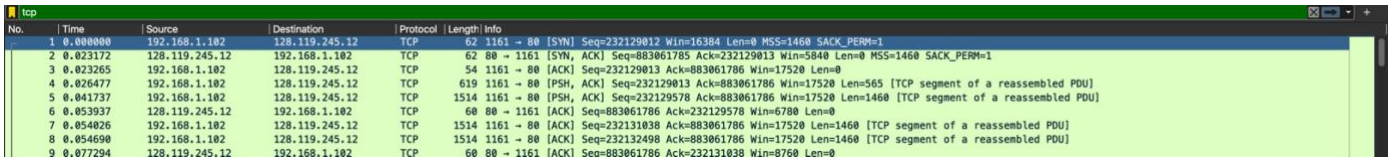
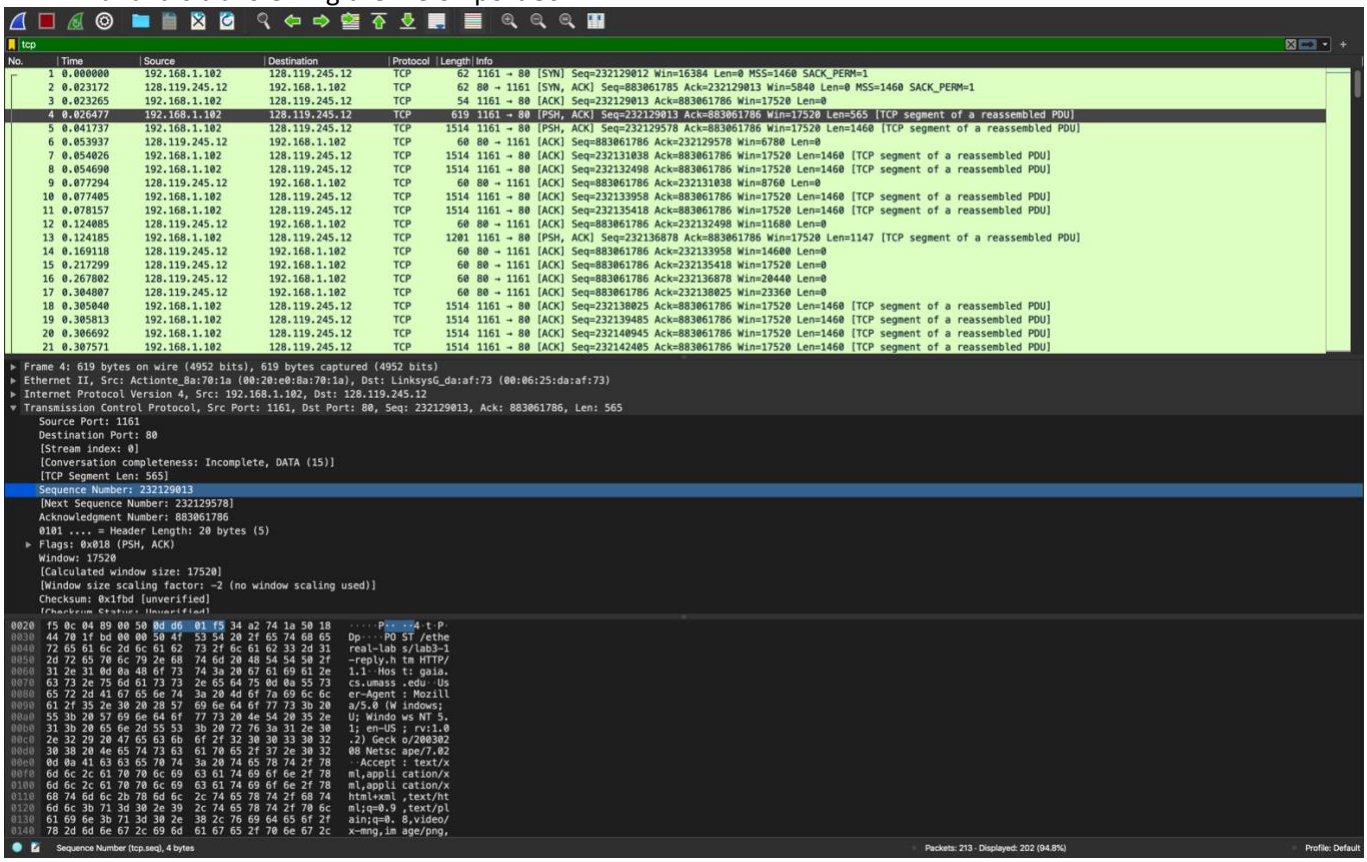
Lab Exercise 4: Exploring TCP

Exercise 1: Understanding TCP using Wireshark



No.	Time	Source	Destination	Protocol	Length	Info
1	0.000000	192.168.1.102	128.119.245.12	TCP	62	1161 → 80 [SYN] Seq=232129012 Win=16384 Len=0 MSS=1460 SACK_PERM=1
2	0.023172	128.119.245.12	192.168.1.102	TCP	62	80 → 1161 [SYN, ACK] Seq=883061785 Ack=232129013 Win=5840 Len=0 MSS=1460 SACK_PERM=1
3	0.023265	192.168.1.102	128.119.245.12	TCP	54	1161 → 80 [ACK] Seq=232129013 Ack=883061786 Win=17520 Len=0
4	0.026477	192.168.1.102	128.119.245.12	TCP	619	1161 → 80 [PSH, ACK] Seq=232129013 Ack=883061786 Win=17520 Len=565 [TCP segment of a reassembled PDU]
5	0.041737	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [PSH, ACK] Seq=232129578 Ack=883061786 Win=17520 Len=1460 [TCP segment of a reassembled PDU]
6	0.053937	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=883061786 Ack=232129578 Win=6780 Len=0
7	0.054026	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=232131038 Ack=883061786 Win=17520 Len=1460 [TCP segment of a reassembled PDU]
8	0.054690	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=232132498 Ack=883061786 Win=17520 Len=1460 [TCP segment of a reassembled PDU]
9	0.077294	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=883061786 Ack=232131038 Win=8760 Len=0

1. The IP address of gaia.cs.umass.ed is 192.168.1.102. It is sending and receiving TCP segments on port 1161. The IP address of the client computer (source) is 128.119.245.12 and it is transferring the file on port 80.



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9	0.077294	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=883061786 Ack=232131038 Win=8760 Len=0
10	0.077405	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=232133958 Ack=883061786 Win=17520 Len=1460 [TCP segment of a reassembled PDU]
11	0.078157	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=232135418 Ack=883061786 Win=17520 Len=1460 [TCP segment of a reassembled PDU]
12	0.124085	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=883061786 Ack=232132498 Win=11680 Len=0
13	0.124185	192.168.1.102	128.119.245.12	TCP	1201	1161 → 80 [PSH, ACK] Seq=232136878 Ack=883061786 Win=17520 Len=1147 [TCP segment of a reassembled PDU]
14	0.169118	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=883061786 Ack=232133958 Win=14600 Len=0
15	0.217299	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=883061786 Ack=232135418 Win=17520 Len=0
16	0.267802	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=883061786 Ack=232136878 Win=20440 Len=0
17	0.304807	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=883061786 Ack=232138025 Win=23360 Len=0
18	0.305040	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=232138025 Ack=883061786 Win=17520 Len=1460 [TCP segment of a reassembled PDU]
19	0.305813	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=232139485 Ack=883061786 Win=17520 Len=1460 [TCP segment of a reassembled PDU]
20	0.306692	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=232140945 Ack=883061786 Win=17520 Len=1460 [TCP segment of a reassembled PDU]
21	0.307571	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=232142405 Ack=883061786 Win=17520 Len=1460 [TCP segment of a reassembled PDU]

2. The sequence number is 232129013.
3.

No.	Sequence No.	Time sent (s)	ACK received (s)	RTT diff (s)	Est. RTT (s)
4	232129013	0.026477	0.053937	0.02746	0.02746
5	232129578	0.041737	0.077294	0.035557	
7	232131038	0.054026	0.124085	0.070059	
8	232132498	0.054690	0.169118	0.114428	
10	232133958	0.077405	0.217299	0.139894	
11	232135418	0.078157	0.267802	0.189645	

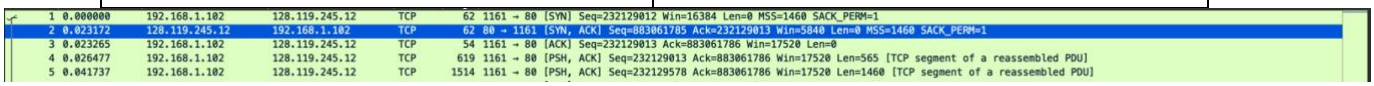
RTT diff = ACK received – Time sent

Est. RTT = 7/8 * (Est. RTT of Prev ACK) + 1/8 * (RTT diff)

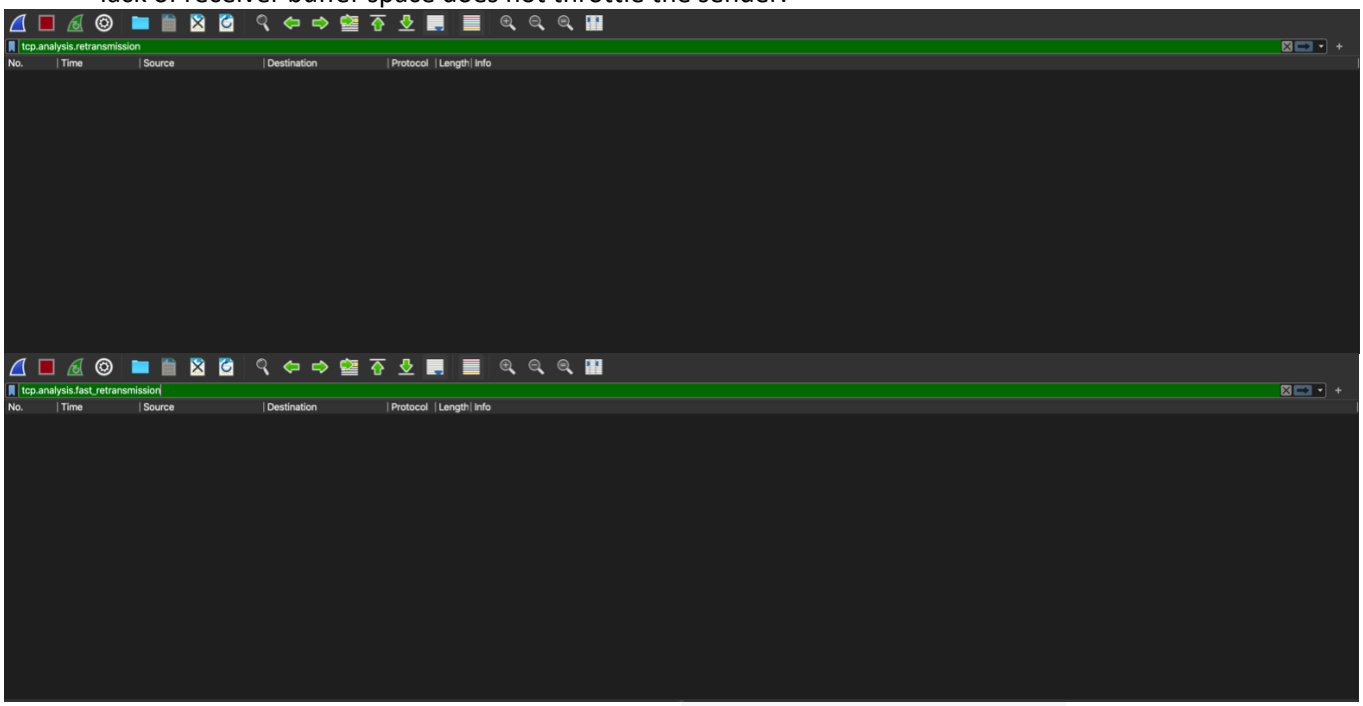
4.

No.	Length (bytes)
4	565

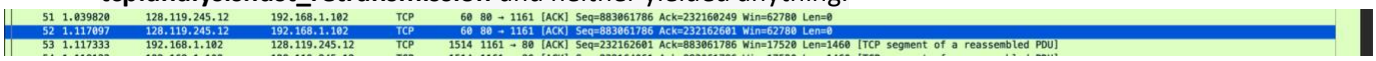
5	1460
7	1460
8	1460
10	1460
11	1460



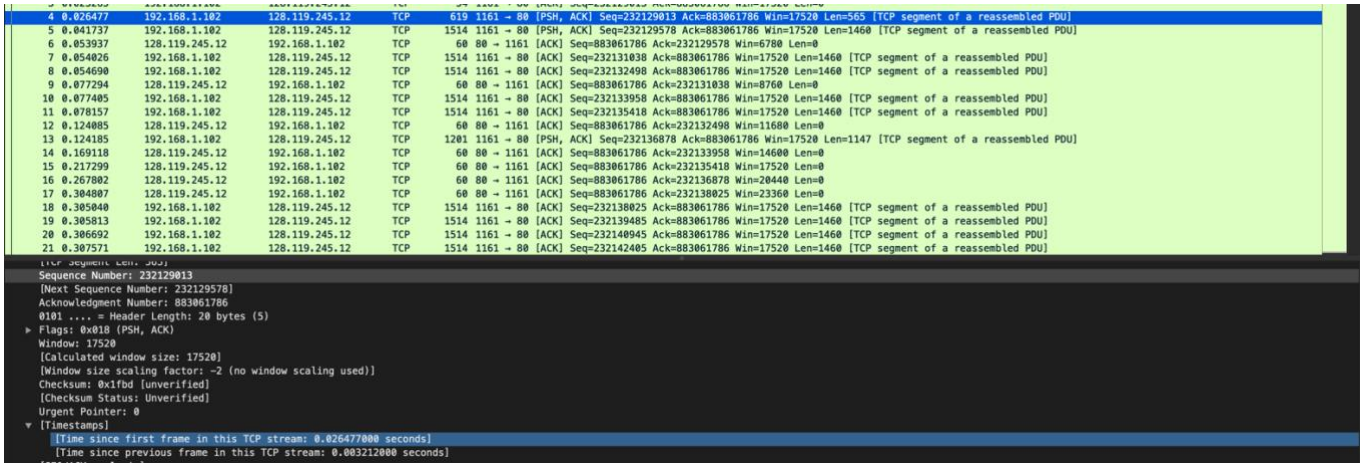
5. The minimum amount of available buffer space is 5840 bytes (Window) in segment 2. The lack of receiver buffer space does not throttle the sender.

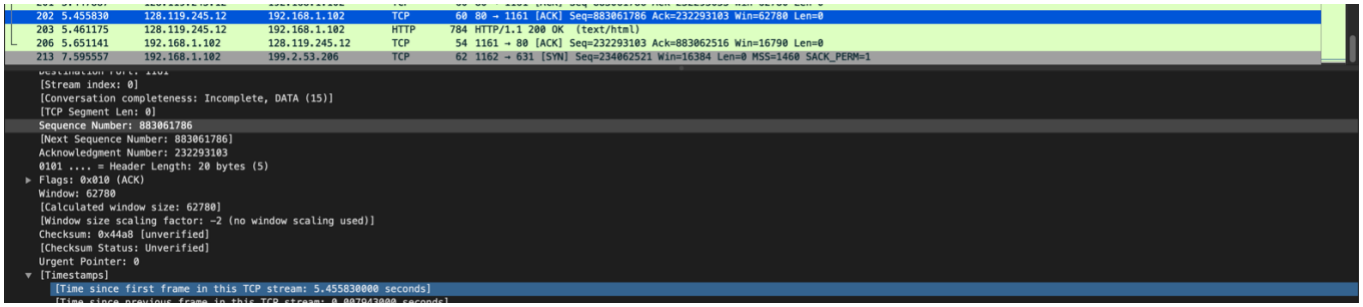


6. No, there are no retransmitted segments. I used **tcp.analysis.retransmission** and **tcp.analysis.fast_retransmission** and neither yielded anything.



7. In an ACK, the receiver typically acknowledging 1460 bytes of data.
   A case where the receiver is ACKing every other received segment is approximately segment 52.





8. Throughput = data (bytes) / transmission time (seconds)
   data = 232293103 (bytes) – 232129013 (bytes) = 164090 (bytes)
   transmission time = 5.45583 (seconds) – 0.026477 (seconds) = 5.429353 (seconds)
   Therefore, Throughput = 164090 (bytes) / 5.429353 (seconds) = 30222.75 (bytes/second)

Exercise 2: TCP Connection Management

No	Source IP	Destination IP	Protocol	Info
295	10.9.16.201	10.99.6.175	TCP	50045 > 5000 [SYN] Seq=2818463618 win=8192 MSS=1460
296	10.99.6.175	10.9.16.201	TCP	5000 > 50045 [SYN, ACK] Seq=1247095790 Ack=2818463619 win=262144 MSS=1460
297	10.9.16.201	10.99.6.175	TCP	50045 > 5000 [ACK] Seq=2818463619 Ack=1247095791 win=65535
298	10.9.16.201	10.99.6.175	TCP	50045 > 5000 [PSH, ACK] Seq=2818463619 Ack=1247095791 win=65535
301	10.99.6.175	10.9.16.201	TCP	5000 > 50045 [ACK] Seq=1247095791 Ack=2818463652 win=262096
302	10.99.6.175	10.9.16.201	TCP	5000 > 50045 [PSH, ACK] Seq=1247095791 Ack=2818463652 win=262144
303	10.9.16.201	10.99.6.175	TCP	50045 > 5000 [ACK] Seq=2818463652 Ack=1247095831 win=65535
304	10.9.16.201	10.99.6.175	TCP	50045 > 5000 [FIN, ACK] Seq=2818463652 Ack=1247095831 win=65535
305	10.99.6.175	10.9.16.201	TCP	5000 > 50045 [FIN, ACK] Seq=1247095831 Ack=2818463652 win=262144
306	10.9.16.201	10.99.6.175	TCP	50045 > 5000 [ACK] Seq=2818463652 Ack=1247095832 win=65535
308	10.99.6.175	10.9.16.201	TCP	5000 > 50045 [ACK] Seq=1247095831 Ack=2818463653 win=262144

1. The sequence number is: 2818463618
2. The sequence number is: 1247095790
   Value of acknowledgement field is: 2818463619
   The server determined that value by adding 1 to the client sequence number.
3. The sequence number is: 2818463619
   Value of acknowledgement field is: 1247095791
   This segment does not contain any data since the sequence number is the same as the previous ACK.
4. The active close was done by both the client and the server. This can be seen as they sent FIN,ACK to each other, meaning it was simultaneous close.
5. Data $_{\text{Client to Server}}$ = $Seq_{304} - Seq_{295} - 1$ = 2818463652 (bytes) – 2818463618 (bytes) = 33 (bytes)
   Data $_{\text{Server to Client}}$ = $Seq_{305} - Seq_{296} - 1$ = 1247095831 (bytes) – 1247095790 (bytes) = 40 (bytes)
   Initial sequence number will be added with sent data to result in the final ACK which can be used to calculate the total data transmitted between the client and server.