

Assignment 4

Part-2

1. Source IP address: **10.200.179.227**

Source TCP port number used to transfer the alice.txt file to gaia.cs.umass.edu: **65349**

http						
No.	Time	Source	Destination	Protocol	Length	Info
682	09:10:28.320355	10.200.179.227	128.119.245.12	HTTP	524	POST /wireshark-labs/lab3-1-reply.htm HTTP/1.1 (text/plain)
695	09:10:28.576757	128.119.245.12	10.200.179.227	HTTP	831	HTTP/1.1 200 OK (text/html)
Transmission Control Protocol, Src Port: 65349, Dst Port: 80, Seq: 152501, Ack: 1, Len: 470						
		Source Port: 65349		0000 44 b6 be 0a 8f 5e		
		Destination Port: 80		0010 01 fe e6 e3 40 0e		
				0020 f5 0c ff 45 00 5e		
				0030 01 00 00 00 00 00		

2. IP address of gaia.cs.umass.edu: **128.119.245.12**

Port number to which it is sending and receiving TCP segments is: **80**

tcp.stream eq 49						
No.	Time	Source	Destination	Protocol	Length	Info
537	09:10:27.311245	10.200.179.227	128.119.245.12	TCP	66	65349 → 80 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM
539	09:10:27.588249	128.119.245.12	10.200.179.227	TCP	66	80 → 65349 [SYN, ACK] Seq=0 Ack=1 Win=29200 Len=0 MSS=1250 SACK_PERM WS=128
540	09:10:27.588525	10.200.179.227	128.119.245.12	TCP	54	65349 → 80 [ACK] Seq=1 Ack=1 Win=262400 Len=0
541	09:10:27.589429	10.200.179.227	128.119.245.12	TCP	1304	65349 → 80 [ACK] Seq=1 Ack=1 Win=262400 Len=1250 [TCP segment of a reassembled PDU]
542	09:10:27.589429	10.200.179.227	128.119.245.12	TCP	1304	65349 → 80 [ACK] Seq=1251 Ack=1 Win=262400 Len=1250 [TCP segment of a reassembled PDU]
543	09:10:27.589429	10.200.179.227	128.119.245.12	TCP	1304	65349 → 80 [ACK] Seq=2501 Ack=1 Win=262400 Len=1250 [TCP segment of a reassembled PDU]
544	09:10:27.589429	10.200.179.227	128.119.245.12	TCP	1304	65349 → 80 [ACK] Seq=3751 Ack=1 Win=262400 Len=1250 [TCP segment of a reassembled PDU]
545	09:10:27.589429	10.200.179.227	128.119.245.12	TCP	1304	65349 → 80 [ACK] Seq=5001 Ack=1 Win=262400 Len=1250 [TCP segment of a reassembled PDU]
546	09:10:27.589429	10.200.179.227	128.119.245.12	TCP	1304	65349 → 80 [ACK] Seq=6251 Ack=1 Win=262400 Len=1250 [TCP segment of a reassembled PDU]
547	09:10:27.589429	10.200.179.227	128.119.245.12	TCP	1304	65349 → 80 [ACK] Seq=7501 Ack=1 Win=262400 Len=1250 [TCP segment of a reassembled PDU]
548	09:10:27.589429	10.200.179.227	128.119.245.12	TCP	1304	65349 → 80 [ACK] Seq=8751 Ack=1 Win=262400 Len=1250 [TCP segment of a reassembled PDU]
549	09:10:27.589429	10.200.179.227	128.119.245.12	TCP	1304	65349 → 80 [ACK] Seq=10001 Ack=1 Win=262400 Len=1250 [TCP segment of a reassembled PDU]
550	09:10:27.589429	10.200.179.227	128.119.245.12	TCP	1304	65349 → 80 [ACK] Seq=11251 Ack=1 Win=262400 Len=1250 [TCP segment of a reassembled PDU]
553	09:10:27.831363	128.119.245.12	10.200.179.227	TCP	54	80 → 65349 [ACK] Seq=1 Ack=6251 Win=41728 Len=0
Transmission Control Protocol, Src Port: 65349, Dst Port: 80, Seq: 0, Len: 0						
		Source Port: 65349		0000 44 b6 be 0a 8f 58 14 13		
		Destination Port: 80		0010 00 34 e6 65 40 00 80 06		
				0020 f5 0c ff 45 00 50 9b c6		
				0030 fa f0 3c f5 00 00 02 04		

Part-3

1. 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 is: **0**

Transmission Control Protocol, Src Port: 65349, Dst Port: 80, Seq: 0, Len: 0						
Source Port: 65349						

The packet is SYN, because flag under SYN bit is **set** (i.e. 1)

Content of the flag:

Flags: 0x002 (SYN)	
000.	Reserved: Not set
...0	Accurate ECN: Not set
.... 0...	Congestion Window Reduced: 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.]	

2.

tcp.stream eq 49						
No.	Time	Source	Destination	Protocol	Length	Info
537	09:10:27.311245	10.200.179.227	128.119.245.12	TCP	66	65349 → 80 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM
539	09:10:27.588249	128.119.245.12	10.200.179.227	TCP	66	80 → 65349 [SYN, ACK] Seq=0 Ack=1 Win=29200 Len=0 MSS=1250 SACK_PERM WS=128

The sequence number of the SYNACK segment sent by gaia.cs.umass.edu is: **0**

The flags under SYN and Acknowledgement(ACK) bit are **set** (i.e. 1)

Content of flags are:

```
Flags: 0x012 (SYN, ACK)
000. .... = Reserved: Not set
...0 .... = Accurate ECN: Not set
.... 0... = Congestion Window Reduced: Not set
.....0.. = ECN-Echo: Not set
.....0. .... = Urgent: Not set
.....1 .... = Acknowledgment: Set
..... 0... = Push: Not set
..... .0.. = Reset: Not set
> .....1. = Syn: Set
..... 0... = Fin: Not set
[TCP Flags: .....A..S.]
```

The value of the Acknowledgement field in the SYNACK segment is: 1

```
> [Conversation completeness: Complete, WITH_DATA (31)]
[TCP Segment Len: 0]
Sequence Number: 0 (relative sequence number)
Sequence Number (raw): 845622129
[Next Sequence Number: 1 (relative sequence number)]
Acknowledgment Number: 1 (relative ack number)
Acknowledgment number (raw): 2613471135
1000 .... = Header Length: 32 bytes (8)
```

The gaia.cs.umass.edu determines the value by adding 1 to the acknowledgement bit value obtained from the previous request made by the client. As we know for a SYN message with sequence number X, the SYNACK message will respond with acknowledgement number X + 1.

3. The sequence number of the TCP segment containing the header of the HTTP POST command is: 1

tcp.stream eq 49						
No.	Time	Source	Destination	Protocol	Length	Info
540	09:10:27.588525	10.200.179.227	128.119.245.12	TCP	54	65349 → 80 [ACK] Seq=1 Ack=1 Win=262400 Len=0
541	09:10:27.589429	10.200.179.227	128.119.245.12	TCP	1304	65349 → 80 [ACK] Seq=1 Ack=1 Win=262400 Len=1250 [TCP segment of a reassembled PDU]
542	09:10:27.589429	10.200.179.227	128.119.245.12	TCP	1304	65349 → 80 [ACK] Seq=1251 Ack=1 Win=262400 Len=1250 [TCP segment of a reassembled PDU]
543	09:10:27.589429	10.200.179.227	128.119.245.12	TCP	1304	65349 → 80 [ACK] Seq=2501 Ack=1 Win=262400 Len=1250 [TCP segment of a reassembled PDU]
544	09:10:27.589429	10.200.179.227	128.119.245.12	TCP	1304	65349 → 80 [ACK] Seq=3751 Ack=1 Win=262400 Len=1250 [TCP segment of a reassembled PDU]
545	09:10:27.589429	10.200.179.227	128.119.245.12	TCP	1304	65349 → 80 [ACK] Seq=5001 Ack=1 Win=262400 Len=1250 [TCP segment of a reassembled PDU]
Destination Port: 80						
[Stream index: 49]						
> [Conversation completeness: Complete, WITH_DATA (31)]						
[TCP Segment Len: 1250]						
Sequence Number: 1 (relative sequence number)						
Sequence Number (raw): 2613471135						
[Next Sequence Number: 1251 (relative sequence number)]						
Acknowledgment Number: 1 (relative ack number)						
Acknowledgment number (raw): 845622130						
0101 = Header Length: 20 bytes (5)						
> Flags: 0x010 (ACK)						
Window: 1025						
[Calculated window size: 262400]						
[Window size scaling factor: 256]						
Checksum: 8x920f [unverified]						
[Checksum Status: Unverified]						
Urgent Pointer: 0						
> [Timestamps]						
> [SEQ/ACK analysis]						
TCP payload (1250 bytes)						
[Reassembled PDU in frame: 682]						
TCP segment data (1250 bytes)						

There are **1250 bytes** of data contained in the payload(data) field of this TCP segment.

No, All of the data in the transferred file alice.txt would not fit into a single segment.

4.

i) The time at which the first segment in the data transfer part of the TCP connection was sent is: **09:10:27.589429**

ii) The time at which the ACK for the first data-containing segment was received is:

09:10:27.831363

iii) The RTT for this first data-containing segment is: **0.241934 seconds** (.831363 - .589429)

iv) The RTT for the second segment is: **0.241934 seconds**

5. The length (header plus payload) for the first 4 data-carrying TCP segments is:

- 1270(20+1250)
- 1270
- 1270
- 1270

541	24.589914	10.200.179.227	128.119.245.12	TCP	1304	65349 → 80 [ACK] Seq=1 Ack=1 Win=262400 Len=1250 [TCP
542	24.589914	10.200.179.227	128.119.245.12	TCP	1304	65349 → 80 [ACK] Seq=1251 Ack=1 Win=262400 Len=1250 [
543	24.589914	10.200.179.227	128.119.245.12	TCP	1304	65349 → 80 [ACK] Seq=2501 Ack=1 Win=262400 Len=1250 [
544	24.589914	10.200.179.227	128.119.245.12	TCP	1304	65349 → 80 [ACK] Seq=3751 Ack=1 Win=262400 Len=1250 [

```
[TCP Segment Len: 1250]
Sequence Number: 1 (relative sequence number)
Sequence Number (raw): 2613471135
[Next Sequence Number: 1251 (relative sequence number)]
Acknowledgment Number: 1 (relative ack number)
Acknowledgment number (raw): 845622130
0101 ... = Header Length: 20 bytes (5)
```

6. The minimum amount of available buffer space advertised to clients by gaia.cs.umass.edu among these first 4 data-carrying TCP segments is: **1025**

Window: 1025

No, The lack of receiver buffer space wouldn't throttle the sender for these first 4 data-carrying segments.

7. **No**, there are no retransmitted segments in the trace file. We checked for the TCP retransmitted information in the info column. To determine if there are any retransmitted segments in the trace file, I checked for duplicate sequence numbers in the TCP packets. If a **packet** with the same sequence number appears multiple times, it indicates that the segment was retransmitted.

8. The receiver typically acknowledges **6250 bytes** of data in an ACK among the first 10 data-carrying segments sent from the client to gaia.cs.umass.edu. No, there has not been a case where the receiver is ACKing every other received segment among these first ten data-carrying segments.

From the screenshot below, we see that the ACK numbers increase in the sequence 6251, 12501, 18751, . . . Note that the ACK numbers increase by 6250 each time, indicating that the receiver is acknowledging 6250 bytes.

TCP	54	80 → 65349 [ACK] Seq=1 Ack=6251 Win=41728 Len=0
TCP	54	80 → 65349 [ACK] Seq=1 Ack=12501 Win=54272 Len=0
TCP	54	80 → 65349 [ACK] Seq=1 Ack=18751 Win=66816 Len=0
TCP	54	80 → 65349 [ACK] Seq=1 Ack=25001 Win=79232 Len=0
TCP	54	80 → 65349 [ACK] Seq=1 Ack=31251 Win=91776 Len=0
TCP	54	80 → 65349 [ACK] Seq=1 Ack=33751 Win=96768 Len=0
TCP	54	80 → 65349 [ACK] Seq=1 Ack=37501 Win=104320 Len=0

9. The throughput for the TCP connection is **25550.6109 bytes per unit 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 acknowledgement number of the first TCP segment (i.e. 1 byte for No. 541 segment) and the acknowledgement number of the last ACK (152971 bytes for No. 831 segment; I looked at the FIN ACK packet which shows an acknowledgement

number of 152971). Therefore, the total data is $152971 - 1 = 152970$ bytes. The whole transmission time is the difference of the time instant of the first TCP segment (i.e. 24.589914 seconds for No.541 segment) and the time instant of the last ACK (i.e. 30.576855 seconds for No. 681 segment). Therefore, the total transmission time is $30.576855 - 24.589914 = 5.986941$ seconds. Hence, the throughput for the TCP connection is computed as $152970/5.986941 = 25.550$ KByte/sec.

Part-4

1. The slow start phase begins at packet 540 and ends at packet 550 in according to the graph then congestion takes over at packet 574.

