НАЦИОНАЛЬНЫЙ ИССЛЕДОВАТЕЛЬСКИЙ УНИВЕРСИТЕТ «ВЫСШАЯ ШКОЛА ЭКОНОМИКИ»

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Дисциплина: «Архитектура вычислительных систем»

МОДЕЛИРОВАНИЕ РАБОТЫ МАГАЗИНА

Пояснительная записка

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Содержание

1. Текст задания

21. Задача о магазине - 2 (забывчивые покупатели). В магазине работают два отдела, каждый отдел обладает уникальным ассортиментом. В каждом отделе работает один продавец. В магазин ходят исключительно забывчивые покупатели, поэтому каждый покупатель носит с собой список товаров, которые желает купить. Покупатель приобретает товары точно в том порядке, в каком они записаны в его списке. Продавец может обслужить только одного покупателя за раз. Покупатель, вставший в очередь, засыпает пока не дойдет до продавца. Продавец засыпает, если в его отделе нет покупателей, и просыпается, если появится хотя бы один. Создать многопоточное приложение, моделирующее работу магазина.

2. Применяемые расчетные методы

2.1. Теория решения задания

Для решения задачи было создано три класса: customer, моделирующий поведение покупателя, department, моделирующий работу отдела и shop, отвечающий за взаимодействие клиента и отдела, а так же обеспечивающий удобное управление отделами. Для синхронизации потоков использовался механизм `condition_variable`, позволяющий гибко управлять сном и пробуждением объектов. Для избежания вечного выполнения программы при введении больших чисел, установлен лимит для отделов. Каждый отдел может продать за день только 20 товаров.

3. Тестирование программы

3.1. Корректные значения


```
Консоль отладки Microsoft Visual Studio
welcome to the shop simulator

Enter number of customers [0; 1000]: 1
Enter number of items in the 1 department [0; 1000000]: 100
Enter number of items in the 2 department [0; 1000000]: 50
Enter max number of items in one product list [0; 1000]: 20
customer 1 product list: [ 56 13 11 43 2 64 133 132 104 113 136 29 60 143 97 ]
department 1 current queue: [ 1<56> ]
department 1 started to sell product 56 to customer 1
department 1 selled product 56 to customer 1
department 1 current queue: [ 1<13> ]
department 1 started to sell product 13 to customer 1
department 1 selled product 13 to customer 1
department 1 current queue: [ 1<11> ]
department 1 started to sell product 11 to customer 1
department 1 selled product 11 to customer 1
department 1 current queue: [ 1<43> ]
department 1 started to sell product 43 to customer 1
department 1 selled product 43 to customer 1
department 1 current queue: [ 1<2> ]
department 1 started to sell product 2 to customer 1
department 1 selled product 2 to customer 1
department 1 current queue: [ 1<64> ]
department 1 started to sell product 64 to customer 1
department 1 selled product 64 to customer 1
department 2 current queue: [ 1<133> ]
department 2 started to sell product 133 to customer 1
department 2 selled product 133 to customer 1
department 2 current queue: [ 1<132> ]
department 2 started to sell product 132 to customer 1
department 2 selled product 132 to customer 1
department 2 current queue: [ 1<104> ]
department 2 started to sell product 104 to customer 1
department 2 selled product 104 to customer 1
department 2 current queue: [ 1<113> ]
department 2 started to sell product 113 to customer 1
department 2 selled product 113 to customer 1
department 2 current queue: [ 1<136> ]
department 2 started to sell product 136 to customer 1
department 2 selled product 136 to customer 1
department 1 current queue: [ 1<29> ]
department 1 started to sell product 29 to customer 1
department 1 selled product 29 to customer 1
department 1 current queue: [ 1<60> ]
department 1 started to sell product 60 to customer 1
department 1 selled product 60 to customer 1
department 2 current queue: [ 1<143> ]
department 2 started to sell product 143 to customer 1
department 2 selled product 143 to customer 1
department 1 current queue: [ 1<97> ]
department 1 started to sell product 97 to customer 1
department 1 selled product 97 to customer 1
customer 1 went home
```

1. *Рисунок 1. Простой случай, когда пришел только один клиент, все выполняется почти последовательно*

```
welcome to the shop simulator

Enter number of customers [0; 1000]: 3
Enter number of items in the 1 department [0; 1000000]: 20
Enter number of items in the 2 department [0; 1000000]: 20
Enter max number of items in one product list [0; 1000]: 10
customer 1 product list: [ 36 36 4 36 ]
customer 2 product list: [ 20 21 ]
department 2 current queue: [ 1<36> ]
department 2 started to sell product 36 to customer 1
customer 3 product list: [ 4 5 6 4 13 14 36 33 13 ]
department 1 current queue: [ 3<4> ]
department 1 started to sell product 4 to customer 3
department 2 selled product 36 to customer 1
department 2 current queue: [ 2<20> ]
department 2 started to sell product 20 to customer 2
department 1 selled product 4 to customer 3
department 1 current queue: [ 3<5> ]
department 1 started to sell product 5 to customer 3
department 2 selled product 20 to customer 2
department 2 current queue: [ 1<36> ]
department 2 started to sell product 36 to customer 1
department 1 selled product 5 to customer 3
department 1 current queue: [ 3<6> ]
department 1 started to sell product 6 to customer 3
department 2 selled product 36 to customer 1
department 2 current queue: [ 2<21> ]
department 2 started to sell product 21 to customer 2
department 1 selled product 6 to customer 3
department 1 current queue: [ 1<4> ]
department 1 started to sell product 4 to customer 1
department 1 selled product 4 to customer 1
department 1 current queue: [ 3<4> ]
department 1 started to sell product 4 to customer 3
department 1 selled product 4 to customer 3
department 1 current queue: [ 3<13> ]
department 1 started to sell product 13 to customer 3
department 2 selled product 21 to customer 2
department 2 current queue: [ 1<36> ]
customer 2 went home
department 2 started to sell product 36 to customer 1
department 1 selled product 13 to customer 3
department 1 current queue: [ 3<14> ]
department 1 started to sell product 14 to customer 3
department 2 selled product 36 to customer 1
customer 1 went home
department 1 selled product 14 to customer 3
department 2 current queue: [ 3<36> ]
department 2 started to sell product 36 to customer 3
department 2 selled product 36 to customer 3
department 2 current queue: [ 3<33> ]
department 2 started to sell product 33 to customer 3
department 2 selled product 33 to customer 3
department 1 current queue: [ 3<13> ]
department 1 started to sell product 13 to customer 3
department 1 selled product 13 to customer 3
customer 3 went home
```

*2. Рисунок 2. 3 клиента, многопоточность работает на полную, но почти
никто не стоит в очереди*

▣ Консоль отладки Microsoft Visual Studio

```
welcome to the shop simulator

Enter number of customers [0; 1000]: 10
Enter number of items in the 1 department [0; 1000000]: 20
Enter number of items in the 2 department [0; 1000000]: 20
Enter max number of items in one product list [0; 1000]: 5
customer 1 product list: [ 20 14 12 14 ]
customer 2 product list: [ 25 20 23 24 ]
department 2 current queue: [ 1<20> ]
department 2 started to sell product 20 to customer 1
customer 3 product list: [ 36 ]
customer 4 product list: [ ]
customer 5 product list: [ 13 ]
customer 4 went home
customer 6 product list: [ 17 17 ]
department 1 current queue: [ 5<13> ]
department 1 started to sell product 13 to customer 5
customer 7 product list: [ 5 35 ]
customer 8 product list: [ 21 37 6 ]
customer 9 product list: [ 39 35 ]
customer 10 product list: [ 16 2 5 ]
department 2 selled product 20 to customer 1
department 2 current queue: [ 2<25> 3<36> 8<21> 9<39> ]
department 2 started to sell product 25 to customer 2
department 1 selled product 13 to customer 5
department 1 current queue: [ 6<17> 7<5> 10<16> 1<14> ]
department 1 started to sell product 17 to customer 6
customer 5 went home
department 2 selled product 25 to customer 2
department 2 current queue: [ 3<36> 8<21> 9<39> ]
department 2 started to sell product 36 to customer 3
department 1 selled product 17 to customer 6
department 1 current queue: [ 7<5> 10<16> 1<14> ]
department 1 started to sell product 5 to customer 7
department 2 selled product 36 to customer 3
customer 3 went home
department 2 current queue: [ 8<21> 9<39> 2<20> ]
department 2 started to sell product 21 to customer 8
department 1 selled product 5 to customer 7
department 1 current queue: [ 10<16> 1<14> 6<17> ]
department 1 started to sell product 16 to customer 10
department 2 selled product 21 to customer 8
department 2 current queue: [ 9<39> 2<20> 7<35> ]
department 2 started to sell product 39 to customer 9
department 2 selled product 39 to customer 9
department 2 current queue: [ 2<20> 7<35> 8<37> ]
department 2 started to sell product 20 to customer 2
department 1 selled product 16 to customer 10
department 1 current queue: [ 1<14> 6<17> ]
department 1 started to sell product 14 to customer 1
department 2 selled product 20 to customer 2
department 2 current queue: [ 7<35> 8<37> 9<35> ]
department 2 started to sell product 35 to customer 7
department 1 selled product 14 to customer 1
department 1 current queue: [ 6<17> 10<2> ]
department 1 started to sell product 17 to customer 6
department 2 selled product 35 to customer 7
customer 7 went home
department 2 current queue: [ 8<37> 9<35> 2<23> ]
department 2 started to sell product 37 to customer 8
department 1 selled product 17 to customer 6
department 1 current queue: [ 10<2> 1<12> ]
```

```
department 1 started to sell product 2 to customer 10
customer 6 went home
department 2 selled product 37 to customer 8
department 2 current queue: [ 9<35> 2<23> ]
department 2 started to sell product 35 to customer 9
department 1 selled product 2 to customer 10
department 1 current queue: [ 1<12> 8<6> ]
department 1 started to sell product 12 to customer 1
department 2 selled product 35 to customer 9
department 2 current queue: [ 2<23> ]
department 2 started to sell product 23 to customer 2
customer 9 went home
department 1 selled product 12 to customer 1
department 1 current queue: [ 8<6> 10<5> ]
department 1 started to sell product 6 to customer 8
department 2 selled product 23 to customer 2
department 2 current queue: [ 2<24> ]
department 2 started to sell product 24 to customer 2
department 1 selled product 6 to customer 8
department 1 current queue: [ 10<5> 1<14> ]
department 1 started to sell product 5 to customer 10
customer 8 went home
department 2 selled product 24 to customer 2
customer 2 went home
department 1 selled product 5 to customer 10
department 1 current queue: [ 1<14> ]
customer 10 went home
department 1 started to sell product 14 to customer 1
department 1 selled product 14 to customer 1
customer 1 went home
```

3. Рисунок 3. Многопоточность и очереди, продавцы почти не спят

3.2. Некорректные значения

При вводе некорректных значений программа устанавливает значения по умолчанию.

```
welcome to the shop simulator

Enter number of customers [0; 1000]: -1
incorrect value, used default (10)
Enter number of items in the 1 department [0; 1000000]: 1000000000
incorrect value, used default (10)
Enter number of items in the 2 department [0; 1000000]: -100
incorrect value, used default (10)
Enter max number of items in one product list [0; 1000]: 0
customer 1 product list: [ ]
customer 2 product list: [ ]
customer 1 went home
customer 3 product list: [ ]
customer 2 went home
customer 4 product list: [ ]
customer 3 went home
customer 5 product list: [ ]
customer 4 went home
customer 6 product list: [ ]
customer 5 went home
customer 7 product list: [ ]
customer 6 went home
customer 8 product list: [ ]
customer 7 went home
customer 9 product list: [ ]
customer 8 went home
customer 10 product list: [ ]
customer 9 went home
customer 10 went home
```

4. Рисунок 4. Максимальное число товаров в списке покупок 0, остальные значения некорректны и заменены на 10

ПРИЛОЖЕНИЕ 1

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