CS350 Assignment 1 Winter 2021

[50 Marks Total]

The purpose of this assignment is to familiarize yourself with threads and synchronization using a common multi-platform library called pthreads (POSIX Threads).

The experience you build using threads and synchronization with this assignment will help you in future assignments within OS/161, but it will also help you in the real-world.

You can find more information about pthreads here:
https://man7.org/linux/man-pages/man7/pthreads.7.html

Please do not add new files to your solution or use any other libraries. Do not use other parts of pthreads to solve these problems other than that which is indicated below.

Question 1:

[30 Marks Total]

Suppose we have a large library filled with articles. We want to know how many times a specific word occurs in the entirety of that library. For example, perhaps we want to know how many times the word “the” occurs on Wikipedia.

Download the starter code in **a1q1.zip**.

The provided code in main.c generates a Library of Articles containing words according to the parameters provided. After creating the Library, it calls CountOccurrences (found in map.c), to determine how many times the specified word (parameter) are found in the Library. The count is output to the screen along with the runtime of the function.

Implement CountOccurrences using threads, and locks (pthread_mutext_t) and condition variables (pthread_cond_t) to create a barrier and protect shared variables. You may add whatever you like to map.c, but you cannot modify the signature of CountOccurences or any other files.

Submission

In the directory for a1q1, use the following command to submit your assignment:

cs350_submit 1q1

Grading Comments

- you need to use at least two threads to receive marks for this question
- due to the simple nature of the task, it is possible that your multi-threaded solution is slower than a single-threaded one

- your solution should not contain any extra or spurious output other than that which is already present in the provided code

Question 2:

[20 Marks Total]

Suppose we have some producing and consuming threads that interact with a resource. We want to synchronize the behaviour of these threads such that the number of consumers permitted into the critical section is always less than or equal to the k times the number of producers, where k is some integer (referred to in our code as the ratio).

For example, if there are currently 5 producers and k = 1, then the maximum number of consumers is 5.

Download the starter code in **a1q2.zip.**

Using the condition variables and mutexes provided, complete the four functions for producers and consumers entering and exiting such that the number of consumers is always less than or equal to k (ratio) times the number of producers.

Your solution should have no output.

Submission

In the directory for a1q2, use the following command to submit your assignment:

cs350_submit 1q2