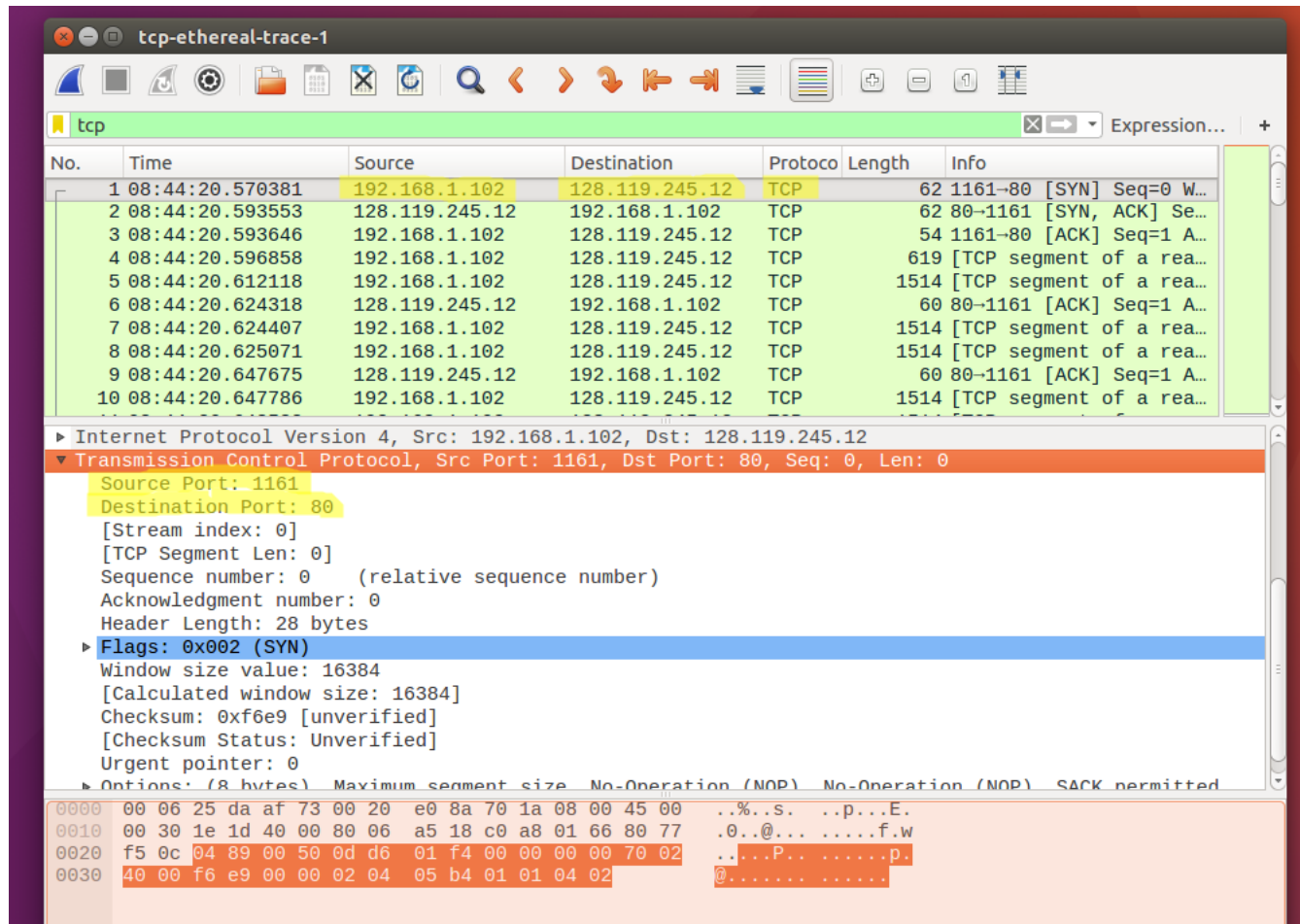


1. What is the IP address and TCP port number used by the client computer (source) that is transferring the file to gaia.cs.umass.edu? To answer this question, it's probably easiest to select an HTTP message and explore the details of the TCP packet used to carry this HTTP message, using the "details of the selected packet header window" (refer to Figure 2 in the "Getting Started with Wireshark" Lab if you're uncertain about the Wireshark windows.

ANS:



Client computer (source):

IP address: 192.168.1.102 (Source)

TCP port number: 1161 (source)

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

ANS:

Destination computer(gaia.cs.umass.edu):

IP address: 128.119.245.12

TCP port number: 80

If you have been able to create your own trace, answer the following question:

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

ANS:

The image shows a Wireshark packet capture window titled '*wlo1'. The filter is set to 'tcp'. The packet list shows a sequence of packets from 192.168.0.16 to 37.221.171.236. The packet details pane for frame 7 shows the source port as 51316 and the destination port as 9005. The packet bytes pane shows the raw data of the segment.

No.	Time	Source	Destination	Protocol	Length	Info
7	11:13:36.044738425	192.168.0.16	37.221.171.236	TCP	631	51316→9005 [PSH, ACK]...
8	11:13:36.407661233	37.221.171.236	192.168.0.16	TCP	66	9005→51316 [ACK] Seq=...
9	11:13:36.407709650	192.168.0.16	37.221.171.236	TCP	631	51316→9005 [PSH, ACK]...
11	11:13:36.574308984	37.221.171.236	192.168.0.16	TCP	631	9005→51316 [PSH, ACK]...
12	11:13:36.574358790	192.168.0.16	37.221.171.236	TCP	66	51316→9005 [ACK] Seq=...
15	11:13:36.660071276	37.221.171.236	192.168.0.16	TCP	66	9005→51316 [ACK] Seq=...
16	11:13:36.660199429	192.168.0.16	37.221.171.236	TCP	1196	51316→9005 [PSH, ACK]...
18	11:13:36.909897812	37.221.171.236	192.168.0.16	TCP	66	9005→51316 [ACK] Seq=...
19	11:13:36.909946439	192.168.0.16	37.221.171.236	TCP	631	51316→9005 [PSH, ACK]...
20	11:13:36.942838142	37.221.171.236	192.168.0.16	TCP	631	9005→51316 [PSH, ACK]...

Frame 7: 631 bytes on wire (5048 bits), 631 bytes captured (5048 bits) on interface 0

Ethernet II, Src: Universa_fb:36:2d (e0:2a:82:fb:36:2d), Dst: ArrisGro_66:f6:3f (e8:6d:52:66:f6:3f)

Internet Protocol Version 4, Src: 192.168.0.16, Dst: 37.221.171.236

Transmission Control Protocol, Src Port: 51316, Dst Port: 9005, Seq: 1, Ack: 1, Len: 565

Source Port: 51316

Destination Port: 9005

[Stream index: 0]

[TCP Segment Len: 565]

Sequence number: 1 (relative sequence number)

[Next sequence number: 566 (relative sequence number)]

Acknowledgment number: 1 (relative ack number)

Header Length: 32 bytes

Flags: 0x018 (PSH, ACK)

Window size value: 4254

[Calculated window size: 4254]

[Window size scaling factor: -1 (unknown)]

0020 ab ec c8 74 23 2d 51 54 4e cf 4a 0d 2d 62 80 18 ...t#-QT N.J.-b..

0030 10 9e 1d 5e 00 00 01 01 08 0a 00 1d 25 c8 71 b7 ...^....%.q.

0040 24 b6 17 03 02 02 30 42 18 48 92 bb 98 8f 3b 34 \$.....OB .H...;4

0050 e4 f2 2e 8f de ee ec 07 57 db eb 7a 14 07 99 1aW..z....

0060 b0 74 d4 88 d2 61 8b 1b 7f e4 d4 3e a1 e6 a2 50 .t...a...>...P

0070 66 55 8d 2d a1 ce 60 b5 6e 7a df eb 02 50 47 40 fU...`..nz...PG@

0080 43 59 93 bf 3b 4d d9 c0 b7 92 2d 25 db 4d 2a 05 CY...M...-%.M*.

IP address: 192.168.0.16

TCP port number: 51316

4. What is the sequence number of the TCP SYN segment that is used to initiate the TCP connection between the client computer and gaia.cs.umass.edu? What is it in the segment that identifies the segment as a SYN segment?

ANS:

Sequence number of the TCP SYN segment is used to initiate the TCP connection between the client computer and gaia.cs.umass.edu. The value is 0 in this trace. The SYN flag is set to 1 and it indicates that this segment is a SYN segment.

The image shows a Wireshark packet capture window titled "tcp-ethereal-trace-1". The packet list on the left shows 10 packets. Packet 1 is a TCP SYN segment from 192.168.1.102 to 128.119.245.12, port 1161 to 80, with sequence number 0. The packet details pane on the right shows the structure of this segment: Ethernet II, Internet Protocol Version 4, and Transmission Control Protocol. The TCP segment details show Source Port: 1161, Destination Port: 80, Sequence number: 0 (relative sequence number), Acknowledgment number: 0, Header Length: 28 bytes, and Flags: 0x002 (SYN). The packet bytes pane at the bottom shows the raw data in hexadecimal and ASCII.

No.	Time	Source	Destination	Protocol	Length	Info
1	08:44:20.570381	192.168.1.102	128.119.245.12	TCP	62	1161→80 [SYN] Seq=0 W...
2	08:44:20.593553	128.119.245.12	192.168.1.102	TCP	62	80→1161 [SYN, ACK] Se...
3	08:44:20.593646	192.168.1.102	128.119.245.12	TCP	54	1161→80 [ACK] Seq=1 A...
4	08:44:20.596858	192.168.1.102	128.119.245.12	TCP	619	[TCP segment of a rea...
5	08:44:20.612118	192.168.1.102	128.119.245.12	TCP	1514	[TCP segment of a rea...
6	08:44:20.624318	128.119.245.12	192.168.1.102	TCP	60	80→1161 [ACK] Seq=1 A...
7	08:44:20.624407	192.168.1.102	128.119.245.12	TCP	1514	[TCP segment of a rea...
8	08:44:20.625071	192.168.1.102	128.119.245.12	TCP	1514	[TCP segment of a rea...
9	08:44:20.647675	128.119.245.12	192.168.1.102	TCP	60	80→1161 [ACK] Seq=1 A...
10	08:44:20.647786	192.168.1.102	128.119.245.12	TCP	1514	[TCP segment of a rea...

Frame 1: 62 bytes on wire (496 bits), 62 bytes captured (496 bits)
Ethernet II, Src: Actionte_8a:70:1a (00:20:e0:8a:70:1a), Dst: LinksysG_da:af:73 (00:06:25:da:af:73)
Internet Protocol Version 4, Src: 192.168.1.102, Dst: 128.119.245.12
Transmission Control Protocol, Src Port: 1161, Dst Port: 80, Seq: 0, Len: 0
Source Port: 1161
Destination Port: 80
[Stream index: 0]
[TCP Segment Len: 0]
Sequence number: 0 (relative sequence number)
Acknowledgment number: 0
Header Length: 28 bytes
Flags: 0x002 (SYN)
Window size value: 16384
[Calculated window size: 16384]
Checksum: 0xf6e9 [unverified]
[Checksum Status: Unverified]

```
0000  00 06 25 da af 73 00 20 e0 8a 70 1a 08 00 45 00  ..%.s.  ..p...E.
0010  00 30 1e 1d 40 00 80 06 a5 18 c0 a8 01 66 80 77  .0..@...  ....f.w
0020  f5 0c 04 89 00 50 0d d6 01 f4 00 00 00 00 70 02  ....P...  ....p.
0030  40 00 f6 e9 00 00 02 04 05 b4 01 01 04 02      @.....
```

5. What is the sequence number of the SYNACK segment sent by gaia.cs.umass.edu to the client computer in reply to the SYN? What is the value of the Acknowledgement field in the SYNACK segment? How did gaia.cs.umass.edu determine that value? What is it in the segment that identifies the segment as a SYNACK segment?

ANS:

Sequence number of the SYNACK segment from gaia.cs.umass.edu to the client computer in reply to the SYN has the value of 0 in this trace. The value of the Acknowledgement field in the SYNACK segment is 1. The value of the Acknowledgement field in the SYNACK segment is determined by gaia.cs.umass.edu by adding 1 to the initial sequence number of SYN segment from the client computer (i.e. the sequence number of the SYN segment initiated by the client computer is 0.). The SYN flag and Acknowledgement flag in the segment are set to 1 and they indicate that this segment is a SYNACK segment.

The image shows a Wireshark packet capture window titled "tcp-ethereal-trace-1". The packet list pane shows several TCP segments. The selected packet is packet 213, which is a SYN segment from 192.168.1.102 to 199.2.53.206. The packet details pane shows the following information:

- Acknowledgment number: 0
- Header Length: 28 bytes
- Flags: 0x002 (SYN)
- 000. = Reserved: Not set
- ...0 = Nonce: Not set
- 0... = Congestion Window Reduced (CWR): Not set
-0.. = ECN-Echo: Not set
-0. = Urgent: Not set
-0 = Acknowledgment: Not set
-0.. = Push: Not set
-0.. = Reset: Not set
- ▶1. = Syn: Set
-0 = Fin: Not set
- [TCP Flags:S.]
- Window size value: 16384
- [Calculated window size: 16384]

The packet bytes pane shows the raw data of the packet, including the IP header and the TCP header.

6. 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.

ANS:

No. 199 segment is the TCP segment containing the HTTP POST command. The sequence number of this segment has the value of 164841.

The image shows a Wireshark packet capture window titled "tcp-ethereal-trace-1". The packet list on the left shows several packets, with packet 199 highlighted. The packet details pane on the right shows the structure of packet 199, which is an HTTP POST request. The packet content pane at the bottom shows the raw data of the packet, including the "POST /ethereal-labs/..." data field.

No.	Time	Source	Destination	Protocol	Length	Info
116	08:44:23.591203	128.119.245.12	192.168.1.102	TCP	60	80→1161 [ACK] Seq=1 A...
123	08:44:23.687683	128.119.245.12	192.168.1.102	TCP	60	80→1161 [ACK] Seq=1 A...
124	08:44:23.786508	128.119.245.12	192.168.1.102	TCP	60	80→1161 [ACK] Seq=1 A...
125	08:44:23.862053	128.119.245.12	192.168.1.102	TCP	60	80→1161 [ACK] Seq=1 A...
2	08:44:20.593553	128.119.245.12	192.168.1.102	TCP	62	80→1161 [SYN, ACK] Se...
203	08:44:26.031556	128.119.245.12	192.168.1.102	HTTP	784	HTTP/1.1 200 OK (tex...
199	08:44:25.867722	192.168.1.102	128.119.245.12	HTTP	104	POST /ethereal-labs/l...
4	08:44:20.596858	192.168.1.102	128.119.245.12	TCP	619	[TCP segment of a rea...
5	08:44:20.612118	192.168.1.102	128.119.245.12	TCP	1514	[TCP segment of a rea...
7	08:44:20.624407	192.168.1.102	128.119.245.12	TCP	1514	[TCP segment of a rea...

Transmission Control Protocol, Src Port: 1161, Dst Port: 80, Seq: 164041, Ack: 1, Len: 50

- Source Port: 1161
- Destination Port: 80
- [Stream index: 0]
- [TCP Segment Len: 50]
- Sequence number: 164041 (relative sequence number)
- [Next sequence number: 164091 (relative sequence number)]
- Acknowledgment number: 1 (relative ack number)
- Header Length: 20 bytes
- Flags: 0x018 (PSH, ACK)
- Window size value: 17520
- [Calculated window size: 17520]
- [Window size scaling factor: -2 (no window scaling used)]
- Checksum: 0x9f0f [unverified]
- [Checksum Status: Unverified]

0020 f5 0c 04 89 00 50 0d d8 82 bd 34 a2 74 1a 50 18P...4.t.P.
0030 44 70 9f 0f 00 00 0d 0a 2d 2d 2d 2d 2d 2d 2d Dp.....
0040 2d 2d 2d 2d 2d 2d 2d 2d 2d 2d 2d 2d 2d 2d 2d -----
0050 2d 2d 2d 2d 2d 32 36 35 30 30 31 39 31 36 39 31 ----265 00191691
0060 35 37 32 34 2d 2d 0d 0a 5724--..

7. 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)? 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 Section 3.5.3, page 239 in text) after the receipt of each ACK? Assume that the value of the EstimatedRTT is equal to the measured RTT for the first segment, and then is computed using the EstimatedRTT equation on page 239 for all subsequent segments.

Note: Wireshark has a nice feature that allows you to plot the RTT for each of the TCP segments sent. Select a TCP segment in the “listing of captured packets” window that is being sent from the client to the gaia.cs.umass.edu server. Then select: Statistics->TCP Stream Graph- >Round Trip Time Graph.

ANS:

The HTTP POST segment is considered as the first segment. Segments 1 – 6 are No. 4, 5, 7, 8, 10, and 11 in this trace respectively. The ACKs of segments 1 – 6 are No. 6, 9, 12, 14, 15, and 16 in this trace.

Segment 1 sequence number: 1

Segment 2 sequence number: 566

Segment 3 sequence number: 2026

Segment 4 sequence number: 3486

Segment 5 sequence number: 4946

Segment 6 sequence number: 6406

$\text{EstimatedRTT} = 0.875 * \text{EstimatedRTT} + 0.125 * \text{SampleRTT}$

EstimatedRTT after the receipt of the ACK of segment 1:

EstimatedRTT = RTT for Segment 1 = 0.02746 second

EstimatedRTT after the receipt of the ACK of segment 2:

$\text{EstimatedRTT} = 0.875 * 0.02746 + 0.125 * 0.035557 = 0.0285$

EstimatedRTT after the receipt of the ACK of segment 3:

$\text{EstimatedRTT} = 0.875 * 0.0285 + 0.125 * 0.070059 = 0.0337$

EstimatedRTT after the receipt of the ACK of segment 4:

$\text{EstimatedRTT} = 0.875 * 0.0337 + 0.125 * 0.11443 = 0.0438$

EstimatedRTT after the receipt of the ACK of segment 5:

$\text{EstimatedRTT} = 0.875 * 0.0438 + 0.125 * 0.13989 = 0.0558$

EstimatedRTT after the receipt of the ACK of segment 6:

$\text{EstimatedRTT} = 0.875 * 0.0558 + 0.125 * 0.18964 = 0.0725 \text{ second}$

1	0.000000	192.168.1.102	128.119.245.12	TCP	1161 > http [SYN] Seq=0 Ack=0 Win=16384 Len=0 MSS=1460
2	0.023172	128.119.245.12	192.168.1.102	TCP	http > 1161 [SYN, ACK] Seq=0 Ack=1 Win=5840 Len=0 MSS=1460
3	0.023265	192.168.1.102	128.119.245.12	TCP	1161 > http [ACK] Seq=1 Ack=1 Win=17520 Len=0
4	0.026477	192.168.1.102	128.119.245.12	HTTP	POST /etherreal-labs/lab3-1-reply.htm HTTP/1.1
5	0.041737	192.168.1.102	128.119.245.12	HTTP	Continuation or non-HTTP traffic
6	0.053937	128.119.245.12	192.168.1.102	TCP	http > 1161 [ACK] Seq=1 Ack=566 Win=6780 Len=0
7	0.054026	192.168.1.102	128.119.245.12	HTTP	Continuation or non-HTTP traffic
8	0.054690	192.168.1.102	128.119.245.12	HTTP	Continuation or non-HTTP traffic
9	0.077294	128.119.245.12	192.168.1.102	TCP	http > 1161 [ACK] Seq=1 Ack=2026 Win=8760 Len=0
10	0.077405	192.168.1.102	128.119.245.12	HTTP	Continuation or non-HTTP traffic
11	0.078157	192.168.1.102	128.119.245.12	HTTP	Continuation or non-HTTP traffic
12	0.124085	128.119.245.12	192.168.1.102	TCP	http > 1161 [ACK] Seq=1 Ack=3486 Win=11680 Len=0
13	0.124185	192.168.1.102	128.119.245.12	HTTP	Continuation or non-HTTP traffic
14	0.169118	128.119.245.12	192.168.1.102	TCP	http > 1161 [ACK] Seq=1 Ack=4946 Win=14600 Len=0
15	0.217299	128.119.245.12	192.168.1.102	TCP	http > 1161 [ACK] Seq=1 Ack=6406 Win=17520 Len=0
16	0.267802	128.119.245.12	192.168.1.102	TCP	http > 1161 [ACK] Seq=1 Ack=7866 Win=20440 Len=0
17	0.304807	128.119.245.12	192.168.1.102	TCP	http > 1161 [ACK] Seq=1 Ack=9013 Win=23360 Len=0
18	0.305040	192.168.1.102	128.119.245.12	HTTP	Continuation or non-HTTP traffic
19	0.305813	192.168.1.102	128.119.245.12	HTTP	Continuation or non-HTTP traffic
20	0.306692	192.168.1.102	128.119.245.12	HTTP	Continuation or non-HTTP traffic

* Frame 11 (1514 bytes on wire, 1514 bytes captured)

* Ethernet II, Src: Actionte_8a:70:1a (00:20:e0:8a:70:1a), Dst: 192.168.1.1 (00:06:25:da:af:73)

* Internet Protocol, Src: 192.168.1.102 (192.168.1.102), Dst: 128.119.245.12 (128.119.245.12)

* Transmission Control Protocol, Src Port: 1161 (1161), Dst Port: http (80), Seq: 6406, Ack: 1, Len: 1460

* Hypertext Transfer Protocol

```

0000  00 06 25 da af 73 00 20 e0 8a 70 1a 08 00 45 00  ..%..s.  ..p...E.
0010  05 dc 1e 26 40 00 80 06 9f 63 c0 a8 01 66 80 77  ...&@...  .c...f.w
0020  f5 0c 04 89 00 50 0d d6 1a fa 34 a2 74 1a 50 10  ....P...  .4.t.P.
0030  44 70 95 83 00 00 20 55 6e 69 74 65 64 20 53 74  Dp....  U nited St

```

segments 1-6

1	0.000000	192.168.1.102	128.119.245.12	TCP	1161 > http [SYN] Seq=0 Ack=0 Win=16384 Len=0 MSS=1460
2	0.023172	128.119.245.12	192.168.1.102	TCP	http > 1161 [SYN, ACK] Seq=0 Ack=1 Win=5840 Len=0 MSS=1460
3	0.023265	192.168.1.102	128.119.245.12	TCP	1161 > http [ACK] Seq=1 Ack=1 Win=17520 Len=0
4	0.026477	192.168.1.102	128.119.245.12	HTTP	POST /etherreal-labs/lab3-1-reply.htm HTTP/1.1
5	0.041737	192.168.1.102	128.119.245.12	HTTP	Continuation or non-HTTP traffic
6	0.053937	128.119.245.12	192.168.1.102	TCP	http > 1161 [ACK] Seq=1 Ack=566 Win=6780 Len=0
7	0.054026	192.168.1.102	128.119.245.12	HTTP	Continuation or non-HTTP traffic
8	0.054690	192.168.1.102	128.119.245.12	HTTP	Continuation or non-HTTP traffic
9	0.077294	128.119.245.12	192.168.1.102	TCP	http > 1161 [ACK] Seq=1 Ack=2026 Win=8760 Len=0
10	0.077405	192.168.1.102	128.119.245.12	HTTP	Continuation or non-HTTP traffic
11	0.078157	192.168.1.102	128.119.245.12	HTTP	Continuation or non-HTTP traffic
12	0.124085	128.119.245.12	192.168.1.102	TCP	http > 1161 [ACK] Seq=1 Ack=3486 Win=11680 Len=0
13	0.124185	192.168.1.102	128.119.245.12	HTTP	Continuation or non-HTTP traffic
14	0.169118	128.119.245.12	192.168.1.102	TCP	http > 1161 [ACK] Seq=1 Ack=4946 Win=14600 Len=0
15	0.217299	128.119.245.12	192.168.1.102	TCP	http > 1161 [ACK] Seq=1 Ack=6406 Win=17520 Len=0
16	0.267802	128.119.245.12	192.168.1.102	TCP	http > 1161 [ACK] Seq=1 Ack=7866 Win=20440 Len=0
17	0.304807	128.119.245.12	192.168.1.102	TCP	http > 1161 [ACK] Seq=1 Ack=9013 Win=23360 Len=0
18	0.305040	192.168.1.102	128.119.245.12	HTTP	Continuation or non-HTTP traffic
19	0.305813	192.168.1.102	128.119.245.12	HTTP	Continuation or non-HTTP traffic
20	0.306692	192.168.1.102	128.119.245.12	HTTP	Continuation or non-HTTP traffic

* Frame 16 (60 bytes on wire, 60 bytes captured)

* Ethernet II, Src: 192.168.1.1 (00:06:25:da:af:73), Dst: Actionte_8a:70:1a (00:20:e0:8a:70:1a)

* Internet Protocol, Src: 128.119.245.12 (128.119.245.12), Dst: 192.168.1.102 (192.168.1.102)

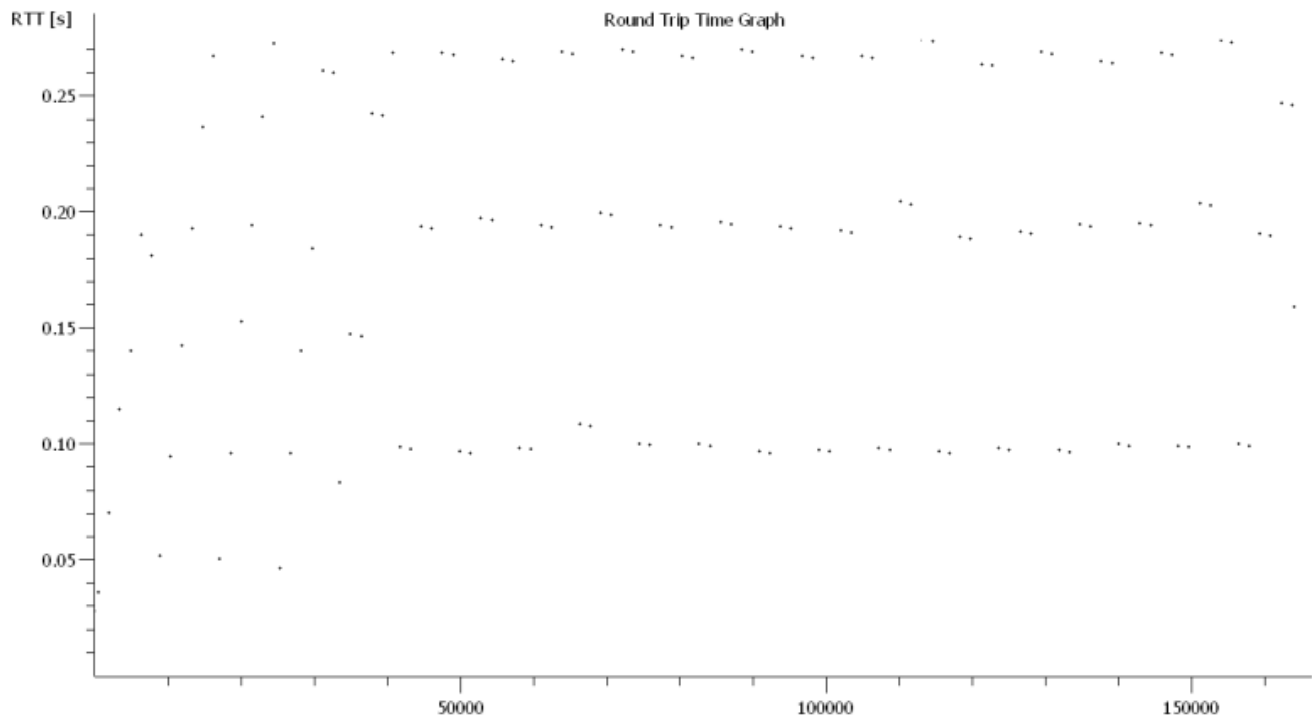
* Transmission Control Protocol, Src Port: http (80), Dst Port: 1161 (1161), Seq: 1, Ack: 7866, Len: 0

```

0000  00 20 e0 8a 70 1a 00 06 25 da af 73 08 00 45 00  ...p...  %..s...E.
0010  00 28 58 77 40 00 37 06 b3 c6 80 77 f5 0c c0 a8  .Cw@.7.  ...w....
0020  01 66 00 50 04 89 34 a2 74 1a 0d d6 20 ae 50 10  .f.P..4.  t... .P.
0030  4f d8 4c 50 00 00 93 c0 00 00 63 ed             o.LP....  ...c.

```

ACK's of segments 1-6



Round trip time graph

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

ANS:

Length of the first TCP segment: 565 bytes

Length of each of the other five TCP segments: 1460 bytes

1	0.000000	192.168.1.102	128.119.245.12	TCP	1161 > http [SYN] Seq=0 Ack=0 Win=16384 Len=0 MSS=1460
2	0.023172	128.119.245.12	192.168.1.102	TCP	http > 1161 [SYN, ACK] Seq=0 Ack=1 Win=5840 Len=0 MSS=1460
3	0.023265	192.168.1.102	128.119.245.12	TCP	1161 > http [ACK] Seq=1 Ack=1 Win=17520 Len=0
4	0.026477	192.168.1.102	128.119.245.12	HTTP	POST /ethereal-labs/lab3-1-reply.htm HTTP/1.1
5	0.041737	192.168.1.102	128.119.245.12	HTTP	Continuation or non-HTTP traffic
6	0.053937	128.119.245.12	192.168.1.102	TCP	http > 1161 [ACK] Seq=1 Ack=566 Win=6780 Len=0
7	0.054026	192.168.1.102	128.119.245.12	HTTP	Continuation or non-HTTP traffic
8	0.054690	192.168.1.102	128.119.245.12	HTTP	Continuation or non-HTTP traffic
9	0.077294	128.119.245.12	192.168.1.102	TCP	http > 1161 [ACK] Seq=1 Ack=2026 Win=8760 Len=0
10	0.077405	192.168.1.102	128.119.245.12	HTTP	Continuation or non-HTTP traffic
11	0.078157	192.168.1.102	128.119.245.12	HTTP	Continuation or non-HTTP traffic
12	0.124085	128.119.245.12	192.168.1.102	TCP	http > 1161 [ACK] Seq=1 Ack=3486 Win=11680 Len=0
13	0.124185	192.168.1.102	128.119.245.12	HTTP	Continuation or non-HTTP traffic
14	0.169118	128.119.245.12	192.168.1.102	TCP	http > 1161 [ACK] Seq=1 Ack=4946 Win=14600 Len=0
15	0.217299	128.119.245.12	192.168.1.102	TCP	http > 1161 [ACK] Seq=1 Ack=6406 Win=17520 Len=0
16	0.267802	128.119.245.12	192.168.1.102	TCP	http > 1161 [ACK] Seq=1 Ack=7866 Win=20440 Len=0

Frame 11 (1514 bytes on wire, 1514 bytes captured)

Ethernet II, Src: Actionte_8a:70:1a (00:20:e0:8a:70:1a), Dst: 192.168.1.1 (00:06:25:da:af:73)

Internet Protocol, Src: 192.168.1.102 (192.168.1.102), Dst: 128.119.245.12 (128.119.245.12)

Transmission Control Protocol, Src Port: 1161 (1161), Dst Port: http (80), Seq: 6406, Ack: 1, Len: 1460

Hypertext Transfer Protocol

Data (1460 bytes)

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

ANS:

The minimum amount of buffer space advertised at gaia.cs.umass.edu for the entire trace is 5840 bytes, which shows in the first acknowledgement from the server. This receiver window grows steadily until a maximum receiver buffer size of 62780 bytes. The sender is never throttled due to lacking of receiver buffer space by inspecting this trace.

1	0.000000	192.168.1.102	128.119.245.12	TCP	1161 > http [SYN] Seq=0 Ack=0 Win=16384 Len=0 MSS=1460
2	0.023172	128.119.245.12	192.168.1.102	TCP	http > 1161 [SYN, ACK] Seq=0 Ack=1 Win=5840 Len=0 MSS=1460
3	0.023265	192.168.1.102	128.119.245.12	TCP	1161 > http [ACK] Seq=1 Ack=1 Win=17520 Len=0
4	0.026477	192.168.1.102	128.119.245.12	HTTP	POST /ethereal-labs/lab3-1-reply.htm HTTP/1.1
5	0.041737	192.168.1.102	128.119.245.12	HTTP	Continuation or non-HTTP traffic
6	0.053937	128.119.245.12	192.168.1.102	TCP	http > 1161 [ACK] Seq=1 Ack=566 Win=6780 Len=0
7	0.054026	192.168.1.102	128.119.245.12	HTTP	Continuation or non-HTTP traffic
8	0.054690	192.168.1.102	128.119.245.12	HTTP	Continuation or non-HTTP traffic
9	0.077294	128.119.245.12	192.168.1.102	TCP	http > 1161 [ACK] Seq=1 Ack=2026 Win=8760 Len=0
10	0.077405	192.168.1.102	128.119.245.12	HTTP	Continuation or non-HTTP traffic
11	0.078157	192.168.1.102	128.119.245.12	HTTP	Continuation or non-HTTP traffic
12	0.124085	128.119.245.12	192.168.1.102	TCP	http > 1161 [ACK] Seq=1 Ack=3486 Win=11680 Len=0
13	0.124185	192.168.1.102	128.119.245.12	HTTP	Continuation or non-HTTP traffic
14	0.169118	128.119.245.12	192.168.1.102	TCP	http > 1161 [ACK] Seq=1 Ack=4946 Win=14600 Len=0
15	0.217299	128.119.245.12	192.168.1.102	TCP	http > 1161 [ACK] Seq=1 Ack=6406 Win=17520 Len=0
16	0.267802	128.119.245.12	192.168.1.102	TCP	http > 1161 [ACK] Seq=1 Ack=7866 Win=20440 Len=0
17	0.304807	128.119.245.12	192.168.1.102	TCP	http > 1161 [ACK] Seq=1 Ack=9013 Win=23360 Len=0
18	0.305040	192.168.1.102	128.119.245.12	HTTP	Continuation or non-HTTP traffic
19	0.305813	192.168.1.102	128.119.245.12	HTTP	Continuation or non-HTTP traffic
20	0.306692	192.168.1.102	128.119.245.12	HTTP	Continuation or non-HTTP traffic

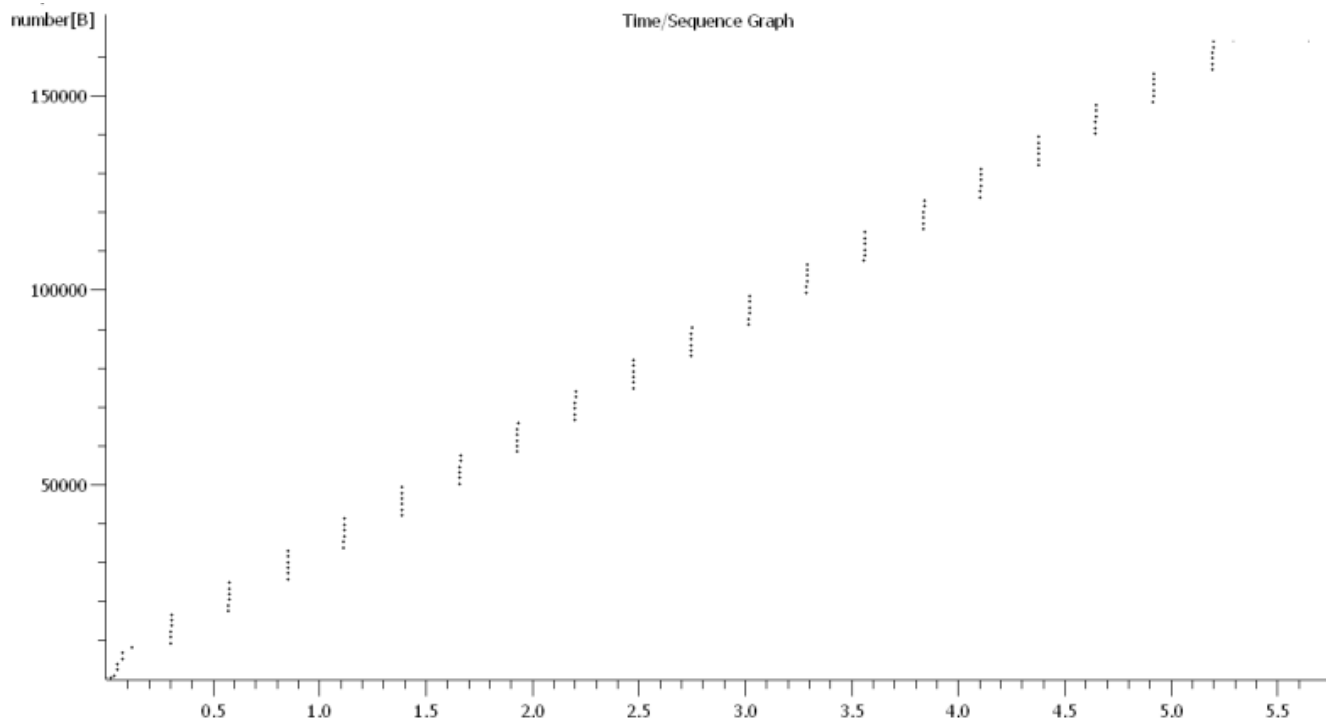
* Frame 2 (62 bytes on wire, 62 bytes captured)
 * Ethernet II, Src: 192.168.1.1 (00:06:25:da:af:73), Dst: Actionte_8a:70:1a (00:20:e0:8a:70:1a)
 * Internet Protocol, Src: 128.119.245.12 (128.119.245.12), Dst: 192.168.1.102 (192.168.1.102)
 * Transmission Control Protocol, Src Port: http (80), Dst Port: 1161 (1161), Seq: 0, Ack: 1, Len: 0

0000	00 20 e0 8a 70 1a 00 06	25 da af 73 08 00 45 00	. . . p . . % . s . . E .
0010	00 30 00 00 40 00 37 06	0c 36 80 77 f5 0c c0 a8	. 0 . . 0 . 7 . . 6 . w . . .
0020	01 66 00 50 04 89 34 a2	74 19 0d d6 01 f5 70 12	. f . P . . 4 . t p .
0030	16 d0 77 4d 00 00 02 04	05 b4 01 01 04 02	. . w M

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

ANS:

There are no retransmitted segments in the trace file. We can verify this by checking the sequence numbers of the TCP segments in the trace file. In the Time-Sequence-Graph of this trace, all sequence numbers from the source (192.168.1.102) to the destination (128.119.245.12) are increasing monotonically with respect to time. If there is a retransmitted segment, the sequence number of this retransmitted segment should be smaller than those of its neighboring segments.



11. How much data does the receiver typically acknowledge in an ACK? Can you identify cases where the receiver is ACKing every other received segment (see Table 3.2 on page 247 in the text).

ANS:

Difference between the acknowledged sequence numbers of two consecutive ACKs indicates the data received by the server between these two ACKs. For example, segment of No. 80 acknowledged data with 2920 bytes = 1460×2 bytes.

72	1.661734	192.168.1.102	128.119.245.12	HTTP	Continuation or non-HTTP traffic
73	1.662474	192.168.1.102	128.119.245.12	HTTP	Continuation or non-HTTP traffic
74	1.663315	192.168.1.102	128.119.245.12	HTTP	Continuation or non-HTTP traffic
75	1.664198	192.168.1.102	128.119.245.12	HTTP	Continuation or non-HTTP traffic
76	1.665254	192.168.1.102	128.119.245.12	HTTP	Continuation or non-HTTP traffic
77	1.666151	192.168.1.102	128.119.245.12	HTTP	Continuation or non-HTTP traffic
78	1.758227	128.119.245.12	192.168.1.102	TCP	http > 1161 [ACK] Seq=1 Ack=52893 Win=62780 Len=0
79	1.860063	128.119.245.12	192.168.1.102	TCP	http > 1161 [ACK] Seq=1 Ack=55813 Win=62780 Len=0
80	1.930880	128.119.245.12	192.168.1.102	TCP	http > 1161 [ACK] Seq=1 Ack=58165 Win=62780 Len=0
81	1.931099	192.168.1.102	128.119.245.12	HTTP	Continuation or non-HTTP traffic
82	1.931879	192.168.1.102	128.119.245.12	HTTP	Continuation or non-HTTP traffic
83	1.932757	192.168.1.102	128.119.245.12	HTTP	Continuation or non-HTTP traffic
84	1.933636	192.168.1.102	128.119.245.12	HTTP	Continuation or non-HTTP traffic
85	1.934770	192.168.1.102	128.119.245.12	HTTP	Continuation or non-HTTP traffic
86	1.935586	192.168.1.102	128.119.245.12	HTTP	Continuation or non-HTTP traffic
87	2.029069	128.119.245.12	192.168.1.102	TCP	http > 1161 [ACK] Seq=1 Ack=61085 Win=62780 Len=0
88	2.126682	128.119.245.12	192.168.1.102	TCP	http > 1161 [ACK] Seq=1 Ack=64005 Win=62780 Len=0
89	2.203195	128.119.245.12	192.168.1.102	TCP	http > 1161 [ACK] Seq=1 Ack=66357 Win=62780 Len=0
90	2.203411	192.168.1.102	128.119.245.12	HTTP	Continuation or non-HTTP traffic
91	2.204125	192.168.1.102	128.119.245.12	HTTP	Continuation or non-HTTP traffic
92	2.204962	192.168.1.102	128.119.245.12	HTTP	Continuation or non-HTTP traffic

* Frame 88 (60 bytes on wire, 60 bytes captured)
 * Ethernet II, Src: 192.168.1.1 (00:06:25:da:af:73), Dst: Actionte_8a:70:1a (00:20:e0:8a:70:1a)
 * Internet Protocol, Src: 128.119.245.12 (128.119.245.12), Dst: 192.168.1.102 (192.168.1.102)
 * Transmission Control Protocol, Src Port: http (80), Dst Port: 1161 (1161), Seq: 1, Ack: 64005, Len: 0

0000	00 20 e0 8a 70 1a 00 06	25 da af 73 08 00 45 00	. . . p . . % . s . . E .
0010	00 28 58 95 40 00 37 06	b3 a8 80 77 f5 0c c0 a8	. (X . 0 . 7 . . . w . . .
0020	01 66 00 50 04 89 34 a2	74 1a 0d d6 fb f9 50 10	. f . P . . 4 . t P .
0030	f5 3c cb 9f 00 00 b2 6a	00 00 37 eb	. < j . . 7 .

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

ANS:

Computation of TCP throughput largely depends on the selection of averaging time period. As a common throughput computation, in this question, we select the average time period as the whole connection time. The average throughput for this TCP connection is computed as the ratio between the total amount data and the total transmission time. The total amount data transmitted can be computed by the difference between the sequence number of the first TCP segment (1 byte for No. 4 segment) and the acknowledged sequence number of the last ACK (164091 bytes for No. 202 segment). Therefore, the total data are $164091 - 1 = 164090$ bytes. The whole transmission time is the difference of the time instant of the first TCP segment (0.026477 second for No.4 segment) and the time instant of the last ACK (5.455830 second for No. 202 segment). The total transmission time is $5.455830 - 0.026477 = 5.4294$ seconds. The throughput for the TCP connection is computed as $164090 / 5.4294 = 30.222$ Kbyte/sec.

13. Use the Time-Sequence-Graph(Stevens) plotting tool to view the sequence number versus time plot of segments being sent from the client to the gaia.cs.umass.edu server. Can you identify where TCP's slowstart phase begins and ends, and where congestion avoidance takes over? Comment on ways in which the measured data differs from the idealized behavior of TCP that we've studied in the text

ANS:

TCP Slow Start begins at the start of the connection, when the HTTP POST segment is sent out. The identification of the TCP slow start phase and congestion avoidance phase depends on the value of the congestion window size of this TCP sender. However, the value of the congestion window size cannot be obtained directly from the Time-Sequence-Graph (Stevens) graph. Nevertheless, we can estimate the lower bound of the TCP window size by the amount of outstanding data because the outstanding data is the amount of data without acknowledgement. We also know that TCP window is constrained by the receiver window size and the receiver buffer can act as the upper bound of the TCP window size. In this trace, the receiver buffer is not the bottleneck; therefore, this upper bound is not quite useful to infer the TCP window size. Hence, we focus on the lower bound of the TCP window size.