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CSE 13S - Winter 2021
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Assignment 2 Design - A Small Numerical Library

Description:
This program implements functions that have been written for arcsin, arccos, arctan, and log and creates a small numerical library with these functions. Then, employing a test-harness, specific functions will be called to output with command-line options.

Files

mathlib-test.c: This file contains the main program that uses command-line options to print out the result from different math functions.
mathlib.c: This file contains all the implementations of math functions: arcsin, arccos, arctan, and log

Initial Pseudocode:

mathlib-test.c
_____*optarg code*
-a: all functions
-s: arcsin function
-c: arccos function
-t: arctan function
-l: log function
if all
run all functions
if arcsin
call sin function from mathlib.c
if arccos
call cos function from mathlib.c
if arctan
call tan function from mathlib.c
if log
call log function from mathlib.c

mathlib.c:
double abs
returns the absolute value of a vale
double arcsin
returns the arcsin value of a given value
double arccos
returns the arccos value of a given value
double arctan

returns the arctan value of a given value

double log

returns the log value of a given function

Final Psuedocode:

mathlib.c

italicizes is helper functions

```
double Abs(double x) {
   if (x < 0) {
      x = x * -1
   }
   return x
}

double Sqrt(double x) {
   long double new = 1.0
   long double old = 0.0
   while (fabsl(new - old) > EPSILON) {
      old = new
      new = 0.5 * (new + x / new)
   }
   return new
}

double Pow(double x) {
   return (x * x)
}

double arcSin(double x) {
   double a = x;
   for (a = x; Abs(sin(x) - a) > EPSILON; x += 0) {
      double num = sin(x) - a;
      x -= num / cos(x)
   }
   return x
}
```

arcCos utilizes the following formula

$$\arccos(x) = \frac{\pi}{2} - \arcsin(x).$$

```
double arcCos(double x) {
   x = fmod(x, (M_PI))
   double mult = M_PI / 2
   return (mult - arcSin(x))
```

```
}
```

arcTan utilizes the following formula

$$\arctan(x) = \arcsin\left(\frac{x}{\sqrt{x^2+1}}\right) = \arccos\left(\frac{1}{\sqrt{x^2+1}}\right), \quad x > 0.$$

```
double arcTan(double x) {
   return arcSin(x / (Sqrt(Pow(x) + 1)))
}

double Exp(double x) {
   double previndiv = 1
   double currindiv = 1
   double sum = 1
   double k = 1
   double absValue = Abs(previndiv)
   while ((absValue) > EPSILON) {
      currindiv = x / k
      currindiv = currindiv * previndiv
      sum += currindiv
      previndiv = currindiv
      k += 1
      absValue = Abs(previndiv)
   }
   return sum;
}

double Log(double x) {
   double prevY = 1
   double currY = 1
   double p = Exp(prevY)
   double absValue = Abs(p - x)
   for (double i = 0; absValue > EPSILON; i++) {
      currY = x - p
      currY /= p
      currY += prevY
      p = Exp(currY)
      prevY = currY
      absValue = Abs(p - x)
   }
   return currY
}
```