

## 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

```
abhilash@administrator-OptiPlex-9020: ~/CCN ASSIGNMENTS/ASSIGNMENT 1 EXPERIMENTS
abhilash@administrator-OptiPlex-9020:~/CCN ASSIGNMENTS/ASSIGNMENT 1 EXPERIMENTS$ gcc myserver.c -o test
abhilash@administrator-OptiPlex-9020:~/CCN ASSIGNMENTS/ASSIGNMENT 1 EXPERIMENTS$ ./test 9999
```

### Client has been connected to server

```
abhilash@administrator-OptiPlex-9020:~/CCN ASSIGNMENTS/ASSIGNMENT 1 EXPERIMENTS$ gcc myserver.c -o test
abhilash@administrator-OptiPlex-9020:~/CCN ASSIGNMENTS/ASSIGNMENT 1 EXPERIMENTS$ ./test 9999
client connected
```

### Client has been asking for Information from server

```
abhilash@administrator-OptiPlex-9020:~/CCN ASSIGNMENTS/ASSIGNMENT 1 EXPERIMENTS$ gcc myclient.c -o test1
abhilash@administrator-OptiPlex-9020:~/CCN ASSIGNMENTS/ASSIGNMENT 1 EXPERIMENTS$ ./test1 9999
Enter Username
```

### Instructor Logged In Using Name and Password

```
abhilash@administrator-OptiPlex-9020:~/CCN ASSIGNMENTS/ASSIGNMENT 1 EXPERIMENTS$ gcc myclient.c -o test1
abhilash@administrator-OptiPlex-9020:~/CCN ASSIGNMENTS/ASSIGNMENT 1 EXPERIMENTS$ ./test1 9999
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
```

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
Shrutti        90               82               88               73               74               81
Kriti          60               52               14               80               40               49
Anan           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
Ajay           16               32               29               40               19               27
Ishan          74               84               83               90               78               81
Smiti          86               62               59               71               68               69

abhilash@administrator-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@administrator-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**

```
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
3
No. of students failed in physics : 3
No. of students failed in chemistry : 3
No. of students failed in maths : 3
No. of students failed in english : 1
No. of students failed in computer science : 2
abhilash@administrator-OptiPlex-9020:~/CCN ASSIGNMENTS/ASSIGNMENT 1 EXPERIMENTS$
```

**When Option 4 is selected best 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
4
best performing student is Abhi and his total marks is 456.000000
abhilash@administrator-OptiPlex-9020:~/CCN ASSIGNMENTS/ASSIGNMENT 1 EXPERIMENTS$
```

## 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@administrator-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@administrator-OptiPlex-9020:~/CCN ASSIGNMENTS/ASSIGNMENT 1 EXPERIMENTS$
```

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

```
Enter Username
Ishan

Enter Password
2000

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
2
Your aggregate percentage is 81.000000
abhilash@administrator-OptiPlex-9020:~/CCN ASSIGNMENTS/ASSIGNMENT 1 EXPERIMENT$
```

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

```
Enter Username
Ayush

Enter Password
3356

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
3
best perfoming subject is Physics and subject marks is 96
abhilash@administrator-OptiPlex-9020:~/CCN ASSIGNMENTS/ASSIGNMENT 1 EXPERIMENT$
```

**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@administrator-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 to 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.

No.	Time	Source	Destination	Protocol	Length	Info
33	19.998074539	127.0.0.1	127.0.0.1	TCP	66	40490 → 9995 [ACK] Seq=35 Ack=101 Win=65536 Len=0 TSval=33673...
34	19.998084068	127.0.0.1	127.0.0.1	TCP	86	9995 → 40490 [PSH, ACK] Seq=101 Ack=35 Win=65536 Len=20 TSval=...
35	19.998097049	127.0.0.1	127.0.0.1	TCP	66	40490 → 9995 [ACK] Seq=35 Ack=121 Win=65536 Len=0 TSval=33673...
36	19.998111981	127.0.0.1	127.0.0.1	TCP	86	9995 → 40490 [PSH, ACK] Seq=121 Ack=35 Win=65536 Len=20 TSval=...
37	19.998122494	127.0.0.1	127.0.0.1	TCP	66	40490 → 9995 [ACK] Seq=35 Ack=141 Win=65536 Len=0 TSval=33673...
38	19.998145302	127.0.0.1	127.0.0.1	TCP	70	9995 → 40490 [PSH, ACK] Seq=141 Ack=35 Win=65536 Len=4 TSval=...
39	19.998153183	127.0.0.1	127.0.0.1	TCP	66	40490 → 9995 [ACK] Seq=35 Ack=145 Win=65536 Len=0 TSval=33673...
40	19.998173153	127.0.0.1	127.0.0.1	TCP	70	9995 → 40490 [PSH, ACK] Seq=145 Ack=35 Win=65536 Len=4 TSval=...
41	19.998180891	127.0.0.1	127.0.0.1	TCP	66	40490 → 9995 [ACK] Seq=35 Ack=149 Win=65536 Len=0 TSval=33673...
42	19.998199712	127.0.0.1	127.0.0.1	TCP	70	9995 → 40490 [PSH, ACK] Seq=149 Ack=35 Win=65536 Len=4 TSval=...
43	19.998207125	127.0.0.1	127.0.0.1	TCP	66	40490 → 9995 [ACK] Seq=35 Ack=153 Win=65536 Len=0 TSval=33673...
44	19.998230771	127.0.0.1	127.0.0.1	TCP	70	9995 → 40490 [PSH, ACK] Seq=153 Ack=35 Win=65536 Len=4 TSval=...
45	19.998239181	127.0.0.1	127.0.0.1	TCP	66	40490 → 9995 [ACK] Seq=35 Ack=157 Win=65536 Len=0 TSval=33673...
46	19.998258270	127.0.0.1	127.0.0.1	TCP	70	9995 → 40490 [PSH, ACK] Seq=157 Ack=35 Win=65536 Len=4 TSval=...
47	19.998266128	127.0.0.1	127.0.0.1	TCP	66	40490 → 9995 [ACK] Seq=35 Ack=161 Win=65536 Len=0 TSval=33673...
48	19.998288919	127.0.0.1	127.0.0.1	TCP	70	9995 → 40490 [PSH, ACK] Seq=161 Ack=35 Win=65536 Len=4 TSval=...
49	19.998295846	127.0.0.1	127.0.0.1	TCP	66	40490 → 9995 [ACK] Seq=35 Ack=165 Win=65536 Len=0 TSval=33673...
50	19.998316770	127.0.0.1	127.0.0.1	TCP	70	9995 → 40490 [PSH, ACK] Seq=165 Ack=35 Win=65536 Len=4 TSval=...
51	19.998341810	127.0.0.1	127.0.0.1	TCP	66	40490 → 9995 [ACK] Seq=35 Ack=169 Win=65536 Len=0 TSval=33673...
52	19.998356345	127.0.0.1	127.0.0.1	TCP	86	9995 → 40490 [PSH, ACK] Seq=169 Ack=35 Win=65536 Len=20 TSval=...
53	19.998396197	127.0.0.1	127.0.0.1	TCP	66	40490 → 9995 [ACK] Seq=35 Ack=189 Win=65536 Len=0 TSval=33673...
54	19.998411548	127.0.0.1	127.0.0.1	TCP	114	9995 → 40490 [PSH, ACK] Seq=189 Ack=35 Win=65536 Len=48 TSval=...
55	19.998484780	127.0.0.1	127.0.0.1	TCP	66	40490 → 9995 [ACK] Seq=35 Ack=237 Win=65536 Len=0 TSval=33673...
56	19.998498340	127.0.0.1	127.0.0.1	TCP	134	9995 → 40490 [PSH, ACK] Seq=237 Ack=35 Win=65536 Len=68 TSval=...
57	19.998586789	127.0.0.1	127.0.0.1	TCP	66	40490 → 9995 [ACK] Seq=35 Ack=305 Win=65536 Len=0 TSval=33673...
58	19.998600786	127.0.0.1	127.0.0.1	TCP	162	9995 → 40490 [PSH, ACK] Seq=305 Ack=35 Win=65536 Len=96 TSval=...
59	19.998723732	127.0.0.1	127.0.0.1	TCP	66	40490 → 9995 [ACK] Seq=35 Ack=401 Win=65536 Len=0 TSval=33673...
60	19.998736709	127.0.0.1	127.0.0.1	TCP	182	9995 → 40490 [PSH, ACK] Seq=401 Ack=35 Win=65536 Len=116 TSva=...
61	19.998787835	127.0.0.1	127.0.0.1	TCP	74	9995 → 40490 [FIN, PSH, ACK] Seq=517 Ack=35 Win=65536 Len=8 T...

Frame 1: 74 bytes on wire (592 bits), 74 bytes captured (592 bits) on interface lo, id 0  
Ethernet II, Src: 00:00:00:00:00:00 (00:00:00:00:00:00), Dst: 00:00:00:00:00:00 (00:00:00:00:00:00)  
Internet Protocol Version 4, Src: 127.0.0.1, Dst: 127.0.0.1  
Transmission Control Protocol, Src Port: 40490, Dst Port: 9995, Seq: 0, Len: 0

0000 00 00 00 00 00 00 00 00 00 00 00 08 00 45 00 .....  
0010 00 3c 95 10 40 00 00 06 a7 a9 7f 00 00 01 7f 00 <...@..  
0020 00 01 9e 2a 27 0b cf 8d 3a 4a 00 00 00 00 a0 02 ...\*...:J..  
0030 ff d7 fe 30 00 00 02 04 ff d7 04 02 08 0a c8 b5 ...@.....  
0040 8b 4e 00 00 00 00 01 03 03 07 ..N.....

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.

```
▼ Frame 1: 74 bytes on wire (592 bits), 74 bytes captured (592 bits) on interface lo, id 0
```

```
  ▶ Interface id: 0 (lo)
    Encapsulation type: Ethernet (1)
    Arrival Time: Aug 23, 2022 23:09:48.974924734 IST
    [Time shift for this packet: 0.000000000 seconds]
    Epoch Time: 1661276388.974924734 seconds
    [Time delta from previous captured frame: 0.000000000 seconds]
    [Time delta from previous displayed frame: 0.000000000 seconds]
    [Time since reference or first frame: 0.000000000 seconds]
    Frame Number: 1
    Frame Length: 74 bytes (592 bits)
    Capture Length: 74 bytes (592 bits)
    [Frame is marked: False]
    [Frame is ignored: False]
    [Protocols in frame: eth:ethertype:ip:tcp]
    [Coloring Rule Name: TCP SYN/FIN]
    [Coloring Rule String: tcp.flags & 0x02 || tcp.flags.fin == 1]
```

## 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.

```
▼ Ethernet II, Src: 00:00:00_00:00:00 (00:00:00:00:00:00), Dst: 00:00:00_00:00:00 (00:00:00:00:00:00)
```

```
  ▼ Destination: 00:00:00_00:00:00 (00:00:00:00:00:00)
    Address: 00:00:00_00:00:00 (00:00:00:00:00:00)
    .... ..0. .... = LG bit: Globally unique address (factory default)
    .... ..0 .... = IG bit: Individual address (unicast)
  ▼ Source: 00:00:00_00:00:00 (00:00:00:00:00:00)
    Address: 00:00:00_00:00:00 (00:00:00:00:00:00)
    .... ..0. .... = LG bit: Globally unique address (factory default)
    .... ..0 .... = IG bit: Individual address (unicast)
```

```
Type: IPv4 (0x0800)
```

## 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: 11]											
0000	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 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.