Design Document

Assignment 2: A Small Numerical Library

Purpose

This program will print out a small numerical library. The numerical library will contain approximations for $\sin^{-1}(x)$, $\cos^{-1}(x)$, $\tan^{-1}(x)$, and $\log(x)$. These approximations will be displayed alongside the values given by the functions from the standard library `<math.h>`. The user will use command-line options to specify which of the four functions to approximate.

Layout/Structure

`mathlib-test.c`

`main()`

Description/Explanation

For this assignment, the `main()` function will interpret the command-line options, and pass them to `printLib(name, start, end)` accordingly.

Pseudocode

Parse the command-line arguments
And record which of the 5 options were given
If you find an option that is not in “asctl”
    Then the option is invalid
    So print the program guide
    And stop the program
Otherwise
    Run the appropriate tests in order
If no options were given
    Then print the program guide
    And stop the program

`printLib(name, start, end)`

Description/Explanation

`printLib(opt)` will use the functions in `mathlib.c` to compute the approximation and print them as a table of values with rows and columns.

Pseudocode

print the table header with correct `name` (column titles)
for every x value from `start` to `end`...
    call function from mathlib.c to get approximation at x
    use `<math.h>` function to compute value at x
    compute the difference
    print row

`printGuide()`

Description/Explanation

`printGuide()` will print the program guide

mathlib.c

arcSin(x)

Description/Explanation

`arcSin(x)` will compute an approximation for $\sin^{-1}(x)$ at x using a Taylor series.

Pseudocode

If `(x < -0.75)`
    Use the first 6 terms of the Taylor series
    For `arcSin(Sqrt(1 - x²)) - PI / 2`
Else if `(x > 0.75)`
    Use the first 6 terms of the Taylor series
    For `PI / 2 - arcSin(Sqrt(1 - x²))`
Else
    Use the first 6 terms of the Taylor series
    For `arcSin(x)`

arcCos(x)

Description/Explanation

`arcCos(x)` will compute an approximation for $\cos^{-1}(x)$ at x using a Taylor series.

Pseudocode

Make use of `arcSin(x)` with an identity
And return `(PI / 2 - arcSin(x))`

arcTan(x)

Description/Explanation

`arcTan(x)` will compute an approximation for $\tan^{-1}(x)$ at x using a Taylor series.

Pseudocode

Make use of `arcCos(x)` with an identity
And return `arcCos(1 / (x² + 1))`

Log(x)

Description/Explanation

`Log(x)` will compute an approximation for $\log(x)$ at x using Newton's method

Pseudocode

Use newton's method
(I ran out of time (which is frustrating) so `Log(x)` *simply returns* `42` *— Life, the Universe and Everything)*