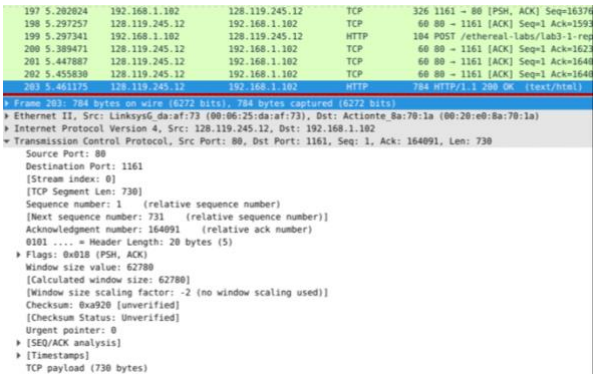
Lab Exercise 4: Exploring TCP

Exercise 1: Understanding TCP using Wireshark

Question 1 . What is the IP address of gaia.cs.umass.edu? On what port number is it sending and receiving TCP segments for this connection?

IP address of gaia.cs.umass.edu: 128.119.245.12

Port number: 80



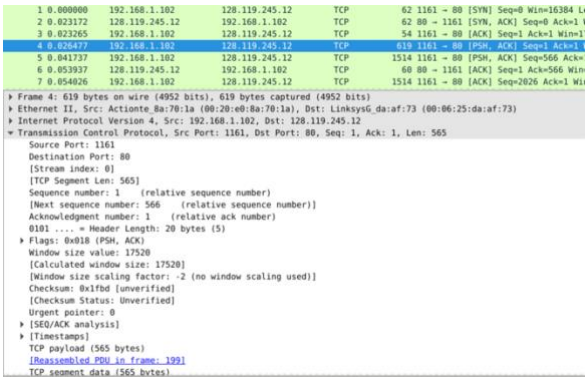
What are the IP address and TCP port numbers used by the client computer (source) that is transferring the file to gaia.cs.umass.edu?

IP address: 192.168.1.102

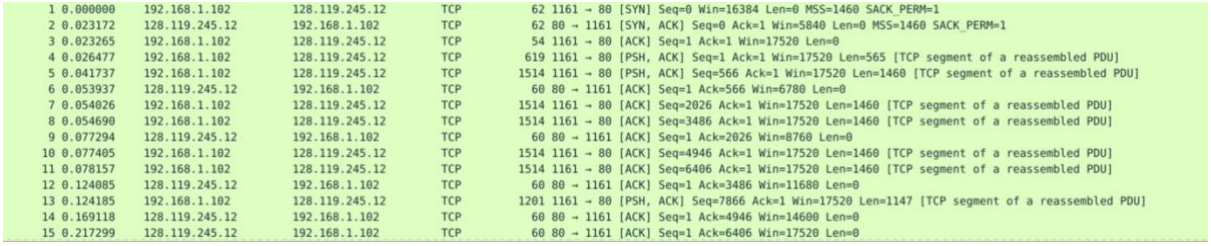
Port number: 1161

Question 2. What is the sequence number of the TCP segment containing the HTTP POST command?

sequence number: 1



Question 3. Consider the TCP segment containing the HTTP POST as the first segment in the TCP connection. What are the sequence numbers of the first six segments in the TCP connection sent from the client to the webserver? At what time was each segment sent? When was the ACK for each segment received? Given the difference between when each TCP segment was sent, and when its acknowledgement was received, what is the RTT value for each of the six segments? What is the EstimatedRTT value after the receipt of each ACK? Assume that the initial value of EstimatedRTT is equal to the measured RTT for the first segment, and then is computed using the EstimatedRTT equation for all subsequent segments. Set alpha to 0.125.



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 1 0.000000    192.168.1.102         128.119.245.12        TCP         62 1161 → 80 [SYN] Seq=0 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=0 Ack=1 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=1 Ack=1 Win=17520 Len=0
 4 0.026477    192.168.1.102         128.119.245.12        TCP        619 1161 → 80 [PSH, ACK] Seq=1 Ack=1 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=566 Ack=1 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=1 Ack=566 Win=6780 Len=0
 7 0.054026    192.168.1.102         128.119.245.12        TCP       1514 1161 → 80 [ACK] Seq=2026 Ack=1 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=3486 Ack=1 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=1 Ack=2026 Win=8760 Len=0
10 0.077405    192.168.1.102         128.119.245.12        TCP       1514 1161 → 80 [ACK] Seq=4946 Ack=1 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=6406 Ack=1 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=1 Ack=3486 Win=11680 Len=0
13 0.124185    192.168.1.102         128.119.245.12        TCP       1201 1161 → 80 [PSH, ACK] Seq=7866 Ack=1 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=1 Ack=4946 Win=14600 Len=0
15 0.217299    128.119.245.12        192.168.1.102         TCP         60 80 → 1161 [ACK] Seq=1 Ack=6406 Win=17520 Len=0
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No.	Sequence number	Sent time (s)	ACK received time (s)	Sample RTT (s)	Estimated RTT (s)
1	1	0.026477	0.053937	0.027460	0.0274600
2	566	0.041737	0.077294	0.035557	0.0284721
3	2026	0.054026	0.124085	0.070059	0.0336705
4	3486	0.054690	0.169118	0.114428	0.0437652
5	4946	0.077405	0.217299	0.139894	0.0557813
6	6406	0.078157	0.267802	0.189645	0.0725142

EstimatedRTT of segment 1 = 0.02746 s

EstimatedRTT of segment 2 = 0.02746 * 0.875 + 0.035557 * 0.125 = 0.0284721s

EstimatedRTT of segment 3 = 0.0284721 * 0.875 + 0.070059 * 0.125 = 0.0336705s

EstimatedRTT of segment 4 = 0.0336705 * 0.875 + 0.114428 * 0.125 = 0.0437652s

EstimatedRTT of segment 5 = 0.0437652 * 0.875 + 0.139894 * 0.125 = 0.0557813s

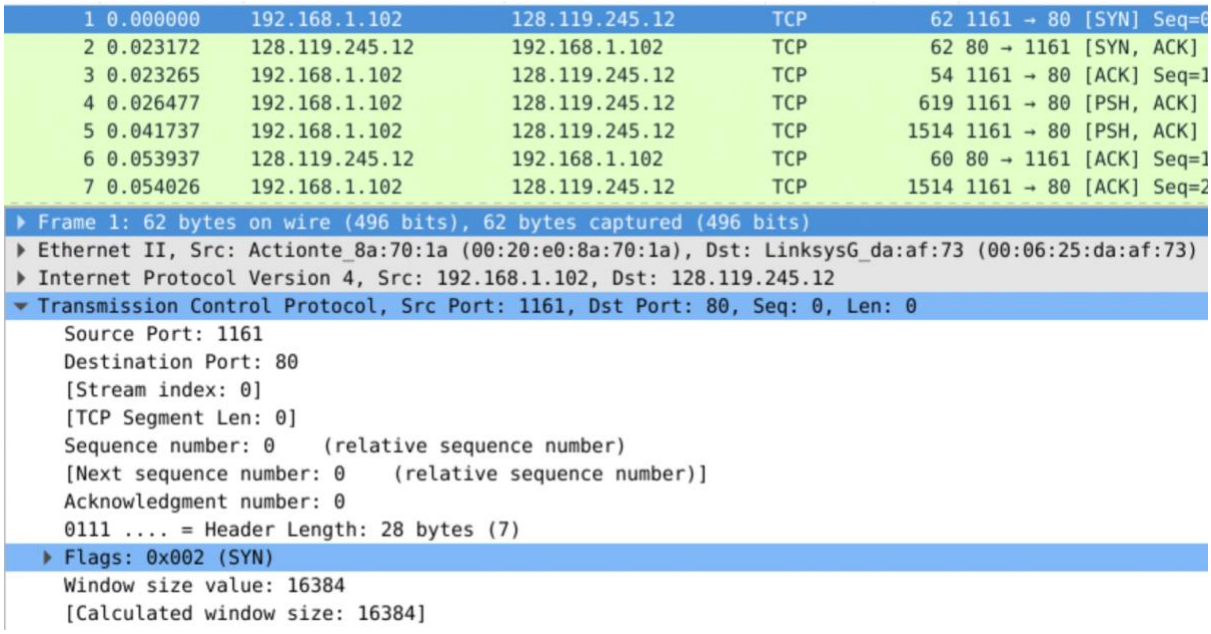
EstimatedRTT of segment 6 = 0.0557813 * 0.875 + 0.189645 * 0.125 = 0.0725142s

Question 4. What is the length of each of the first six TCP segments? (same six segments as Q3)

Length of segment 1 = 565

Length of segment 2, 3, 4, 5, 6 = 1460

Question 5. What is the minimum amount of available buffer space advertised at the receiver for the entire trace? Does the lack of receiver buffer space ever throttle the sender?



The minimum amount: 16384

No, this reviver window will grow until it reaches the maximum receiver buffer size (62780 bytes).

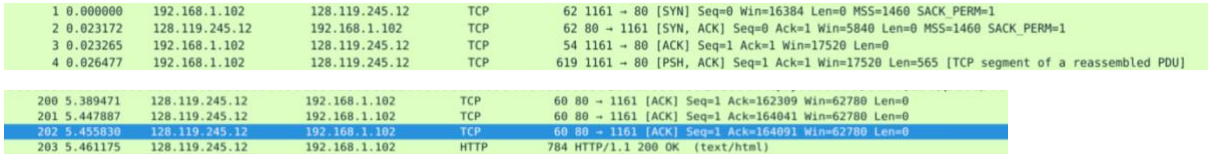
Question 6. Are there any retransmitted segments in the trace file? What did you check for in order to answer this question?

No. According to the result, All serial numbers from the source to the end increase over time. If there is a retransmission segment, the sequence number of the retransmission segment shall be less than its adjacent segment. Therefore, there is no retransmitted segments in the trace file.

Question 7. How much data does the receiver typically acknowledge in an ACK? Can you identify cases where the receiver is ACKing every other received segment?

According to the result, in this case, the receiver typically acknowledges in an ACK normally get 1460 bytes data. The result is getting by checking the difference between the serial numbers of two consecutive ACKS.

Question 8. What is the throughput for the TCP connection? Explain how you calculated this value.



$$The\ size\ of\ the\ data\ =\ the\ sequence\ number\ of\ last\ ACK\ -\ 1\ =\ 164091 - 1\ =\ 164090\ bytes$$

$$The\ time\ of\ using\ time\ =\ the\ time\ of\ last\ ACK\ -\ the\ time\ of\ the\ first\ ACK\ =\ 5.455830\ -\ 0.026477\ =\ 5.429353s$$

$$Throughput\ =\ \frac{The\ size\ of\ the\ data}{The\ time\ of\ using\ time} = \frac{164090\ \text{bytes}}{5.429353s} = 30222.753982\ Bytes/s$$

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

Question 1 . What is the sequence number of the TCP SYN segment that is used to initiate the TCP connection between the client computer and server?

The sequence number of the SYN: 2818463618

Question 2. What is the sequence number of the SYNACK segment sent by the server to the client computer in reply to the SYN? What is the value of the Acknowledgement field in the SYNACK segment? How did the server determine that value?

The sequence number of the SYN ACK: 1247095790

The ACK: 2818463619

The server determines the client's ISN (2818463618) add 1.

Question 3 . What is the sequence number of the ACK segment sent by the client computer in response to the SYNACK? What is the value of the Acknowledgment field in this ACK segment? Does this segment contain any data?

The sequence number of the SYN ACK: 2818463619

The ACK: 1247095791

No, the next segment used the same sequence number.

Question 4 . Who has done the active close? client or the server? how you have determined this? What type of closure has been performed? 3 Segment (FIN/FINACK/ACK), 4 Segment (FIN/ACK/FIN/ACK) or Simultaneous close?

From checking the sequence number of segment 304 and 305, The client and the server both send the FIN to the other. The sequence number of first is 2818463652 and the second is 1247095831. The sequence of the first plus one does not equal the second. Therefore, client and server closed simultaneously.

Question 5 . How many data bytes have been transferred from the client to the server and from the server to the client during the whole duration of the connection? What relationship does this have with the Initial Sequence Number and the final ACK received from the other side?

$$Data_{client} = the\ sequence\ number\ of\ last\ client\ ACK - ISN\ of\ client - 2$$
$$= 2818463653 - 2818463618 - 2 = 33\ Bytes$$

$$Data_{server} = the\ sequence\ number\ of\ last\ server\ ACK - ISN\ of\ server - 2$$
$$= 1247095832 - 1247095790 - 2 = 40\ Bytes$$