CST 357/457
Michael Ruth
Homework #5
Due: 11/29/23 (by midnight)

For this assignment, you will be writing five separate C programs. You will create a folder which contains all programs and requested documentation and then zip the folder for submission to blackboard. Please be sure to document your programs appropriately. You must rename the file using your last name followed by your first name followed by a dash followed by the assignment name (For instance, this is homework5, so I'd turn it in as RuthMichael-Homework5.zip)

For this homework, we'll create single-threaded and multi-threaded applications which recursively determines the frequency of the letters (A-Z) while ignoring case for a given directory. We'll create a few versions to consider the costs and benefits of using threads for the given operations. You'll need to add a timer to each of the following programs (Make sure you are timing the entire operation).

1. **(10%)** For the first system, do the given work without threads. You should use the file you are given to do this part of the assignment (You're simply given credit for adding the timer to this file).
2. **(15%)** For the second system, modify the program from 1 which creates a thread for each directory (don't forget to use locks, joins, and your timer appropriately)
3. **(15%)** For the third system, modify the program from 1 in which threads are based on one per alphabet letter (no locks are necessary, but you'll still need a timer and joins)
4. **(15%)** For the fourth system, modify the program from 1 which creates a thread for each file (don't forget to use locks, joins, and your timer appropriately)
5. **(15%)** For the fifth system, modify the program from 1 which creates a thread for each file and directory (don't forget to use locks, joins, and your timer appropriately)
6. **(30%)** Compare the results of the timing across all three systems and put your discussion of the results in the file "results.txt". You should run each program 10 times and each program should output the average time using nanosecond resolution of 1000 runs each. (IE, every time the program runs, it calculates the time taken in nanosecond resolution 1000 times and outputs the average time to a file named system1.txt for system one, system2.txt for system two and system3.txt for the third system and so on and we should run each of the 5 programs 10 times)

Note:

- If you don't turn in the file in the correct format, I will take **10 points** off the total score.
- If you don't name the files or methods correctly, I will take **10 points** off the total score.
- If you include an executable in your homework, I will take **10 points** off the total score.
- If you include an unnecessary artifact not asked for, I will take **10 points** off the total score.
- You SHOULD NOT need to use material learned outside this class. If you choose to do so, you will earn NO points on this homework.
- If someone else turns in your homework, you both get a zero whether or NOT you know each other.
- Do NOT try to do this last minute!