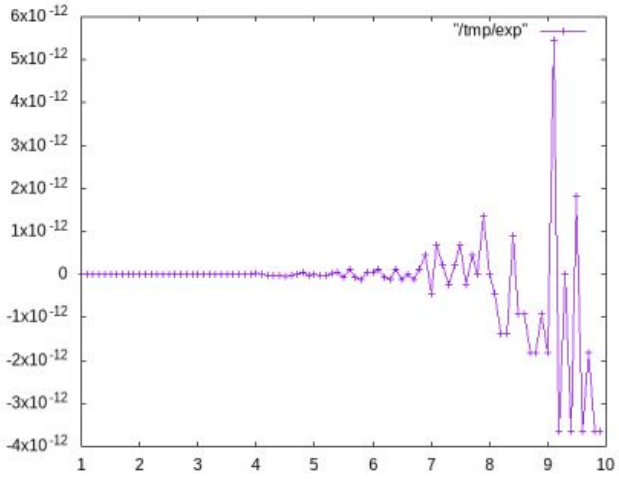

"cos.out"
1
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
-1
-8
-6
-4
-2
0
2
4
6
8

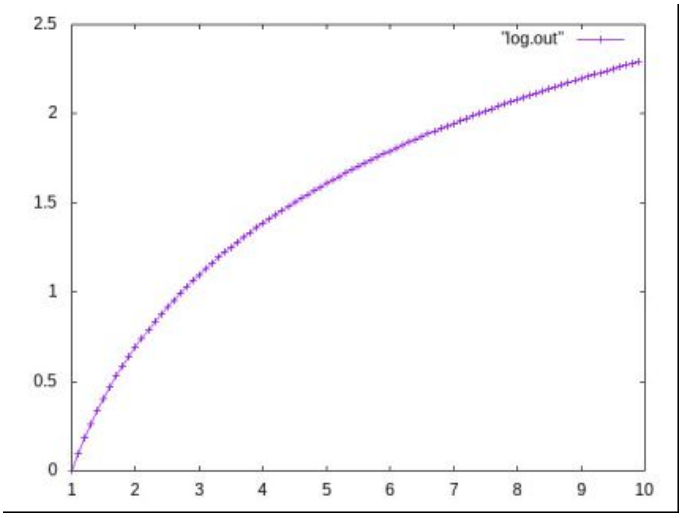

"/tmp/cos"
5x10-15
0
-5x10-15
-1x10-14
-1.5x10-14
-2x10-14
-8
-6
-4
-2
0
2
4
6
8

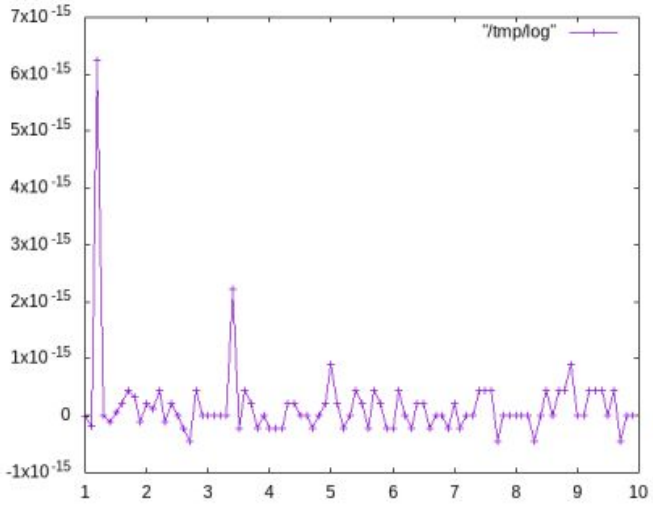

"tan.out"
1.5
1
0.5
0
-0.5
-1
-1.5
-2
-1.5
-1
-0.5
0
0.5
1


"/tmp/tan"
6x10-16
4x10-16
2x10-16
0
-2x10-16
-4x10-16
-6x10-16
-8x10-16
-1.5
-1
-0.5
0
0.5
1


"exp.out"
20000
18000
16000
14000
12000
10000
8000
6000
4000
2000
0
1
2
3
4
5
6
7
8
9
10


"/tmp/exp"
6x10-12
5x10-12
4x10-12
3x10-12
2x10-12
1x10-12
0
-1x10-12
-2x10-12
-3x10-12
-4x10-12
1
2
3
4
5
6
7
8
9
10





Explanation of graphs/results:

Each set of graphs displays the outputs of the math function created through implementing Taylor series expansion values(left) and the difference between created function values & library values(right). We can see from the graphs on the left that on average, the values outputted by the created functions match those from a traditional graph of these functions. This is further emphasized by the lack of significant differences between the outputs of the library functions and the ones that were constructed. Any differences that do exist (i.e. usually values of <0.0000000001) may be due to the fact that the functions that were written are not really calculating to the same degree of accuracy as the functions from the library. The reason for this is that constructed math functions will obviously and inevitably have fewer(limited) parameters to pass into it than the functions within math.h. The most amount of difference between the two can be seen at the ends of the specified ranges, most likely due to the fact that greater x values result in more variation in output values because of the difference in parameters. In addition, the way the constructed functions round floating point numbers may differ from how the library's functions handle those numbers when it comes to rounding, which further explains the divergence in output values at range ends and the resulting differences of ±0.0000000000.