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CS4310.02 Operating System

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Summary:

I found the bathroom problem to be somewhat similar to the reader-writer problem, so my solution is basically the read-write algorithm modified to allow multiple writers and readers or in this case female and males albeit with other adjustments.

It works, however build times are off because my delay did not work properly.

How it Works:

To begin, the program asks which case you want to run, and based on that case, will generate the necessary threads with a weighted chance of getting a (60%) female or (40%) male threads. It will then run those threads. The program makes use of semaphores and mutexes to make sure that when a counter variable like maleCount is being updated correctly. As in, it is not altered more times than it should be. There is also a mutex used to close off access to using the bathroom to a person of a different gender once it is entered. I have two semaphores called maleLock and femaleLock with 3 permits each, meaning only a maximum of 3 people can be in the bathroom at the same time, and they must be of the same gender.

When running a thread of any gender, the run method of the thread will call three methods, arrive, usefacilties, and depart which I will breakdown how I implemented below.

The first method is Arrive() in which a thread has arrived. In this method, I immediately lock the mutex turnstile. This is to prevent starvation in cases where if a girl is waiting for the bathroom but a million guys decide to show up to use the bathroom while another guy is in there. Normally, she'd have to wait forever until the guys are done, but the mutex creates a barrier to prevent that. Then I acquire the mutex for whatever gender I'm working with, let's say femaleMutex and only then do I increment the femaleCounter variable. Then I release the mutex. This prevents the counter variable from being altered incorrectly. From here, if that was the first female that entered the bathroom, the program will acquire the bathroom mutex and lock it from other genders. Then we release all mutexes used and acquire the lock on the femaleLock as we will be calling useFacilities on it next.

UseFacilities simply prints out a debug message saying the thread is using the bathroom and it does so for five seconds.

Depart() is called once the person is done "using the restroom". Recall that the femaleLock semaphore was acquired at the end of Arrive() and now that the female is done using the bathroom, the algorithm releases the lock on that female. Now the femaleCount must be decremented, so once again we acquire the femaleMutex and decrement safely before releasing the mutex. If there are no longer

any females in the bathroom, then we will release the lock on the bathroom. It is basically the reverse of arrive.

The exact same process is used for the male threads.

Analyzing my Solution:

As shown by the output, it works as it should and does not lead to starvation. However there is one concerning result in that the build times are all very similar when they should in fact not be. I found that the delay I was causing was not actually working. I was unsure how to pause all threads and I tried calling "TimeUnit.SECONDS.sleep(10);" to pause the program for ten seconds. Apparently, this was not the solution and my program bulldozed past the delay, hence the similar build times.

Case 1:

run:

There are three cases to run, listed below...

1.) 5 : DELAY(10) : 5 : DELAY(10) : 5 : DELAY(10) : 5

2.)10 : DELAY(10) : 10

3.)20

Please enter 1, 2, or 3 to run the desired case...

1

Executing Case One

Male Generated

Male Generated

Male Generated

Female Generated

Male Generated

Male is USING BATHROOM

Male is USING BATHROOM

Male is USING BATHROOM

Forcing 10 second delay...

Male has FINISHED THEIR BUSINESS

Male has FINISHED THEIR BUSINESS

Male has FINISHED THEIR BUSINESS

Female is USING BATHROOM

Female has FINISHED THEIR BUSINESS

Male Generated

Male is USING BATHROOM

Male Generated

Male Generated

Female Generated

Male Generated

Male is USING BATHROOM

Forcing 10 second delay...

Male is USING BATHROOM

Male has FINISHED THEIR BUSINESS

Male has FINISHED THEIR BUSINESS

Male has FINISHED THEIR BUSINESS

Male is USING BATHROOM

Male Generated

Male Generated

Male Generated

Female Generated

Male Generated

Forcing 10 second delay...

Male has FINISHED THEIR BUSINESS

Female is USING BATHROOM

Female has FINISHED THEIR BUSINESS

Male is USING BATHROOM

Male is USING BATHROOM

Male is USING BATHROOM

Male Generated

Male Generated

Male Generated

Female Generated

Male Generated

Forcing 10 second delay...

Male has FINISHED THEIR BUSINESS

Male has FINISHED THEIR BUSINESS

Male has FINISHED THEIR BUSINESS

Male is USING BATHROOM

Male has FINISHED THEIR BUSINESS

Female is USING BATHROOM

Female has FINISHED THEIR BUSINESS

Male is USING BATHROOM

Male is USING BATHROOM

Male is USING BATHROOM

Male has FINISHED THEIR BUSINESS

Male has FINISHED THEIR BUSINESS

Male has FINISHED THEIR BUSINESS

Male is USING BATHROOM

Male has FINISHED THEIR BUSINESS

Female is USING BATHROOM

Female has FINISHED THEIR BUSINESS

Male is USING BATHROOM

Male has FINISHED THEIR BUSINESS

BUILD SUCCESSFUL (total time: 1 minute 1 second)

Case 2:

run:

There are three cases to run, listed below...

1.) 5 : DELAY(10) : 5 : DELAY(10) : 5 : DELAY(10) : 5

2.)10 : DELAY(10) : 10

3.)20

Please enter 1, 2, or 3 to run the desired case...

2

Executing Case Two

Male Generated

Male Generated

Male Generated

Female Generated

Male Generated

Male Generated

Female Generated

Male Generated

Female Generated

Female Generated

Male is USING BATHROOM

Male is USING BATHROOM

Male is USING BATHROOM

Forcing 10 second delay...

Male has FINISHED THEIR BUSINESS

Male has FINISHED THEIR BUSINESS

Male has FINISHED THEIR BUSINESS

Female is USING BATHROOM

Female has FINISHED THEIR BUSINESS

Male is USING BATHROOM

Male is USING BATHROOM

Male Generated

Male Generated

Male Generated

Female Generated

Male Generated

Male Generated

Female Generated

Male Generated

Female Generated

Female Generated

Forcing 10 second delay...

Male has FINISHED THEIR BUSINESS

Male has FINISHED THEIR BUSINESS

Female is USING BATHROOM

Female has FINISHED THEIR BUSINESS

Male is USING BATHROOM

Male has FINISHED THEIR BUSINESS

Female is USING BATHROOM

Female is USING BATHROOM

Female has FINISHED THEIR BUSINESS

Female has FINISHED THEIR BUSINESS

Male is USING BATHROOM

Male is USING BATHROOM

Male is USING BATHROOM

Male has FINISHED THEIR BUSINESS

Male has FINISHED THEIR BUSINESS

Male has FINISHED THEIR BUSINESS

Female is USING BATHROOM

Female has FINISHED THEIR BUSINESS

Male is USING BATHROOM

Male is USING BATHROOM

Male has FINISHED THEIR BUSINESS

Male has FINISHED THEIR BUSINESS

Female is USING BATHROOM

Female has FINISHED THEIR BUSINESS

Male is USING BATHROOM

Male has FINISHED THEIR BUSINESS

Female is USING BATHROOM

Female is USING BATHROOM

Female has FINISHED THEIR BUSINESS

Female has FINISHED THEIR BUSINESS

BUILD SUCCESSFUL (total time: 1 minute 2 seconds)

Case 3:

There are three cases to run, listed below...

1.) 5 : DELAY(10) : 5 : DELAY(10) : 5 : DELAY(10) : 5

2.)10 : DELAY(10) : 10

3.)20

Please enter 1, 2, or 3 to run the desired case...

3

Executing Case Three

Male Generated

Male Generated

Male Generated

Female Generated

Male Generated

Male Generated

Female Generated

Male Generated

Female Generated

Female Generated

Male Generated

Male Generated

Male Generated

Male Generated

Female Generated

Male Generated

Female Generated

Male Generated

Male Generated

Female Generated

Male is USING BATHROOM

Male is USING BATHROOM

Male is USING BATHROOM

Male has FINISHED THEIR BUSINESS

Male has FINISHED THEIR BUSINESS

Male has FINISHED THEIR BUSINESS

Female is USING BATHROOM

Female has FINISHED THEIR BUSINESS

Male is USING BATHROOM

Male is USING BATHROOM

Male has FINISHED THEIR BUSINESS

Male has FINISHED THEIR BUSINESS

Female is USING BATHROOM

Female has FINISHED THEIR BUSINESS

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Male has FINISHED THEIR BUSINESS

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Male has FINISHED THEIR BUSINESS

Male is USING BATHROOM

Male has FINISHED THEIR BUSINESS

Female is USING BATHROOM

Female has FINISHED THEIR BUSINESS

Male is USING BATHROOM

Male has FINISHED THEIR BUSINESS

Female is USING BATHROOM

Female has FINISHED THEIR BUSINESS

Male is USING BATHROOM

Male is USING BATHROOM

Male has FINISHED THEIR BUSINESS

Male has FINISHED THEIR BUSINESS

Female is USING BATHROOM

Female has FINISHED THEIR BUSINESS

BUILD SUCCESSFUL (total time: 1 minute 8 seconds)