INDIAN INSTITUTE OF TECHNOLOGY KHARAGPUR

OPERATING SYSTEMS LABORATORY

Assignment-5

Usage of Semaphores to synchronize between threads

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1 Design for the three threads

1.1 Main thread :

The main thread takes in the input variable, performs a check on them, and then instantiates the room data structure, which is an array of structures with numerous fields in them to mark the current state of the room. It then creates guest and staff threads.

1.2 Guest thread :

The guest threads first take up a priority according to the scheme mentioned in the question and then sleeps for some time. It then wakes up and requests for the room. If room is available, it gets it and sleeps, else it either sleeps for a room to get empty or knocks out a low priority guest and then sleeps. After completion of the stay, it again repeates the cycle.

1.3 Staff thread :

The staff threads come into action when all the rooms have had 2 guests in them. As soon as all the rooms get 2 guests, the staffs arrive for cleaning and then chooses the room for cleaning. If a guest is in the room already, then the guest is removed and it again repeats its cycle of sleeping and requesting for room. Staff thread then sleeps for (time the room has been used for)/3 seconds and the again repeates this process until all the rooms are cleaned. The guests are kept waiting until all the rooms are cleaned.
*time the room has been used for :- This is the sum of stay times of the previous guests in the room since the last time the room was cleaned.

2 Data Structures used for various purposes

2.1 Room Information

We have used an array for this purpose as it makes iterating and random access of a room very easy. It is an array of structures with numerous fields in them to mark the current state of the room.

2.2 Removing low priority Guest

Once a guest is assigned a room, we push the pair of guest priority and its alloted room number into the set. We only push those rooms which have previous guests ¡ 2 so that the cleaning criteria is satisfied. Using this set, we can get the guest with the least priority in the hotel to be replaced. Once replaced, this pair is removed from the set and the new guest is pushed. Also, the pair of guest leaving the hotel is also removed from the set to ensure validity of data in the set.

3 Usage of Semaphores in the assignment

We have used 3 semaphores in the assignment, namely

- num_availabe_rooms,
- invoke_cleaner_thread,
- staff_room_cleaning_over.

num_availabe_rooms is used to ensure that only limited guests enter the hotel for room allocation. If rooms is not available and it can not remove any guest, the guest has to wait on sema_wait of this semaphore.

invoke_cleaner_thread is used to start the cleaner threads once all the rooms have been used for 2 times. ALl the cleaner threads wait on sema_wait of this semaphore and they come into action only when all the rooms are used and sema_post is begin called.

staff_room_cleaning_over is used to stop the cleaner threads once all the rooms are cleaned and start allocating rooms to the waiting guest threads.