

1) development environment and how to build dependencies

+) ubuntu-18.04.4-desktop-amd64.iso (Linux OS)

+) gcc/g++ 7.5.0 (with std::tr1 support for function, bind, shared_from_this, ...)

+) pthread (multi thread)

+) glog (debug logging)

+) gtest (googletest unit test)

+) valgrind (memory leak)

+) exprtk (c++ mathematical expression library)

a) step 1: update ubuntu with command line:

```
sudo apt update
```

b) step 2: install gcc/g++ with command line:

```
sudo apt install gcc g++
```

c) step 3: libpthread.so is available in ubuntu 18.04.4 with path “/usr/lib/x86_64-linux-gnu”

d) step 4: install glog with command line:

```
sudo apt install autoconf libtool make
```

```
tar xvf glog-0.4.0.tar.gz
```

```
cd glog-0.4.0/
```

```
./autogen.sh
```

```
./configure --prefix=$HOME/CocCoc/glog-0.4.0
```

```
make
```

```
make install
```

e) step 5: install gtest with command line:

```
sudo apt install cmake
```

```
tar xvf googletest-release-1.8.1.tar.gz
```

```
cd googletest-release-1.8.1/
```

```
mkdir mybuild
```

```
cd mybuild/
```

```
cmake ../ -DCMAKE_INSTALL_PREFIX=$HOME/CocCoc/googletest-release-1.8.1
```

```
make
```

```
make install
```

f) step 6: install valgrind with command line:

```
sudo apt install valgrind
```

2) how to build unit test (googletest) using makefile

+ step 1: clean all with command line as follow:

```
make clean
```

+ step 2: build eventmanager test with command line as follow:

```
make eventmanager_test
```

+ step 3: build iobuffer test with command line as follow:

```
make iobuffer_test
```

+ step 4: build tcp test with command line as follow:

```
make tcp_test
```

3) how to run unit test (googletest) and memory leak (valgrind) using makefile

+ step 1: run eventmanager test with command line as follow:

make eventmanager_valgrind

```
quang@ubuntu: ~/Desktop/coccoc_edit/homework/final/homework_assignment
File Edit View Search Terminal Help
-----] 11 tests from EventManagerTest
RUN    ] EventManagerTest.StartStop
      OK ] EventManagerTest.StartStop (3 ms)
RUN    ] EventManagerTest.NotificationDelayedRaise
      OK ] EventManagerTest.NotificationDelayedRaise (2 ms)
RUN    ] EventManagerTest.NotificationPreDelayRaise
      OK ] EventManagerTest.NotificationPreDelayRaise (1 ms)
RUN    ] EventManagerTest.StartEnqueueStop
      OK ] EventManagerTest.StartEnqueueStop (2 ms)
RUN    ] EventManagerTest.StartEnqueueStop2
      OK ] EventManagerTest.StartEnqueueStop2 (2 ms)
RUN    ] EventManagerTest.StartEnqueueStop3
      OK ] EventManagerTest.StartEnqueueStop3 (6 ms)
RUN    ] EventManagerTest.StartEnqueueStop4
      OK ] EventManagerTest.StartEnqueueStop4 (6 ms)
RUN    ] EventManagerTest.CallMethodsFromWorkerThread
      OK ] EventManagerTest.CallMethodsFromWorkerThread (3 ms)
RUN    ] EventManagerTest.WatchFdAndRemoveFdFromWorker
      OK ] EventManagerTest.WatchFdAndRemoveFdFromWorker (5 ms)
RUN    ] EventManagerTest.WatchFdConcurrentReadWrite
      OK ] EventManagerTest.WatchFdConcurrentReadWrite (4 ms)
RUN    ] EventManagerTest.TestCancel
      OK ] EventManagerTest.TestCancel (2 ms)
-----] 11 tests from EventManagerTest (45 ms total)

-----] Global test environment tear-down
=====] 11 tests from 1 test case ran. (48 ms total)
[PASSED] 11 tests.
==22202==
==22202== HEAP SUMMARY:
==22202==   in use at exit: 0 bytes in 0 blocks
==22202==   total heap usage: 16,984 allocs, 16,984 frees, 1,715,749 bytes allocated
==22202==
==22202== All heap blocks were freed -- no leaks are possible
==22202==
==22202== ERROR SUMMARY: 0 errors from 0 contexts (suppressed: 0 from 0)
==22202== ERROR SUMMARY: 0 errors from 0 contexts (suppressed: 0 from 0)
quang@ubuntu:~/Desktop/coccoc_edit/homework/final/homework_assignment$
```

+ step 2: run iobuffer test with command line as follow:

make iobuffer_valgrind

```
quang@ubuntu: ~/Desktop/coccoc_edit/homework/final/homework_assignment
File Edit View Search Terminal Help
=====] Running 2 tests from 1 test case.
-----] Global test environment set-up.
-----] 2 tests from IOBufferTest
RUN    ] IOBufferTest.AppendBytes
      OK ] IOBufferTest.AppendBytes (1 ms)
RUN    ] IOBufferTest.ConsumeBeforePullDown
      OK ] IOBufferTest.ConsumeBeforePullDown (1 ms)
-----] 2 tests from IOBufferTest (3 ms total)

-----] Global test environment tear-down
=====] 2 tests from 1 test case ran. (5 ms total)
[PASSED] 2 tests.

Repeating all tests (iteration 100) . . .

=====] Running 2 tests from 1 test case.
-----] Global test environment set-up.
-----] 2 tests from IOBufferTest
RUN    ] IOBufferTest.AppendBytes
      OK ] IOBufferTest.AppendBytes (1 ms)
RUN    ] IOBufferTest.ConsumeBeforePullDown
      OK ] IOBufferTest.ConsumeBeforePullDown (1 ms)
-----] 2 tests from IOBufferTest (3 ms total)

-----] Global test environment tear-down
=====] 2 tests from 1 test case ran. (5 ms total)
[PASSED] 2 tests.
--24494-- REDIR: 0x56939c0 (libc.so.6:free) redirected to 0x4c30cd0 (free)
==24494==
==24494== HEAP SUMMARY:
==24494==   in use at exit: 0 bytes in 0 blocks
==24494==   total heap usage: 3,096 allocs, 3,096 frees, 721,459 bytes allocated
==24494==
==24494== All heap blocks were freed -- no leaks are possible
==24494==
==24494== ERROR SUMMARY: 0 errors from 0 contexts (suppressed: 0 from 0)
==24494== ERROR SUMMARY: 0 errors from 0 contexts (suppressed: 0 from 0)
quang@ubuntu:~/Desktop/coccoc_edit/homework/final/homework_assignment$
```

- + step 3: run tcp test with command line as follow:
make tcp_valgrind

```
quang@ubuntu: ~/Desktop/coccoc_edit/homework/final/homework_assignment
File Edit View Search Terminal Help
===== 7 tests from 1 test case ran. (174 ms total)
[PASSED] 7 tests.

Repeating all tests (iteration 100) . . .

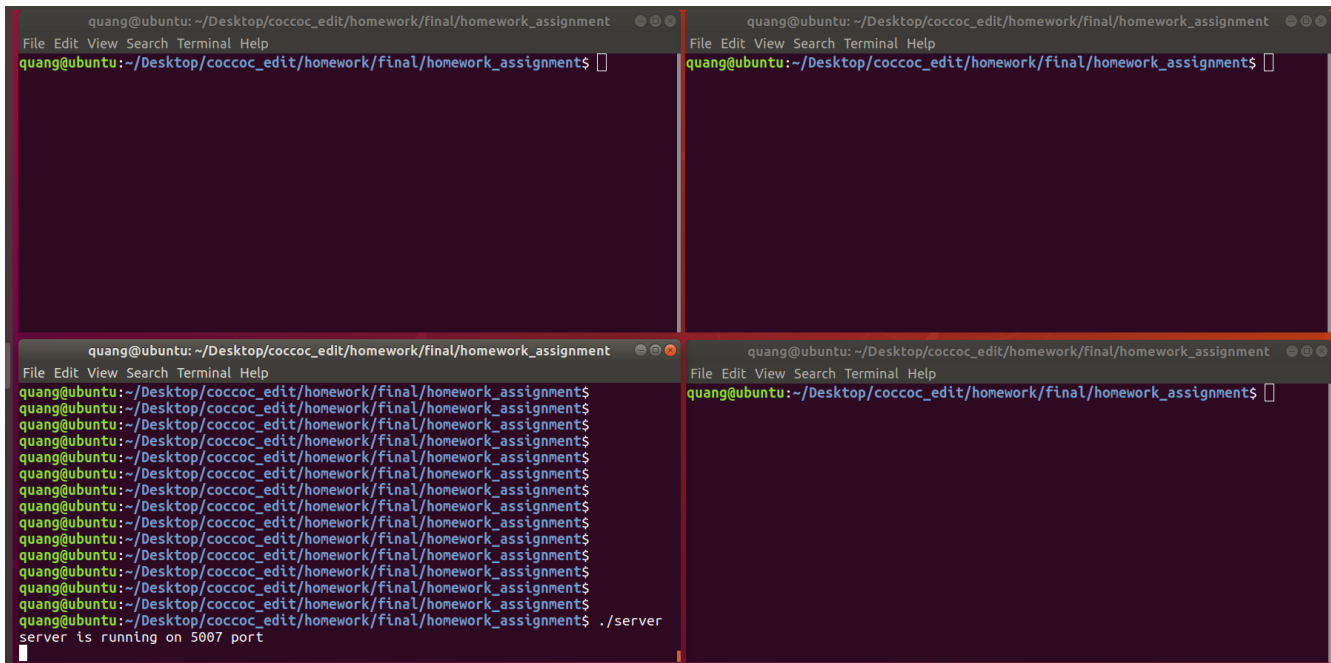
===== Running 7 tests from 1 test case.
----- Global test environment set-up.
----- 7 tests from TCPTTest
RUN    OK    TCPTTest.ListenTest
RUN    OK    TCPTTest.ListenTest (3 ms)
RUN    OK    TCPTTest.ListenConnectTest
RUN    OK    TCPTTest.ListenConnectTest (2 ms)
RUN    OK    TCPTTest.ListenConnectSendDataTest
RUN    OK    TCPTTest.ListenConnectSendDataTest (14 ms)
RUN    OK    TCPTTest.ListenConnectDisconnectTest
RUN    OK    TCPTTest.ListenConnectDisconnectTest (8 ms)
RUN    OK    TCPTTest.WriteBeforeStartedClient
0915 23:34:03.229988 24701 tcp_test.cpp:173] Print 0
RUN    OK    TCPTTest.WriteBeforeStartedClient (11 ms)
RUN    OK    TCPTTest.FillWriteBuffer
RUN    OK    TCPTTest.FillWriteBuffer (108 ms)
RUN    OK    TCPTTest.WriteAfterDisconnect
RUN    OK    TCPTTest.WriteAfterDisconnect (13 ms)
----- 7 tests from TCPTTest (162 ms total)

----- Global test environment tear-down
===== 7 tests from 1 test case ran. (164 ms total)
[PASSED] 7 tests.

==24701==
==24701== HEAP SUMMARY:
==24701==   in use at exit: 0 bytes in 0 blocks
==24701==   total heap usage: 52,978 allocs, 52,978 frees, 611,497,624 bytes allocated
==24701==
==24701== All heap blocks were freed -- no leaks are possible
==24701==
==24701== ERROR SUMMARY: 0 errors from 0 contexts (suppressed: 0 from 0)
==24701== ERROR SUMMARY: 0 errors from 0 contexts (suppressed: 0 from 0)
quang@ubuntu:~/Desktop/coccoc_edit/homework/final/homework_assignment$
```

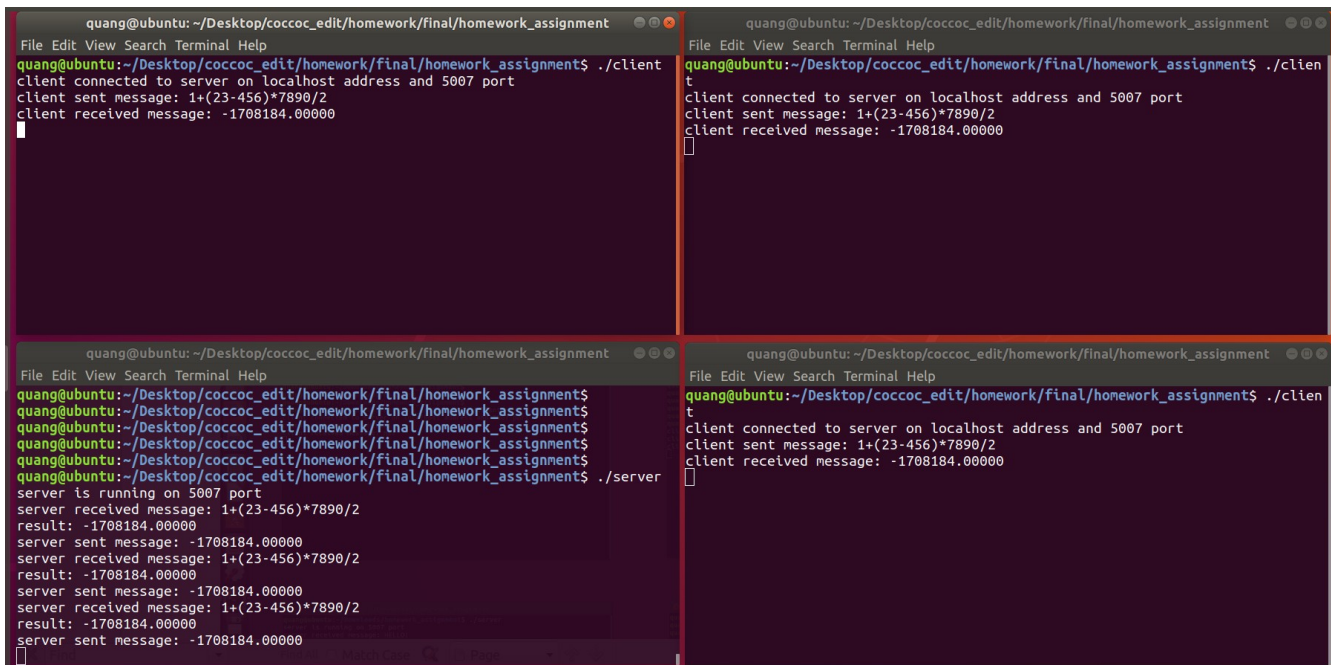
- 4) how to build socket (server and client) using makefile
 - + step 1: build server with command line as follow:
make server
 - + step 2: build client with command line as follow:
make client

5) how to test communication between server and client via tcp socket
+ Server is running on 5007 port: run command line as follow:
./server



The image shows four terminal windows arranged in a 2x2 grid. Each window has a title bar that reads 'quang@ubuntu: ~/Desktop/coccoc_edit/homework/final/homework_assignment'. The top-left and top-right windows are empty, showing only the prompt 'quang@ubuntu:~/Desktop/coccoc_edit/homework/final/homework_assignment\$'. The bottom-left window shows the command './server' being executed, followed by the output 'server is running on 5007 port'. The bottom-right window is empty, showing only the prompt.

+ Client connected to server on localhost address and 5007 port: run command line as follow:
./client



The image shows four terminal windows arranged in a 2x2 grid. The top-left window shows the command './client' being executed, followed by the output: 'client connected to server on localhost address and 5007 port', 'client sent message: 1+(23-456)*7890/2', and 'client received message: -1708184.00000'. The top-right window shows the same output as the top-left window. The bottom-left window shows the command './server' being executed, followed by the output: 'server is running on 5007 port', 'server received message: 1+(23-456)*7890/2', 'result: -1708184.00000', 'server sent message: -1708184.00000', 'server received message: 1+(23-456)*7890/2', 'result: -1708184.00000', 'server sent message: -1708184.00000', 'server received message: 1+(23-456)*7890/2', 'result: -1708184.00000', and 'server sent message: -1708184.00000'. The bottom-right window shows the same output as the bottom-left window.