

# Exercise 1

## Q1

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 DES IP address of gaia.cs.umass.edu is 128.119.245.12 use port number is 80. The source IP was 192.168.1.102 and use port 1161.

## Q2

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
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The seq number is 232129013.

## Q3

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]
12	0.124085	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=883061786 Ack=232132498 Win=11680 Len=0
13	0.124185	192.168.1.102	128.119.245.12	TCP	1201	1161 → 80 [PSH, ACK] Seq=232136878 Ack=883061786 Win=17520 Len=1147 [TCP segment of a reassembled PDU]
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
17	0.304807	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=883061786 Ack=232138025 Win=23360 Len=0

Segment	Sequence	Time-send(sec)	Received(sec)	RTT-diff (sec)	Est-RTT (sec)
4	232129013	0.026477	0.053937	0.02746	0.02746
5	232129578	0.041737	0.077294	0.035557	0.028472125
7	232131038	0.054026	0.124085	0.070059	0.032784875
8	232132498	0.054690	0.169118	0.114428	0.038331
10	232133958	0.077405	0.217299	0.139894	0.04151425
11	232135418	0.078157	0.267802	0.189645	0.047733125

## Q4

The first length of TCP segment was 565 bytes and the rest of five segments length are 1460 bytes.

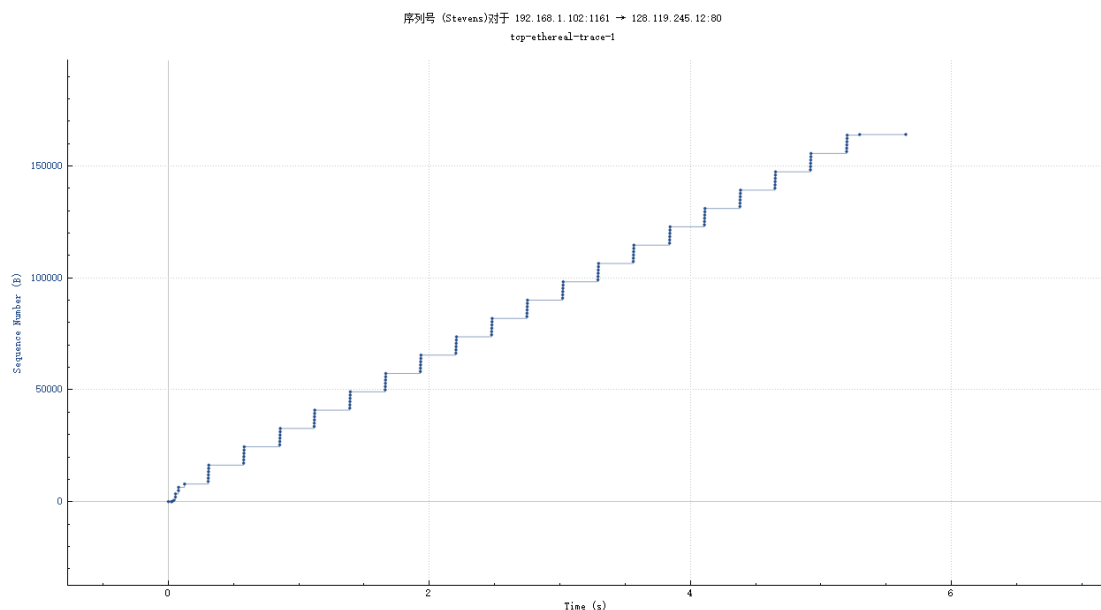
## Q5

1	0.000000	192.168.1.102	128.119.245.12	TCP	62	1161 → 80	[SYN] Seq=232129012
2	0.023172	128.119.245.12	192.168.1.102	TCP	62	80 → 1161	[SYN, ACK] Seq=883061785

> Frame 2: 62 bytes on wire (496 bits), 62 bytes captured (496 bits)  
 > Ethernet II, Src: LinksysG\_da:af:73 (00:06:25:da:af:73), Dst: Actionte\_8a:70:1a (00:20:e0:8a:70:1a)  
 > Internet Protocol Version 4, Src: 128.119.245.12, Dst: 192.168.1.102  
 > Transmission Control Protocol, Src Port: 80, Dst Port: 1161, Seq: 883061785, Ack: 232129013, Len: 0  
     Source Port: 80  
     Destination Port: 1161  
     [Stream index: 0]  
     [Conversation completeness: Incomplete, DATA (15)]  
     [TCP Segment Len: 0]  
     Sequence Number: 883061785  
     [Next Sequence Number: 883061786]  
     Acknowledgment Number: 232129013  
     0111 .... = Header Length: 28 bytes (7)  
     > Flags: 0x012 (SYN, ACK)  
     Window: 5840  
     [Calculated window size: 5840]

The window size was 5840 bytes and the lack of receiver buffer space does not will throttle the sender.

## Q6



From this sequence graph we can see there are no sequence number decrease, if there exist a retransmitted segment, then we sequence number will decrease on some point.

## Q7

18	0.305040	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80	[ACK] Seq=232138025 Ack=883061786 Win=17520 Len=1460
19	0.305813	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80	[ACK] Seq=232139485 Ack=883061786 Win=17520 Len=1460
20	0.306692	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80	[ACK] Seq=232140945 Ack=883061786 Win=17520 Len=1460
21	0.307571	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80	[ACK] Seq=232142405 Ack=883061786 Win=17520 Len=1460
22	0.308699	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80	[ACK] Seq=232143865 Ack=883061786 Win=17520 Len=1460
23	0.309553	192.168.1.102	128.119.245.12	TCP	946	1161 → 80	[PSH, ACK] Seq=232145325 Ack=883061786 Win=17520 Len=
24	0.356437	128.119.245.12	192.168.1.102	TCP	60	80 → 1161	[ACK] Seq=883061786 Ack=232139485 Win=26280 Len=0
25	0.400164	128.119.245.12	192.168.1.102	TCP	60	80 → 1161	[ACK] Seq=883061786 Ack=232140945 Win=29200 Len=0
26	0.448613	128.119.245.12	192.168.1.102	TCP	60	80 → 1161	[ACK] Seq=883061786 Ack=232142405 Win=32120 Len=0
27	0.500029	128.119.245.12	192.168.1.102	TCP	60	80 → 1161	[ACK] Seq=883061786 Ack=232143865 Win=35040 Len=0
28	0.545052	128.119.245.12	192.168.1.102	TCP	60	80 → 1161	[ACK] Seq=883061786 Ack=232145325 Win=37960 Len=0
29	0.576417	128.119.245.12	192.168.1.102	TCP	60	80 → 1161	[ACK] Seq=883061786 Ack=232146217 Win=37960 Len=0

The receiver typically acknowledges 1460 bytes data in an ACK.

52	1.117097	128.119.245.12	192.168.1.102	TCP	60 80 → 1161 [ACK] Seq=883061786 Ack=232162601 Win=62780 Len=0
53	1.117333	192.168.1.102	128.119.245.12	TCP	1514 1161 → 80 [ACK] Seq=232162601 Ack=883061786 Win=17520 Len=1460 [TCP segment of a reassembled PDU]
54	1.118133	192.168.1.102	128.119.245.12	TCP	1514 1161 → 80 [ACK] Seq=232164061 Ack=883061786 Win=17520 Len=1460 [TCP segment of a reassembled PDU]
55	1.119029	192.168.1.102	128.119.245.12	TCP	1514 1161 → 80 [ACK] Seq=232165521 Ack=883061786 Win=17520 Len=1460 [TCP segment of a reassembled PDU]
56	1.119858	192.168.1.102	128.119.245.12	TCP	1514 1161 → 80 [ACK] Seq=232166981 Ack=883061786 Win=17520 Len=1460 [TCP segment of a reassembled PDU]
57	1.120902	192.168.1.102	128.119.245.12	TCP	1514 1161 → 80 [ACK] Seq=232168441 Ack=883061786 Win=17520 Len=1460 [TCP segment of a reassembled PDU]
58	1.121891	192.168.1.102	128.119.245.12	TCP	946 1161 → 80 [PSH, ACK] Seq=232169901 Ack=883061786 Win=17520 Len=892 [TCP segment of a reassembled PDU]
59	1.200421	128.119.245.12	192.168.1.102	TCP	60 80 → 1161 [ACK] Seq=883061786 Ack=232164061 Win=62780 Len=0
60	1.265026	128.119.245.12	192.168.1.102	TCP	60 80 → 1161 [ACK] Seq=883061786 Ack=232166981 Win=62780 Len=0
61	1.362074	128.119.245.12	192.168.1.102	TCP	60 80 → 1161 [ACK] Seq=883061786 Ack=232169901 Win=62780 Len=0
62	1.389886	128.119.245.12	192.168.1.102	TCP	60 80 → 1161 [ACK] Seq=883061786 Ack=232170793 Win=62780 Len=0

From above picture we notice there have 4 ACKs(segments 59 to 62) for 6 packets(segments 53 to 58). This is because TCP use delayed ACK to send cumulative ACKs.

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

To get this TCP throughput we can use the first TCP segment and last TCP segment.  
The TCP throughput = Total amount data/Total transmission time  

$$= (232293103 - 232129013 - 1) / (5.455830 - 0.026477)$$
  

$$= 30222.5697979 \text{ bytes/sec}$$

## Exercise 2

### Q1

The sequence number of the TCP SYN segment that is used to initiate the TCP connection is 2818463618.

### Q2

The sequence number 1247095790 is the SYNACK segment sent by the server to the client computer in reply to the SYN and the value 2818463619 is the Acknowledgement field in the SYNACK segment which is the sequence number of SYN segment plus 1.

### Q3

The sequence number 2818463619 is the ACK segment sent by the client computer in response to the SYNACK and the value 1247095791 is the Acknowledgment field in this ACK segment and this segment does not contain data.

### Q4

The client and server both done the active close because they active close (sent FIN

flag) without receive ACK flag from each other. The type of closure is simultaneous close.

#### Q4

The data bytes have been transferred from the client to server is

$$281846353 - 281846318 = 35 \text{ bytes}$$

And we need minus 2 bytes SYN and FIN segment which is  $35 - 2 = 33$  bytes.  
and from the server to the client is

$$1247095831 - 1247095790 - 2 = 39 \text{ bytes.}$$

The final ACK number indicates the Initial Sequence Number plus the whole data size of this TCP transmission from other side. If we have these two numbers we can easily calculate how many data are transferred from this connection.