# NTNU
Kunnskap for en bedre verden

## Department of Computer Science

## TDT4186 - Operating System

# Practical Assignment

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# Implementation explanation

## Clock

Clock has not been changed from skeleton code.

## Customer

A customer is initiated with a CustomerID. The customer has a method for ordering. This method randomly generates an amount of orders, both takeaway and served. The customer sits down and eats for a while, putting the thread to sleep, but still maintaining control of the monitor.

## Door

The door is assigned a waiting area on initiation and creates into this area customers on a random interval up to the set limit.

## SushiBar

In SushiBar all aspects of the sushibar is initiated in the appropriate order. Then we wait for all threads to terminate before we print the statistics.

## SynchronizedInteger

The only alteration i have made is adding a return statement to the increment and decrement methods. This was necessary for assigning customerID efficiently.

## Waitress

Waitresses handle the longest waiting customer and after waiting a period, allows them to order, calling the order method of the customer. The wait time is the thread set to sleep for a set time.

## WaitingArea

The waiting area has a given size, an occupancy and a queue to manage the customer line, so that waitresses handle the longest waiting customer. If the room is full, the wait method is called on the thread. If not, the customer is added and the method notifies all threads that the monitor is available. The next() method gets the next person in line, if there are any and updates the line. The other threads are then notified.

# Assignment Questions

## Wait()

Wait causes the thread to wait until another thread notifies of change. Whilst it is waiting it releases its lock on the ownership of the monitor. therefore, when awoken, it must wait until it can reclaim ownership of the monitor to continue execution.

## Notify()

A call to notify() wakes a single arbitrary thread from the ones which are waiting for the monitor. It is woken from its wait cycle and can then make an attempt at aquiring ownership of the monitor.

## NotifyAll()

A call to notifyAll() wakes every thread which are waiting for the monitor. They are woken from their wait cycle and can then make an attempt at aquiring ownership of the monitor. They will compete in the same manner as usual.

## Difference between notify() and notifyAll()

Both these wakes threads which are waiting for availability of the monitor. The difference lies in wether only one thread should be awoken or wether all threads.

## Shared Variables

servedOrders, takeawayOrders, totalOrders, customerIdTeller are all shared synchronized variables and have special methods to manage and modify them.

We also have maxOrder, waitressWait, customerWait and doorWait. These are used widely but are never monified.

The last one is isOpen, which is a variable only modified by the clock.

## Final Statistics

The final statistics are reported by the main function which waits for all the threads of the waitresses to finish before reporting. Therefore it knows that all customers are finished and left before it colses and reports statistics. Final statistics can be found at the end of the Program Output.

# Program Ouput

```
17:16:31:932 , Door Thread : Customer 1 is now created .
17:16:31:933 , Door Thread : Customer 1 is now waiting .
17:16:31:934 , Thread −7: Customer 1 is now fetched .
17:16:32:01 , Thread −7: Customer 1 is now eating .
17:16:32:32 , Door Thread : Customer 2 is now created .
17:16:32:34 , Door Thread : Customer 2 is now waiting .
17:16:32:37 , Thread −1: Customer 2 is now fetched .
17:16:32:39 , Door Thread : Customer 3 is now created .
17:16:32:39 , Door Thread : Customer 3 is now waiting .
17:16:32:40 , Thread −6: Customer 3 is now fetched .
17:16:32:71 , Door Thread : Customer 4 is now created .
17:16:32:72 , Door Thread : Customer 4 is now waiting .
17:16:32:74 , Thread −2: Customer 4 is now fetched .
17:16:32:98 , Thread −1: Customer 2 is now eating .
17:16:32:101 , Thread −6: Customer 3 is now eating .
17:16:32:136 , Thread −2: Customer 4 is now leaving .
17:16:32:182 , Door Thread : Customer 5 is now created .
17:16:32:183 , Door Thread : Customer 5 is now waiting .
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17:16:32:183 , Thread−2: Customer 5 is now fetched.
17:16:32:202 , Door Thread: Customer 6 is now created.
17:16:32:204 , Door Thread: Customer 6 is now waiting.
17:16:32:205 , Thread−3: Customer 6 is now fetched.
17:16:32:248 , Thread−2: Customer 5 is now eating.
17:16:32:266 , Thread−3: Customer 6 is now leaving.
17:16:32:320 , Door Thread: Customer 7 is now created.
17:16:32:321 , Door Thread: Customer 7 is now waiting.
17:16:32:321 , Thread−3: Customer 7 is now fetched.
17:16:32:331 , Door Thread: Customer 8 is now created.
17:16:32:331 , Door Thread: Customer 8 is now waiting.
17:16:32:332 , Thread−4: Customer 8 is now fetched.
17:16:32:382 , Thread−3: Customer 7 is now eating.
17:16:32:398 , Thread−4: Customer 8 is now eating.
17:16:32:430 , Door Thread: Customer 9 is now created.
17:16:32:431 , Door Thread: Customer 9 is now waiting.
17:16:32:431 , Thread−5: Customer 9 is now fetched.
17:16:32:493 , Thread−5: Customer 9 is now leaving.
17:16:32:515 , Door Thread: Customer 10 is now created.
17:16:32:517 , Door Thread: Customer 10 is now waiting.
17:16:32:518 , Thread−5: Customer 10 is now fetched.
17:16:32:562 , Door Thread: Customer 11 is now created.
17:16:32:563 , Door Thread: Customer 11 is now waiting.
17:16:32:582 , Thread−5: Customer 10 is now eating.
17:16:32:599 , Door Thread: Customer 12 is now created.
17:16:32:599 , Door Thread: Customer 12 is now waiting.
17:16:32:643 , Door Thread: Customer 13 is now created.
17:16:32:643 , Door Thread: Customer 13 is now waiting.
17:16:32:645 , Door Thread: Customer 14 is now created.
17:16:32:645 , Door Thread: Customer 14 is now waiting.
17:16:32:754 , Door Thread: Customer 15 is now created.
17:16:32:756 , Door Thread: Customer 15 is now waiting.
17:16:32:793 , Door Thread: Customer 16 is now created.
17:16:32:793 , Door Thread: Customer 16 is now waiting.
17:16:32:832 , Door Thread: Customer 17 is now created.
17:16:32:833 , Door Thread: Customer 17 is now waiting.
17:16:32:952 , Door Thread: Customer 18 is now created.
17:16:32:953 , Door Thread: Customer 18 is now waiting.
17:16:33:51 , Door Thread: Customer 19 is now created.
17:16:33:53 , Door Thread: Customer 19 is now waiting.
17:16:33:118 , Door Thread: Customer 20 is now created.
17:16:33:120 , Door Thread: Customer 20 is now waiting.
17:16:33:235 , Door Thread: Customer 21 is now created.
17:16:33:236 , Door Thread: Customer 21 is now waiting.
17:16:33:315 , Door Thread: Customer 22 is now created.
17:16:33:315 , Door Thread: Customer 22 is now waiting.
17:16:33:365 , Door Thread: Customer 23 is now created.
17:16:33:366 , Door Thread: Customer 23 is now waiting.
17:16:33:406 , Door Thread: Customer 24 is now created.
17:16:33:406 , Door Thread: Customer 24 is now waiting.
17:16:33:495 , Door Thread: Customer 25 is now created.
17:16:33:497 , Door Thread: Customer 25 is now waiting.
17:16:33:531 , Door Thread: Customer 26 is now created.
17:16:33:532 , Door Thread: Customer 26 is now waiting.
17:16:33:583 , Door Thread: Customer 27 is now created.
17:16:33:584 , Door Thread: Customer 27 is now waiting.
17:16:33:694 , Door Thread: Customer 28 is now created.
17:16:33:696 , Door Thread: Customer 28 is now waiting.
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17:16:33:799 , Door Thread : Customer 29 is now created .
17:16:33:801 , Door Thread : Customer 29 is now waiting .
17:16:33:816 , Door Thread : Customer 30 is now created .
17:16:33:817 , Door Thread : Customer 30 is now waiting .
17:16:33:833 , Door Thread : Customer 31 is now created .
17:16:37:108 , Thread−6: Customer 3 is now leaving .
17:16:37:109 , Thread−6: Customer 11 is now fetched .
17:16:37:111 , Door Thread : Customer 31 is now waiting .
17:16:37:111 , ***** DOOR CLOSED *****
17:16:37:172 , Thread−6: Customer 11 is now eating .
17:16:37:386 , Thread−3: Customer 7 is now leaving .
17:16:37:386 , Thread−3: Customer 12 is now fetched .
17:16:37:451 , Thread−3: Customer 12 is now eating .
17:16:39:676 , Thread−6: Customer 11 is now leaving .
17:16:39:677 , Thread−6: Customer 13 is now fetched .
17:16:39:743 , Thread−6: Customer 13 is now eating .
17:16:39:902 , Thread−4: Customer 8 is now leaving .
17:16:39:904 , Thread−4: Customer 14 is now fetched .
17:16:39:968 , Thread−4: Customer 14 is now leaving .
17:16:39:968 , Thread−4: Customer 15 is now fetched .
17:16:40:34 , Thread−4: Customer 15 is now eating .
17:16:42:02 , Thread−7: Customer 1 is now leaving .
17:16:42:04 , Thread−7: Customer 16 is now fetched .
17:16:42:70 , Thread−7: Customer 16 is now leaving .
17:16:42:70 , Thread−7: Customer 17 is now fetched .
17:16:42:104 , Thread−1: Customer 2 is now leaving .
17:16:42:105 , Thread−1: Customer 18 is now fetched .
17:16:42:135 , Thread−7: Customer 17 is now eating .
17:16:42:171 , Thread−1: Customer 18 is now eating .
17:16:42:454 , Thread−3: Customer 12 is now leaving .
17:16:42:456 , Thread−3: Customer 19 is now fetched .
17:16:42:518 , Thread−3: Customer 19 is now leaving .
17:16:42:518 , Thread−3: Customer 20 is now fetched .
17:16:42:584 , Thread−3: Customer 20 is now leaving .
17:16:42:584 , Thread−3: Customer 21 is now fetched .
17:16:42:645 , Thread−3: Customer 21 is now eating .
17:16:44:641 , Thread−7: Customer 17 is now leaving .
17:16:44:643 , Thread−7: Customer 22 is now fetched .
17:16:44:709 , Thread−7: Customer 22 is now eating .
17:16:45:83 , Thread−5: Customer 10 is now leaving .
17:16:45:85 , Thread−5: Customer 23 is now fetched .
17:16:45:146 , Thread−5: Customer 23 is now leaving .
17:16:45:147 , Thread−5: Customer 24 is now fetched .
17:16:45:209 , Thread−5: Customer 24 is now eating .
17:16:49:745 , Thread−6: Customer 13 is now leaving .
17:16:49:747 , Thread−6: Customer 25 is now fetched .
17:16:49:810 , Thread−6: Customer 25 is now eating .
17:16:52:254 , Thread−2: Customer 5 is now leaving .
17:16:52:255 , Thread−2: Customer 26 is now fetched .
17:16:52:320 , Thread−2: Customer 26 is now eating .
17:16:52:538 , Thread−4: Customer 15 is now leaving .
17:16:52:540 , Thread−4: Customer 27 is now fetched .
17:16:52:604 , Thread−4: Customer 27 is now eating .
17:16:55:212 , Thread−5: Customer 24 is now leaving .
17:16:55:212 , Thread−5: Customer 28 is now fetched .
17:16:55:278 , Thread−5: Customer 28 is now eating .
17:16:57:326 , Thread−2: Customer 26 is now leaving .
17:16:57:327 , Thread−2: Customer 29 is now fetched .
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17:16:57:389 ,  Thread−2: Customer  29  is  now  eating .
17:16:57:650 ,  Thread−3: Customer  21  is  now  leaving .
17:16:57:652 ,  Thread−3: Customer  30  is  now  fetched .
17:16:57:716 ,  Thread−3: Customer  30  is  now  eating .
17:17:00:222 ,  Thread−3: Customer  30  is  now  leaving .
17:17:00:224 ,  Thread−3: Customer  31  is  now  fetched .
17:17:00:279 ,  Thread−5: Customer  28  is  now  leaving .
17:17:00:285 ,  Thread−3: Customer  31  is  now  eating .
17:17:07:174 ,  Thread−1: Customer  18  is  now  leaving .
17:17:07:214 ,  Thread−7: Customer  22  is  now  leaving .
17:17:09:815 ,  Thread−6: Customer  25  is  now  leaving .
17:17:10:108 ,  Thread−4: Customer  27  is  now  leaving .
17:17:17:389 ,  Thread−2: Customer  29  is  now  leaving .
17:17:22:791 ,  Thread−3: Customer  31  is  now  leaving .
17:17:22:792 ,  ***** NO MORE CUSTOMERS − THE SHOP IS CLOSED NOW.  *****
17:17:22:793 ,  Total  number  of  orders :  258
17:17:22:793 ,  Total  number  of  takeaway  orders :  151
17:17:22:794 ,  Total  number  of  orders  that  customers  have  eaten  at  the  bar :  107
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