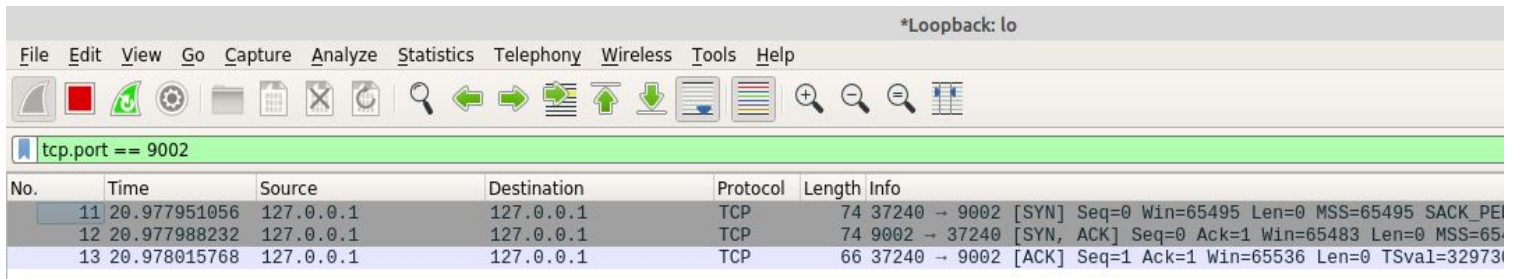


Assignment 1

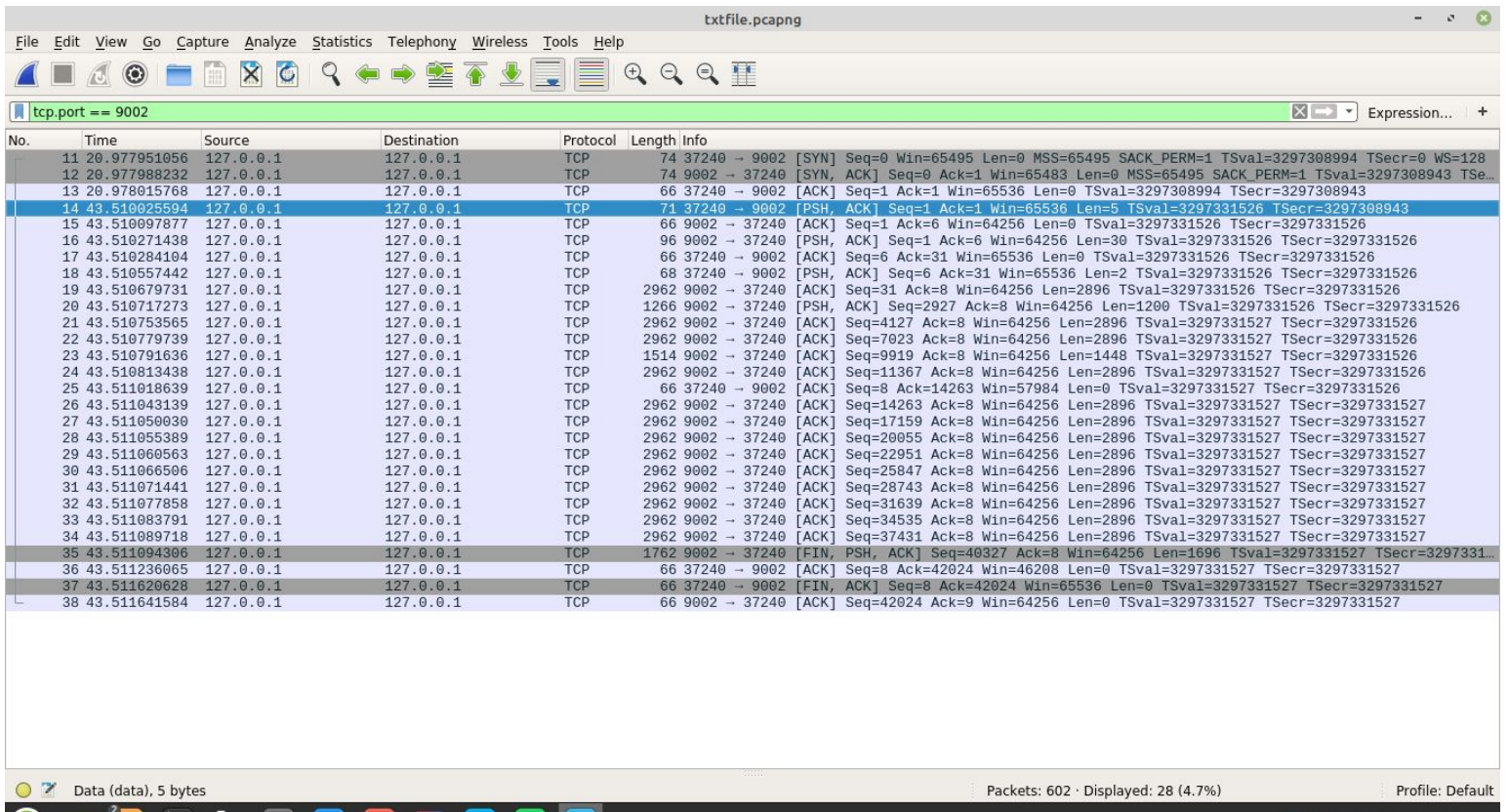
Q1. Please find attached code files in their respective folders.

Q2. I have attached the screenshots below and in the zipped file also, please also find the **pcap** file attached, in case screenshots are not clear.



No.	Time	Source	Destination	Protocol	Length	Info
11	20.977951056	127.0.0.1	127.0.0.1	TCP	74	37240 → 9002 [SYN] Seq=0 Win=65495 Len=0 MSS=65495 SACK_PERM=1 TSval=3297308994 TSecr=3297308943
12	20.977988232	127.0.0.1	127.0.0.1	TCP	74	9002 → 37240 [SYN, ACK] Seq=0 Ack=1 Win=65483 Len=0 MSS=65495 SACK_PERM=1 TSval=3297308943 TSecr=3297308994
13	20.978015768	127.0.0.1	127.0.0.1	TCP	66	37240 → 9002 [ACK] Seq=1 Ack=1 Win=65536 Len=0 TSval=3297308994 TSecr=3297308943

The above screenshot was taken when the connection was established and the client now waits for the name of the file from the user. **(Screenshot 1)**



No.	Time	Source	Destination	Protocol	Length	Info
11	20.977951056	127.0.0.1	127.0.0.1	TCP	74	37240 → 9002 [SYN] Seq=0 Win=65495 Len=0 MSS=65495 SACK_PERM=1 TSval=3297308994 TSecr=3297308943
12	20.977988232	127.0.0.1	127.0.0.1	TCP	74	9002 → 37240 [SYN, ACK] Seq=0 Ack=1 Win=65483 Len=0 MSS=65495 SACK_PERM=1 TSval=3297308943 TSecr=3297308994
13	20.978015768	127.0.0.1	127.0.0.1	TCP	66	37240 → 9002 [ACK] Seq=1 Ack=1 Win=65536 Len=0 TSval=3297308994 TSecr=3297308943
14	43.510025594	127.0.0.1	127.0.0.1	TCP	71	37240 → 9002 [PSH, ACK] Seq=1 Ack=1 Win=65536 Len=5 TSval=3297331526 TSecr=3297331526
15	43.510097877	127.0.0.1	127.0.0.1	TCP	66	9002 → 37240 [ACK] Seq=1 Ack=6 Win=64256 Len=0 TSval=3297331526 TSecr=3297331526
16	43.510271438	127.0.0.1	127.0.0.1	TCP	96	9002 → 37240 [PSH, ACK] Seq=1 Ack=6 Win=64256 Len=30 TSval=3297331526 TSecr=3297331526
17	43.510284104	127.0.0.1	127.0.0.1	TCP	66	37240 → 9002 [ACK] Seq=6 Ack=31 Win=65536 Len=0 TSval=3297331526 TSecr=3297331526
18	43.510557442	127.0.0.1	127.0.0.1	TCP	68	37240 → 9002 [PSH, ACK] Seq=6 Ack=31 Win=65536 Len=2 TSval=3297331526 TSecr=3297331526
19	43.510679731	127.0.0.1	127.0.0.1	TCP	2962	9002 → 37240 [ACK] Seq=31 Ack=8 Win=64256 Len=2896 TSval=3297331526 TSecr=3297331526
20	43.510717273	127.0.0.1	127.0.0.1	TCP	1266	9002 → 37240 [PSH, ACK] Seq=2927 Ack=8 Win=64256 Len=1200 TSval=3297331526 TSecr=3297331526
21	43.510753565	127.0.0.1	127.0.0.1	TCP	2962	9002 → 37240 [ACK] Seq=4127 Ack=8 Win=64256 Len=2896 TSval=3297331527 TSecr=3297331526
22	43.510779739	127.0.0.1	127.0.0.1	TCP	2962	9002 → 37240 [ACK] Seq=7023 Ack=8 Win=64256 Len=2896 TSval=3297331527 TSecr=3297331526
23	43.510791636	127.0.0.1	127.0.0.1	TCP	1514	9002 → 37240 [ACK] Seq=9919 Ack=8 Win=64256 Len=1448 TSval=3297331527 TSecr=3297331526
24	43.510813438	127.0.0.1	127.0.0.1	TCP	2962	9002 → 37240 [ACK] Seq=11367 Ack=8 Win=64256 Len=2896 TSval=3297331527 TSecr=3297331526
25	43.511018639	127.0.0.1	127.0.0.1	TCP	66	37240 → 9002 [ACK] Seq=8 Ack=14263 Win=57984 Len=0 TSval=3297331527 TSecr=3297331526
26	43.511043139	127.0.0.1	127.0.0.1	TCP	2962	9002 → 37240 [ACK] Seq=14263 Ack=8 Win=64256 Len=2896 TSval=3297331527 TSecr=3297331527
27	43.511050030	127.0.0.1	127.0.0.1	TCP	2962	9002 → 37240 [ACK] Seq=17159 Ack=8 Win=64256 Len=2896 TSval=3297331527 TSecr=3297331527
28	43.511055389	127.0.0.1	127.0.0.1	TCP	2962	9002 → 37240 [ACK] Seq=20055 Ack=8 Win=64256 Len=2896 TSval=3297331527 TSecr=3297331527
29	43.511060563	127.0.0.1	127.0.0.1	TCP	2962	9002 → 37240 [ACK] Seq=22951 Ack=8 Win=64256 Len=2896 TSval=3297331527 TSecr=3297331527
30	43.511066506	127.0.0.1	127.0.0.1	TCP	2962	9002 → 37240 [ACK] Seq=25847 Ack=8 Win=64256 Len=2896 TSval=3297331527 TSecr=3297331527
31	43.511071441	127.0.0.1	127.0.0.1	TCP	2962	9002 → 37240 [ACK] Seq=28743 Ack=8 Win=64256 Len=2896 TSval=3297331527 TSecr=3297331527
32	43.511077858	127.0.0.1	127.0.0.1	TCP	2962	9002 → 37240 [ACK] Seq=31639 Ack=8 Win=64256 Len=2896 TSval=3297331527 TSecr=3297331527
33	43.511083791	127.0.0.1	127.0.0.1	TCP	2962	9002 → 37240 [ACK] Seq=34535 Ack=8 Win=64256 Len=2896 TSval=3297331527 TSecr=3297331527
34	43.511089718	127.0.0.1	127.0.0.1	TCP	2962	9002 → 37240 [ACK] Seq=37431 Ack=8 Win=64256 Len=2896 TSval=3297331527 TSecr=3297331527
35	43.511094306	127.0.0.1	127.0.0.1	TCP	1762	9002 → 37240 [FIN, PSH, ACK] Seq=40327 Ack=8 Win=64256 Len=1696 TSval=3297331527 TSecr=3297331527
36	43.511236065	127.0.0.1	127.0.0.1	TCP	66	37240 → 9002 [ACK] Seq=8 Ack=42024 Win=46208 Len=0 TSval=3297331527 TSecr=3297331527
37	43.511620628	127.0.0.1	127.0.0.1	TCP	66	37240 → 9002 [FIN, ACK] Seq=8 Ack=42024 Win=65536 Len=0 TSval=3297331527 TSecr=3297331527
38	43.511641584	127.0.0.1	127.0.0.1	TCP	66	9002 → 37240 [ACK] Seq=42024 Ack=9 Win=64256 Len=0 TSval=3297331527 TSecr=3297331527

This screenshot was taken when the file transfer was successfully completed and the client disconnects. **(Screenshot 2)**

Answers for question 2

a. How many TCP connections are made?

One TCP connection is made between the server and the client.

b. What is the port number of the server and what is that of the client?

Port number for Server: 9002

Port number for Client: 37240

c. How many packets are exchanged between client and server?

28 packets.

You can see this on screenshot 2 at the bottom. (**Displayed: 28**)

d. How much time is needed to download the file?

I have considered that the time to download the file is the time period between sending an **acknowledgement** from **client to server**, of the **last data packet** of the text file being received successfully **and** sending the **first data packet** of the text file from the **server to the client**.

No.	Time	Source	Destination	Protocol	Length	Info
11	20.977951056	127.0.0.1	127.0.0.1	TCP	74	37240 → 9002 [SYN, Seq=0 Win=65495 Len=0 MSS=65495 SA=127.0.0.1, D=127.0.0.1]
12	20.977988232	127.0.0.1	127.0.0.1	TCP	74	9002 → 37240 [SYN, ACK, Seq=0 Ack=1 Win=65483 Len=0 MSS=65483 SA=127.0.0.1, D=127.0.0.1]
13	20.978015768	127.0.0.1	127.0.0.1	TCP	66	37240 → 9002 [ACK, Seq=1 Ack=1 Win=65536 Len=0 TSval=127.0.0.1, TSsec=0, Tsoffset=0, Tstime=0, Tstimeout=0, Reset=0]
14	43.510025594	127.0.0.1	127.0.0.1	TCP	71	37240 → 9002 [PSH, ACK, Seq=1 Ack=1 Win=65536 Len=5 TSval=127.0.0.1, TSsec=0, Tsoffset=0, Tstime=0, Tstimeout=0, Reset=0]
15	43.510097877	127.0.0.1	127.0.0.1	TCP	66	9002 → 37240 [ACK, Seq=1 Ack=6 Win=64256 Len=0 TSval=127.0.0.1, TSsec=0, Tsoffset=0, Tstime=0, Tstimeout=0, Reset=0]
16	43.510271438	127.0.0.1	127.0.0.1	TCP	96	9002 → 37240 [PSH, ACK, Seq=1 Ack=6 Win=64256 Len=30 TSval=127.0.0.1, TSsec=0, Tsoffset=0, Tstime=0, Tstimeout=0, Reset=0]
17	43.510284104	127.0.0.1	127.0.0.1	TCP	66	37240 → 9002 [ACK, Seq=6 Ack=31 Win=65536 Len=0 TSval=127.0.0.1, TSsec=0, Tsoffset=0, Tstime=0, Tstimeout=0, Reset=0]
18	43.510557442	127.0.0.1	127.0.0.1	TCP	68	37240 → 9002 [PSH, ACK, Seq=6 Ack=31 Win=65536 Len=2 TSval=127.0.0.1, TSsec=0, Tsoffset=0, Tstime=0, Tstimeout=0, Reset=0]
19	43.510679731	127.0.0.1	127.0.0.1	TCP	2962	9002 → 37240 [ACK, Seq=31 Ack=8 Win=64256 Len=2896 TSval=127.0.0.1, TSsec=0, Tsoffset=0, Tstime=0, Tstimeout=0, Reset=0]
20	43.510717273	127.0.0.1	127.0.0.1	TCP	1266	9002 → 37240 [PSH, ACK, Seq=2927 Ack=8 Win=64256 Len=1258]
21	43.510753565	127.0.0.1	127.0.0.1	TCP	2962	9002 → 37240 [ACK, Seq=4127 Ack=8 Win=64256 Len=2896 TSval=127.0.0.1, TSsec=0, Tsoffset=0, Tstime=0, Tstimeout=0, Reset=0]
22	43.510779739	127.0.0.1	127.0.0.1	TCP	2962	9002 → 37240 [ACK, Seq=7023 Ack=8 Win=64256 Len=2896 TSval=127.0.0.1, TSsec=0, Tsoffset=0, Tstime=0, Tstimeout=0, Reset=0]
23	43.510791636	127.0.0.1	127.0.0.1	TCP	1514	9002 → 37240 [ACK, Seq=9919 Ack=8 Win=64256 Len=1448 TSval=127.0.0.1, TSsec=0, Tsoffset=0, Tstime=0, Tstimeout=0, Reset=0]
24	43.510813438	127.0.0.1	127.0.0.1	TCP	2962	9002 → 37240 [ACK, Seq=11367 Ack=8 Win=64256 Len=2896 TSval=127.0.0.1, TSsec=0, Tsoffset=0, Tstime=0, Tstimeout=0, Reset=0]
25	43.511018630	127.0.0.1	127.0.0.1	TCP	66	37240 → 9002 [ACK, Seq=8 Ack=14263 Win=57084 Len=0 TSval=127.0.0.1, TSsec=0, Tsoffset=0, Tstime=0, Tstimeout=0, Reset=0]

Frame 18: 68 bytes on wire (544 bits), 68 bytes captured (544 bits) on interface 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: 37240, Dst Port: 9002, Seq: 6, Ack: 31, Len: 2

Data (2 bytes)

0000 00 00 00 00 00 00 00 00 00 00 00 08 00 45 00E..

0010 00 36 31 14 40 00 06 0b ac 7f 00 00 01 7f 00 ..61·@·@.....

0020 00 01 91 78 23 2a d7 b4 bf f3 87 1e e2 a9 80 18 ...X#*.....

0030 02 00 fe 2a 00 00 01 01 08 0a c4 89 49 46 c4 89 ...*.....IF..

0040 49 46 4f 6bIFOk

The above screenshot shows “Ok” message sent from **client to server** in the **packet no. 18**, I have sent this message as a **notification from the client to the server** that the client has created a new file pointer and is now ready to write on that file. This can be observed in the

above screenshot, below the Data section. **(Screenshot 3 / 3.png)**. So the packet after this must **begin** the transfer of a file/download, which is **packet no. 19**.

For the packet number that marks the end of the file, we need to see the acknowledgement sent from client to server just before the client disconnects. This can be seen in the **packet number 36**, where we send an acknowledgement from client to server just before it disconnects (send the FIN packet).

For File size = 42Kb

The time required to download the file =

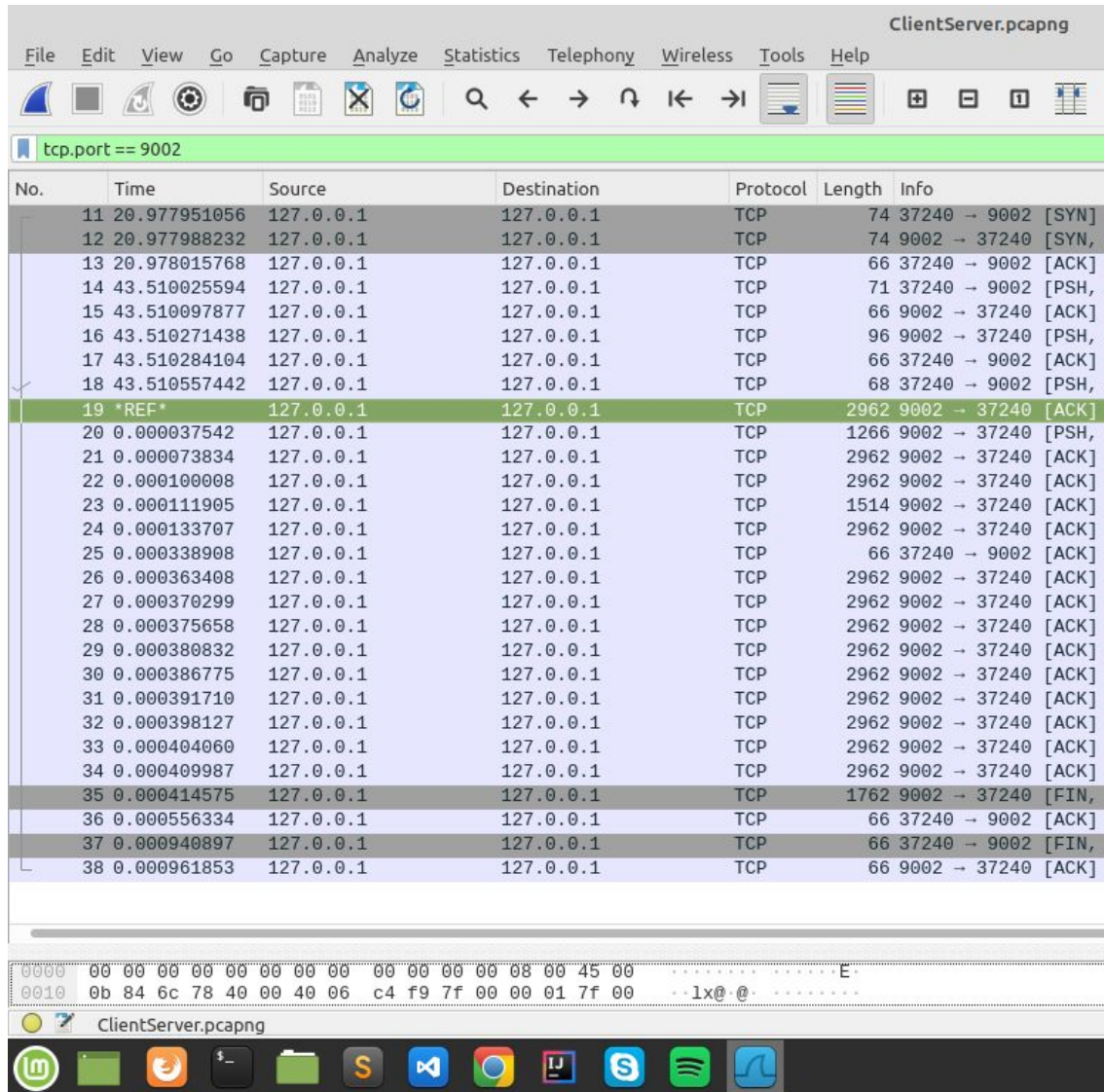
= Time of packet 36 - Time of packet 19 [Explanation mentioned above]
(Download ends) (Download starts)

= 43.511236065 seconds - 43.510679731 seconds

= 0.000556334 seconds

= 0.556334 Milliseconds

You can set the packet 19 as a reference and then you can get the time directly from Wireshark for the Packet number 36. The screenshot is attached below.



(Screenshot 4)