

Technical Task “Client-Server”

GiTHUB Repo link:

https://github.com/Ahmed17Said06/5G_PCSE_Technical_Task.git

Design:

Server:

- 1- Simulation function generate bounded random number to simulate temperature degree readings.
- 2- Multi-threaded server uses the simulation function each one second to get new reading, and has one non-blocking socket always exposed to listen to any incoming join requests from clients.
- 3- Once server detects a request on the listening port, it spin a new socket to handle the communication with the concerned client. “system allows multi-clients simultaneously”.
- 4- Server running in while infinite loop, keeps listening and generating the degrees.
- 5- Once it has a connection it spin new socket and save it in a vector each second it spin on the vector sockets to send them the readings.
- 6- If server dies the connection to all clients stops, and each client print that the server is lost.
- 7- If client went down, server keeps running, no matter there is clients or not.
- 8- Environment Ubuntu 22.04 LTS VM on VMware Player, and VS code.

Client:

- 1- Multi-threaded client, client listens on port “5400” on the local host.
- 2- Client saves the readings for the last 5 seconds into buffer, then do its calculations on it and print it.
- 3- If no server found it prints no there is no server and terminate as there is no point to keep looping without having a server to listen for.
- 4- If client is terminated, other clients keep working normally without interruption.
- 5- Client does the 2 average and accumulation calculations in two different threads.
- 6- Once it detects that the server dies, it closes the socket immediately, print that server lost and halt its operations.

Network:

- 1- Connection is TCP/IP socket “BSD sockets” on localhost on port “5400”.
- 2- Can be changed easily to UDP by changing the related protocol on the TCP of BSD socket functions.
- 3- Network handle multiple clients.

Containerized the solution:

- 1- Under source files there is Docker directory, that has client directory, server directory and docker-compose yaml file.
- 2- Wrapped the server and the clients each on separate docker file.
- 3- Then used docker compose to spin the 2 containers and to handle that the both are connected on localhost ports 54000.

Snippets from the output conveying the requirements:

One client:

The screenshot shows a terminal window titled "ahmed@ahmed-virtual-machine: ~/projects/phase_4". The terminal displays the output of a server program. The first part of the output shows the server listening on port 54824. The second part shows the server receiving a connection from localhost. The third part shows the server calculating the average of the last 5 seconds readings and the accumulation over the last 5 seconds and over all time. The output is as follows:

```
server
last 5 seconds readings are: 44 44 40 51 43
Accumulation over last 5s = 230
Average over last 5s = 46
Accumulation over all time = 230
Average over all time = 46

last 5 seconds readings are: 35 35 38 45 38
Accumulation over last 5s = 191
Average over last 5s = 38.2
Accumulation over all time = 421
Average over all time = 42.1

last 5 seconds readings are: 43 43 39 42 33
Accumulation over last 5s = 206
Average over last 5s = 40
Accumulation over all time = 621
Average over all time = 41.4
```

Two Clients:

The screenshot shows a terminal window titled "ahmed@ahmed-virtual-machine: ~/projects/phase_4". The terminal displays the output of a server program. The first part of the output shows the server listening on port 42654. The second part shows the server receiving a connection from localhost. The third part shows the server calculating the average of the last 5 seconds readings and the accumulation over the last 5 seconds and over all time. The output is as follows:

```
server
last 5 seconds readings are: 45 48 43 46 47
Accumulation over last 5s = 229
Average over last 5s = 45.8
Accumulation over all time = 2485
Average over all time = 41.4167

last 5 seconds readings are: 40 37 42 49 31
Accumulation over last 5s = 199
Average over last 5s = 39.8
Accumulation over all time = 2684
Average over all time = 41.2923

last 5 seconds readings are: 47 50 51 48 35
Accumulation over last 5s = 231
Average over last 5s = 46.2
Accumulation over all time = 2915
Average over all time = 41.6429

last 5 seconds readings are: 49 42 41 36 47
Accumulation over last 5s = 215
Average over last 5s = 43
Accumulation over all time = 3130
Average over all time = 41.7333

last 5 seconds readings are: 46 39 38 46 41
Accumulation over last 5s = 210
Average over last 5s = 42
Accumulation over all time = 3346
Average over all time = 41.75

last 5 seconds readings are: 39 34 46 39 48
Accumulation over last 5s = 206
Average over last 5s = 41.2
Accumulation over all time = 3546
Average over all time = 41.7176
```

Three clients:

```
ahmed@ahmed-virtual-machine: ~/projects/phase_4
Accumulation over last 5s = 198
Average over last 5s = 39.6
Accumulation over all time = 9318
Average over all time = 41.4133

client localhost connected on port 60136
last 5 seconds readings are: 33 37 40 43
Accumulation over last 5s = 190
Average over last 5s = 38
Accumulation over all time = 9508
Average over all time = 41.3391

last 5 seconds readings are: 47 44 35 41 44
Accumulation over last 5s = 211
Average over last 5s = 42.2
Accumulation over all time = 9719
Average over all time = 41.3574

last 5 seconds readings are: 34 41 42 38 44
Accumulation over last 5s = 199
Average over last 5s = 39.8
Accumulation over all time = 9918
Average over all time = 41.325

last 5 seconds readings are: 35 37 39 38 42
Accumulation over last 5s = 191
Average over last 5s = 38.2
Accumulation over all time = 10109
Average over all time = 41.2612

last 5 seconds readings are: 44 48 35 35 46
Accumulation over last 5s = 208
Average over last 5s = 41.6
Accumulation over all time = 10317
Average over all time = 41.268

last 5 seconds readings are: 45 36 38 48 39
Accumulation over last 5s = 206
Average over last 5s = 41.0
Accumulation over all time = 10523
Average over all time = 41.268

ahmed@ahmed-virtual-machine: ~/projects/phase_4
Accumulation over last 5s = 186
Average over last 5s = 37.2
Accumulation over all time = 6172
Average over all time = 41.1467

last 5 seconds readings are: 40 43 47 44 35
Accumulation over last 5s = 209
Average over last 5s = 41.8
Accumulation over all time = 6381
Average over all time = 41.1077

last 5 seconds readings are: 41 44 34 41 42
Accumulation over last 5s = 202
Average over last 5s = 41.8
Accumulation over all time = 6583
Average over all time = 41.1677

last 5 seconds readings are: 38 44 35 37 39
Accumulation over last 5s = 193
Average over last 5s = 38.6
Accumulation over all time = 6776
Average over all time = 41.0667

last 5 seconds readings are: 38 42 44 48 35
Accumulation over last 5s = 207
Average over last 5s = 41.4
Accumulation over all time = 6983
Average over all time = 41.0765

last 5 seconds readings are: 35 46 45 36 38
Accumulation over last 5s = 200
Average over last 5s = 40
Accumulation over all time = 7183
Average over all time = 41.0457

last 5 seconds readings are: 48 39 42 42 38
Accumulation over last 5s = 209
Average over last 5s = 41.8
Accumulation over all time = 7392
Average over all time = 41.0667

ahmed@ahmed-virtual-machine: ~/projects/phase_4
Accumulation over last 5s = 186
Average over last 5s = 37.2
Accumulation over all time = 384
Average over all time = 38.4

last 5 seconds readings are: 40 43 47 44 35
Accumulation over last 5s = 209
Average over last 5s = 41.8
Accumulation over all time = 593
Average over all time = 39.5333

last 5 seconds readings are: 41 44 34 41 42
Accumulation over last 5s = 202
Average over last 5s = 40.4
Accumulation over all time = 795
Average over all time = 39.75

last 5 seconds readings are: 38 44 35 37 39
Accumulation over last 5s = 193
Average over last 5s = 38.6
Accumulation over all time = 988
Average over all time = 39.52

last 5 seconds readings are: 38 42 44 48 35
Accumulation over last 5s = 207
Average over last 5s = 41.4
Accumulation over all time = 1195
Average over all time = 39.8333

last 5 seconds readings are: 35 46 45 36 38
Accumulation over last 5s = 200
Average over last 5s = 40
Accumulation over all time = 1395
Average over all time = 39.8571

last 5 seconds readings are: 48 39 42 42 38
Accumulation over last 5s = 209
Average over last 5s = 41.8
Accumulation over all time = 1604
Average over all time = 40.1
```

```
ahmed@ahmed-virtual-machine: ~/projects/phase_4
server
Accumulation over last 5s = 199
Average over last 5s = 39.8
Accumulation over all time = 10223
Average over all time = 41.7

client localhost connected on port 53458
last 5 seconds readings are: 48 41 34 39 37
Accumulation over last 5s = 199
Average over last 5s = 39.8
Accumulation over all time = 10223
Average over all time = 41.7

client localhost connected on port 53460
last 5 seconds readings are: 43 42 44 45 44
Accumulation over last 5s = 218
Average over last 5s = 43.6
Accumulation over all time = 417
Average over all time = 41.7

client localhost connected on port 39576
last 5 seconds readings are: 50 39 47 45 37
Accumulation over last 5s = 218
Average over last 5s = 43.6
Accumulation over all time = 635
Average over all time = 42.3333

last 5 seconds readings are: 42 48 41 40 36
Accumulation over last 5s = 207
Average over last 5s = 41.4
Accumulation over all time = 842
Average over all time = 42.1

ahmed@ahmed-virtual-machine: ~/projects/phase_4
server
Accumulation over last 5s = 205
Average over last 5s = 41
Accumulation over all time = 205
Average over all time = 41

client
last 5 seconds readings are: 39 37 43 42 44
Accumulation over last 5s = 205
Average over last 5s = 41
Accumulation over all time = 205
Average over all time = 41

ahmed@ahmed-virtual-machine: ~/projects/phase_4
server
Accumulation over last 5s = 225
Average over last 5s = 45
Accumulation over all time = 430
Average over all time = 43

client
last 5 seconds readings are: 45 44 50 39 47
Accumulation over last 5s = 225
Average over last 5s = 45
Accumulation over all time = 430
Average over all time = 43

ahmed@ahmed-virtual-machine: ~/projects/phase_4
server
Accumulation over last 5s = 225
Average over last 5s = 45
Accumulation over all time = 430
Average over all time = 43

client
last 5 seconds readings are: 42 44 45 44 50
Accumulation over last 5s = 225
Average over last 5s = 45
Accumulation over all time = 430
Average over all time = 43
```

Server Shutdown terminates the client listening.

```
ahmed@ahmed-virtual-machine: ~/projects/phase_4
last 5 seconds readings are: 46 46 44 36 45
Accumulation over last 5s = 217
Average over last 5s = 39.8
Accumulation over all time = 3351
Average over all time = 41.7867

last 5 seconds readings are: 40 37 37 38 36
Accumulation over last 5s = 188
Average over last 5s = 37.6
Accumulation over all time = 3539
Average over all time = 41.6353

last 5 seconds readings are: 36 45 44 37 36
Accumulation over last 5s = 198
Average over last 5s = 39.6
Accumulation over all time = 3727
Average over all time = 41.5222

last 5 seconds readings are: 46 46 42 36 51
Accumulation over last 5s = 221
Average over last 5s = 44.2
Accumulation over all time = 3958
Average over all time = 41.6632

last 5 seconds readings are: 48 44 43 44 32
Accumulation over last 5s = 211
Average over last 5s = 42.2
Accumulation over all time = 4169
Average over all time = 41.65

last 5 seconds readings are: 40 34 41 45 31
Accumulation over last 5s = 191
Average over last 5s = 38.2
Accumulation over all time = 4360
Average over all time = 41.5238

ERROR: connection to the server is lost
Server connection lost either terminated or crashed
This is enforced termination for the client as server seems to be down now, check server side!
ahmed@ahmed-virtual-machine: ~/projects/phase_4
```

Unit Test:

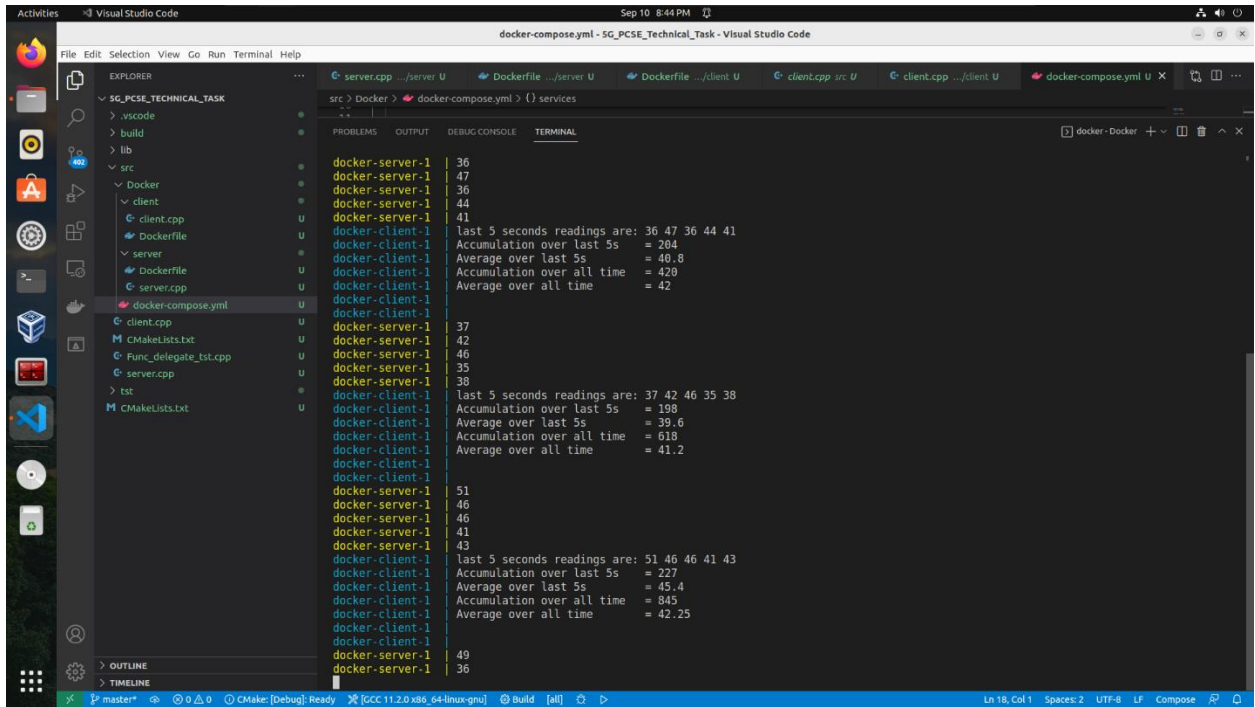
```
unit_test.cpp - SG_PCSE_Technical_Task - Visual Studio Code
1  #include <iostream>
2  #include <vector>
3  #include <gtest/gtest.h>
4
5  using namespace std;
6
7  TEST(unit_test1, accu_calc_test) {
8      std::vector<int> vec = {50,50,50,50,50};
9      int accu_temp = 0;
10
11      EXPECT_EQ(250, accu_calc_test(vec, accu_temp));
12  }
13
14  int main() {
15      return 0;
16  }
```

```
ahmed@ahmed-virtual-machine: ~/projects/SG_PCSE_Technical_Task/build/tst$ ./SG_PCSE_Technical_Task_tst
Running 2 tests from 2 test suites.
Global test environment set-up.
1 test from unit_test1
[ RUN      ] unit_test1.accu_calc_test
[ OK       ] unit_test1.accu_calc_test (0 ms)
1 test from unit_test1 (0 ms total)

1 test from unit_test2
[ RUN      ] unit_test2.avg_calc_test
[ OK       ] unit_test2.avg_calc_test (0 ms)
1 test from unit_test2 (0 ms total)

Global test environment tear-down
2 tests from 2 test suites ran. (0 ms total)
PASSED 2 tests.
```

Containerization (Docker and Docker Compose):



```
src > Docker > docker-compose.yml > {} services
PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL
docker-server-1 36
docker-server-1 47
docker-server-1 36
docker-server-1 44
docker-server-1 41
docker-client-1 last 5 seconds readings are: 36 47 36 44 41
docker-client-1 Accumulation over last 5s = 204
docker-client-1 Average over last 5s = 40.8
docker-client-1 Accumulation over all time = 420
docker-client-1 Average over all time = 42
docker-client-1
docker-server-1 37
docker-server-1 42
docker-server-1 46
docker-server-1 35
docker-server-1 38
docker-client-1 last 5 seconds readings are: 37 42 46 35 38
docker-client-1 Accumulation over last 5s = 198
docker-client-1 Average over last 5s = 39.6
docker-client-1 Accumulation over all time = 618
docker-client-1 Average over all time = 41.2
docker-client-1
docker-server-1 51
docker-server-1 46
docker-server-1 46
docker-server-1 41
docker-server-1 43
docker-client-1 last 5 seconds readings are: 51 46 46 41 43
docker-client-1 Accumulation over last 5s = 227
docker-client-1 Average over last 5s = 45.4
docker-client-1 Accumulation over all time = 845
docker-client-1 Average over all time = 42.25
docker-client-1
docker-server-1 49
docker-server-1 36
```