Homework 5

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1. Problem Definition

This homework is a multi threaded application using pthreads for flower delivery. Clients makes requests for flowers, the main thread collects those requests, and then delegates the work to the closest florist that has the kind of flower requested. It is provided with a file containing the list of florists, flowers that they sell and clients. The list of florists, flowers that they sell can be an arbitrary number. They have an infinite amount of each. Clients always requests a single flower type.For example:

Ayse (10,25; 1.5): orchid, rose, violet

It means Ayse sells the there three types of flowers, and her shop is located at (10,25) coordinates her deliveries are made with an average speed of 1.5 clicks per ms (click = 1 unit of distance in the grid).

client1 (55,76): orchid

It means that client1 is at (55,76) coordinates and has made a request for a orchid.

Main thread has a pool of one thread for every florist. Then it processes the clients' requests one by one. It delegate the requests to closest florist. Finds closest florist using the Chebyshev distance. Florist prepares requests between 1-250 ms and delivers them in speed*distance ms.

Once all requests have been processed, all florist threads terminate and return their sale statistics to the central thread which will then print on screen that information in a nicely formatted table along with the number of requests handled by each client.

2. Implementation

I implement every florist as a separate threads. For all thread, I used separate mutexes and conditional variables. Main thread reads the file, then gets florist information and client information with *floristInfos* and *clientInfos* functions. This functions parse the lines and gets x coordinate, y coordinate and so on. After reading file, it processes the clients' requests one by one. For each request, it delegates it to the closest florist with respect to the client using the Chebyshev distance. It finds closest florist with *closestFlorist* function. This function returns closest florists' index. To find distance between florists and clients, it uses *calcDistance* function. This function calculates max of absolute values of differences between x coordinates and y coordinates. Main thread finds closest florist, adds client to request array, increases the *order* by one. Then sends signal to this florist to notify it. After last client is processed, it assigns 1 to *exit_flag* to notify all requests are processed. It sends signal to all threads to wake them. Then it waits for threads with *pthread_join*. Last of all, it prints sale statistics.

In thread pool, florists checks *order* and *exit_flag*. If they are zero, then they waits for signal with *pthread_cond_wait*. If signal is came, checks again *order* and *exit_flag*. If *order* is 0 and *exit_flag* is 1, this means that there are no more client so it breaks the loop. If *order* is bigger than zero, it means that this florist has some client. It prepares the request and delivers it. Then it reduces *order* 1. Once all requests are processed florisrs returns their sale statistics and terminate.

There is a singal handler. In case of CTRL-C, handler catch it and exits program by deallocating all resources and printing an informative message. Threads can not cancelled from handler so I create a signal mask. Before thread creation, I blocked the mask and after threads join, I unblocked the mask. Thus, threads terminate gracefully. There is also a *clean* function that reallocates the memory, closes opened files and so on. Before program exits, it cleans the memory.

3. Tests

3.1 Sample Input/Output 1

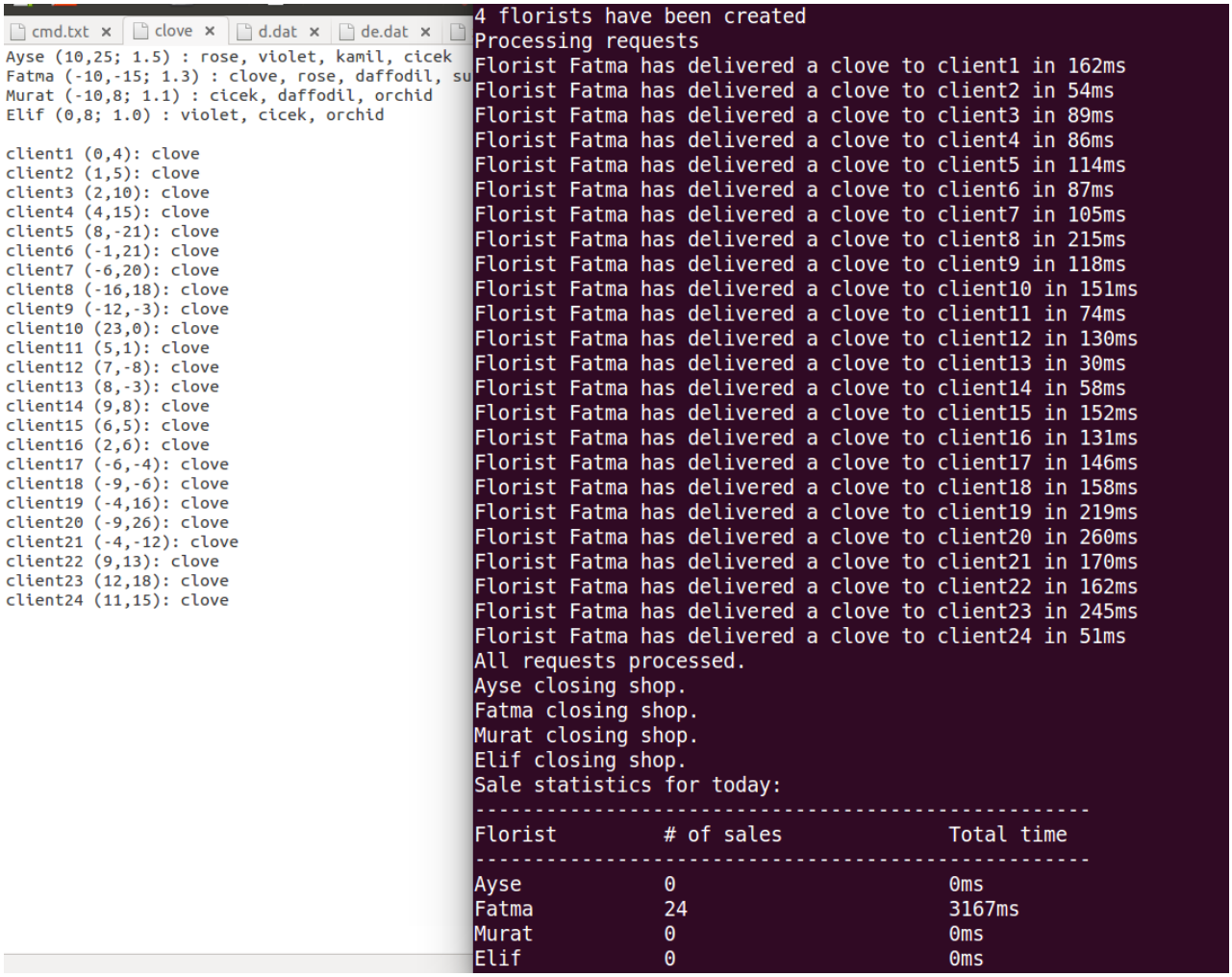
cmd.txt | clove | d.dat | de.dat

```
Ayse (10,25; 1.5) : orchid, rose, violet
Fatma (-10,-15; 1.3) : clove, rose, daffodil
Murat (-10,8; 1.1) : violet, daffodil, orchid

client1 (0,4): orchid
client2 (1,5): clove
client3 (2,10): daffodil
client4 (4,15): orchid
client5 (8,-21): violet
client6 (-1,21): orchid
client7 (-6,20): rose
client8 (-16,18): rose
client9 (-12,-3): rose
client10 (23,0): violet
client11 (5,1): orchid
client12 (7,-8): violet
client13 (8,-3): clove
client14 (9,8): orchid
client15 (6,5): orchid
client16 (2,6): clove
client17 (-6,-4): daffodil
client18 (-9,-6): daffodil
client19 (-4,16): rose
client20 (-9,26): orchid
client21 (-4,-12): daffodil
client22 (9,13): rose
client23 (12,18): rose
client24 (11,15): orchid
```

```
3 florists have been created
Processing requests
Florist Murat has delivered a orchid to client1 in 34ms
Florist Fatma has delivered a clove to client2 in 264ms
Florist Fatma has delivered a rose to client9 in 52ms
Florist Fatma has delivered a clove to client13 in 103ms
Florist Fatma has delivered a clove to client16 in 35ms
Florist Fatma has delivered a daffodil to client17 in 194ms
Florist Fatma has delivered a daffodil to client18 in 45ms
Florist Fatma has delivered a daffodil to client21 in 41ms
Florist Ayse has delivered a orchid to client4 in 75ms
Florist Ayse has delivered a orchid to client6 in 195ms
Florist Ayse has delivered a rose to client7 in 183ms
Florist Ayse has delivered a rose to client8 in 121ms
Florist Ayse has delivered a violet to client10 in 158ms
Florist Ayse has delivered a orchid to client14 in 168ms
Florist Ayse has delivered a rose to client19 in 63ms
Florist Ayse has delivered a rose to client22 in 195ms
Florist Ayse has delivered a rose to client23 in 20ms
Florist Ayse has delivered a orchid to client24 in 11ms
Florist Murat has delivered a daffodil to client3 in 145ms
Florist Murat has delivered a violet to client5 in 40ms
Florist Murat has delivered a orchid to client11 in 243ms
Florist Murat has delivered a violet to client12 in 73ms
Florist Murat has delivered a orchid to client15 in 71ms
Florist Murat has delivered a orchid to client20 in 204ms
All requests processed.
Ayse closing shop.
Fatma closing shop.
Murat closing shop.
Sale statistics for today:
-------------------------------------------------
Florist         # of sales              Total time
-------------------------------------------------
Ayse            10                     1189ms
Fatma           7                      734ms
Murat           7                      810ms
-------------------------------------------------
```

3.2 Sample Input/Output 2



cmd.txt | clove | d.dat | de.dat

```
Ayse (10,25; 1.5) : rose, violet, kamil, cicek
Fatma (-10,-15; 1.3) : clove, rose, daffodil, su
Murat (-10,8; 1.1) : cicek, daffodil, orchid
Elif (0,8; 1.0) : violet, cicek, orchid

client1 (0,4): clove
client2 (1,5): clove
client3 (2,10): clove
client4 (4,15): clove
client5 (8,-21): clove
client6 (-1,21): clove
client7 (-6,20): clove
client8 (-16,18): clove
client9 (-12,-3): clove
client10 (23,0): clove
client11 (5,1): clove
client12 (7,-8): clove
client13 (8,-3): clove
client14 (9,8): clove
client15 (6,5): clove
client16 (2,6): clove
client17 (-6,-4): clove
client18 (-9,-6): clove
client19 (-4,16): clove
client20 (-9,26): clove
client21 (-4,-12): clove
client22 (9,13): clove
client23 (12,18): clove
client24 (11,15): clove
```

```
4 florists have been created
Processing requests
Florist Fatma has delivered a clove to client1 in 162ms
Florist Fatma has delivered a clove to client2 in 54ms
Florist Fatma has delivered a clove to client3 in 89ms
Florist Fatma has delivered a clove to client4 in 86ms
Florist Fatma has delivered a clove to client5 in 114ms
Florist Fatma has delivered a clove to client6 in 87ms
Florist Fatma has delivered a clove to client7 in 105ms
Florist Fatma has delivered a clove to client8 in 215ms
Florist Fatma has delivered a clove to client9 in 118ms
Florist Fatma has delivered a clove to client10 in 151ms
Florist Fatma has delivered a clove to client11 in 74ms
Florist Fatma has delivered a clove to client12 in 130ms
Florist Fatma has delivered a clove to client13 in 30ms
Florist Fatma has delivered a clove to client14 in 58ms
Florist Fatma has delivered a clove to client15 in 152ms
Florist Fatma has delivered a clove to client16 in 131ms
Florist Fatma has delivered a clove to client17 in 146ms
Florist Fatma has delivered a clove to client18 in 158ms
Florist Fatma has delivered a clove to client19 in 219ms
Florist Fatma has delivered a clove to client20 in 260ms
Florist Fatma has delivered a clove to client21 in 170ms
Florist Fatma has delivered a clove to client22 in 162ms
Florist Fatma has delivered a clove to client23 in 245ms
Florist Fatma has delivered a clove to client24 in 51ms
All requests processed.
Ayse closing shop.
Fatma closing shop.
Murat closing shop.
Elif closing shop.
Sale statistics for today:
-------------------------------------------------
Florist         # of sales              Total time
-------------------------------------------------
Ayse            0                      0ms
Fatma           24                     3167ms
Murat           0                      0ms
Elif            0                      0ms
```

3.3 Testing Command Line Arguments

```
gtucpp@ubuntu:~/Desktop/homework5$ ./floristApp -i
Wrong command line arguments!
Usage: ./program -i filename
 -i represents the file that contains the list of florists, the type of flowers
that they sell and the requests made by clients
gtucpp@ubuntu:~/Desktop/homework5$ ./floristApp
Wrong command line arguments!
Usage: ./program -i filename
 -i represents the file that contains the list of florists, the type of flowers
that they sell and the requests made by clients
gtucpp@ubuntu:~/Desktop/homework5$ ./floristApp -i data.txt s
Wrong command line arguments!
Usage: ./program -i filename
 -i represents the file that contains the list of florists, the type of flowers
that they sell and the requests made by clients
gtucpp@ubuntu:~/Desktop/homework5$
```