Name:

Do your work in this directory:

/data/courses/ece\_1111/current/quizzes/qu\_05/lastname\_firstname/p01

and create a file named p01.cc that contains your main program. *Your executable must be named p01.exe.* You must use a make file and header file as we have done for all our C programs. Your implementation of the function below must be in a file *p01\_00.cc*. When I type “make clean”, all your object and executable files should be removed. When I type “make”, *p01.exe* should be created from *p01.cc* and *p01\_00.cc*.

If you use a code generation tool for this assignment, you will need to come to my office and explain each step in great detail. Code generation tools are going to solve this problem in a much more complicated way than is needed.

**Task:** Write a C program that integrates a sine function over the range *[x, y]*. Do this by iterating over this range in $9,999$ steps, evaluating the sine function for each step, and summing the result. Next, since it is well known that the integral of a sine function is a cosine, show that your result matches what you would get if you solved the problem analytically, and evaluated the result over the same interval. In other words, write a program that demonstrates that the integral of a sine function is a cosine.

Your program needs to use a function like this for the integration:

**float integrate\_sin(float x\_min, float x\_max);**

This function must be implemented in *p01\_00.cc*. The function must use 32-bit floats for all calculations.

Your interface should take a filename as an argument:

**p01.exe filename.txt x y**

The min and max values of the range *[x,y]* must be specified from the command line.

The output file, if successful, needs to show exactly this:

**the integral of a sinewave over one period = <xxxx.xxxx>**

**the theoretical value is: <xxxx.xxxx>**

**difference = <xxxx.xxxx>**

In this case, “<xxxx.xxxx>” means you print the actual calculated value using four decimal points (e.g., 1234.1234).

You must do the actual calculations in your code. You cannot simply print the expected results. Obviously, if all goes well, the difference will be close to zero, but not exactly zero.

Assuming you get the correct result, your code will be graded based on the simplicity and clarity of your solution. Solutions that provide overly complicated solutions will be penalized.

If you are rusty on integration, look here: *https://www.cuemath.com/calculus/integral-of-sin-x/*.