

GEBZE TECHNICAL UNIVERSITY

COMPUTER ENGINEERING



CSE-344 SYSTEM PROGRAMMING

HOMEWORK-5 REPORT

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1 INTRODUCTION

1.1 Problem Definition

This homework is about multithread usage. Simulation of florist application. There is a file and that file contains a list of arbitrary number of florists, flower names and clients. Florists have name, coordinates, different flower types and deliver speed. Clients have client number, coordinate and one flower name that is order of client. Clients make requests for flowers, central thread sends this requests for closest florists. After, the closest florists for clients that are also threads receive own requests, prepare and deliver them. While doing this, they are also print on screen how long preparation and deliver took in total. Important point is central thread must process the requests as fast as possible, that means it should delegate the request to the closest florist even if she/he is busy preparing/delivering a request in the meantime. When all requests have been processed, all threads should be terminated and sale statistics should be printed nicely formatted table.

2 METHOD

2.1 Problem Solution

For solving this problem, firstly I created a structure for florists, and I also created a structure for clients. In florist structure, I kept florist name, coordinate x, coordinate y, deliver speed, flower array, flower numbers, total time for orders, total sales, Client queue and size of queue. In clients structure, I kept client number, coordinate x, coordinate y and one flower name. After, I read file and I found total client number and florist number and I allocated memory for structure arrays. After that, I read file again and I found how many flowers had florists and according to that flower number I allocated area for flowers array for each florist. After, I read file last time and I initialized structure arrays for florists and clients. So clients and florists were created. After, I created thread mutex array and condition variable array for each florists. And I allocated area for these. Then, I created florist number thread and main thread. In main thread, I created a loop for every clients. For every client, I found the closest florist that had order flower of client. Then, I added this client, client queue of closest florist and I increased queue size. Then I sent condition signal for florist. I made this operations between `pthread_mutex_lock`

and `pthread_mutex_unlock`. In florist thread functions, if queue length was 0 and total delivered order number was not equal client number, I waited signal with `pthread_cond_wait`. Else cases, I made operations of florists. I took client from queue, I calculated deliver time that was distance/speed and I took random time between 1-250 for simulate preparation and I created sleep for preparation and deliver time. And I printed information on screen. When total order number was equal total client number, I broke loop because all orders was delivered. I made all this operations of florist threads between `pthread_mutex_lock` and `pthread_mutex_unlock`. And between each florist thread and main thread, their own mutexes and condition variables were used. After, I print nicely formatted sale statistic table on screen by main thread. And lastly, I free all resources.

2.2 Functions that I use in Homework

- **void find_clients_and_florists(int fdInput):** This function finds clients and florist number in file and allocates area from memory for them.
- **void allocate_flowers(int fdInput):** This function finds flower number of each florist and allocates area for flower array according to flower number.
- **void initialize(int fdInput):** This function initializes florists and clients according to read file.
- **double ChebyshevDistance(client c, florist f):** Cherbyshev Distance function.
- **int findFlower(florist f, char* name):** This function finds whether a flower is in given florist or not.
- **int closestFlorist(client c):** Finds closest florist for given client according to Chebyshev Distance.
- **void freeStructures():** This function to free allocated areas for florists and clients and mutexes.
- **void initilializeMutexesAndConds():** Initializes thread mutexes and condition variables.
- **static void *florists(void *arg):** Florist thread function.

- **void mainThread():**Main thread function.
- **void saleStatistic(florist returnArr[],int size)**Prints sale statistics by main thread on screen.
- **void sigIntHandler(int sigNo):**SIGINT signal handler.Exiting gracefully.
- **int main(int argc, char *argv[]):**Main function.

NOTE:According to my code,there should be always a newline at the end of file for completely true result.Otherwise last client is not calculated.

3 RUNNING RESULTS

Input File:

```
home > nevro > Desktop > hw5 > data.dat
1  Ayse (10,25; 1.5) : orchid, rose, violet
2  Fatma (-10,-15; 1.3) : clove, rose, daffodil
3  Murat (-10,8; 1.1) : violet, daffodil, orchid
4
5  client1 (0,4): orchid
6  client2 (1,5): clove
7  client3 (2,10): daffodil
8  client4 (4,15): orchid
9  client5 (8,-21): violet
10 client6 (-1,21): orchid
11 client7 (-6,20): rose
12 client8 (-16,18): rose
13 client9 (-12,-3): rose
14 client10 (23,0): violet
15 client11 (5,1): orchid
16 client12 (7,-8): violet
17 client13 (8,-3): clove
18 client14 (9,8): orchid
19 client15 (6,5): orchid
20 client16 (2,6): clove
21 client17 (-6,-4): daffodil
22 client18 (-9,-6): daffodil
23 client19 (-4,16): rose
24 client20 (-9,26): orchid
25 client21 (-4,-12): daffodil
26 client22 (9,13): rose
27 client23 (12,18): rose
28 client24 (11,15): orchid
29
30
```

Output:

```
nevra@ubuntu:~/Desktop/hw5$ ./FloristApp -i data.dat
Florist application initializing from file: data.dat
3 Florists have been created
Processing requests
Florist Fatma has delivered a daffodil to client21 in 233ms
Florist Ayse has delivered a orchid to client24 in 235ms
Florist Murat has delivered a orchid to client20 in 245ms
Florist Fatma has delivered a daffodil to client18 in 142ms
Florist Ayse has delivered a rose to client23 in 152ms
Florist Murat has delivered a orchid to client15 in 158ms
Florist Ayse has delivered a rose to client22 in 65ms
Florist Fatma has delivered a daffodil to client17 in 128ms
Florist Murat has delivered a violet to client12 in 190ms
Florist Fatma has delivered a clove to client16 in 110ms
Florist Ayse has delivered a rose to client19 in 192ms
Florist Fatma has delivered a clove to client13 in 156ms
Florist Murat has delivered a orchid to client11 in 259ms
Florist Ayse has delivered a orchid to client14 in 245ms
Florist Fatma has delivered a rose to client9 in 229ms
Florist Fatma has delivered a clove to client2 in 44ms
Florist Ayse has delivered a violet to client10 in 159ms
Florist Murat has delivered a violet to client5 in 221ms
Florist Ayse has delivered a rose to client8 in 200ms
Florist Ayse has delivered a rose to client7 in 12ms
Florist Murat has delivered a daffodil to client3 in 259ms
Florist Murat has delivered a orchid to client1 in 77ms
Florist Ayse has delivered a orchid to client6 in 170ms
Florist Ayse has delivered a orchid to client4 in 13ms
All requests processed.
Ayse closing shop.
Murat closing shop.
Fatma closing shop.

Sale statistics for today:
-----
Florist      # of sales      Total time
-----
Ayse          10             1443ms
Fatma          7             1042ms
Murat          7             1409ms
-----
nevra@ubuntu:~/Desktop/hw5$
```

When compile with valgrind,no leak and error:

```
Sale statistics for today:
-----
Florist      # of sales      Total time
-----
Ayse          10             1191ms
Fatma          7             1066ms
Murat          7             789ms
-----
==43456==
==43456== HEAP SUMMARY:
==43456==    in use at exit: 0 bytes in 0 blocks
==43456==   total heap usage: 26 allocs, 26 frees, 1,587,870 bytes allocated
==43456==
==43456== All heap blocks were freed -- no leaks are possible
==43456==
==43456== For counts of detected and suppressed errors, rerun with: -v
==43456== ERROR SUMMARY: 0 errors from 0 contexts (suppressed: 0 from 0)
nevra@ubuntu:~/Desktop/hw5$
```

Input File:

```
home > nevra > Desktop > hw5 > $ data.dat
1 Ayse (10,25; 1,5) : orchid, rose, violet
2 Fatma (-10,-15; 1,3) : clove, rose, daffodil
3 Murat (-10,8; 1,1) : violet, daffodil, orchid
4 Selda (-10,12; 1,2) : daisy, violet, clove
5 Ahmet (-10,11; 1,3) : rose, daisy
6
7 client1 (0,4): orchid
8 client2 (1,5): clove
9 client3 (2,10): daffodil
10 client4 (4,15): orchid
11 client5 (6,-21): violet
12 client6 (-1,21): orchid
13 client7 (-6,20): rose
14 client8 (-16,18): rose
15 client9 (-12,3): rose
16 client10 (23,0): violet
17 client11 (5,1): orchid
18 client12 (7,-8): violet
19 client13 (8,-3): clove
20 client14 (9,8): orchid
21 client15 (6,3): orchid
22 client16 (2,6): clove
23 client17 (-6,-4): daffodil
24 client18 (-9,-6): daffodil
25 client19 (-4,16): rose
26 client20 (-9,26): orchid
27 client21 (-4,-12): daffodil
28 client22 (9,13): rose
29 client23 (12,18): rose
30 client24 (11,15): orchid
31 client25 (11,14): daisy
32
33
```

Output:

```
nevra@ubuntu:~/Desktop/hw5$ ./FloristApp -i data.dat
Florist application initializing from file: data.dat
5 Florists have been created
Processing requests
Florist Ahmet has delivered a rose to client19 in 86ms
Florist Fatma has delivered a daffodil to client21 in 86ms
Florist Ayse has delivered a orchid to client24 in 88ms
Florist Murat has delivered a orchid to client20 in 90ms
Florist Selda has delivered a daisy to client25 in 99ms
Florist Fatma has delivered a daffodil to client18 in 63ms
Florist Ayse has delivered a rose to client23 in 90ms
Florist Selda has delivered a clove to client16 in 112ms
Florist Ahmet has delivered a rose to client8 in 165ms
Florist Fatma has delivered a daffodil to client17 in 155ms
Florist Murat has delivered a orchid to client15 in 258ms
Florist Selda has delivered a clove to client2 in 147ms
Florist Ayse has delivered a rose to client22 in 221ms
Florist Murat has delivered a violet to client12 in 88ms
Florist Ahmet has delivered a rose to client7 in 219ms
Florist Fatma has delivered a clove to client13 in 177ms
Florist Murat has delivered a orchid to client11 in 92ms
Florist Ayse has delivered a orchid to client14 in 159ms
Florist Murat has delivered a violet to client5 in 107ms
Florist Ayse has delivered a violet to client10 in 87ms
Florist Fatma has delivered a rose to client9 in 191ms
Florist Ayse has delivered a orchid to client6 in 194ms
Florist Murat has delivered a daffodil to client3 in 225ms
Florist Ayse has delivered a orchid to client4 in 62ms
Florist Murat has delivered a orchid to client1 in 190ms
All requests processed.
Murat closing shop.
Ahmet closing shop.
Selda closing shop.
Fatma closing shop.
Ayse closing shop.

Sale statistics for today:
-----
Florist      # of sales      Total time
-----
Ayse         7                901ms
Fatma        5                672ms
Murat        7                1066ms
Selda        3                358ms
Ahmet        3                470ms
-----
nevra@ubuntu:~/Desktop/hw5$
```

When compile with valgrind,no leak and error:

```
Sale statistics for today:
-----
Florist      # of sales      Total time
-----
Ayse          7                929ms
Fatma         5                963ms
Murat         7               1066ms
Selda         3                326ms
Ahmet         3                348ms
-----

==43549==
==43549== HEAP SUMMARY:
==43549==   in use at exit: 0 bytes in 0 blocks
==43549==   total heap usage: 37 allocs, 37 frees, 1,595,892 bytes allocated
==43549==
==43549== All heap blocks were freed -- no leaks are possible
==43549==
==43549== For counts of detected and suppressed errors, rerun with: -v
==43549== ERROR SUMMARY: 0 errors from 0 contexts (suppressed: 0 from 0)
nevra@ubuntu:~/Desktop/hw5$
```

Input File:

```
home > nevra > Desktop > hw5 > ⇐ data.dat
1  Ayse (10,25; 1.5) : orchid, rose, violet
2  Fatma (-10,-15; 1.3) : clove, rose, daffodil
3  Murat (-10,8; 1.1) : tulip, daffodil, orchid
4  Mustafa (-10,12; 1.2) : daisy, violet, clove
5  Pelin (-10,9; 1.5) : rose, daisy, tulip
6
7  client1 (0,4): orchid
8  client2 (1,5): clove
9  client3 (2,10): daffodil
10 client4 (4,15): orchid
11 client5 (8,-21): violet
12 client6 (-1,21): tulip
13 client7 (-6,20): rose
14 client8 (-16,18): rose
15 client9 (-12,-3): rose
16 client10 (23,0): violet
17 client11 (5,1): daisy
18 client12 (7,-8): violet
19 client13 (8,-3): clove
20 client14 (9,8): orchid
21 client15 (6,5): orchid
22 client16 (2,6): clove
23 client17 (-6,-4): rose
24 client18 (-9,-6): daffodil
25 client19 (-4,16): rose
26 client20 (-9,26): orchid
27 client21 (-4,-12): daffodil
28 client22 (9,13): rose
29 client23 (12,18): rose
30 client24 (11,15): orchid
31 client25 (11,14): daisy
32
33
```

Output:

```
nevr@ubuntu:~/Desktop/hw5$ ./floristApp -t data.dat
Florist application initializing from file: data.dat
5 florists have been created
Processing requests
Florist Pelin has delivered a rose to client19 in 173ms
Florist Fatma has delivered a daffodil to client21 in 173ms
Florist Ayse has delivered a orchid to client24 in 175ms
Florist Murat has delivered a orchid to client20 in 185ms
Florist Mustafa has delivered a daisy to client25 in 186ms
Florist Mustafa has delivered a clove to client16 in 37ms
Florist Ayse has delivered a rose to client23 in 78ms
Florist Pelin has delivered a rose to client8 in 93ms
Florist Fatma has delivered a daffodil to client18 in 94ms
Florist Ayse has delivered a rose to client22 in 19ms
Florist Pelin has delivered a rose to client7 in 33ms
Florist Pelin has delivered a tulip to client6 in 22ms
Florist Mustafa has delivered a violet to client12 in 104ms
Florist Mustafa has delivered a daisy to client11 in 33ms
Florist Murat has delivered a orchid to client15 in 211ms
Florist Fatma has delivered a rose to client17 in 198ms
Florist Ayse has delivered a orchid to client14 in 248ms
Florist Murat has delivered a daffodil to client3 in 211ms
Florist Mustafa has delivered a violet to client5 in 262ms
Florist Fatma has delivered a clove to client13 in 251ms
Florist Murat has delivered a orchid to client1 in 125ms
Florist Ayse has delivered a violet to client10 in 234ms
Florist Mustafa has delivered a clove to client2 in 134ms
Florist Fatma has delivered a rose to client9 in 163ms
Florist Ayse has delivered a orchid to client4 in 159ms
All requests processed.
Ayse closing shop.
Pelin closing shop.
Mustafa closing shop.
Fatma closing shop.
Murat closing shop.

Sale statistics for today:
-----
Florist      # of sales      Total time
-----
Ayse         6                913ms
Fatma        5                879ms
Murat        4                732ms
Mustafa      6                756ms
Pelin        4                321ms
-----
nevr@ubuntu:~/Desktop/hw5$
```

When compile with valgrind,no leak and error:

```
All requests processed.
Mustafa closing shop.
Ayse closing shop.
Pelin closing shop.
Fatma closing shop.
Murat closing shop.

Sale statistics for today:
-----
Florist      # of sales      Total time
-----
Ayse         6                851ms
Fatma        5                645ms
Murat        4                497ms
Mustafa      6                843ms
Pelin        4                749ms
-----
==43621==
==43621== HEAP SUMMARY:
==43621==   in use at exit: 0 bytes in 0 blocks
==43621== total heap usage: 38 allocs, 38 frees, 1,595,905 bytes allocated
==43621==
==43621== All heap blocks were freed -- no leaks are possible
==43621==
==43621== For counts of detected and suppressed errors, rerun with: -v
==43621== ERROR SUMMARY: 0 errors from 0 contexts (suppressed: 0 from 0)
nevr@ubuntu:~/Desktop/hw5$
```