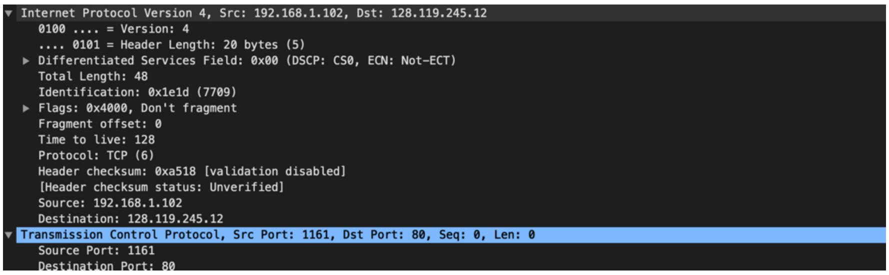
Exercise 1

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

The IP address of gaia.cs.umass.edu is 128.119.245.12.

The port number is it sending and receiving TCP segments for this connection is 80.

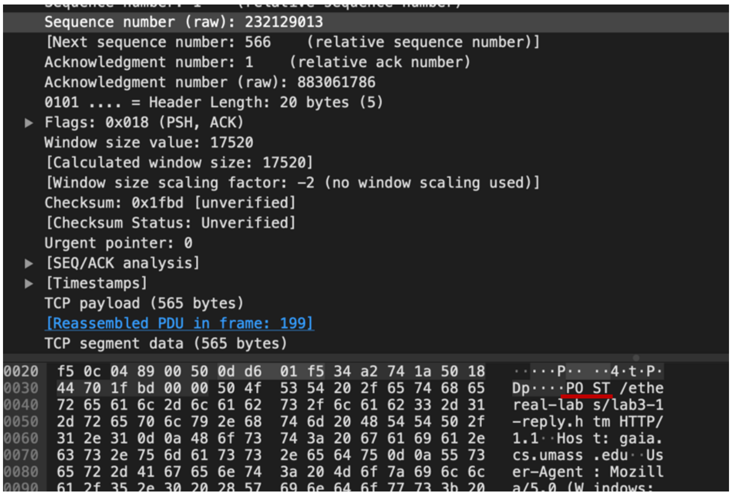
The IP address and TCP port number used by the client computer is 192.168.1.102 and 1161



```
▼ Internet Protocol Version 4, Src: 192.168.1.102, Dst: 128.119.245.12
    0100 .... = Version: 4
    .... 0101 = Header Length: 20 bytes (5)
  ▶ Differentiated Services Field: 0x00 (DSCP: CS0, ECN: Not-ECT)
    Total Length: 48
    Identification: 0x1e1d (7709)
  ▶ Flags: 0x4000, Don't fragment
    Fragment offset: 0
    Time to live: 128
    Protocol: TCP (6)
    Header checksum: 0xa518 [validation disabled]
    [Header checksum status: Unverified]
    Source: 192.168.1.102
    Destination: 128.119.245.12
▼ Transmission Control Protocol, Src Port: 1161, Dst Port: 80, Seq: 0, Len: 0
    Source Port: 1161
    Destination Port: 80
```

Question 2. What is the sequence number of the TCP segment containing the HTTP POST command? Note that in order to find the POST command, you'll need to dig into the packet content field at the bottom of the Wireshark window, looking for a segment with a "POST" within its DATA field.

The sequence number of the TCP segment containing the HTTP POST command is 232129013.



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    Sequence number: 1    (relative sequence number)
    Sequence number (raw): 232129013
    [Next sequence number: 566    (relative sequence number)]
    Acknowledgment number: 1    (relative ack number)
    Acknowledgment number (raw): 883061786
    0101 .... = Header Length: 20 bytes (5)
  ▶ Flags: 0x018 (PSH, ACK)
    Window size value: 17520
    [Calculated window size: 17520]
    [Window size scaling factor: -2 (no window scaling used)]
    Checksum: 0x1fbd [unverified]
    [Checksum Status: Unverified]
    Urgent pointer: 0
  ▶ [SEQ/ACK analysis]
  ▶ [Timestamps]
    TCP payload (565 bytes)
    [Reassembled PDU in frame: 199]
    TCP segment data (565 bytes)
0020  f5 0c 04 89 00 50 0d d6  01 f5 34 a2 74 1a 50 18   ·····P·· ··4·t·P·
0030  44 70 1f bd 00 00 50 4f  53 54 20 2f 65 74 68 65   Dp····PO ST /ethe
0040  72 65 61 6c 2d 6c 61 62  73 2f 6c 61 62 33 2d 31   real-lab s/lab3-1
0050  2d 72 65 70 6c 79 2e 68  74 6d 20 48 54 54 50 2f   -reply.h tm HTTP/
0060  31 2e 31 0d 0a 48 6f 73  74 3a 20 67 61 69 61 2e   1.1··Hos t: gaia.
0070  63 73 2e 75 6d 61 73 73  2e 65 64 75 0d 0a 55 73   cs.umass .edu··Us
0080  65 72 2d 41 67 65 6e 74  3a 20 4d 6f 7a 69 6c 6c   er-Agent : Mozill
0090  61 2f 35 2e 30 20 28 57  69 6e 64 6f 77 73 3b 20   a/5.0 (W indows;
```

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 (including the segment containing the HTTP POST) sent from the client to the web server (Do not consider the ACKs received from the server as part of these six segments)? 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 (see relevant parts of Section 3.5 or lecture slides) after the receipt of each ACK? Assume that the initial value of *EstimatedRTT* is equal to the measured RTT (*SampleRTT*) for the first segment, and then is computed using the *EstimatedRTT* equation for all subsequent segments. Set alpha to 0.125.

Sequence number	Time sent	ACK received time	RTT	EstimatedRTT
232129013	0.026477	0.053937	0.027460	0.027460
232129578	0.041737	0.077294	0.035557	0.028472
232131038	0.054026	0.124085	0.070059	0.033670
232132498	0.054690	0.169118	0.114428	0.043765
232133958	0.077405	0.217299	0.139894	0.055781
232135418	0.078157	0.267802	0.189645	0.072514

Question 4. What is the length of each of the first six TCP segments?

Sequence number	Length
232129013	565
232129578	1460
232131038	1460
232132498	1460
232133958	1460
232135418	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?

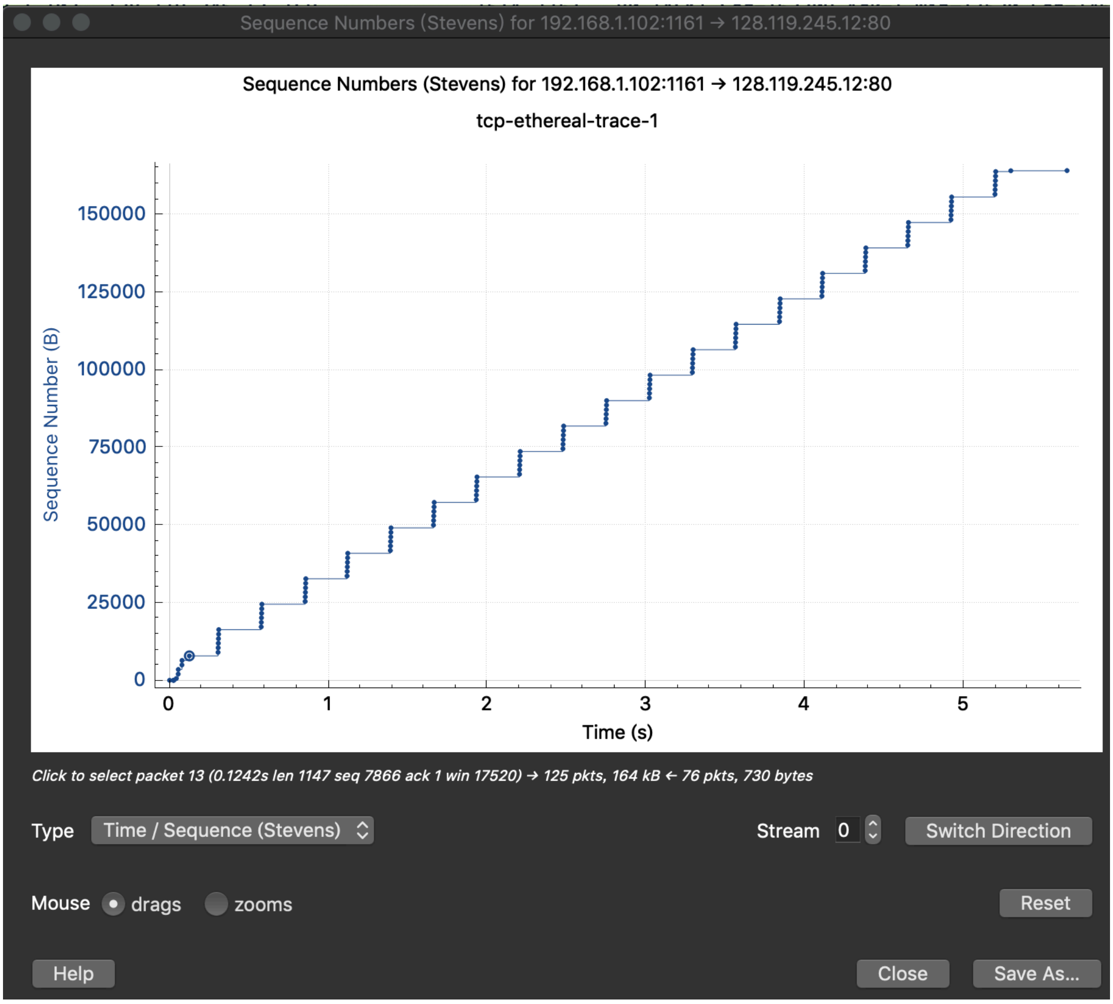
The minimum amount of available buffer space advertised at the receiver for the entire trace is 5840bytes.

There is no lack of receiver buffer space because the window sizes are bigger than the segment sizes at any time.

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

There is no retransmitted segments in the trace file.

Because we can see that the sequence number kept increasing as the time goes by after connection established. If there is a retransmitted segment, the sequence number will keep the same in different times.



Click to select packet 13 (0.1242s len 1147 seq 7866 ack 1 win 17520) → 125 pkts, 164 kB ← 76 pkts, 730 bytes

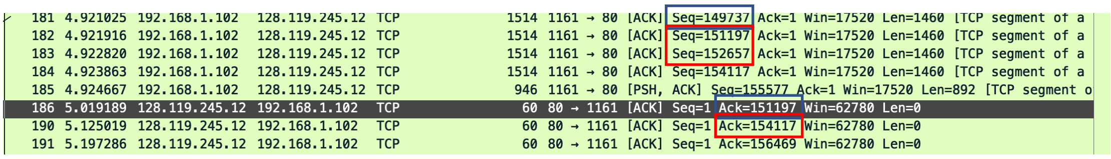
Type: Time / Sequence (Stevens)

Stream: 0 Switch Direction

Mouse: ● drags ○ zooms

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 (recall the discussion about delayed acks from the lecture notes or Section 3.5 of the text).

The size of one segment is usually 1460 bytes and the receiver acknowledge onr segment in one ACK.



```
181 4.921025 192.168.1.102   128.119.245.12 TCP   1514 1161 → 80 [ACK] Seq=149737 Ack=1 Win=17520 Len=1460 [TCP segment of a
182 4.921916 192.168.1.102   128.119.245.12 TCP   1514 1161 → 80 [ACK] Seq=151197 Ack=1 Win=17520 Len=1460 [TCP segment of a
183 4.922820 192.168.1.102   128.119.245.12 TCP   1514 1161 → 80 [ACK] Seq=152657 Ack=1 Win=17520 Len=1460 [TCP segment of a
184 4.923863 192.168.1.102   128.119.245.12 TCP   1514 1161 → 80 [ACK] Seq=154117 Ack=1 Win=17520 Len=1460 [TCP segment of a
185 4.924667 192.168.1.102   128.119.245.12 TCP    946 1161 → 80 [PSH, ACK] Seq=155577 Ack=1 Win=17520 Len=892 [TCP segment o
186 5.019189 128.119.245.12 192.168.1.102  TCP     60 80 → 1161 [ACK] Seq=1 Ack=151197 Win=62780 Len=0
190 5.125019 128.119.245.12 192.168.1.102  TCP     60 80 → 1161 [ACK] Seq=1 Ack=154117 Win=62780 Len=0
191 5.197286 128.119.245.12 192.168.1.102  TCP     60 80 → 1161 [ACK] Seq=1 Ack=156469 Win=62780 Len=0
```

As the picture we can see that the receiver ACK the segment 149737 at line 186 which ack=151197, it means the befored 151198 bytes has be received. When the next segments arrived which numbers are 151197 and 152657 and the len are 1460 the receiver will ack 156469 and it means that the data before 156469 bytes has be received.

Question 8. What is the throughput (bytes transferred per unit time) for the TCP connection? Explain how you calculated this value.

$$
\begin{aligned}
throughput &= \frac{amount\ of\ data\ transmitted}{time\ used} \\
&= \frac{amount\ of\ data\ transmitted}{last\ Ack\ received\ time - first\ sending\ segment\ time} \\
&= \frac{164090\ bytes}{5.455830s - 0.026477s} = 30.223\ kB/s
\end{aligned}
$$

Exercise 2

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 is 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 SYNACK segment sent by the server to the client computer in reply to the SYN is 1247095790. The value is 2818463619.

The server just adds 1 to the to the sequence number of the SYN segment because there is no data.

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 is 2818463619.

The value is 1247095791.

Yes, it contain 33 Bytes data.(2818463652 – 2818463619 = 33)

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?

Both of client and server done the active close.

Because they simultaneous sent FINACK to other at NO.304 and NO.305. And the reponsed ACK at NO.306 and NO.307.

It indicates that this is a simultaneous close.

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 bytes have been transferred	final ACK received- Initial Sequence Number
client to the server	33 Bytes	35 Bytes
server to the client	40 Bytes	42 Bytes

final ACK received - Initial Sequence Number =

data bytes have been transferred

+ 1 Bytes (used for indicating state as initial three way handshake bytes (SYN, SYNACK, ACK) which do not contain any data)

+ 1 Bytes (used for indicating state as finishing bytes (FIN) which do not contain any data)