OPERATING SYSTEM – LABORATORY 5: SYNCHRONIZATION – THE BARBER SHOP

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The barber shop problem says that a barber shop has N1 barbers for man hair, N2 barbers for woman hair, N3 barbers for both and there are M chairs in the waiting room. Assuming that there is N0 number of customer arrivals, they take a seat on the waiting room and wake up the corresponding barbers for getting a haircut.

The solution for the barber shop problem includes eight semaphores. The first one is semaphore for customer which will count the number of customer arrivals. The three next semaphores define whether barber (barber for man, barber for woman and barber for both) is idle or is working. The three next semaphores are used for checking the number of available barbers for each type of barber, that will make customer wake up the right barber. The last one is mutex, which is used for mutually exclusive access.

To simulate the barber shop problem, from the beginning of the program, the main process will start (N1+N2+N3) copies of Barber thread and N0 copies of Customer thread.

In the barber thread, when the barber shop open, the barbers joins the shop, go to sleep and waits for the customer.

When the customer arrives, the customer will execute the Customer thread, he/she acquires the mutex for entering the critical region, if another customer tries to enter, the second one will not be able to do anything until the first one release the mutex. After that, the customer checks the chair in the waiting room, if there is no free chair then he/she leaves the shop. If there is a free chair, the customer will take a seat. The customer will take the seat in order, whoever comes first will sit in a smaller numbered seat and they will be served first. After take a seat on the waiting room, the customer will release the mutex to allow the next customer to take the next free seat, and then, he/she will signal the corresponding barber that there is a customer waiting, and this customer will waiting for the barber responding. At this time, the customer will lock mutex to protect the seat changes.

In the barber thread, the barber will choose the first customer in queue to serve. The thread will release the mutex, call a customer and decrease the number of available customers by 1. When the haircut is done, the barber thread will increase the number of available customers by 1. If there is no corresponding customer in the waiting room, the barber will go to sleep and waiting for the next customer.

The program uses an array to exchange the ID between barber and customer, each element of this array will store the ID of customer, the barber will access this array from the first one to serve firstly.
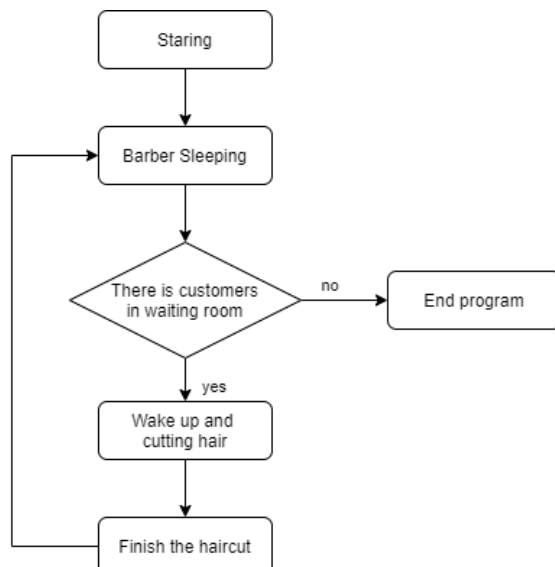
The program will run until N0 customer is served.

The flow chart for Customer thread and Barber thread:

Customer thread
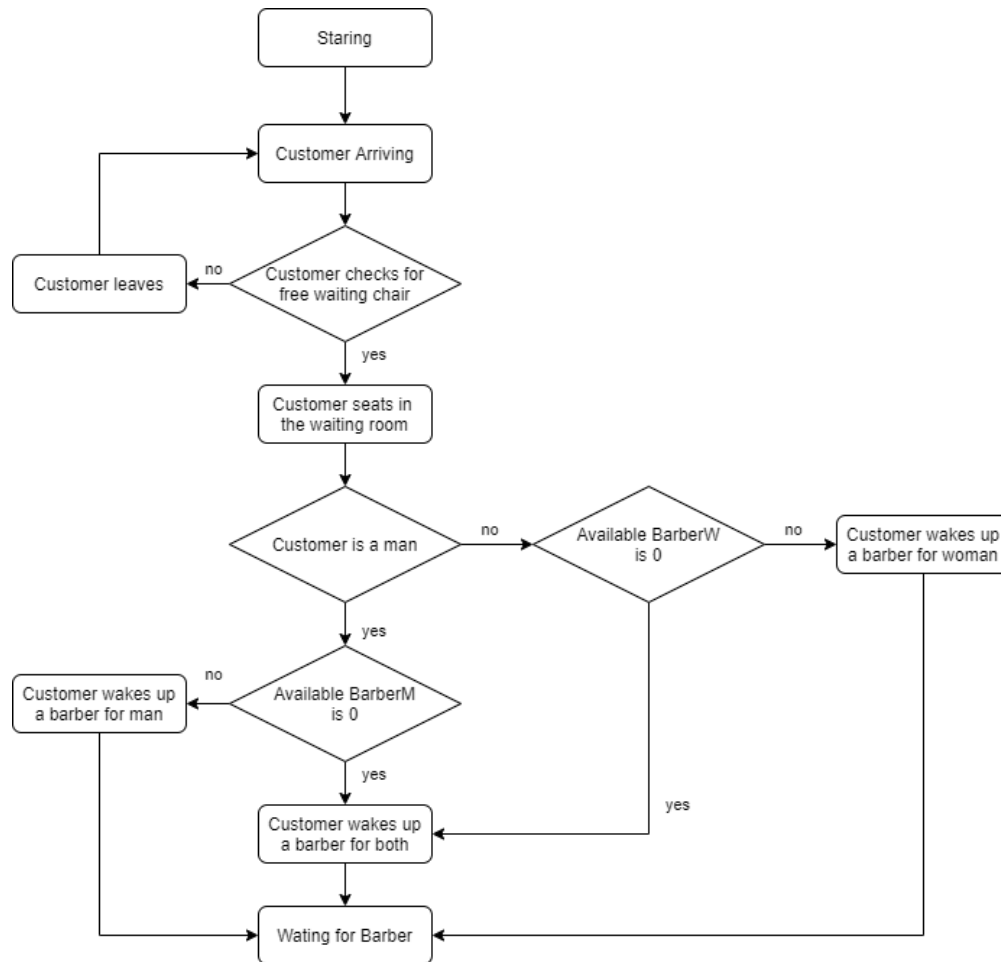
Barber Thread

The result of program when:

Number of Barbers for Man is 3, for Woman is 1 and for Both is 2. Maximum customer is 5 and number of chairs in waiting room is 5.

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!!-----------Barber Shop Opens-----------!!
Barber(M)[0]: Joins Shop. Barber(M)[0]: Gone To Sleep.
Barber(M)[1]: Joins Shop. Barber(M)[1]: Gone To Sleep.
Barber(M)[2]: Joins Shop. Barber(M)[2]: Gone To Sleep.
Barber(W)[0]: Joins Shop. Barber(W)[0]: Gone To Sleep.
Barber(B)[0]: Joins Shop. Barber(B)[0]: Gone To Sleep.
Barber(B)[1]: Joins Shop. Barber(B)[1]: Gone To Sleep.
Customer[1]: Entered Shop. Customer is a man. Customer[1]: Sits In Waiting Room.
Barber(M)[0]: Wakes Up & Is Cutting Hair Of Customer[1].
Customer[2]: Entered Shop. Customer is a woman. Customer[2]: Sits In Waiting Room.
Barber(W)[0]: Wakes Up & Is Cutting Hair Of Customer[2].
Customer[3]: Entered Shop. Customer is a woman. Customer[3]: Sits In Waiting Room.
Barber(B)[0]: Wakes Up & Is Cutting Hair Of Customer[3].
Customer[4]: Entered Shop. Customer is a woman. Customer[4]: Sits In Waiting Room.
Barber(B)[1]: Wakes Up & Is Cutting Hair Of Customer[4].
Customer[5]: Entered Shop. Customer is a woman. Customer[5]: Sits In Waiting Room.
Barber(M)[0]: Finishes. Barber(M)[0]: Gone To Sleep.
Barber(W)[0]: Finishes. Barber(W)[0]: Gone To Sleep.
Customer[6]: Entered Shop. Customer is a man. Customer[6]: Sits In Waiting Room.
Barber(M)[1]: Wakes Up & Is Cutting Hair Of Customer[5].
Customer[7]: Entered Shop. Customer is a man. Customer[7]: Sits In Waiting Room.
Barber(M)[2]: Wakes Up & Is Cutting Hair Of Customer[6].
Customer[8]: Entered Shop. Customer is a woman. Customer[8]: Sits In Waiting Room.
Barber(W)[0]: Wakes Up & Is Cutting Hair Of Customer[7].
Customer[9]: Entered Shop. Customer is a woman. Customer[9]: Sits In Waiting Room.
Customer[10]: Entered Shop. Customer is a woman. Customer[10]: Sits In Waiting Room.
Barber(B)[0]: Finishes. Barber(B)[0]: Gone To Sleep.
Barber(B)[0]: Wakes Up & Is Cutting Hair Of Customer[8].
Barber(B)[1]: Finishes. Barber(B)[1]: Gone To Sleep.
Barber(B)[1]: Wakes Up & Is Cutting Hair Of Customer[9].
Barber(M)[1]: Finishes. Barber(M)[1]: Gone To Sleep.
Barber(M)[2]: Finishes. Barber(M)[2]: Gone To Sleep.
Barber(W)[0]: Finishes. Barber(W)[0]: Gone To Sleep.
Barber(B)[0]: Finishes. Barber(B)[0]: Gone To Sleep.
Barber(B)[0]: Wakes Up & Is Cutting Hair Of Customer[10].
!!-----------Barber Shop Closes-----------!!
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