Tanya Gyanmote

tgyanmot@ucsc.edu

Fall 2022

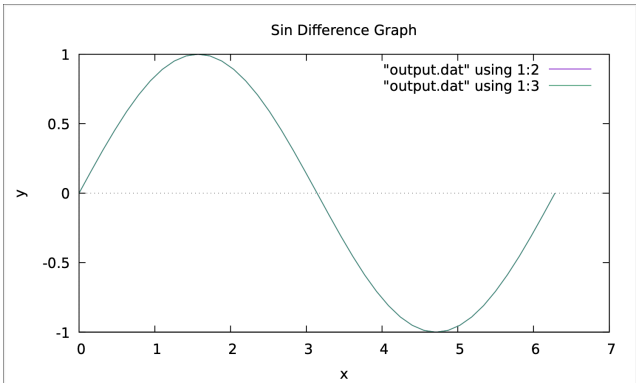
CSE13S Assignment 2 - A Small Numerical Library

Programming Analysis:

This program implements functions, created in mathlib.c which is a small numerical library and has a corresponding test harness. The functions in mathlib.c, sin, cos, sin−1 (arcsin), cos−1 (arccos), tan−1 (arctan) program the Taylor series expansion near some point f(a). The program takes certain command line arguments like -a, -s, etc;

Sin(x)

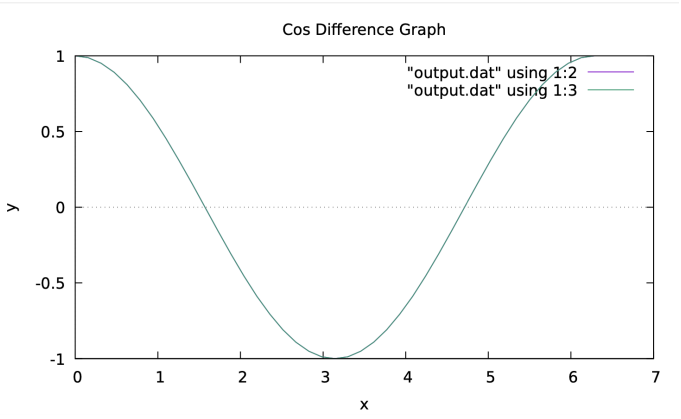
x	sin	Library	Difference
0.0000	0.000000000	0.000000000	0.000000000000
0.1571	0.156434465	0.156434465	0.000000000000
0.3142	0.309016994	0.309016994	0.000000000000
0.4712	0.453990500	0.453990500	-0.000000000000
0.6283	0.587785252	0.587785252	0.000000000000
0.7854	0.707106781	0.707106781	0.000000000000
0.9425	0.809016994	0.809016994	0.000000000000
1.0996	0.891006524	0.891006524	-0.000000000000
1.2566	0.951056516	0.951056516	-0.000000000000
1.4137	0.987688341	0.987688341	0.000000000000
1.5708	1.000000000	1.000000000	0.000000000000
1.7279	0.987688341	0.987688341	0.000000000000
1.8850	0.951056516	0.951056516	-0.000000000000
2.0420	0.891006524	0.891006524	-0.000000000000
2.1991	0.809016994	0.809016994	-0.000000000000
2.3562	0.707106781	0.707106781	-0.000000000001
2.5133	0.587785252	0.587785252	0.000000000000
2.6704	0.453990500	0.453990500	0.000000000000
2.8274	0.309016994	0.309016994	0.000000000001
2.9845	0.156434465	0.156434465	-0.000000000000
3.1416	-0.000000000	0.000000000	-0.000000000000
3.2987	-0.156434465	-0.156434465	-0.000000000001
3.4558	-0.309016994	-0.309016994	-0.000000000002
3.6128	-0.453990500	-0.453990500	0.000000000000
3.7699	-0.587785252	-0.587785252	0.000000000000
3.9270	-0.707106781	-0.707106781	0.000000000001
4.0841	-0.809016994	-0.809016994	-0.000000000000
4.2412	-0.891006524	-0.891006524	-0.000000000000
4.3982	-0.951056516	-0.951056516	-0.000000000001
4.5553	-0.987688341	-0.987688341	-0.000000000001
4.7124	-1.000000000	-1.000000000	0.000000000000
4.8695	-0.987688341	-0.987688341	0.000000000000
5.0265	-0.951056516	-0.951056516	0.000000000001
5.1836	-0.891006524	-0.891006524	0.000000000002
5.3407	-0.809016994	-0.809016994	-0.000000000000
5.4978	-0.707106781	-0.707106781	-0.000000000000
5.6549	-0.587785252	-0.587785252	-0.000000000001
5.8119	-0.453990500	-0.453990500	-0.000000000002
5.9690	-0.309016994	-0.309016994	0.000000000000
6.1261	-0.156434465	-0.156434465	0.000000000000



my_sin(x) I created has a similar output to the library sin(x) with an acceptable difference. I created my_sin(x) using the pseudocode I had mentioned in my Design Document. As you can see the pink line is from my_sin(x) and the green is from the library sin(x) value and you can't see a difference between them, they blend in together into a blue line. The difference is within an exceptional margin of error.

Cos(x)

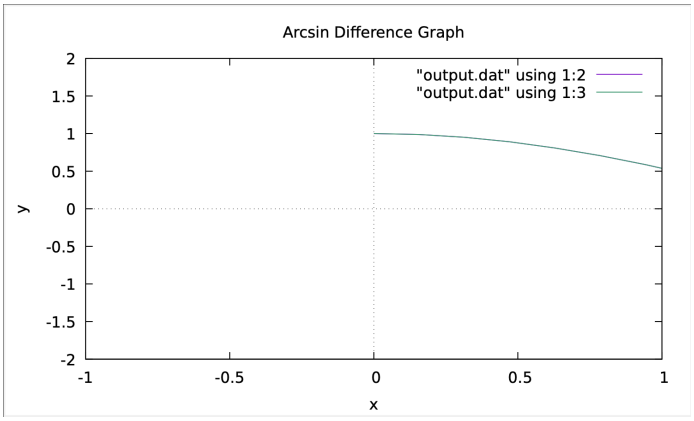
x	cos	Library	Difference
0.0000	1.000000000	1.000000000	0.000000000000
0.1571	0.987688341	0.987688341	0.000000000000
0.3142	0.951056516	0.951056516	-0.000000000000
0.4712	0.891006524	0.891006524	-0.000000000000
0.6283	0.809016994	0.809016994	0.000000000000
0.7854	0.707106781	0.707106781	0.000000000000
0.9425	0.587785252	0.587785252	0.000000000000
1.0996	0.453990500	0.453990500	-0.000000000000
1.2566	0.309016994	0.309016994	0.000000000000
1.4137	0.156434465	0.156434465	-0.000000000000
1.5708	0.000000000	0.000000000	-0.000000000000
1.7279	-0.156434465	-0.156434465	-0.000000000000
1.8850	-0.309016994	-0.309016994	-0.000000000000
2.0420	-0.453990500	-0.453990500	0.000000000000
2.1991	-0.587785252	-0.587785252	-0.000000000000
2.3562	-0.707106781	-0.707106781	-0.000000000000
2.5133	-0.809016994	-0.809016994	-0.000000000000
2.6704	-0.891006524	-0.891006524	0.000000000000
2.8274	-0.951056516	-0.951056516	0.000000000000
2.9845	-0.987688341	-0.987688341	-0.000000000000
3.1416	-1.000000000	-1.000000000	-0.000000000000
3.2987	-0.987688341	-0.987688341	-0.000000000000
3.4558	-0.951056516	-0.951056516	0.000000000000
3.6128	-0.891006524	-0.891006524	0.000000000000
3.7699	-0.809016994	-0.809016994	0.000000000000
3.9270	-0.707106781	-0.707106781	0.000000000001
4.0841	-0.587785252	-0.587785252	-0.000000000000
4.2412	-0.453990500	-0.453990500	-0.000000000000
4.3982	-0.309016994	-0.309016994	-0.000000000001
4.5553	-0.156434465	-0.156434465	0.000000000000
4.7124	0.000000000	-0.000000000	0.000000000000
4.8695	0.156434465	0.156434465	0.000000000001
5.0265	0.309016994	0.309016994	0.000000000002
5.1836	0.453990500	0.453990500	-0.000000000000
5.3407	0.587785252	0.587785252	-0.000000000000
5.4978	0.707106781	0.707106781	-0.000000000001
5.6549	0.809016994	0.809016994	0.000000000000
5.8119	0.891006524	0.891006524	0.000000000000
5.9690	0.951056516	0.951056516	0.000000000001
6.1261	0.987688341	0.987688341	0.000000000001



my_cos(x) I created has a similar output to the library cos(x) with an acceptable difference. I created my_cos(x) using the pseudocode I had mentioned in my Design Document. As you can see the pink line is from my_cos(x) and the green is from the library cos(x) value and you can't see a difference between them, they blend in together into a blue line. The difference is within an exceptional margin of error.

Arcsin(x)

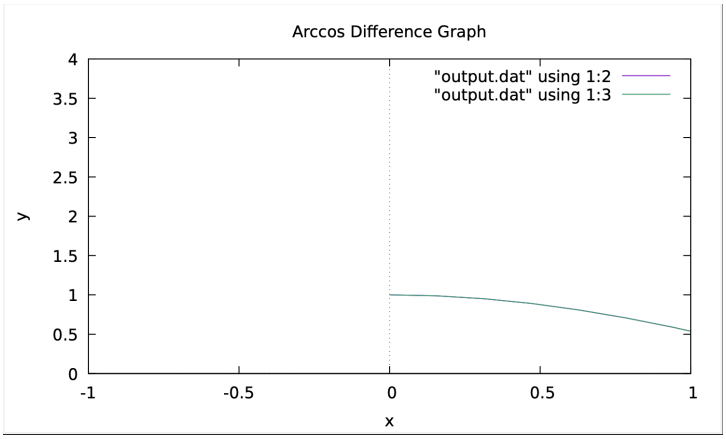
x	arccos	Library	Difference
-1.0000	3.141592358	3.141592654	-0.000000295286
-0.9500	2.824032224	2.824032224	0.000000000000
-0.9000	2.690565842	2.690565842	0.000000000000
-0.8500	2.586781621	2.586781621	0.000000000000
-0.8000	2.498091545	2.498091545	-0.000000000000
-0.7500	2.418858406	2.418858406	-0.000000000000
-0.7000	2.346193823	2.346193823	-0.000000000000
-0.6500	2.278380764	2.278380764	-0.000000000000
-0.6000	2.214297436	2.214297436	-0.000000000000
-0.5500	2.153160565	2.153160565	0.000000000000
-0.5000	2.094395102	2.094395102	0.000000000000
-0.4500	2.037561666	2.037561666	0.000000000000
-0.4000	1.982313173	1.982313173	0.000000000000
-0.3500	1.928367430	1.928367430	0.000000000000
-0.3000	1.875488981	1.875488981	-0.000000000000
-0.2500	1.823476582	1.823476582	-0.000000000000
-0.2000	1.772154248	1.772154248	-0.000000000000
-0.1500	1.721364600	1.721364600	0.000000000000
-0.1000	1.670963748	1.670963748	0.000000000000
-0.0500	1.620817184	1.620817184	-0.000000000000
0.0000	1.570796327	1.570796327	0.000000000000
0.0500	1.520775470	1.520775470	0.000000000000
0.1000	1.470628906	1.470628906	-0.000000000000
0.1500	1.420228054	1.420228054	0.000000000000
0.2000	1.369438406	1.369438406	0.000000000000
0.2500	1.318116072	1.318116072	0.000000000000
0.3000	1.266103673	1.266103673	0.000000000000
0.3500	1.213225223	1.213225223	-0.000000000000
0.4000	1.159279481	1.159279481	-0.000000000000
0.4500	1.104030988	1.104030988	-0.000000000000
0.5000	1.047197551	1.047197551	-0.000000000000
0.5500	0.988432089	0.988432089	-0.000000000000
0.6000	0.927295218	0.927295218	0.000000000000
0.6500	0.863211890	0.863211890	0.000000000000
0.7000	0.795398830	0.795398830	0.000000000000
0.7500	0.722734248	0.722734248	0.000000000000
0.8000	0.643501109	0.643501109	0.000000000000
0.8500	0.554811033	0.554811033	-0.000000000000
0.9000	0.451026812	0.451026812	-0.000000000000
0.9500	0.317560429	0.317560429	-0.000000000000



my_cos(x) I created has a similar output to the library cos(x) with an acceptable difference. I created my_cos(x) using the pseudocode I had mentioned in my Design Document. As you can see the pink line is from my_arcsin(x) and the green is from the library asin(x) value and you can't see a difference between them, they blend in together into a blue line. The difference is within an exceptional margin of error.

Arccos(x)

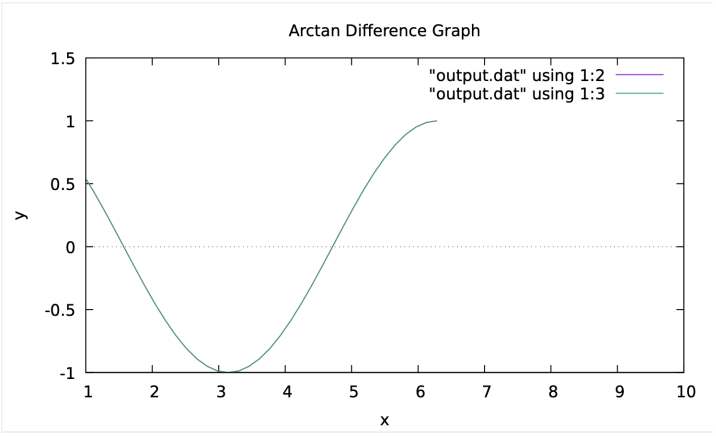
x	arccos	Library	Difference
−1.0000	3.141592358	3.141592654	−0.000000295286
−0.9500	2.824032224	2.824032224	0.000000000000
−0.9000	2.690565842	2.690565842	0.000000000000
−0.8500	2.586781621	2.586781621	0.000000000000
−0.8000	2.498091545	2.498091545	−0.000000000000
−0.7500	2.418858406	2.418858406	−0.000000000000
−0.7000	2.346193823	2.346193823	−0.000000000000
−0.6500	2.278380764	2.278380764	−0.000000000000
−0.6000	2.214297436	2.214297436	−0.000000000000
−0.5500	2.153160565	2.153160565	0.000000000000
−0.5000	2.094395102	2.094395102	0.000000000000
−0.4500	2.037561666	2.037561666	0.000000000000
−0.4000	1.982313173	1.982313173	0.000000000000
−0.3500	1.928367430	1.928367430	0.000000000000
−0.3000	1.875488981	1.875488981	−0.000000000000
−0.2500	1.823476582	1.823476582	−0.000000000000
−0.2000	1.772154248	1.772154248	−0.000000000000
−0.1500	1.721364600	1.721364600	0.000000000000
−0.1000	1.670963748	1.670963748	0.000000000000
−0.0500	1.620817184	1.620817184	−0.000000000000
0.0000	1.570796327	1.570796327	0.000000000000
0.0500	1.520775470	1.520775470	0.000000000000
0.1000	1.470628906	1.470628906	−0.000000000000
0.1500	1.420228054	1.420228054	0.000000000000
0.2000	1.369438406	1.369438406	0.000000000000
0.2500	1.318116072	1.318116072	0.000000000000
0.3000	1.266103673	1.266103673	0.000000000000
0.3500	1.213225223	1.213225223	−0.000000000000
0.4000	1.159279481	1.159279481	−0.000000000000
0.4500	1.104030988	1.104030988	−0.000000000000
0.5000	1.047197551	1.047197551	−0.000000000000
0.5500	0.988432089	0.988432089	−0.000000000000
0.6000	0.927295218	0.927295218	0.000000000000
0.6500	0.863211890	0.863211890	0.000000000000
0.7000	0.795398830	0.795398830	0.000000000000
0.7500	0.722734248	0.722734248	0.000000000000
0.8000	0.643501109	0.643501109	0.000000000000
0.8500	0.554811033	0.554811033	−0.000000000000
0.9000	0.451026812	0.451026812	−0.000000000000
0.9500	0.317560429	0.317560429	−0.000000000000



my_arccos(x) I created has a similar output to the library acos(x) with an acceptable difference. I created my_arccos(x) using the pseudocode I had mentioned in my Design Document. As you can see the pink line is from my_arccos(x) and the green is from the library acos(x) value and you can't see a difference between them, they blend in together into a blue line. The difference is within an exceptional margin of error.

Arctan(x)

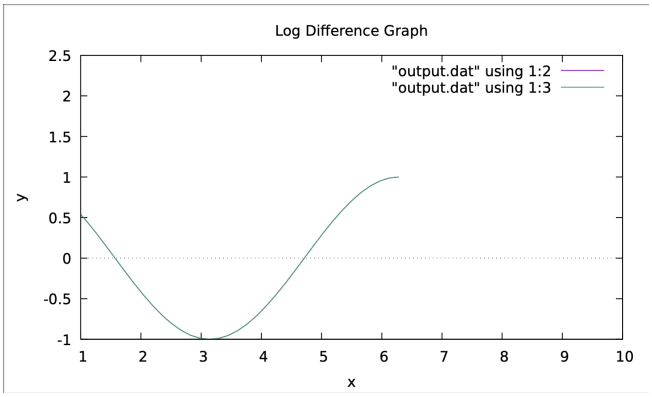
x	arctan	Library	Difference
1.0000	0.785398163	0.785398163	0.000000000033
1.0500	0.809783573	0.809783573	-0.000000000032
1.1000	0.832981267	0.832981267	-0.000000000001
1.1500	0.855052737	0.855052737	0.000000000024
1.2000	0.876058051	0.876058051	0.000000000041
1.2500	0.896055385	0.896055385	0.000000000044
1.3000	0.915100701	0.915100701	-0.000000000003
1.3500	0.933247529	0.933247529	-0.000000000005
1.4000	0.950546841	0.950546841	0.000000000047
1.4500	0.967046993	0.967046993	-0.000000000052
1.5000	0.982793723	0.982793723	-0.000000000002
1.5500	0.997830184	0.997830184	0.000000000029
1.6000	1.012197011	1.012197011	0.000000000029
1.6500	1.025932411	1.025932411	0.000000000014
1.7000	1.039072259	1.039072260	-0.000000000046
1.7500	1.051650213	1.051650213	-0.000000000039
1.8000	1.063697822	1.063697822	0.000000000007
1.8500	1.075244653	1.075244653	-0.000000000020
1.9000	1.086318398	1.086318398	0.000000000054
1.9500	1.096944990	1.096944990	-0.000000000016
2.0000	1.107148718	1.107148718	0.000000000064
2.0500	1.116952325	1.116952325	0.000000000014
2.1000	1.126377117	1.126377117	0.000000000057
2.1500	1.135443052	1.135443052	0.000000000069
2.2000	1.144168834	1.144168834	-0.000000000062
2.2500	1.152571997	1.152571997	0.000000000045
2.3000	1.160668986	1.160668986	0.000000000032
2.3500	1.168475229	1.168475229	-0.000000000083
2.4000	1.176005207	1.176005207	0.000000000035



my_arctan(x) I created has a similar output to the library atan(x) with an acceptable difference. I created my_arctan(x) using the pseudocode I had mentioned in my Design Document.As you can see the pink line is from my_arctan(x) and the green is from the library atan(x) value and you can't see a difference between them, they blend in together into a blue line. The difference is within an exceptional margin of error.

Log(x)

x	log	Library	Difference
1.0000	0.000000000	0.000000000	0.000000000000
1.0500	0.048790164	0.048790164	0.000000000000
1.1000	0.095310180	0.095310180	0.000000000000
1.1500	0.139761942	0.139761942	0.000000000000
1.2000	0.182321557	0.182321557	0.000000000001
1.2500	0.223143551	0.223143551	0.000000000000
1.3000	0.262364264	0.262364264	0.000000000000
1.3500	0.300104592	0.300104592	0.000000000001
1.4000	0.336472237	0.336472237	0.000000000000
1.4500	0.371563556	0.371563556	0.000000000000
1.5000	0.405465108	0.405465108	0.000000000001
1.5500	0.438254931	0.438254931	0.000000000002
1.6000	0.470003629	0.470003629	0.000000000000
1.6500	0.500775288	0.500775288	0.000000000000
1.7000	0.530628251	0.530628251	0.000000000001
1.7500	0.559615788	0.559615788	0.000000000001
1.8000	0.587786665	0.587786665	0.000000000002
1.8500	0.615185639	0.615185639	0.000000000000
1.9000	0.641853886	0.641853886	0.000000000000
1.9500	0.667829373	0.667829373	0.000000000000
2.0000	0.693147181	0.693147181	0.000000000001
2.0500	0.717839793	0.717839793	0.000000000001
2.1000	0.741937345	0.741937345	0.000000000002
2.1500	0.765467842	0.765467842	0.000000000002
2.2000	0.788457360	0.788457360	0.000000000000
2.2500	0.810930216	0.810930216	0.000000000000
2.3000	0.832909123	0.832909123	0.000000000000
2.3500	0.854415328	0.854415328	0.000000000001
2.4000	0.875468737	0.875468737	0.000000000001
2.4500	0.896088025	0.896088025	0.000000000001
2.5000	0.916290732	0.916290732	0.000000000001
2.5500	0.936093359	0.936093359	0.000000000002
2.6000	0.955511445	0.955511445	0.000000000002
2.6500	0.974559640	0.974559640	0.000000000000



my_log(x) I created has a similar output to the library log(x) with an acceptable difference. I created my_log(x) using the pseudocode I had mentioned in my Design Document. As you can see the pink line is from my_log(x) and the green is from the library log(x) value and you can’t see a difference between them, they blend in together into a blue line. The difference is within an exceptional margin of error.