COMP3331 Lab04 Report

Exercise 1.
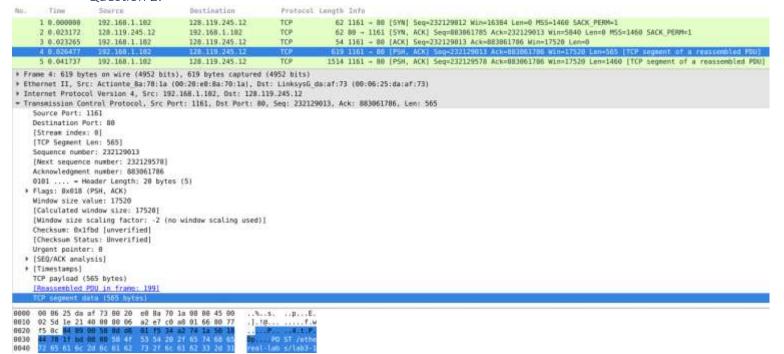
Question 1.

No.	Time	Source	Destination	Protocol	Length	Info
1	0.000000	192.168.1.102	128.119.245.12	TCP	62	1161 → 80 [SYN] Seq=
2	0.023172	128.119.245.12	192.168.1.102	TCP	62	80 → 1161 [SYN, ACK]

The IP address of gaia.cs.umass.edu is **128.119.245.1**2 and its port number is **80**.
The IP address of the client computer(Source) is **192.168.1.102** and its port number is **1161**.

Question 2.

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=232129013 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=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 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]

▸ Frame 4: 619 bytes on wire (4952 bits), 619 bytes captured (4952 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: 232129013, Ack: 883061786, Len: 565
    Source Port: 1161
    Destination Port: 80
    [Stream index: 0]
    [TCP Segment Len: 565]
    Sequence number: 232129013
    [Next sequence number: 232129578]
    Acknowledgment number: 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)

```
0000  00 06 25 da af 73 00 20  e0 8a 70 1a 08 00 45 00   ..%..s. ..p...E.
0010  02 5d 1e 21 40 00 80 06  a2 e7 c0 a8 01 66 80 77   .].!@... .....f.w
0020  f5 8c 04 89 00 50 0d 06  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
```

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

Question 3.

Segment #	Sequence #	Time sent (sec)	ACK received (sec)	RTT difference (sec)	EstimatedRTT (sec)
1 (#4)	232129013	0.026477	0.053937 (#6)	0.02746	0.02746
2 (#5)	232129578	0.041737	0.077294 (#9)	0.035557	0.028472125
3 (#7)	232131038	0.054026	0.124085 (#12)	0.070059	0.032784875
4 (#8)	232132498	0.054690	0.169118 (#14)	0.114428	0.038331
5 (#10)	232133958	0.077405	0.217299 (#15)	0.139894	0.04151425
6 (#11)	232135418	0.078157	0.267802 (#16)	0.189645	0.047733125

Question 4.

4 0.026477	192.168.1.102	128.119.245.12	TCP	619 1161 → 80 [PSH, ACK]
5 0.041737	192.168.1.102	128.119.245.12	TCP	1514 1161 → 80 [PSH, ACK]
6 0.053937	128.119.245.12	192.168.1.102	TCP	60 80 → 1161 [ACK] Seq=8

▶ Frame 4: 619 bytes on wire (4952 bits), 619 bytes captured (4952 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: 232129013, Ack: 883061786, Len: 56
  Source Port: 1161
  Destination Port: 80
  [Stream index: 0]
  [TCP Segment Len: 565]

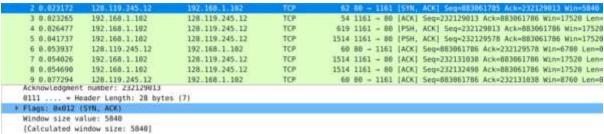|					
5 0.041737	192.168.1.102	128.119.245.12	TCP	1514 1161 → 80 [PSH, ACK]
6 0.053937	128.119.245.12	192.168.1.102	TCP	60 80 → 1161 [ACK] Seq=8
7 0.054026	192.168.1.102	128.119.245.12	TCP	1514 1161 → 80 [ACK] Seq=2

▶ Frame 5: 1514 bytes on wire (12112 bits), 1514 bytes captured (12112 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: 232129578, Ack: 883061786, Len: 14
  Source Port: 1161
  Destination Port: 80
  [Stream index: 0]
  [TCP Segment Len: 1460]

7 0.054026	192.168.1.102	128.119.245.12	TCP	1514 1161 → 80 [ACK]
8 0.054690	192.168.1.102	128.119.245.12	TCP	1514 1161 → 80 [ACK]
9 0.077294	128.119.245.12	192.168.1.102	TCP	60 80 → 1161 [ACK]

▶ Frame 7: 1514 bytes on wire (12112 bits), 1514 bytes captured (12112 bits)
▶ Ethernet II, Src: Actionte_8a:70:1a (00:20:e0:8a:70:1a), Dst: LinksysG_da:af:73 (00:06:25:da:af
▶ Internet Protocol Version 4, Src: 192.168.1.102, Dst: 128.119.245.12
▼ Transmission Control Protocol, Src Port: 1161, Dst Port: 80, Seq: 232131038, Ack: 883061786, Le
  Source Port: 1161
  Destination Port: 80
  [Stream index: 0]
  [TCP Segment Len: 1460]

8 0.054690	192.168.1.102	128.119.245.12	TCP	1514 1161 → 80 [ACK]
9 0.077294	128.119.245.12	192.168.1.102	TCP	60 80 → 1161 [ACK]
10 0.077405	192.168.1.102	128.119.245.12	TCP	1514 1161 → 80 [ACK]

▶ Frame 8: 1514 bytes on wire (12112 bits), 1514 bytes captured (12112 bits)
▶ Ethernet II, Src: Actionte_8a:70:1a (00:20:e0:8a:70:1a), Dst: LinksysG_da:af:73 (00:06:25:da:af
▶ Internet Protocol Version 4, Src: 192.168.1.102, Dst: 128.119.245.12
▼ Transmission Control Protocol, Src Port: 1161, Dst Port: 80, Seq: 232132498, Ack: 883061786, Le
  Source Port: 1161
  Destination Port: 80
  [Stream index: 0]
  [TCP Segment Len: 1460]
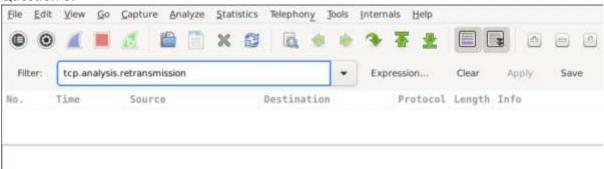
10 0.077405	192.168.1.102	128.119.245.12	TCP	1514 1161 → 80 [ACK]
11 0.078157	192.168.1.102	128.119.245.12	TCP	1514 1161 → 80 [ACK]
12 0.124085	128.119.245.12	192.168.1.102	TCP	60 80 → 1161 [ACK]

▶ Frame 10: 1514 bytes on wire (12112 bits), 1514 bytes captured (12112 bits)
▶ Ethernet II, Src: Actionte_8a:70:1a (00:20:e0:8a:70:1a), Dst: LinksysG_da:af:73 (00:06:25:da:af
▶ Internet Protocol Version 4, Src: 192.168.1.102, Dst: 128.119.245.12
▼ Transmission Control Protocol, Src Port: 1161, Dst Port: 80, Seq: 232133958, Ack: 883061786, Le
  Source Port: 1161
  Destination Port: 80
  [Stream index: 0]
  [TCP Segment Len: 1460]

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11 0.078157    192.168.1.102      128.119.245.12      TCP     1514 1161 → 80 [ACK]
12 0.124085    128.119.245.12     192.168.1.102       TCP       60 80 → 1161 [ACK]
13 0.124185    192.168.1.102      128.119.245.12      TCP     1201 1161 → 80 [PSH,
```

▶ Frame 11: 1514 bytes on wire (12112 bits), 1514 bytes captured (12112 bits)
▶ Ethernet II, Src: Actionte_8a:70:1a (00:20:e0:8a:70:1a), Dst: LinksysG_da:af:73 (00:06:25:da:af
▶ Internet Protocol Version 4, Src: 192.168.1.102, Dst: 128.119.245.12
▼ Transmission Control Protocol, Src Port: 1161, Dst Port: 80, Seq: 232135418, Ack: 883061786, Le
    Source Port: 1161
    Destination Port: 80
    [Stream index: 0]
    [TCP Segment Len: 1460]

The length of the first six segments is 565, 1460, 1460, 1460, 1460 bytes respectively.

Question 5.


```
 2 0.023172    128.119.245.12     192.168.1.102       TCP     62 80 → 1161 [SYN, ACK] Seq=883061785 Ack=232129013 Win=5840
 3 0.023265    192.168.1.102      128.119.245.12      TCP     54 1161 → 80 [ACK] Seq=232129013 Ack=883061786 Win=17520 Len=
 4 0.026477    192.168.1.102      128.119.245.12      TCP     619 1161 → 80 [PSH, ACK] Seq=232129013 Ack=883061786 Win=17520
 5 0.041737    192.168.1.102      128.119.245.12      TCP     1514 1161 → 80 [PSH, ACK] Seq=232129578 Ack=883061786 Win=17520
 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=
 8 0.054690    192.168.1.102      128.119.245.12      TCP     1514 1161 → 80 [ACK] Seq=232132498 Ack=883061786 Win=17520 Len=
 9 0.077294    128.119.245.12     192.168.1.102       TCP     60 80 → 1161 [ACK] Seq=883061786 Ack=232131038 Win=8760 Len=0
```

  Acknowledgment number: 232129013
  0111 .... = Header Length: 28 bytes (7)
▶ Flags: 0x012 (SYN, ACK)
  Window size value: 5840
  [Calculated window size: 5840]

The minimum amount of the buffer space advertised at the receiver for the entire space is **5840**. Since the window size is increasing, the lack of receiver buffer space **does not** throttle the sender.

Question 6.

There is **no** retransmitted segment in the listing of captured packets. We applied "**tcp.analysis.retransmission**" for the filter to check for any retransmitted segments.

Question 7.

The data size that the receiver typically acknowledge in ACK is 1460 bytes.

At the beginning, we could find that the receiver will acknowledge each packet. However, at segment #60, it acknowledges two segments with sequence number of 232164061 and 232165521. The receiver sends a cumulative ACK for the two segments. In addition, there are some same cases happened that the receiver sends ACK for two received segments after segment #60. The reason why is because TCP uses delayed ACK for the next segment and send cumulative ACK for the received segments.

Question 8.

We take sequence #4 and #202 for example.

Segment #	Data (bytes)	Time (sec)
4	232129013	0.026477
202	232293103	5.455830

$$Total\ amount\ of\ data = 232293103 - 232129013 = 164090\ bytes$$

$$Total\ transmission\ time = 5.455830 - 0.026477 = 5.429353\ sec$$

$$Throughput = \frac{Total\ amount\ of\ data}{Total\ transmission\ time} = \frac{164090}{5.429353} = \mathbf{30222.75398\ bytes/s}$$

Exercise 2.

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.
The sequence number of the TCP SYN segment that is used to initiate the TCP connection between client and server is **2818463618**.

Question 2.
The sequence number of the SYNACK segment sent by the server to the client in reply to the SYN is **1247095790**. The value of the Acknowledge field in the SYNACK segment is **2818463619**. It is determined by the addition of the sequence number from client and 1.

Question 3.
The sequence number of the ACK segment sent by the client in response to the SYNACK is **2818463619**. The value of the Acknowledgement field in this ACK segment is **1247095791**. This segment **does not** contain any data since its sequence number is same as the one from segment #298.

Question 4.
Both client and server **have** done the active close since both have sent [FIN, ACK] flags to each other without receiving ACK flag. In addition, the sequence number in segment #304 is equal to the value of the acknowledgement field in segment #305. Hence, after both sent ACK to each other, the value of the acknowledgement field is equal to the sequence number + 1, which means that both client and server have received FIN flag, then both close connections. The type of closure is **simultaneous close**.

Question 5.
$$From\ client\ to\ server = 2818463653 - 2818463618 - 2(SYN\ \&\ FIN) = \textbf{33 bytes}$$
$$From\ server\ to\ client = 1247095831 - 1247095790 - 2(SYN\ \&\ FIN) = \textbf{40 bytes}$$
Note that SYN and FIN flags will increase 1 for the value of acknowledgement field without containing any data.
Since the segment with Sequence Number and Data is sent from client to server or vice versa, and server is expected to receive the segment that contains the value of acknowledgement field which is equal to the addition of the sequence number and data length from the previous segment. This relationship can be used to calculate the data transfer.