Report

1DV701 Computer Networks - an introduction

Assignment 1: UDP/TCP socket programming

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Task 1:


```
ubuntu@ubuntu-VirtualBox:~$ ping 192.168.56.5 -c 5
PING 192.168.56.5 (192.168.56.5) 56(84) bytes of data.
64 bytes from 192.168.56.5: icmp_seq=1 ttl=128 time=0.403 ms
64 bytes from 192.168.56.5: icmp_seq=2 ttl=128 time=0.989 ms
64 bytes from 192.168.56.5: icmp_seq=3 ttl=128 time=0.893 ms
64 bytes from 192.168.56.5: icmp_seq=4 ttl=128 time=1.03 ms
64 bytes from 192.168.56.5: icmp_seq=5 ttl=128 time=1.04 ms

--- 192.168.56.5 ping statistics ---
5 packets transmitted, 5 received, 0% packet loss, time 4006ms
rtt min/avg/max/mdev = 0.403/0.872/1.048/0.243 ms
ubuntu@ubuntu-VirtualBox:~$
```

This task aims to check the network connection between host and virtual machine. The version of Ubuntu is 15.04, and the host machine is Windows 10 Home with 64-bit operating system. After completing the installation of the environment, the virtual machine send five messages to the host machine by the "ping -c 5" program. According to the statistics, each message spent around 0.872 ms on transferring.

Task 2:


```
C:\Users\Ann Stormrage\eclipse-workspace\701\bin>java -cp . dv201.labb2/UDPEchoClient 192.168.56.4 4950 1024 5
16 bytes sent and received
Number 1 message(s).
16 bytes sent and received
Number 2 message(s).
16 bytes sent and received
Number 3 message(s).
16 bytes sent and received
Number 4 message(s).
16 bytes sent and received
Number 5 message(s).
End client cause one second reached.

C:\Users\Ann Stormrage\eclipse-workspace\701\bin>
```

For sending 5 messages in one second, the server program was executed on the virtual machine and the client program was executed on the host machine. The four parameters are IP address, port number, buffer size, and transfer rate.

The including exception are listed as following:

1. The user does not input four parameters with correct value.
2. The format of the IP address is not correct.
3. The buffer size is outside of the reasonable range.
4. The socket can not be initialized.
5. The socket can not be bind with the IP address or port number.
6. The message should be send at least once, and the transfer rate value for UDP should be a positive integer.
7. The amount of clients should also be a positive integer.
8. The packet does not send.
9. The sent packet does not receive.
10. The steam can not be transfer.
11. The received message is not equal to the sent one.

VG-task 1

```
C:\Users\Ann Stormrage\eclipse-workspace\701\bin>java -cp . dv201.labb2/UDPEchoClient 192.168.56.4 4950 1024 366
16 bytes sent and received
Number 1 message(s)
16 bytes sent and received
Number 2 message(s)
16 bytes sent and received
Number 3 message(s)
```

....

```
16 bytes sent and received
Number 325 message(s)
16 bytes sent and received
Number 326 message(s)
16 bytes sent and received
Number 327 message(s)
16 bytes sent and received
Number 328 message(s)
16 bytes sent and received
Number 329 message(s)
End client cause one second reached. The amount of remaining messages is 37

C:\Users\Ann Stormrage\eclipse-workspace\701\bin>
```

This task asks to send the specified amount of messages in exactly one second, and notify the user about the amount of remaining messages when the transfer rate is too big. For example, the picture illustrated the result of sending 366 messages per second. The amount of remaining messages is 37 when one second reached. I found the maximum transfer rate is around 300 to 400 messages every second on my laptop.

VG-task 2
This is the last part of my implementation, this task updated the structure of my codes. The abstract class, Networklayer, is extended by both UDP and TCP classes. The result can be viewed in the src folder. Due to the transfer rate is just required by the UDP client, it is not included in this layer. However, the stream reader is used by both

TCP client and server thus it belongs to the abstract class. The abstract layer conclude the common application of two kind of protocols.

Task 3:

3.1 TCP supports multiple clients


```
C:\Users\Ann Stormrage\eclipse-workspace\701\bin>java -cp . dv201.labb2/TCPEchoClient 192.168.56.4 4950 1024 10
The 1 message(s)  has been sent.
The 2 message(s)  has been sent.
The 3 message(s)  has been sent.
The 4 message(s)  has been sent.
The 6 message(s)  has been sent.
The 7 message(s)  has been sent.
The 8 message(s)  has been sent.
The 9 message(s)  has been sent.
The 5 message(s)  has been sent.
The 10 message(s)  has been sent.

C:\Users\Ann Stormrage\eclipse-workspace\701\bin>
```

```
^Croot@ubuntu-VirtualBox:/media/sf_bin# java -cp . dv201.labb2/TCPEchoServer
TCP Server Start.
Client (ID: 1 ) joined.
New message: Hello from the another sideaaaaaaaa From client 1
Client (ID: 1 ) disconnected.

Client (ID: 2 ) joined.
New message: Hello from the another sideaaaaaaaa From client 2
Client (ID: 2 ) disconnected.

Client (ID: 3 ) joined.
New message: Hello from the another sideaaaaaaaa From client 3
Client (ID: 3 ) disconnected.

Client (ID: 4 ) joined.
New message: Hello from the another sideaaaaaaaa From client 4
Client (ID: 4 ) disconnected.

Client (ID: 6 ) joined.
New message: Hello from the another sideaaaaaaaa From client 6
Client (ID: 6 ) disconnected.

          joined.
   ...ello from the another sideaaaaaaaa From client 7
Client (ID: 7 ) disconnected.

Client (ID: 8 ) joined.
New message: Hello from the another sideaaaaaaaa From client 8
Client (ID: 8 ) disconnected.

Client (ID: 9 ) joined.
New message: Hello from the another sideaaaaaaaa From client 9
Client (ID: 9 ) disconnected.

Client (ID: 5 ) joined.
New message: Hello from the another sideaaaaaaaa From client 5
Client (ID: 5 ) disconnected.

Client (ID: 10 ) joined.
New message: Hello from the another sideaaaaaaaa From client 10
Client (ID: 10 ) disconnected.

^Croot@ubuntu-VirtualBox:/media/sf_bin# 
```

It is the first requirement of problem 3. For showing that the TCP supports multiple client connections, the Java threads are used for updating the codes from task 1. The screenshot shows that 10 clients send messages by threads from the host machine to the server that was started by the virtual machine.

3.2 Smaller buffer size and bigger messages size

Then the client buffer size was adjusted from 1024 to smaller value 64 in the abstract

class and size of message becomes bigger.

TCP:

```
^Croot@ubuntu-VirtualBox:/media/sf_bin# java -cp . dv201.labb2/TCPEchoServer
TCP Server Start.
Client (ID: 1 ) joined.
New message: CATMEOWMEOWMEOWCATMEOWMEOWMEOWCATMEOWMEOWMEOWCATMEOWMEOWMEOWCATMEOWMEOWMEOWCATMEOWMEOWMEOWCATM
EOWMEOWMEOWCATMEOWMEOWMEOWCATMEOWMEOWMEOWCATMEOWMEOWMEOWCATMEOWMEOWMEOWCATMEOWMEOWMEOW From client 1
Client (ID: 2 ) joined.
New message: CATMEOWMEOWMEOWCATMEOWMEOWMEOWCATMEOWMEOWMEOWCATMEOWMEOWMEOWCATMEOWMEOWMEOWCATMEOWMEOWMEOWCATM
EOWMEOWMEOWCATMEOWMEOWMEOWCATMEOWMEOWMEOWCATMEOWMEOWMEOWCATMEOWMEOWMEOWCATMEOWMEOWMEOW From client 2
Client (ID: 2 ) disconnected.

Client (ID: 1 ) disconnected.

Client (ID: 3 ) joined.
New message: CATMEOWMEOWMEOWCATMEOWMEOWMEOWCATMEOWMEOWMEOWCATMEOWMEOWMEOWCATMEOWMEOWMEOWCATMEOWMEOWMEOWCATM
EOWMEOWMEOWCATMEOWMEOWMEOWCATMEOWMEOWMEOWCATMEOWMEOWMEOWCATMEOWMEOWMEOWCATMEOWMEOWMEOW From client 3
Client (ID: 3 ) disconnected.

Client (ID: 4 ) joined.
New message: CATMEOWMEOWMEOWCATMEOWMEOWMEOWCATMEOWMEOWMEOWCATMEOWMEOWMEOWCATMEOWMEOWMEOWCATMEOWMEOWMEOWCATM
EOWMEOWMEOWCATMEOWMEOWMEOWCATMEOWMEOWMEOWCATMEOWMEOWMEOWCATMEOWMEOWMEOWCATMEOWMEOWMEOW From client 4
Client (ID: 4 ) disconnected.

Client (ID: 5 ) joined.
New message: CATMEOWMEOWMEOWCATMEOWMEOWMEOWCATMEOWMEOWMEOWCATMEOWMEOWMEOWCATMEOWMEOWMEOWCATMEOWMEOWMEOWCATM
EOWMEOWMEOWCATMEOWMEOWMEOWCATMEOWMEOWMEOWCATMEOWMEOWMEOWCATMEOWMEOWMEOWCATMEOWMEOWMEOW From client 5
Client (ID: 5 ) disconnected.

Client (ID: 6 ) joined.
New message: CATMEOWMEOWMEOWCATMEOWMEOWMEOWCATMEOWMEOWMEOWCATMEOWMEOWMEOWCATMEOWMEOWMEOWCATMEOWMEOWMEOWCATM
EOWMEOWMEOWCATMEOWMEOWMEOWCATMEOWMEOWMEOWCATMEOWMEOWMEOWCATMEOWMEOWMEOWCATMEOWMEOWMEOW From client 6
Client (ID: 6 ) disconnected.
```

......

```
New message: CATMEOWMEOWMEOWCATMEOWMEOWMEOWCATMEOWMEOWMEOWCATMEOWMEOWMEOWCATMEOWMEOWMEOWCATMEOWMEOWMEOWCATM
EOWMEOWMEOWCATMEOWMEOWMEOWCATMEOWMEOWMEOWCATMEOWMEOWMEOWCATMEOWMEOWMEOWCATMEOWMEOWMEOW From client 15
Client (ID: 15 ) disconnected.

Client (ID: 30 ) joined.
New message: CATMEOWMEOWMEOWCATMEOWMEOWMEOWCATMEOWMEOWMEOWCATMEOWMEOWMEOWCATMEOWMEOWMEOWCATMEOWMEOWMEOWCATM
EOWMEOWMEOWCATMEOWMEOWMEOWCATMEOWMEOWMEOWCATMEOWMEOWMEOWCATMEOWMEOWMEOWCATMEOWMEOWMEOW From client 30
New message: CATMEOWMEOWMEOWCATMEOWMEOWMEOWCATMEOWMEOWMEOWCATMEOWMEOWMEOWCATMEOWMEOWMEOWCATMEOWMEOWMEOWCATM
EOWMEOWMEOWCATMEOWMEOWMEOWCATMEOWMEOWMEOWCATMEOWMEOWMEOWCATMEOWMEOWMEOWCATMEOWMEOWMEOW From client 29
Client (ID: 29 ) disconnected.

Client (ID: 30 ) disconnected.

Client (ID: 12 ) disconnected.

Client (ID: 10 ) disconnected.

Client (ID: 16 ) disconnected.

^Croot@ubuntu-VirtualBox:/media/sf_bin#
```

```
C:\Users\Ann Stormrage\eclipse-workspace\701\bin>java -cp . dv201.labb2/TCPEchoClient 192.168.56.4 4950 64 30
The 1 message(s)  has been sent.
The 2 message(s)  has been sent.
The 3 message(s)  has been sent.
The 4 message(s)  has been sent.
The 5 message(s)  has been sent.
The 6 message(s)  has been sent.
The 7 message(s)  has been sent.
The 8 message(s)  has been sent.
The 9 message(s)  has been sent.
The 11 message(s)  has been sent.
The 28 message(s)  has been sent.
The 27 message(s)  has been sent.
The 26 message(s)  has been sent.
The 25 message(s)  has been sent.
The 24 message(s)  has been sent.
The 22 message(s)  has been sent.
The 23 message(s)  has been sent.
The 20 message(s)  has been sent.
The 21 message(s)  has been sent.
The 19 message(s)  has been sent.
The 18 message(s)  has been sent.
The 17 message(s)  has been sent.
The 14 message(s)  has been sent.
The 13 message(s)  has been sent.
The 10 message(s)  has been sent.
The 12 message(s)  has been sent.
The 15 message(s)  has been sent.
The 16 message(s)  has been sent.
The 30 message(s)  has been sent.
The 29 message(s)  has been sent.

C:\Users\Ann Stormrage\eclipse-workspace\701\bin>
```

UDP:

With UDP, the received messages are not equal to the sent one because the packets were lost. The difference is that the Packet Loss Rate of UDP is higher than TCP. When the same amount of messages sent, the UDP would receive fewer bytes than TCP, especially, for the sending packet is big. Because the TCP is more reliable but UDP is connectionless protocol. The detailed differences between the two protocols that caused packet losing will be explained in the next task.

Task 4:

This task asks to capture the traffic for both UDP and TCP by Wireshark software and repeat experiments with a small buffer size.

Explanation:

1. ACK in the TCP header is the acknowledgement number. It means that the machine sending the packet with ACK is acknowledging data that it had received from the other machine. ACK is beneficial for solving the packet loss problem.

2. SYN is the synchronize sequence number. It is used to indicate the start a TCP session. And FIN is used to indicate the termination of a TCP session.

3. PSH is push. It is an indication by the sender that the receiving machine's TCP implementation should provide the received data for reading.

TCP

UDP

The difference between TCP and UDP are listed in the following table after repeating experiments and searching on Internet.

Difference	UDP	TCP
Connection	Unreliable connectionless protocol	Reliable Connection-Oriented protocol
Transfer capacity	Suitable for sending small packet (max 64 k)	Bigger packet
Transfer speed	Quicker	Slower
System resource	Occupy less	Occupy more
Packet loss rate	Higher	Lower
Application	Live broadcasts	Browser