

Exercise 1:

Q1

+	199	5.297341	192.168.1.102	128.119.245.12	HTTP	104	POST /etherreal-labs/lab3-1-reply.htm HTTP/1.1 (text/plain)
+	203	5.461175	128.119.245.12	192.168.1.102	HTTP	784	HTTP/1.1 200 OK (text/html)

```

> Frame 199: 104 bytes on wire (832 bits), 104 bytes captured (832 bits)
> Ethernet II, Src: Actionte_8a:70:1a (00:20:e0:8a:70:1a), Dst: Linksys_6a: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: 232293053, Ack: 883061786, Len: 50
> [122 Reassembled TCP Segments (164090 bytes): #4(565), #5(1460), #7(1460), #8(1460), #10(1460), #11(1460), #13(1147), #18(1460), #19(1460), #20
> Hypertext Transfer Protocol
> MIME multipart media encapsulation, type: multipart/form-data, Boundary: "-----265001916015724"

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The IP address of 'gaia.cs.umass.edu' is 192.168.1.102. It sending and receiving TCP segments for this connection in the port number 80.

the IP address and TCP port numbers used by the client computer (source) that is transferring the file to gaia.cs.umass.edu is 192.168.1.102, 1161.

Q2

Applications: TCP WireShark | C:\... tcp-etheral-trace-1

tcp-etheral-trace-1

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tcp

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 [ACK] Seq=883061785 Ack=232129013 Win=5840 Len=0 MSS=1460
3	0.023205	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 data (565 bytes)]
5	0.041377	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [PSH, ACK] Seq=232129578 Ack=883061786 Win=17520 Len=1460 [TCP segment data (1460 bytes)]
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	0.064026	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=232131038 Ack=883061786 Win=17520 Len=1460 [TCP segment data (1460 bytes)]
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 data (1460 bytes)]
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 data (1460 bytes)]

Window: 17520
 [Calculated window size: 17520]
 [Window size scaling factor: -2 (no window scaling used)]
 Checksum: 0x1bf6 [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)

0000 00 06 25 da af 73 00 20 e0 8a 70 1a 08 00 45 00 ...%s...p...E
 0001 02 5f 1e 21 40 00 00 06 a2 67 c0 a8 01 66 80 77 ...]g...f w
 0002 75 0c 04 bd 00 50 0d 06 e1 75 34 a2 74 1a 50 18 ...P...d.t.p
 0003 44 70 1f bd 00 00 50 4f 53 54 20 2f 05 7a 68 05 Dp...PO St /eth
 0004 72 05 01 6c 20 6c 61 62 73 2f 6c 61 62 33 2d 31 real-lab s/lab3-1
 0005 2d 72 65 70 6c 79 2e 08 74 6d 29 48 64 54 50 2f .reply.htm HTTP
 0006 51 2e 21 6d 0a 48 0f 73 74 3a 20 67 61 69 61 26 t...nos G gnu
 0007 63 73 20 75 6d 61 73 73 2e 65 64 75 0d 9a 55 73 cs.umass.edu/~Us
 0008 05 72 2d 41 67 65 6e 6a 3a 28 4d 67 7a 69 6c 6c er.Agent : Mozill
 0009 01 2f 35 2e 39 20 28 57 69 6e 64 67 77 73 3b 2b a/5.0 (Windows;
 000a 55 3b 20 57 69 6e 64 67 77 73 20 4e 64 20 35 2e u; Windows NT 5.
 000b 51 3b 20 65 6e 6d 20 55 53 3b 20 72 70 3a 31 2e 30 t; en-US ; rv:1.0

Bytes 54-618: TCP segment data (tcp.segment.data)

Packets: 213 · Displayed: 202 (94.8%)

Profile: Default

As the chart, the sequence number of the TCP segment containing the HTTP POST command is 232129013.

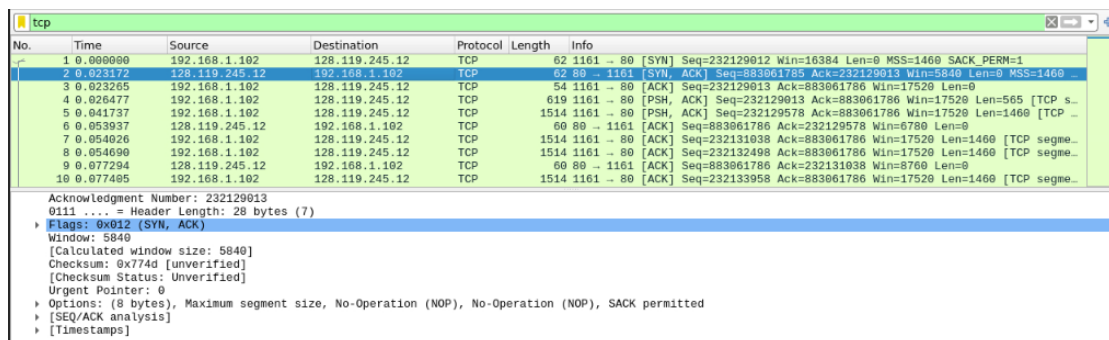
Q3

Seq. NO.	time sent	time ack	SampleRTT	Est. RTT	length
232129013	0.026477	0.053937	0.02746	0.02746	565
232129578	0.041737	0.077294	0.035557	0.02847213	1460
232136878	0.124185	0.169118	0.044933	0.03052973	1147
232145325	0.309553	0.356437	0.046884	0.03257402	892
232153517	0.581074	0.626496	0.045422	0.03418002	892
232161709	0.857683	0.899423	0.04174	0.03512501	892

Q4.

As the chart in the Q3 has e length of each of the first six TCP segments.

Q5.



The image shows a Wireshark packet capture of a TCP connection. The packet list pane shows the first six TCP segments, each with its sequence number, time, source, destination, protocol, length, and info. The packet details pane for the first segment (Seq=232129013) is expanded, showing the header and options. The window size is 5840, and the flags are SYN, ACK. The options include Maximum segment size, No-Operation (NOP), and SACK permitted.

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	0.026477	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=883061786 Ack=232129013 Win=5840 Len=0 MSS=1460
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 s...
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 ...
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 segme...
8	0.054090	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=232132498 Ack=883061786 Win=17520 Len=1460 [TCP segme...
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	0.077495	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=232133958 Ack=883061786 Win=17520 Len=1460 [TCP segme...

Acknowledgment Number: 232129013
 0111 ... = Header Length: 28 bytes (7)
 Flags: 0x012 (SYN, ACK)
 Window: 5840
 [Calculated window size: 5840]
 Checksum: 0x774d [unverified]
 [Checksum Status: Unverified]
 Urgent Pointer: 0
 Options: (8 bytes), Maximum segment size, No-Operation (NOP), No-Operation (NOP), SACK permitted
 [SEQ/ACK analysis]
 [Timestamps]

As the chart, the minimum amount of available buffer space advertised at the receiver for the entire trace is 5840. The lack of receiver buffer space will throttle the sender.

Q6.

Because the sequence numbers tend to increase, there are no retransmissions.

Q7.

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=232129012 Win=0 MSS=1460 Len=0
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 data len 1460 Seq=232129013]
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 data len 1460 Seq=232129578]
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 data len 1460 Seq=232131038]
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 data len 1460 Seq=232132498]
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	0.077495	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=232133958 Ack=883061786 Win=17520 Len=1460 [TCP segment of data len 1460 Seq=232133958]

About 1460 bits data does the receiver typically acknowledge in an ACK.

Q8.

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 data len 1460 Seq=232129013]
202	5.455830	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=883061786 Ack=232293103 Win=62780 Len=0

The throughput=(232293103-232129013)/1000/(5.45583-0.026477)=30.223kbit/s

Exercise2

Q1.

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

The sequence is 2818463618.

Q2.

296	10.99.6.175	10.9.16.201	TCP	5000 > 50045 [SYN, ACK] Seq=1247095790 Ack=2818463619 win=262144 MSS=1460
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The reply sequence is 1247095790, the value of the Acknowledgement field in the SYNACK segment is 1460.

Q3.

297	10.9.16.201	10.99.6.175	TCP	50045 > 5000 [ACK] Seq=2818463619 Ack=1247095791 win=65535
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the sequence number of the ACK segment sent by the client computer in response to the SYNACK is 2818463619. The value of the Acknowledgment field in this ACK segment is 1247095791. The segment contain 1 bit data.

Q4.

Both client and server done the active close since the connect close only need one (FIN,ACK/ACK), but it has two. So the client and server are close at the same time. This is a 4 Segment of Simultaneous close.

Q5.

There are $(2818463652 - 2818463618) = 34 \text{ bit} = 4.25 \text{ bytes}$ data transferred from the client to the server and $(1247095831 - 1247095790) = 41 \text{ bit} = 5.125 \text{ bytes}$ from the server to the client during the whole duration of the connection.

the final ACK received from the other side minus Initial Sequence Number can get the data during the transferred.