COMP 304

Operating Systems

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Project 1
Global Pandemic

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What does this code simulate?

There are 8 different residents named “Resident 1-8”, an employee, and 3 stores in a neighborhood. This neighborhood is in lockdown period because of the pandemic, and people need to buy products, but only 3 residents can be in a single shop at just one time, and they can buy all the products if they have them in their shopping list. Residents walk the stores one by one to get all their products, they can buy different items from shop at the same time, but if they wanted to buy same item at the same time they need to wait each other, if they finished their first list they wait for a while and starts shopping again to complete their second list if they finished both its enough for them and they can’t go out again.

How does the code work?

The employee and each one of the residents are different threads, which means they can work together at the same time, to control them there are semaphores in the stores, which locks the stores and letting maximum three residents buy different items at the same time from the same shop. On each thread’s runner function, they know the thing that they can’t join a shop if there are less than 3 customers, in other words, threads in there.

The time on output is the counter of visitors in total time.

Five different structs used in the code they are productCategory, store, shoppingList, shoppingListItem, and person.

- The productCategory struct is for the product types, their current stock value, and max stock value in a shop.
- The store has a name, different product categories, total number of categories, and the number of its current visitors to check at most three-person situation.
- ShoppingListItem holds each category’s name that is in the shopping list, their amount to buy, and how much of them are currently bought by the resident to find how much left.
- ShoppingList holds the shopping list items and the number of different categories to prevent visiting all the shops with a control statement.
- Person struct holds the name, role like resident or employee, shopping list, completed lists because each person will complete two lists and a Boolean array named visited stores. It needs the Boolean array because it will check is the store visited, if all are visited it will restore all values to zero to visit them again.

Residents visit shops randomly at random times when they finished their first list they wait for a while after that they start their second lists and finish them, within the residents also, employee visits the shops and refills the stocks of these stores, that situation takes time too.

To buy items, each thread goes into buyItems method. This method checks each element of shopping list whether they in the current visited store or not, then if they are method checks whether it is the stocks enough, if it is not enough, buy rest of them, else, buy currently wanted amount. Also, each resident or employee locks the items if they are on them, with mutex locks. By the pthread_trylock method’s return value code understands if two customers wanted to buy the same item at the same time from the same shop if they wanted to buy the same item one of them can’t buy it and looks for the next item in his/her list.

Shortly there are semaphores to control the maximum three people in a shop situation, and there are mutex locks on each of the categories in each shop to control just one customer can buy from a category of a shop in a specific time situation.

How to run code?

This code is written by C programming language and it uses fcntl.h, unistd.h, errno.h, stdio.h, stdlib.h, pthread.h, string.h, semaphore.h, string.h libraries.

To run this code use “gcc filename.c -lpthread”, “./a.out” commands on UNIX command prompt.

Sample Output

At time t=0, Resident 6 wants to buy, 4 breads, 16 personal care products, 3 snacks from Store 2.
At time t=1, Resident 3 wants to buy, 8 cleaning products, 20 beverages, 1 breads from Store 1.
At time t=2, Resident 7 wants to buy, 10 diary products from Store 1.
At time t=3, Resident 1 wants to buy, 7 diary products, 16 breads from Store 3.
At time t=4, Employee 1 visits Store 3.
At time t=5, Employee 1 fills all counters at Store 3.
At time t=5, Resident 8 wants to buy, 17 diary products, 3 breads from Store 3.
At time t=6, Resident 6 buys 3 snacks from Store 2.
At time t=6, Resident 5 wants to buy, 3 personal care products from Store 2.
At time t=7, Resident 2 wants to buy, 7 diary products, 10 snacks from Store 1.
At time t=8, Resident 7 buys 10 diary products from Store 1.
At time t=8, Resident 4 wants to buy, 17 snacks, 9 personal care products from Store 2.
At time t=9, Resident 8 wants to buy, 17 diary products, 3 breads from Store 2.
At time t=9, Resident 5 wants to buy, 3 personal care products from Store 3.
At time t=9, Resident 2 buys 7 diary products from Store 1.
At time t=9, Resident 1 wants to buy, 7 diary products, 16 breads from Store 2.
At time t=9, Resident 6 wants to buy, 4 breads, 16 personal care products from Store 3.
At time t=13, Resident 3 buys 20 beverages, 1 breads from Store 1.
At time t=13, Resident 4 buys 12 snacks from Store 2.
At time t=13, Employee 1 visits Store 2.
At time t=13, Resident 5 buys 3 personal care products from Store 3.
At time t=13, Resident 2 wants to buy, 10 snacks from Store 2.
At time t=13, Resident 1 wants to buy, 7 diary products, 16 breads from Store 1.
At time t=14, Resident 6 wants to buy, 4 breads, 16 personal care products from Store 1.
At time t=16, Employee 1 fills all counters at Store 2.
At time t=16, Resident 4 wants to buy, 5 snacks, 9 personal care products from Store 3.
At time t=18, Resident 3 wants to buy, 8 cleaning products from Store 2.
At time t=19, Resident 8 wants to buy, 17 diary products, 3 breads from Store 1.
At time t=20, Resident 6 buys 4 breads from Store 1.
At time t=20, Resident 4 buys 7 personal care products from Store 3.
At time t=20, Resident 2 buys 10 snacks from Store 2.
At time t=20, Resident 8 buys 17 diary products from Store 1.
At time t=20, Resident 3 wants to buy, 8 cleaning products from Store 3.
At time t=21, Resident 4 wants to buy, 5 snacks, 2 personal care products from Store 1.
At time t=22, Resident 1 buys 7 diary products, 15 breads from Store 1.
At time t=22, Resident 7 wants to buy, 19 beverages from Store 2.
At time t=23, Employee 1 visits Store 1.
At time t=24, Employee 1 fills all counters at Store 1.

At time t=24, Resident 3 buys 8 cleaning products from Store 3.
At time t=24, Resident 7 buys 19 beverages from Store 2.
At time t=24, Resident 6 wants to buy, 16 personal care products from Store 1.
At time t=25, Employee 1 visits Store 3.
At time t=26, Employee 1 fills all counters at Store 3.
Resident 7 has completed the lists.
Exiting...
At time t=26, Resident 6 wants to buy, 16 personal care products from Store 3.
At time t=27, Resident 5 wants to buy, 11 frozen foods from Store 1.
At time t=28, Resident 2 wants to buy, 3 breads from Store 3.
At time t=29, Resident 6 buys 10 personal care products from Store 3.
At time t=29, Resident 1 wants to buy, 1 breads from Store 1.
At time t=30, Resident 8 wants to buy, 3 breads from Store 1.
At time t=31, Resident 2 wants to buy, 3 breads from Store 2.
At time t=32, Resident 5 wants to buy, 11 frozen foods from Store 3.
At time t=33, Employee 1 visits Store 2.
At time t=34, Employee 1 fills all counters at Store 2.
At time t=34, Resident 4 wants to buy, 5 snacks, 2 personal care products from Store 2.
At time t=35, Resident 1 buys 1 breads from Store 1.
At time t=35, Resident 6 wants to buy, 6 personal care products from Store 2.
At time t=35, Resident 5 wants to buy, 11 frozen foods from Store 2.
At time t=36, Employee 1 visits Store 1.
At time t=37, Employee 1 fills all counters at Store 1.
At time t=37, Resident 8 wants to buy, 3 breads from Store 2.
At time t=37, Resident 3 wants to buy, 19 personal care products from Store 1.
At time t=38, Resident 4 buys 5 snacks from Store 2.
At time t=39, Resident 2 wants to buy, 3 breads from Store 1.
At time t=40, Resident 3 wants to buy, 19 personal care products from Store 3.
At time t=41, Resident 5 buys 11 frozen foods from Store 2.
At time t=42, Resident 2 buys 3 breads from Store 1.
At time t=42, Employee 1 visits Store 3.
At time t=43, Employee 1 fills all counters at Store 3.
At time t=43, Resident 3 wants to buy, 19 personal care products from Store 2.
At time t=43, Resident 4 wants to buy, 2 personal care products from Store 3.
Resident 5 has completed the lists.
Exiting...
At time t=45, Resident 8 wants to buy, 3 breads from Store 3.
Resident 2 has completed the lists.
Exiting...
At time t=46, Resident 4 buys 2 personal care products from Store 3.
At time t=46, Employee 1 visits Store 2.
At time t=47, Employee 1 fills all counters at Store 2.
At time t=47, Employee 1 visits Store 1.
At time t=48, Employee 1 fills all counters at Store 1.
At time t=48, Resident 3 wants to buy, 19 personal care products from Store 1.
At time t=49, Resident 6 wants to buy, 6 personal care products from Store 2.
At time t=50, Resident 1 wants to buy, 4 breads, 17 personal care products, 20 beverages from Store 3.
At time t=51, Resident 3 wants to buy, 19 personal care products from Store 2.
At time t=52, Employee 1 visits Store 3.
At time t=53, Employee 1 fills all counters at Store 3.
At time t=53, Resident 4 wants to buy, 8 frozen foods from Store 1.

At time t=54, Resident 3 wants to buy, 19 personal care products from Store 3.
At time t=55, Resident 6 wants to buy, 6 personal care products from Store 1.
At time t=56, Resident 8 wants to buy, 3 breads from Store 2.
At time t=57, Resident 1 buys 8 personal care products, 20 beverages from Store 3.
At time t=57, Resident 8 wants to buy, 3 breads from Store 1.
At time t=58, Resident 3 buys 10 personal care products from Store 3.
At time t=58, Resident 4 wants to buy, 8 frozen foods from Store 3.
At time t=59, Employee 1 visits Store 2.
At time t=60, Employee 1 fills all counters at Store 2.
At time t=60, Resident 1 wants to buy, 4 breads, 9 personal care products from Store 2.
At time t=61, Resident 8 buys 3 breads from Store 1.
At time t=61, Resident 6 wants to buy, 6 personal care products from Store 3.
At time t=62, Resident 1 wants to buy, 4 breads, 9 personal care products from Store 1.
At time t=63, Resident 4 wants to buy, 8 frozen foods from Store 2.
At time t=64, Employee 1 visits Store 1.
At time t=65, Employee 1 fills all counters at Store 1.
At time t=65, Resident 1 buys 4 breads from Store 1.
At time t=65, Resident 4 buys 8 frozen foods from Store 2.
Resident 4 has completed the lists.
Exiting...
At time t=65, Resident 3 wants to buy, 9 personal care products from Store 1.
At time t=66, Resident 8 wants to buy, 5 breads from Store 2.
At time t=67, Resident 8 wants to buy, 5 breads from Store 3.
At time t=68, Employee 1 visits Store 3.
At time t=69, Employee 1 fills all counters at Store 3.
At time t=69, Resident 3 wants to buy, 9 personal care products from Store 2.
At time t=70, Resident 8 wants to buy, 5 breads from Store 1.
At time t=71, Resident 3 wants to buy, 9 personal care products from Store 3.
At time t=72, Resident 8 buys 5 breads from Store 1.
At time t=72, Resident 6 wants to buy, 6 personal care products from Store 1.
At time t=73, Resident 1 wants to buy, 9 personal care products from Store 3.
At time t=74, Employee 1 visits Store 2.
At time t=75, Employee 1 fills all counters at Store 2.
At time t=75, Resident 3 buys 9 personal care products from Store 3.
At time t=75, Resident 6 wants to buy, 6 personal care products from Store 3.
Resident 8 has completed the lists.
Exiting...
At time t=76, Resident 1 wants to buy, 9 personal care products from Store 2.
At time t=77, Resident 6 buys 1 personal care products from Store 3.
Resident 3 has completed the lists.
Exiting...
At time t=77, Resident 1 wants to buy, 9 personal care products from Store 1.
At time t=78, Employee 1 visits Store 1.
At time t=79, Employee 1 fills all counters at Store 1.
At time t=79, Resident 6 wants to buy, 5 personal care products from Store 2.
At time t=80, Resident 1 wants to buy, 9 personal care products from Store 1.
At time t=81, Resident 6 wants to buy, 5 personal care products from Store 2.
At time t=82, Resident 1 wants to buy, 9 personal care products from Store 2.
At time t=83, Resident 6 wants to buy, 5 personal care products from Store 1.
At time t=84, Employee 1 visits Store 3.
At time t=85, Employee 1 fills all counters at Store 3.
At time t=85, Resident 1 wants to buy, 9 personal care products from Store 3.

At time t=86, Resident 6 wants to buy, 5 personal care products from Store 3.
At time t=87, Resident 1 buys 9 personal care products from Store 3.
Resident 1 has completed the lists.
Exiting...
At time t=87, Employee 1 visits Store 2.
At time t=88, Employee 1 fills all counters at Store 2.
At time t=88, Employee 1 visits Store 1.
At time t=89, Employee 1 fills all counters at Store 1.
At time t=89, Resident 6 wants to buy, 5 personal care products from Store 1.
At time t=90, Resident 6 wants to buy, 5 personal care products from Store 2.
At time t=91, Resident 6 wants to buy, 5 personal care products from Store 3.
At time t=92, Resident 6 buys 1 personal care products from Store 3.
At time t=92, Employee 1 visits Store 3.
At time t=93, Employee 1 fills all counters at Store 3.
At time t=93, Employee 1 visits Store 2.
At time t=94, Employee 1 fills all counters at Store 2.
At time t=94, Employee 1 visits Store 1.
At time t=95, Employee 1 fills all counters at Store 1.
At time t=95, Resident 6 wants to buy, 4 personal care products from Store 3.
At time t=96, Resident 6 buys 4 personal care products from Store 3.
At time t=96, Employee 1 visits Store 3.
At time t=97, Employee 1 fills all counters at Store 3.
At time t=97, Employee 1 visits Store 2.
At time t=98, Employee 1 fills all counters at Store 2.
At time t=98, Employee 1 visits Store 1.
At time t=99, Employee 1 fills all counters at Store 1.
At time t=99, Resident 6 wants to buy, 9 beverages from Store 2.
At time t=100, Resident 6 buys 9 beverages from Store 2.
Resident 6 has completed the lists.
Exiting...