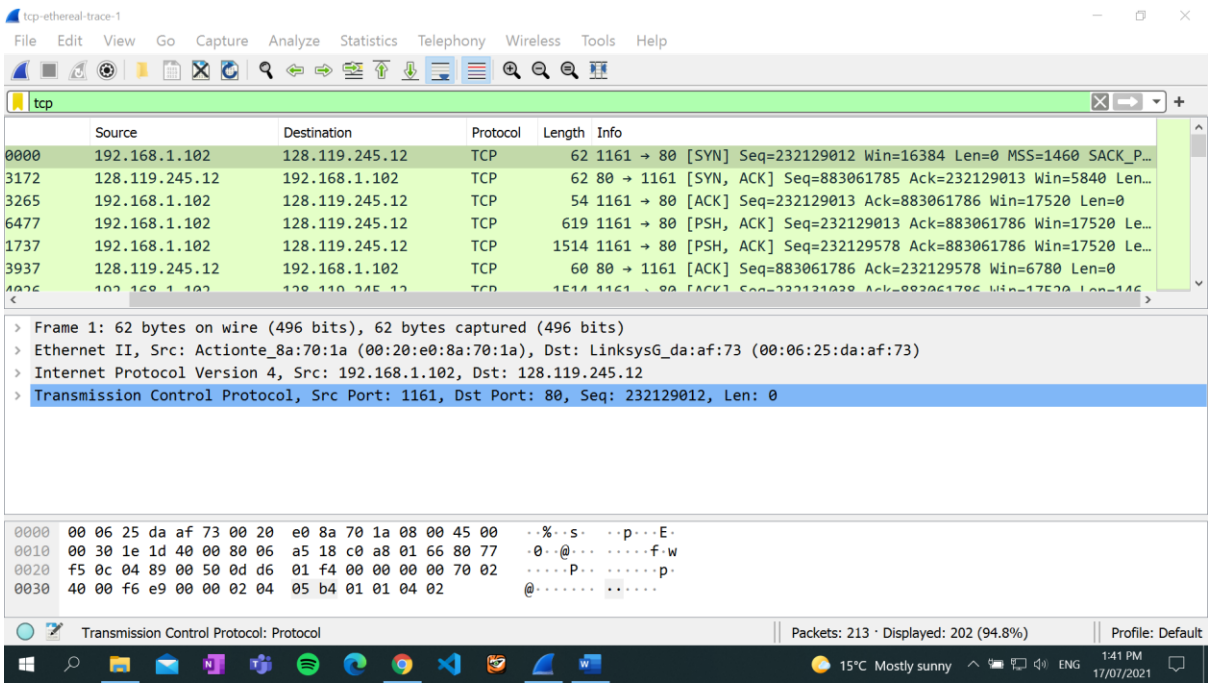
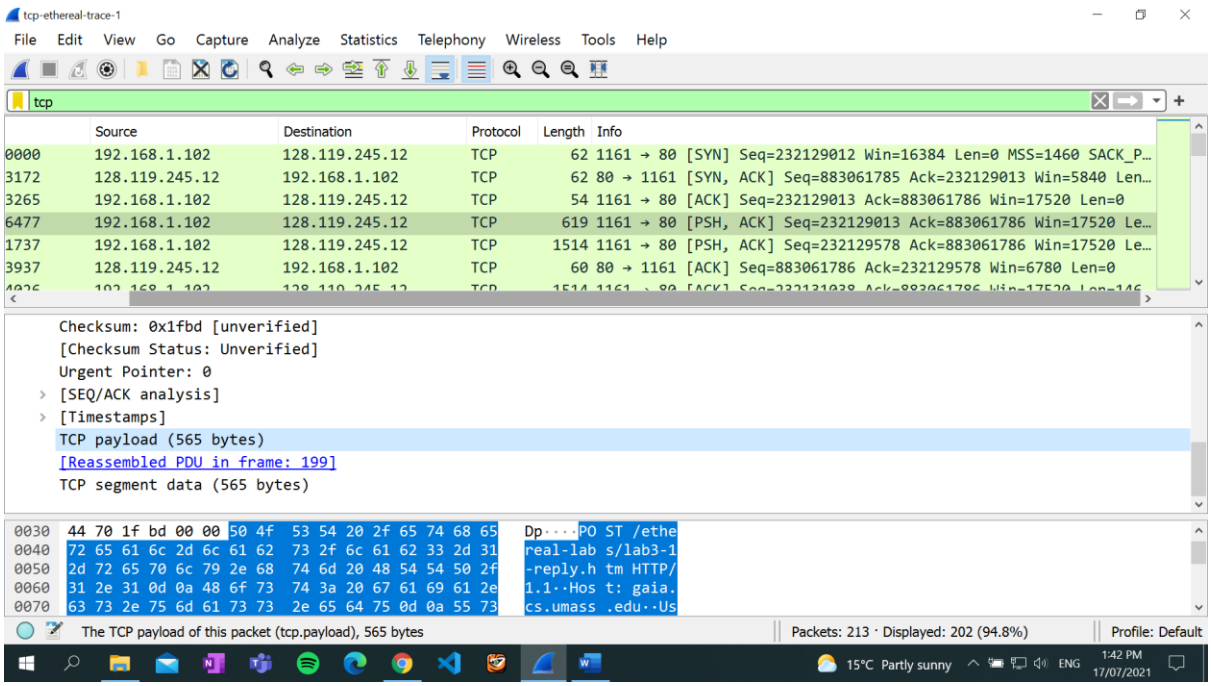
Question1.1



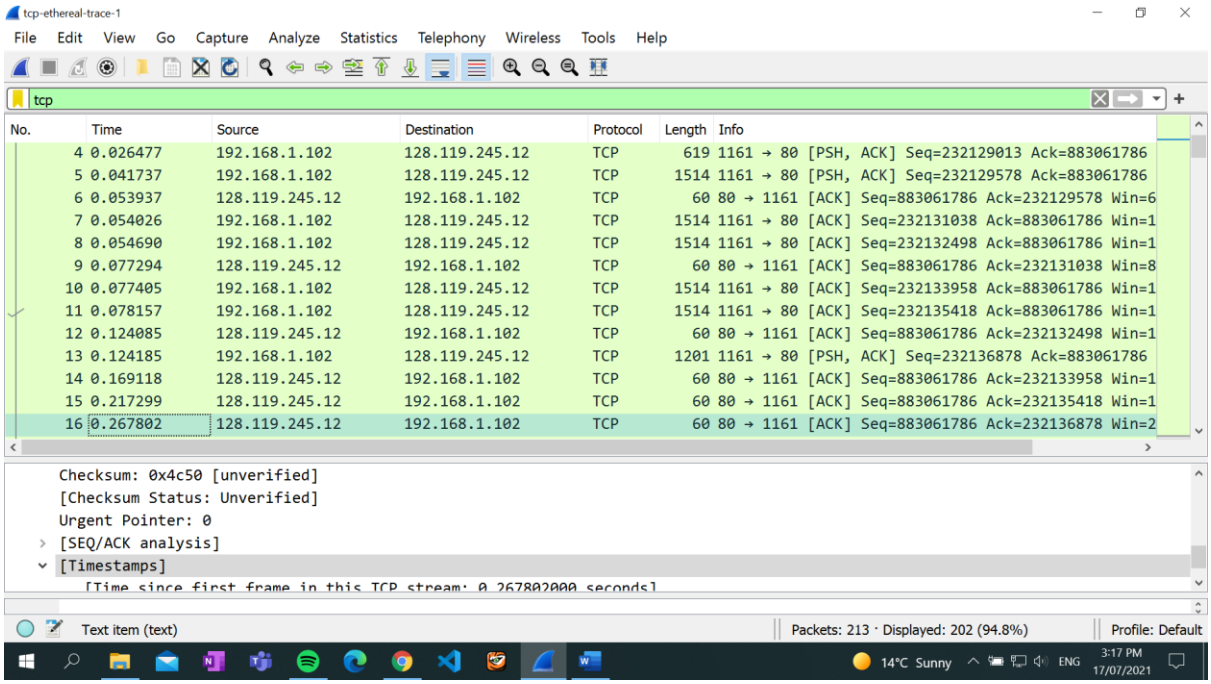
The IP address of gaia.cs.umass.edu is 128.119.245.12. The port for sending and receiving is 80. The IP address of the client is 192.168.1.102, it's port is 1161.

Question1.2



Its sequence number is 232129013.

Question 1.3



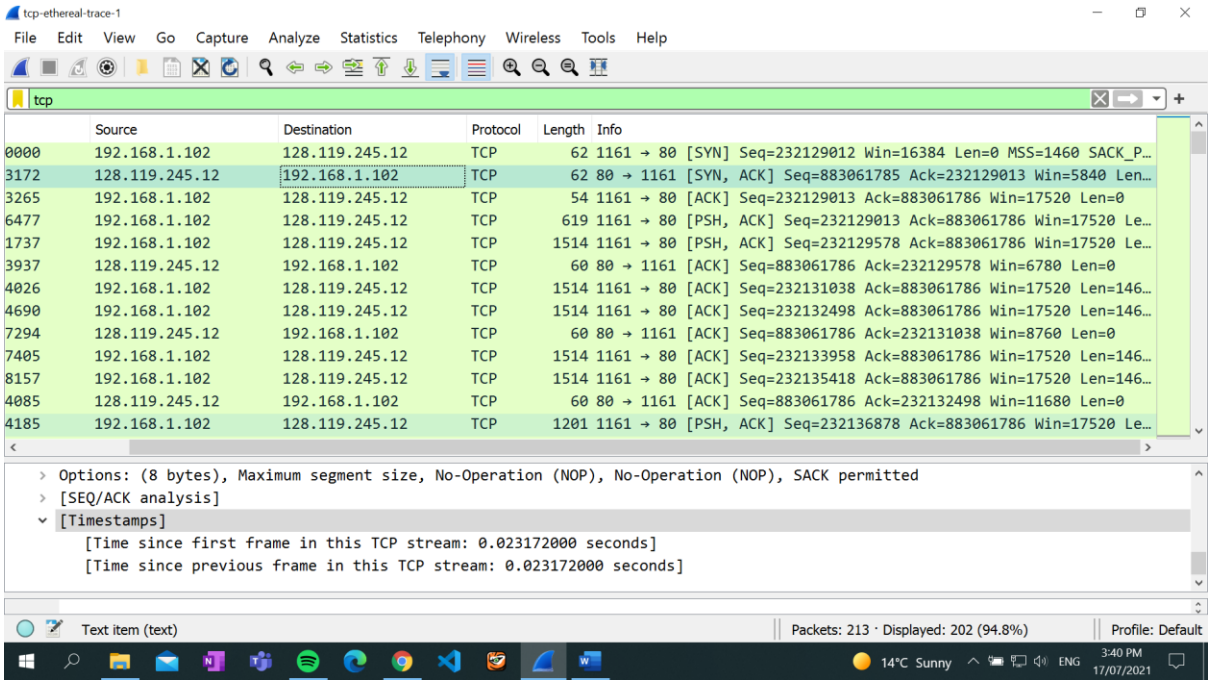
They are 232129013, 232129578, 232131038, 232132498, 232133958, 232135418.

Sequence number	Time sent	ACK	RTT	Estimated RTT
232129013	0.026477	0.053937	0.027460	0.027460
232129578	0.041737	0.077294	0.035557	0.875*0.027460+0.125*0.035557 = 0.02847
232131038	0.054026	0.124085	0.070059	0.875*0.02847 +0.125*0.070059 = 0.03367
232132498	0.054690	0.169118	0.114428	0.875*0.03367+0.125*0.114428 = 0.04376
232133958	0.077405	0.217299	0.139894	0.875*0.04376+0.125*0.139894 = 0.05578
232135418	0.078157	0.267802	0.189645	0.875*0.05578+0.125*0.189645 = 0.07251

Question1.4

Sequence number	Length (Bytes)
232129013	565
232129578	1460
232131038	1460
232132498	1460
232133958	1460
232135418	1460

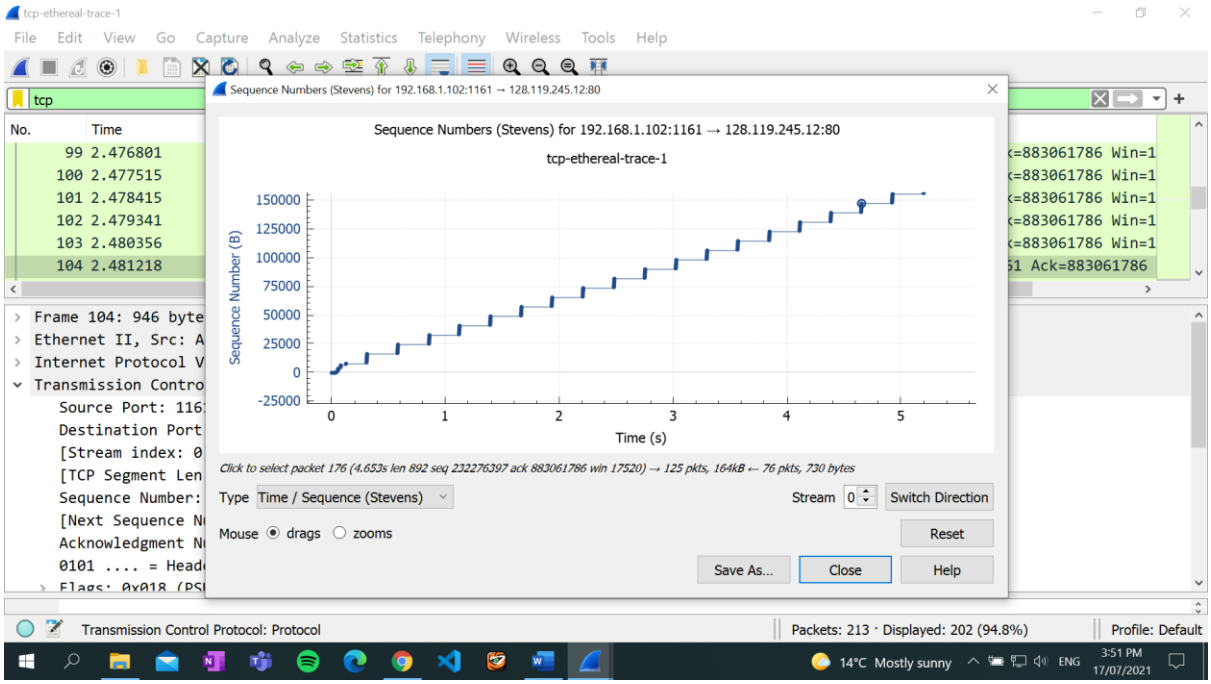
Question1.5



The minimum buffer space of the receiver is 5840.

The window sizes keep increasing until a window size of 67280. It never throttles the sender.

Question1.6



No, there is no retransmitted segment. Because the sequence numbers are linearly increasing.

Question1.7

The data of acknowledge is the difference of acknowledged sequence number between each acknowledgement. The receiver typically acknowledges 1460 bytes of data. There are no delayed transmit, so there is no case the receiver acknowledges every other received segment.

Question 1.8

First acknowledgement is NO.4

Sequence number of the first acknowledgement is 232129013.

Time of the first acknowledgement is 0.026477.

First acknowledgement is NO.202

Sequence number of the last acknowledgement is 232293103.

Time of the last acknowledgement is 5.455830.

Total bytes = 232293103 – 232129013 = 164090 bytes.

Time difference = 5.455830 - 0.026477 = 5.429353 seconds.

Throughput = 164090 / 5.429353 = 30222.75 bytes/second.

Question 2.1

The sequence number is 2818463618.

Question2.2

The sequence number is 1247095790. The acknowledgement number is 2818463619. It is the received sequence number + 1 byte of acknowledgement.

Question2.3

The sequence number is 2818463619. The acknowledgement number is 1247095791. It does not contain any data because the acknowledgement number is the received sequence number + 1 byte of acknowledgement.

Question2.4

Both have done the active close. Because both send FIN+ACK flag, and the seq numbers did not change.

Question 2.5

The initial sequence number of the client is 2818463618.

The final acknowledgement number of the server is 2818463653.

The initial sequence number of the server is 1247095790.

The final acknowledgement number of the client is 1479095832.

Both send 2 bytes for SYN and FIN, we need to subtract them.

The data sent by the client is 2818463653 – 2818463618 – 2 = 33 bytes.

The data sent by the server is 1479095832– 1247095790– 2 = 40 bytes.

The relationship with the Initial Sequence Number and the final ACK received from the other side is we need to subtract 2 bytes to get the actual data sent.