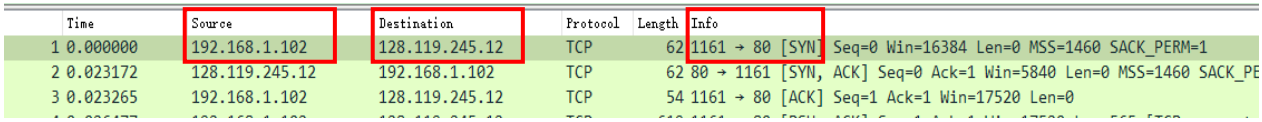
Exercise 1 : TCP

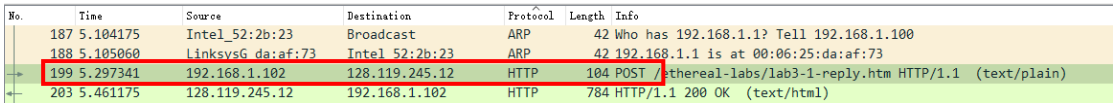


	Time	Source	Destination	Protocol	Length	Info
1	0.000000	192.168.1.102	128.119.245.12	TCP	62	1161 → 80 [SYN] Seq=0 Win=16384 Len=0 MSS=1460 SACK_PERM=1
2	0.023172	128.119.245.12	192.168.1.102	TCP	62	80 → 1161 [SYN, ACK] Seq=0 Ack=1 Win=5840 Len=0 MSS=1460 SACK_PE
3	0.023265	192.168.1.102	128.119.245.12	TCP	54	1161 → 80 [ACK] Seq=1 Ack=1 Win=17520 Len=0

Q1:

As the gaia.cs.umass.edu is the server, which should be the destination (128.119.245.12) in the 1st hand shake. And the port number relevant should be 80. The IP of the host is the source, which shows as 192.168.1.102

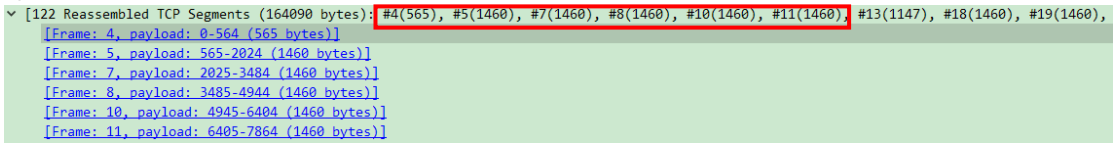
Q2:



No.	Time	Source	Destination	Protocol	Length	Info
187	5.104175	Intel_52:2b:23	Broadcast	ARP	42	Who has 192.168.1.1? Tell 192.168.1.100
188	5.105060	LinksysG_da:af:73	Intel_52:2b:23	ARP	42	192.168.1.1 is at 00:06:25:da:af:73
199	5.297341	192.168.1.102	128.119.245.12	HTTP	104	POST /ethereal-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)

The seq of POST is

Q3:



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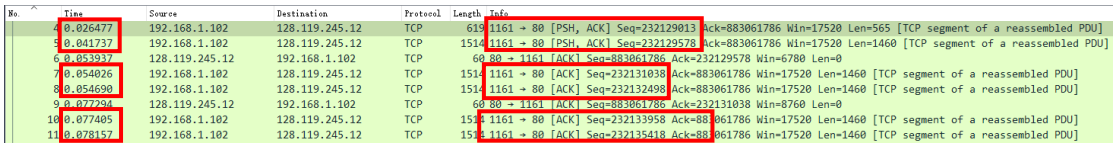
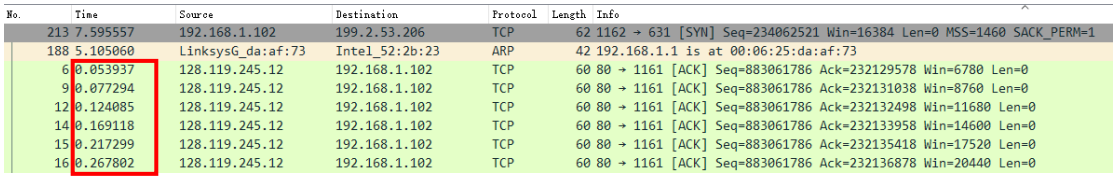
[122 Reassembled TCP Segments (164090 bytes): #4(565), #5(1460), #7(1460), #8(1460), #10(1460), #11(1460), #13(1147), #18(1460), #19(1460),
    [Frame: 4, payload: 0-564 (565 bytes)]
    [Frame: 5, payload: 565-2024 (1460 bytes)]
    [Frame: 7, payload: 2025-3484 (1460 bytes)]
    [Frame: 8, payload: 3485-4944 (1460 bytes)]
    [Frame: 10, payload: 4945-6404 (1460 bytes)]
    [Frame: 11, payload: 6405-7864 (1460 bytes)]
```



No.	Time	Source	Destination	Protocol	Length	Info
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
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]



No.	Time	Source	Destination	Protocol	Length	Info
213	7.595557	192.168.1.102	199.2.53.206	TCP	62	1162 → 631 [SYN] Seq=234062521 Win=16384 Len=0 MSS=1460 SACK_PERM=1
188	5.105060	LinksysG_da:af:73	Intel_52:2b:23	ARP	42	192.168.1.1 is at 00:06:25:da:af:73
6	0.053937	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=883061786 Ack=232129578 Win=6780 Len=0
9	0.077294	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=883061786 Ack=232131038 Win=8760 Len=0
12	0.124085	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=883061786 Ack=232132498 Win=11680 Len=0
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

No.	Seq	sentTime	receivedTime	SampleRTT	EstimatedRTT
1	232129013	0.026477	0.053937	0.02746	0.02746
2	232129578	0.041737	0.077294	0.035557	0.028472125
3	232131038	0.054026	0.124085	0.070059	0.033670484
4	232132498	0.05469	0.169118	0.114428	0.043765174
5	232133958	0.077405	0.217299	0.139894	0.055781277
6	232135418	0.078157	0.267802	0.189645	0.072514242

Here, the first 6 segments are frame #4, #5, #7, #8, #10, #11. The seq, sentTime, receiveTime and SampleRTT as shown in the red squares above.

In order to calculate the EstimatedRTT, we need to use formula from lecture notes :

EstimatedRTT = 0.875*EstimatedRTT(previous) + 0.125*SampleRTT

(PS. The EstimatedRTT are calculated in the excel file, which is posted inside the Lab04.tar)

Q4:

The length of these 6 segments are 565, 1460, 1460, 1460, 1460, 1460. (as the figure 1 in Q3

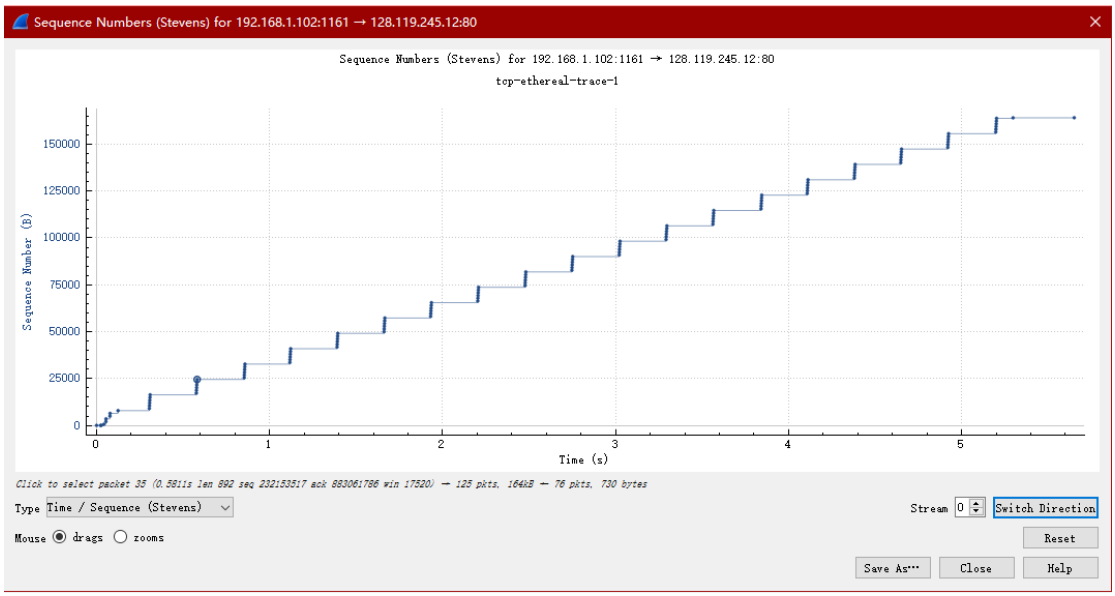
shows).

Q5:

	Time	Source	Destination	Protocol	Length	Info
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_PE
3	0.023265	192.168.1.102	128.119.245.12	TCP	54	1161 → 80 [ACK] Seq=1 Ack=1 Win=17520 Len=0

The SYN-ACK message gives out the minimum size of buffer space, which is 5840 bytes.
No, lack of receiver buffer space will not throttle the sender.

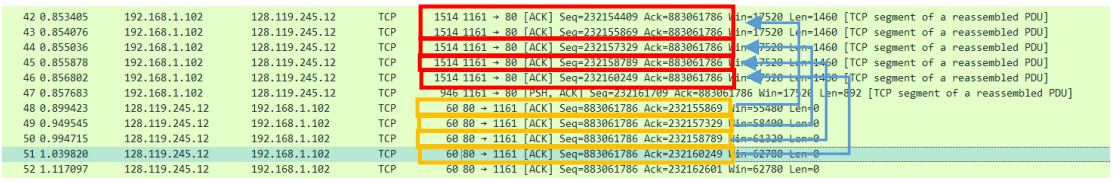
Q6:



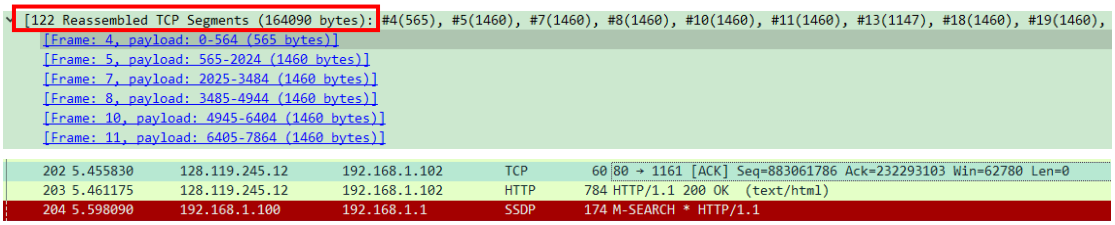
There is no retransmitted segments in the trace file. The image resembles an ascending, equal-length staircase. If there are repeatedly sent segments, there will be cases where the retransmitted segment have a smaller seq than its neighboring segments.

Q7:

The size of ACK is usually 1460 bytes.



As the diagram shows, these 4 server segments acknowledged to the relevant client segment. So the ack #232155869 is acknowledging #232154409 and #232155869, where the receiver send a cumulative ACK for 2 different segments.



Q8:

The average throughput of TCP is the ratio of the total transmission data to the total transmission time.

In this lab, there are 122 segments reassembled and the total size of them is 164090 bytes.

As the time of last segment(#199) is 5.297341 sec, and the first segment(#4) is 0.026477 sec.

the time cost of these 122 segments is (5.297341 - 0.026477) = 5.270864 sec.

Therefore, the TCP average throughput is 164090 bytes / 5.270864 sec = 31.131 Kbyte/sec.

Exercise 2 : TCP

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

Q1:

As the table shows, the seq is 2818463618.

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

Q2:

Seq is 1247095790. ACK number is 2818463619.

This ACK is determined by adding 1 on the initial sequence number that received from client.

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

Q3:

Seq is 2818463619. ACK number is 1247095791.

There is no content data include in this message.

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

Q4:

The conversation is closed by both client and server. In the FIN stage, client and server will both generated FINs based on previous-received ACK and Seq. The ACK will not increased.

Q5:

Client: (final ACK – Initial Seq) – SYN – FIN = 2818463653 – 2818463618 – 2 = 33 Bytes.

Client: (final ACK – Initial Seq) – SYN – FIN = 1247095832 – 1247095790 – 2 = 40 Bytes.