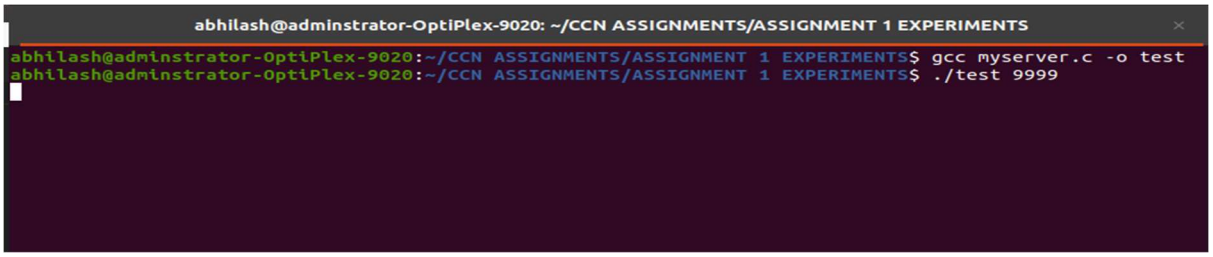
Special header files used on server and client side:

- sys/types.h : contains the definition of data types used in system calls.
- sys/socket.h : contains the definition of structure needed for socket.
- netinet/in.h : contains constants and structures needed for internet domain address.

In this assignment, separate menu are created for instructor and students and those menu are displayed accordingly when a student or instructor login. The username and password are pre stored in a text file named **user_pass.txt** and students' marks are stored in **student_marks.csv**.

Following are the screenshots taken when the program is run by the user:

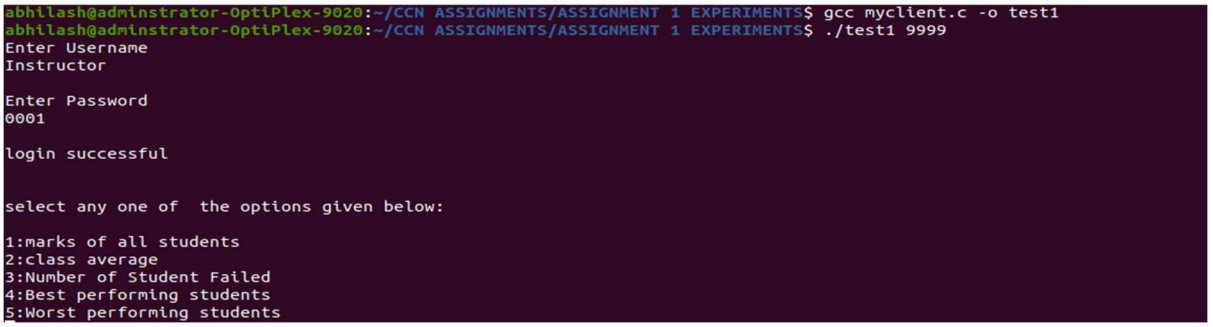
Server is in Listening Mode



Client has been connected to server

Client has been asking for Information from server

Instructor Logged In Using Name and Password



When instructor is logged in using the correct user id and password then menu opens up showing options as displayed in the above snippet's.

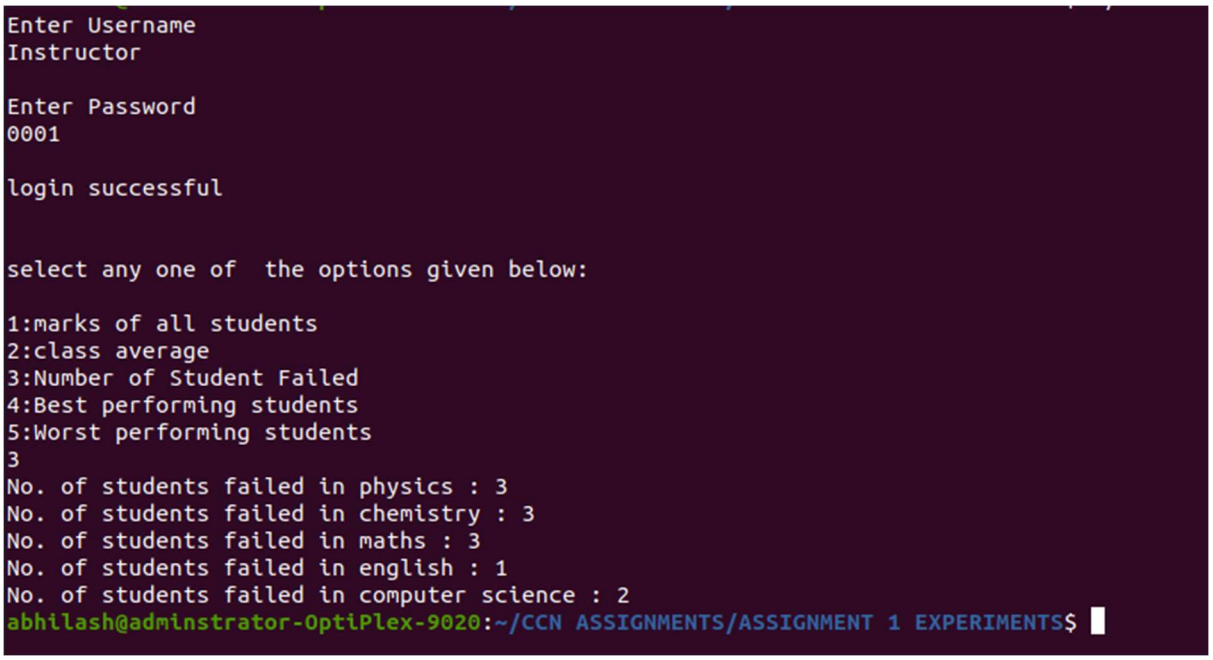
When Option '1' is selected student name and marks in respected subjects is displayed for every student.

```
Enter Username
Instructor

Enter Password
0001

login successful


select any one of  the options given below:

1:marks of all students
2:class average
3:Number of Student Failed
4:Best performing students
5:Worst performing students
1
Name                    Physics                 Chemistry               Maths                   English                 Computer science        Aggregate percentage
Daya                    96                      92                      89                      91                      85                      90
Abhi                    97                      91                      87                      99                      82                      91
Shek                    84                      83                      91                      66                      78                      80
Shivam                  78                      55                      41                      77                      59                      62
Sagar                   91                      86                      98                      86                      89                      90
Ayush                   96                      88                      86                      91                      90                      90
Rishi                   31                      30                      44                      20                      21                      29
Rohit                   88                      72                      89                      81                      86                      83
Sachin                  63                      87                      89                      61                      78                      75
Jyoti                   91                      90                      82                      89                      78                      86
Shruti                  90                      82                      88                      73                      74                      81
Kriti                   60                      52                      14                      80                      40                      49
Aman                    33                      25                      20                      41                      38                      31
Vivek                   66                      72                      69                      61                      68                      67
Arun                    86                      90                      85                      93                      80                      86
Ashish                  76                      52                      69                      81                      83                      72
Shivani                 66                      62                      79                      71                      78                      71
Ajeet                   16                      32                      29                      40                      19                      27
Ishan                   74                      84                      83                      90                      78                      81
Smriti                  86                      62                      59                      71                      68                      69
abhilash@adminstrator-OptiPlex-9020:~/CCN ASSIGNMENTS/ASSIGNMENT 1 EXPERIMENTS$
```

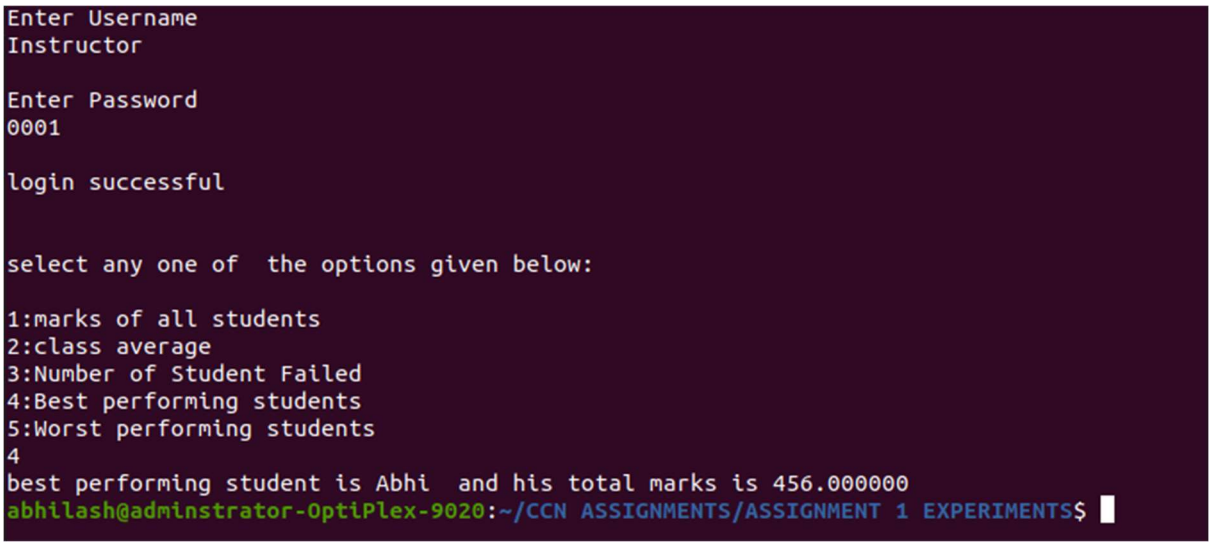
When Option 2 is Selected class average and subject average is displayed

```
Enter Username
Instructor

Enter Password
0001

login successful


select any one of  the options given below:

1:marks of all students
2:class average
3:Number of Student Failed
4:Best performing students
5:Worst performing students
2
Physics average = 73.400002
chemistry average = 69.349998
mathematics average = 69.550003
English average = 73.099998
Computer  science average = 68.599998
overall average = 70.800003
abhilash@adminstrator-OptiPlex-9020:~/CCN ASSIGNMENTS/ASSIGNMENT 1 EXPERIMENTS$
```

When Option 3 is Selected numbers of students failed subject-wise (having marks less than 33.33%) is displayed



When Option 4 is selected best performing student is displayed



When Option 5 is selected worst performing student is displayed

```
Enter Username
Instructor

Enter Password
0001

login successful


select any one of  the options given below:

1:marks of all students
2:class average
3:Number of Student Failed
4:Best performing students
5:Worst performing students
5
worst performing student is Ajeet  and his total marks is 136.000000
abhilash@adminstrator-OptiPlex-9020:~/CCN ASSIGNMENTS/ASSIGNMENT 1 EXPERIMENTS$
```

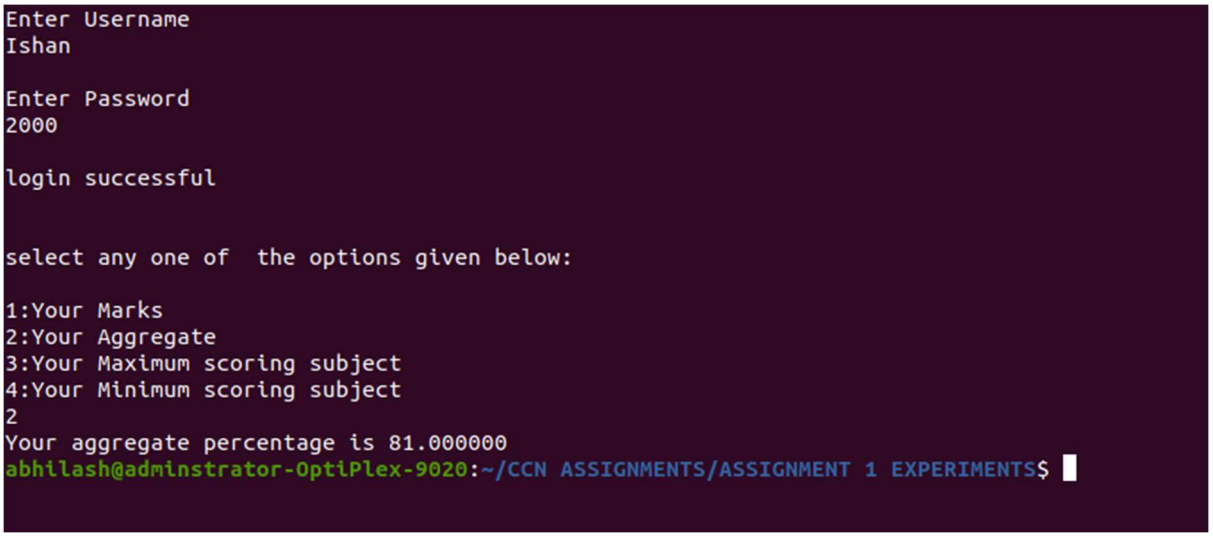
When student is logged in using student name and his password following menu is shown as given in the snippet below

```
Enter Username
Shivam

Enter Password
1122

login successful


select any one of  the options given below:

1:Your Marks
2:Your Aggregate
3:Your Maximum scoring subject
4:Your Minimum scoring subject
```

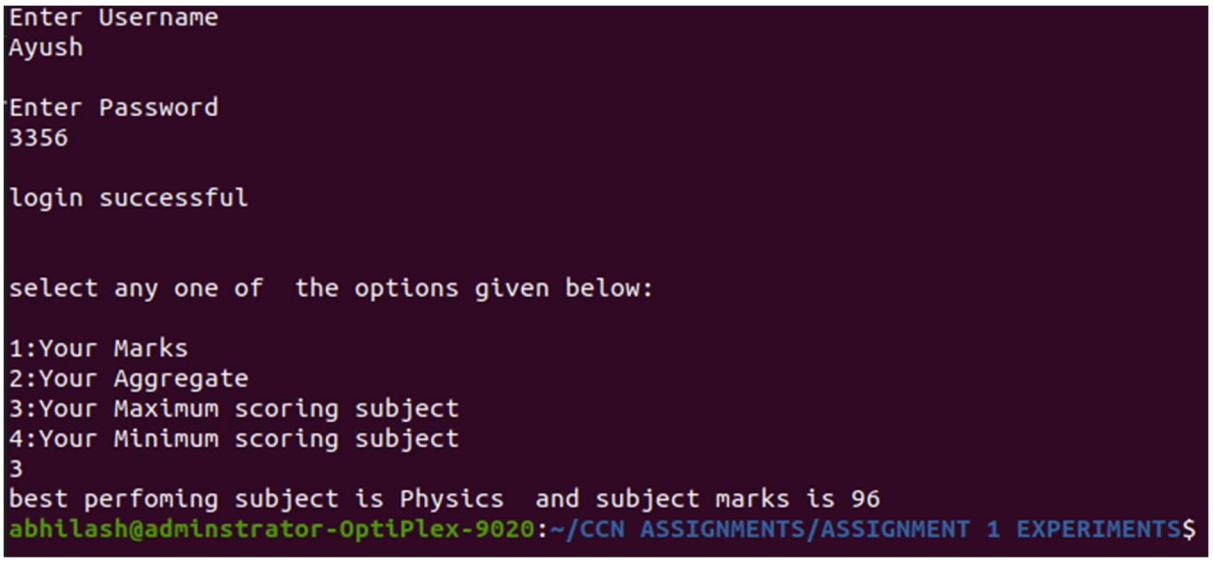
When Student select option 1, his/her marks is displayed

```
Enter Username
Shivam

Enter Password
1122

login successful


select any one of  the options given below:

1:Your Marks
2:Your Aggregate
3:Your Maximum scoring subject
4:Your Minimum scoring subject
1
Physics = 78     Chemistry = 55     Mathematics = 41     English = 77     Computer Science = 59
abhilash@adminstrator-OptiPlex-9020:~/CCN ASSIGNMENTS/ASSIGNMENT 1 EXPERIMENTS$
```

When Student select option 2, his/her Aggregate is displayed



When student select option 3, his/her maximum scoring subject is displayed



When student select option 4, his/her minimum scoring subject is displayed

```
Enter Username
Kriti

Enter Password
1219

login successful


select any one of  the options given below:

1:Your Marks
2:Your Aggregate
3:Your Maximum scoring subject
4:Your Minimum scoring subject
4
worst perfoming subject is Mathematics  and subject marks is 14
abhilash@adminstrator-OptiPlex-9020:~/CCN ASSIGNMENTS/ASSIGNMENT 1 EXPERIMENTS$
```

On entering wrong username or password, following message is displayed and server and client exit the connection.

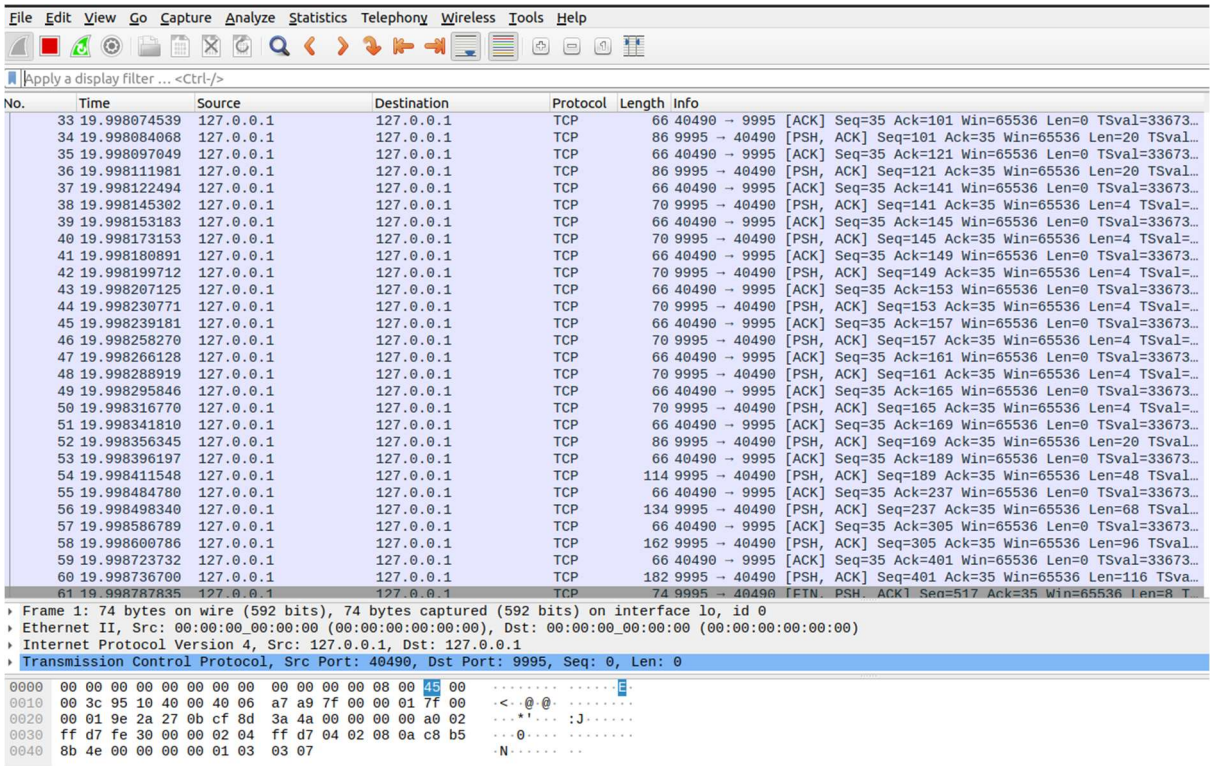
```
Enter Username
Daya

Enter Password
5678

login failed
```

Wireshark Analysis

- Wireshark is used to capture different types of network hardware such as Ethernet and shows the traffic flow.
- It can capture multiple network interface simultaneously.
- It also shows the decoded packets simultaneously.

Wireshark Environment

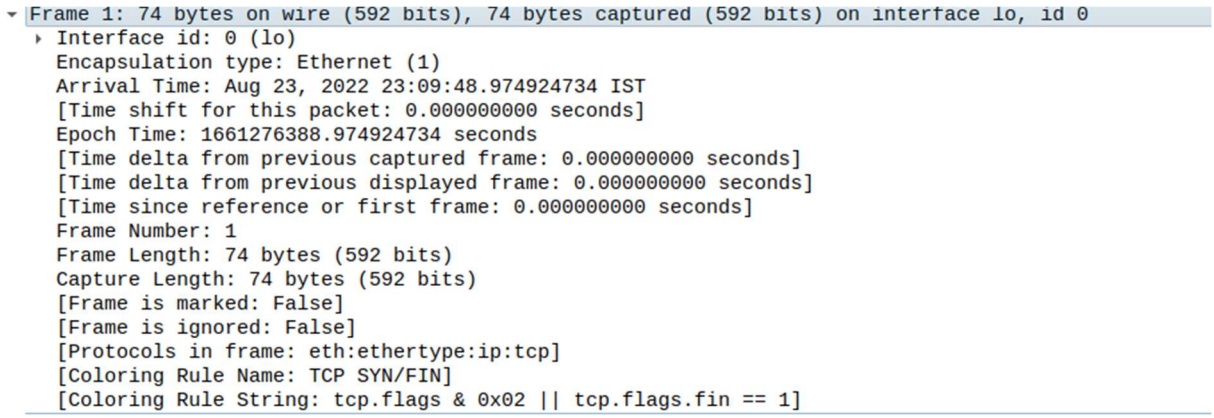
In this environment, while implementing client and server socket program we are able see the traffic flow between server and client and information like time source, destination , protocol(TCP) used between them ,length and some other information related to ports used. We start capturing the packets once the client server program is executed and stopped when execution is completed.



At the bottom of screen we see some raw data which is flowing from server and client in encrypted form and some other information also about frame, ethernet connection, transmission control protocol and data.

Frame Summary

This gives information about the frame number, frame length and captured length.



Ethernet summary

Here we can see the source and destination address for packet flowing in the network. Since we are using same system for both client and server, the source and destination address is same.

Internet protocol summary

This layer is concerned with the moving between the network. It shows the IP version that is being transmitted, the IP header length, the flags, the time-to-live and the protocol used. It also indicates the header checksum, IP source and destination addresses.

```
▾ Internet Protocol Version 4, Src: 127.0.0.1, Dst: 127.0.0.1
    0100 .... = Version: 4
    .... 0101 = Header Length: 20 bytes (5)
  ▸ Differentiated Services Field: 0x00 (DSCP: CS0, ECN: Not-ECT)
    Total Length: 60
    Identification: 0x9510 (38160)
  ▸ Flags: 0x4000, Don't fragment
    Fragment offset: 0
    Time to live: 64
    Protocol: TCP (6)
    Header checksum: 0xa7a9 [validation disabled]
    [Header checksum status: Unverified]
    Source: 127.0.0.1
    Destination: 127.0.0.1
```

Transmission Control Protocol summary

The transport layer is where the application communicates via the use of port. We observe that source port is 40490 and destination port is 9995.The length of header is 40 byte and window size value is 65495 and checksum is 0xfe30 which is unverified.

```
▾ Transmission Control Protocol, Src Port: 40490, Dst Port: 9995, Seq: 0, Len: 0
    Source Port: 40490
    Destination Port: 9995
    [Stream index: 0]
    [TCP Segment Len: 0]
    Sequence number: 0    (relative sequence number)
    Sequence number (raw): 3482139210
    [Next sequence number: 1    (relative sequence number)]
    Acknowledgment number: 0
    Acknowledgment number (raw): 0
    1010 .... = Header Length: 40 bytes (10)
  ▾ Flags: 0x002 (SYN)
      000. .... .... = Reserved: Not set
      ...0 .... .... = Nonce: Not set
      .... 0... .... = Congestion Window Reduced (CWR): Not set
      .... .0.. .... = ECN-Echo: Not set
      .... ..0. .... = Urgent: Not set
      .... ...0 .... = Acknowledgment: Not set
      .... .... 0... = Push: Not set
      .... .... .0.. = Reset: Not set
    ▸ .... .... ..1. = Syn: Set
      .... .... ...0 = Fin: Not set
      [TCP Flags: ··········S·]
    Window size value: 65495
    [Calculated window size: 65495]
    Checksum: 0xfe30 [unverified]
    [Checksum Status: Unverified]
    Urgent pointer: 0
  ▾ Options: (20 bytes), Maximum segment size, SACK permitted, Timestamps, No-Operation (NOP), Window scale
    ▸ TCP Option - Maximum segment size: 65495 bytes
    ▸ TCP Option - SACK permitted
    ▸ TCP Option - Timestamps: TSval 3367340878, TSecr 0
    ▸ TCP Option - No-Operation (NOP)
    ▸ TCP Option - Window scale: 7 (multiply by 128)
  ▾ [Timestamps]
      [Time since first frame in this TCP stream: 0.000000000 seconds]
      [Time since previous frame in this TCP stream: 0.000000000 seconds]
```

```
[Length: 14]
0000  00 00 00 00 00 00 00 00  00 00 00 00 08 00 45 00   ........ ......E·
0010  00 42 80 29 40 00 40 06  bc 8a 7f 00 00 01 7f 00   ·B·)@·@· ........
0020  00 01 27 0e 9e 7e 44 f4  e4 56 42 35 4c 35 80 18   ··'··~D· ·VB5L5··
0030  02 00 fe 36 00 00 01 01  08 0a cc 18 1d 3c cc 18   ···6···· ·····<··
0040  1d 3c 45 6e 74 65 72 20  50 61 73 73 77 6f 72 64   ·<Enter  Password
```

Here, we are not using any encryption in this server and client socket programming, The flow of information can be accessed easily by any unauthorized person. As in the below snippet we can easily see the password of the user.

```
0000  00 00 00 00 00 00 00 00  00 00 00 00 08 00 45 00   ........ ......E·
0010  00 38 7c 38 40 00 40 06  c0 85 7f 00 00 01 7f 00   ·8|8@·@· ........
0020  00 01 9e 7e 27 0e 42 35  4c 35 44 f4 e4 64 80 18   ···~'·B5 L5D··d··
0030  02 00 fe 2c 00 00 01 01  08 0a cc 18 29 c9 cc 18   ···,···· ····)···
0040  1d 3c 30 30 30 31                                 ·<0001
```

Hops are defined as number of routers that a packet jumps for reaching the destination. Since the flow of information of client and server is taking place on the same device, there is no hopping in this connection.