CS 558: Computer Systems Lab Assignment
Deadline: 11:59 pm, 06 February 2022

Instructions:

- This assignment is to be done in groups. Continue with the same group partner you had for the last assignment.
- The programs can be written in C/C++/Java.
- Your code should have a readme file, a makefile, and it should be well commented. These will carry separate marks for each question.
- No extensions in submission are allowed. Delay in submission will lead to penalty in marks.
- Assignments submitted before the deadline will only be considered for evaluation.
- Please do not email your assignments separately to the TAs, it will not be considered for evaluation.
- Your code will be checked for plagiarism. Any kind of academic dishonesty, plagiarism, etc. will lead to penalties.
- No sharing of code between students, submission of downloaded code is allowed.
- The first instance of code copying will result in ZERO marks for the assignment.
- The second instance of code copying will result in a `F' grade. Students may also be reported to the Students Disciplinary Committee, which can impose additional penalties.

1. In the campus of IIT Guwahati, a new restaurant is established. The chef at this restaurant has a very unique way to prepare the dishes for his customer.   (30 marks)

- The chef starts preparing the dish as soon as an order arrives.
- The chef first prepares the dish, which requires the smallest amount of time to prepare among all the available orders.
- If during the preparation of a dish, another order arrives with less preparation time, the chef stops the preparation of the current order and starts preparing the recently arrived order.
- The preparation of the dish that was stopped earlier in between, can be continued from that exact moment where it was stopped.
- Once, the preparation of a dish is completed, it is served to the customer and the chef starts the preparation of other available orders based on the above rules.

You need to simulate the above scenario and print a Gantt chart representing the sequence of preparation of the orders and the average waiting time for the dishes till they were prepared.

There are the following conditions:

- If two orders take the same time to complete, the chef chooses to prepare the order which arrived earlier.

- Every order has a unique Order Id.
- If two orders take the same time to complete and also arrived at the same time, then the order with a lower-order Id is chosen to prepare.

The arrival time for 10 orders is given in the text file "arrival.txt". Each line of the file consists of space-separated integers, that represent the arrival time of orders sorted by their order Id (p0 to p9). Time taken to prepare the dish for any order is a random number (system generated) between (1-8) minutes.

2. A Person named Shubham will be having his marriage on February 15, 2022. So, all of his friends decided to give him a single wedding card that will contain formal wedding wishes written by all of his friends. Suppose there are n friends of Shubham. The wedding card is kept in a commonplace, where any friend can go to write on that card or read from the card what others have written.   (30 marks)

All of the n friends have been assigned a 3 digit unique coupon number. The person having the lowest value of coupon number is given the highest priority to access (read or write) the card first. Therefore, the order in which the friends will get access to the card depends on their assigned coupon number. Only one friend is allowed to write on that card at a given time i.e. no other friend is allowed to read or write when someone else is writing on it. In addition to this, any number of friends can read from the card at the same time but no other person is allowed to write on that card when others are reading from it.

Write a C /C++/JAVA code to implement the above scenario where two functions need to be written - write_to_card() and read_from_card() using Semaphores. Take n as input denoting the number of friends who can access the card. Also, take 3 digits unique coupon number input for each individual with a variable named c. The coupon numbers should be unique 3 digit positive integers.

   i.   One semaphore will be used that will take care of the order in which the card will be accessed by the friends. The semaphore will be taken by any friend that will request access to the card based on his coupon number and is released as soon as this friend gains access to that card.

   ii. One more Semaphore will be used by any friend to request access to the card for writing on it.

   iii. Another Semaphore will be used by any friend who wants to request access to the card for reading from it.

   iv. Another variable named no_of_friends_reading must be declared to keep track of the number of friends currently reading the card. Unless this value becomes 0, no one else can write on that card.

3. Lauriat, a very exclusive IITG restaurant, would like to accommodate 'n' dinner parties, P0 through Pn, in one evening. The restaurant has a total of 'm' items (plate, bowl, cutlery etc.)

and total available quantity of each item at the restaurant is given in the input file. Due to observance of proper etiquette, each group of diners will stop eating and wait for the waiter to bring a requested item (plate, bowl, cutlery etc.) to the table when it is required. The maximum claim and current allocation of each items to all the 'n' dinner parties is also provided in the input file. Once all the items were available to any party it will finish off and all the items allocated to it will be available to be given for other parties.

Write a program to find if there exists a sequence in which the items available at the restaurant at any instance of time should be allocated so that all the parties can be accommodated successfully. If there exist a sequence then simulate the whole scenario of allocating the items using multithreading by creating a thread for each of the n parties.

You need to read the input from the input file and print the output in output file.

Input file:
- First line of input file contains value of 'n' and 'm' separated by space.
- Second line contains 'm' space separated integers denoting the total quantity of each of the 'm' items available at restaurant.
- Next **n** lines, each contains **m** space separated integers denoting current allocation of each items to all the 'n' dinner parties.
- Next **n** lines, each contains **m** space separated integers denoting maximum number of items required to all the 'n' dinner parties.

Output file:
- In the output file first you need to print the safe sequence if exist. After that for each party thread running you need to print currently allocated and needed item values for that party. Also you need to print available quantity of each items before and after the request for allocating the items to that thread is served.   (30 marks)