

ASSIGNMENT 2 DESIGN DOCUMENT

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1 Goal

Write a simple math library containing functions to calculate PI, e, and square root. Additionally, write a test harness allowing a user to input command line options in order to run each library function. Include statistics for each function run, as well as comparisons to C's math.h library values.

2 Pseudocode

TEST HARNESS

- This is a main function using GETOPT: Allows the user to run and display the various math functions from the terminal
- Include mathlib.h (the header for the assignment math library), math.h (C's standard math library) and unistd.h (for getopt)
- Specify the command line options: "saebmrnh"
- using a switch statement, write cases for each option
- every option besides -h will toggle a variable to 1, corresponding to each function
- EX: if -e is input, etoggle = 1
- h instead displays a help message and returns 1 to terminate the program
- after the switch statement, check each the value of each toggle variable
- if a variable is set to 1 (meaning the option has been input into the terminal), run the corresponding math function and compare the returned value to C's math function's return

SQRT FUNCTION

- This function calculates the sqrt of a value (to a certain accuracy) and keeps track of the iterations the function takes to reach said accuracy
- accuracy is determined by EPSILON, which is a small value given to us
- uses a for loop
- exit condition is when the absolute value of the previous guess for the sqrt - the current guess is less than epsilon
- value = (value + number/value) / 2
- increments iteration value by 1 to keep track of iterations

E FUNCTION

- This function calculates value of e to a certain accuracy given by EPSILON, and also keeps track of iterations to reach said accuracy
- uses a for loop
- exit condition is when the absolute value of the previous guess for e - the current guess is \leq than epsilon
- value = (value + 1/f)
- f set to f* loop index
- f starts at 1
- increments iteration value by 1 to keep track of iterations

PI FUNCTION (EULER)

- calculates PI to a certain accuracy
- for loop
- val = val + 1/loop index * loop index

PI FUNCTION (VIETE)

- calculates PI to a certain accuracy
- for loop
- exit condition is when the difference between terms is \leq EPSILON
- create a value to represent the numerator of a fraction
- if its the first time running the loop, set the numerator value to sqrt(2)
- else, set the value to sqrt(2 + previous numerator value)
- multiply the final answer by numerator/2
- return the final answer once the loop terminates

PI FUNCTION (BBP)

- for loop
- exit condition is when the current term \leq EPSILON
- create a value to represent 1/16 to the power of the current loop iteration
- if its the first time running the loop, set the power to 1, since 1/16 to the power of 0 is one
- else, power = power * 1/16
- calculate the term of the bbp series, when k = the loop iteration, using the power value from before
- add this term to the final answer
- when the loop terminates, return the final answer

PI FUNCTION (MADHAVA)

- very similar to bbp, except using 1/-3 instead of 1/16, and a different equation for terms
- for loop
- exit condition is when the current term \leq EPSILON
- create a value to represent 1/-3 to the power of the current loop iteration
- if its the first time running the loop, set the power to 1, since 1/-3 to the power of 0 is one
- else, power = power * 1/-3
- calculate the term of the madhava series, when k = the loop iteration, using the power value from before
- add this term to the final answer
- when the loop terminates, return the final answer

MAKEFILE

- Compiles and formats all .c files
- compiles the test harness, and links it to the math library functions, allowing them to be used by the harness