**Individual Assignment 1 (15%)**

CSE 4600 (Section #) – Operating Systems – Fall 2021

Submitted to

Department of Computer Science and Engineering

California State University, San Bernardino, California

by

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*No copy and paste from other colleagues with the same answers and description (particularly in part 1) is allowed. It is required that you carry out the exercises by yourself (with the possibility for collaborating with other colleagues) and provide descriptions (with screenshots wherever necessary) based on your own experience. Copied material from other colleagues will be considered as cheating and dealt with seriously through University academic integrity policies.*

Email: CSUSB Email

1. **(8%) Write a C/C++ program that takes an input (array) from 1 to n (say n = 50) and displays the string representations of those numbers with following conditions**

**If the current number is divisible by 2, then print CSU**

**If the current number is divisible by 5, then print SB**

**If the current number is divisible by both 2 and 5, then print CSUSB**

**If the number is neither divisible by 2 nor 5, then print the number**

**Example:** 1 CSU 3 CSU SB CSU 7 CSU 9 CSUSB 11 CSU 13 CSU SB CSU 17 CSU 19 CSUSB …

**Tasks to do:**

1. (4%) Implement the solution using a single thread (i.e., without using threads and only a main function with any other possible helper function for ease) with all the above conditions implemented in the correct order so that the results are correct. Reason about what can cause the algorithm to print unwanted results (think about the order in which you will write the above conditions). Provide your reasoning about the correct order and the result using single threaded application.
2. (4%) Implement a synchronized multithreaded version of CSUSB with four threads. The same instance of CSUSB (array of 1 to 50) will be passed to four different threads:

* Thread 1 should call csu() to check if divisible by 2 then print CSU.
* Thread 2 should call sb() to check if divisible by 5 then print SB.
* Thread 3 should call csusb() to check if divisible by 2 and 5 then output CSUSB.
* Thread 4 should call number() which should only print the numbers.

Submit your code for both parts as separate files (C, Java or CPP) and submit your reasoning on your results (MS word document) that should include brief descriptions of both parts. For multithreaded part, please include your reasoning on the code portion where synchronization is implemented and why. For help, please refer to the lectures and codes where we implemented Dining philosophers, and readers and writers problems using semaphores and pthread\_cond\_wait variables. You are given the choice between semaphores and pthread conditional wait variables whichever seems easier or convenient to you.

**Note:** *Copy and paste of the solutions from other colleagues or online without any reasoning will be automatically marked 0.* While this is an open book assignment and you can search for help online, copying and pasting solutions from online sources with only the variable names changed is strictly prohibited. Please note that the exact copies of your code from either your colleagues or online solutions will automatically be capped to only 50% even if you provided your own explanation. You should clearly cite the references you used for help to avoid automatic 50% deduction and provide the screenshots of your program along with code files. You can use <https://repl.it> to write your program and get the results (screenshots).

1. **(7%) Write a multithreaded program using only Pthreads that uses several threads to multiply two matrices. The multiplication of matrix A with M rows and L columns, and a matrix B with L rows and N columns gives a resulting matrix C with M rows and N columns, and is given by the formula,**



**In matrix multiplication, each element *Cij* is the dot product of the ith row vector of A with the jth column vector of B. The program uses one thread to calculate a dot product.**

A =

Note: For help, please watch the bulb video (Matrix multiplication using threads) in Week 10 folder that explains the above problem in detail and provides partial solution in SDL thread library.

**What to submit?**

Submit your code (C/C++ file) that either asks for matrix input via the command line or has hard coded matrix values as above (i.e. matrices A and B) in the program which should then run multiple threads using pthread library for each row of A and each column of B. Submit a one paragraph explanation of your edited code as asked above with a screenshot of the result (that should precisely display the Result matrix as given above).

Text

Description automatically generated

Text

Description automatically generated

A screenshot of a computer

Description automatically generated with medium confidence

The code uses the pthread to multiply two set matrices, using a for loop creating multiple threads for each row and colum to multiply the numbers from the set matrices in global space. to get a results and strored them into a new 2d array with the results.