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CSE13S Spring 2021
Assignment 2: A Small Numerical Library
Design Document

This lab is about making a small library that will calculate arcSin, arcCos, arcTan, or Log of a value. The lab will also contain a test harness that will test the methods and determine the difference between the lab results and the given results from a standard library.

Top Level Diagram

Mathlib.c

Include math.h
Define variables
Pi = M_pi
Epsilon = 10^-10

arcSin(x)

Variable guess = 0
Variable improvement
While (x - sin(guess) > epsilon)
    Improvement = x - sin(guess)
    improvement = improvement / cos(guess)
    Guess = guess + improvement

arcCos(x)

Use math identity pi/2 - arcsin(x)

arcTan(x)

Use math identity
arcSin(x/sqrt(x^2+1))

Log(x)

Variable guess = 1
Variable improvement
While (x- exp(guess) > epsilon)
    Improvement = x - exp(guess)
    Improvement = improvement / exp(guess)
    Guess = guess + improvement
Return guess

Exp function (given)

Calculates e^x using taylor's series

Mathlib-test.c

```
Main(arguments)
        Variable opt
        Variable boolean asin
        Variable boolean acos
        Variable boolean atan
        Variable boolean log
        While (opt = getopt(argc, argv, option) != 0)
                switch (opt)
                Case a
                        Asin = true
                        Acos = true
                        Atan = true
                        log = true
                Case s
                        Asin = true
                Case c
                        Acos = true
                Case t
                        Atan = true
                Case l
                        log = true

        If asin
                Do asin tests
                Compare with Asin from math.h
                Difference = local test - math.h test
        If acos
                Do acos tests
                Compare with Acos from math.h
                Difference = local test - math.h test
        If atan
                Do atan tests
                Compare with Acos from math.h
                Difference = local test - math.h test
        If log
```

Do log tests
Compare with log from math.h
Difference = local test - math.h test

Design Progress:

- First design was made on 4/15
- Design changed on 4/18 to reflect final code
- Decided to use trig identity for arcCos/arcTan instead of using newton's method for both

I actually learned a lot of math during this lab compared to actual code. I learned how Newton's method worked. Also learned the trig identity for arcCos and arcTan. I also learned how to use GNU plot to plot stuff from a .dat file and output it to a png file. Also learned how to make a makefile instead of just copying it from a given markfile code.