

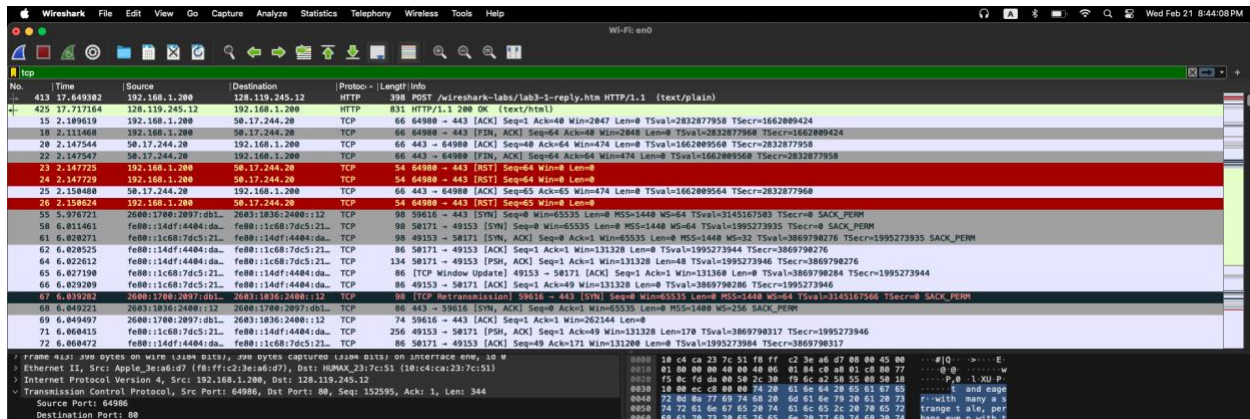
Faris Soepangat
1001374988
CSE 4344-002

Lab 2

Due date: March 1st, 11:59pm

1. Capturing a bulk TCP transfer from your computer to a remote server

2. A first look at the captured trace



No.	Time	Source	Destination	Protocol	Length	Info
413	17.449382	192.168.1.200	128.119.245.12	HTTP	396	POST /wireshark-labs/lab3-1-reply.htm HTTP/1.1 (text/plain)
425	17.717164	128.119.245.12	192.168.1.200	HTTP	831	HTTP/1.1 200 OK (text/html)
15	2.109619	192.168.1.200	50.17.244.20	TCP	66	64980 → 443 [ACK] Seq=1 Ack=0 Win=2847 Len=0 TSval=2832877958 TSecr=1662809424
18	2.111468	192.168.1.200	50.17.244.20	TCP	66	64988 → 443 [FIN, ACK] Seq=64 Ack=0 Win=2848 Len=0 TSval=2832877968 TSecr=1662809424
20	2.147544	50.17.244.20	192.168.1.200	TCP	66	443 → 64980 [ACK] Seq=0 Ack=64 Win=474 Len=0 TSval=1662809568 TSecr=2832877958
22	2.147547	50.17.244.20	192.168.1.200	TCP	66	443 → 64980 [FIN, ACK] Seq=64 Ack=64 Win=474 Len=0 TSval=1662809568 TSecr=2832877958
23	2.147725	192.168.1.200	50.17.244.20	TCP	54	64980 → 443 [RST] Seq=64 Win=0 Len=0
24	2.147729	192.168.1.200	50.17.244.20	TCP	54	64988 → 443 [RST] Seq=64 Win=0 Len=0
25	2.150408	50.17.244.20	192.168.1.200	TCP	66	443 → 64980 [ACK] Seq=65 Ack=65 Win=474 Len=0 TSval=1662809564 TSecr=2832877968
26	2.150624	192.168.1.200	50.17.244.20	TCP	54	64980 → 443 [RST] Seq=65 Win=0 Len=0
55	5.976721	2603:1836:2400::12	2603:1836:2400::12	TCP	98	59616 → 443 [SYN] Seq=0 Win=65535 Len=0 MSS=1440 WS=64 TSval=3145167583 TSecr=0 SACK_PERM
56	6.012461	fe80::14d6:f404::da	fe80::1c68:7dc5::21	TCP	98	58171 → 49153 [SYN] Seq=0 Win=65535 Len=0 MSS=1440 WS=64 TSval=1995273935 TSecr=0 SACK_PERM
61	6.020271	fe80::1c68:7dc5::21	fe80::14d6:f404::da	TCP	98	49153 → 58171 [SYN, ACK] Seq=0 Ack=1 Win=65535 Len=0 MSS=1440 WS=32 TSval=3869798276 TSecr=1995273935 SACK_PERM
62	6.020525	fe80::14d6:f404::da	fe80::1c68:7dc5::21	TCP	86	58171 → 49153 [ACK] Seq=1 Ack=1 Win=131328 Len=0 TSval=1995273944 TSecr=3869798276
64	6.022632	fe80::14d6:f404::da	fe80::1c68:7dc5::21	TCP	134	58171 → 49153 [PSH, ACK] Seq=1 Ack=1 Win=131328 Len=48 TSval=1995273946 TSecr=3869798276
65	6.027198	fe80::1c68:7dc5::21	fe80::14d6:f404::da	TCP	86	[TCP Window Update] 49153 → 58171 [ACK] Seq=1 Ack=1 Win=131328 Len=0 TSval=3869798284 TSecr=1995273944
66	6.029289	fe80::1c68:7dc5::21	fe80::14d6:f404::da	TCP	86	49153 → 58171 [ACK] Seq=1 Ack=49 Win=131328 Len=0 TSval=3869798286 TSecr=1995273946
67	6.039282	2603:1836:2400::12	2603:1836:2400::12	TCP	98	[TCP Retransmission] 59616 → 443 [SYN] Seq=0 Win=65535 Len=0 MSS=1440 WS=64 TSval=3145167586 TSecr=0 SACK_PERM
68	6.049221	2603:1836:2400::12	2603:1836:2400::12	TCP	86	59616 → 443 [SYN, ACK] Seq=0 Ack=1 Win=65535 Len=0 MSS=1440 WS=256 SACK_PERM
69	6.049497	2603:1836:2400::12	2603:1836:2400::12	TCP	74	59616 → 443 [ACK] Seq=1 Ack=1 Win=262144 Len=0
71	6.060435	fe80::1c68:7dc5::21	fe80::14d6:f404::da	TCP	256	49153 → 58171 [PSH, ACK] Seq=1 Ack=49 Win=131328 Len=178 TSval=1995273946 TSecr=3869798317
72	6.060472	fe80::14d6:f404::da	fe80::1c68:7dc5::21	TCP	86	58171 → 49153 [ACK] Seq=49 Ack=171 Win=131328 Len=0 TSval=1995273946 TSecr=3869798317

1)
What is the IP address and TCP port number used by the client computer (source) that is transferring the alice.txt file to gaia.cs.umass.edu?

- IP address: 192.168.1.200
- TCP port number: 64986 (Source Port)

2)
What is the IP address of gaia.cs.umass.edu?
- The IP address of gaia.cs.umass.edu: 128.119.245.12.

On what port number is it sending and receiving TCP segments for this connection?
- The port number it is sending and receiving TCP segments for this connection: 80 (Destination Port)

3. TCP Basics

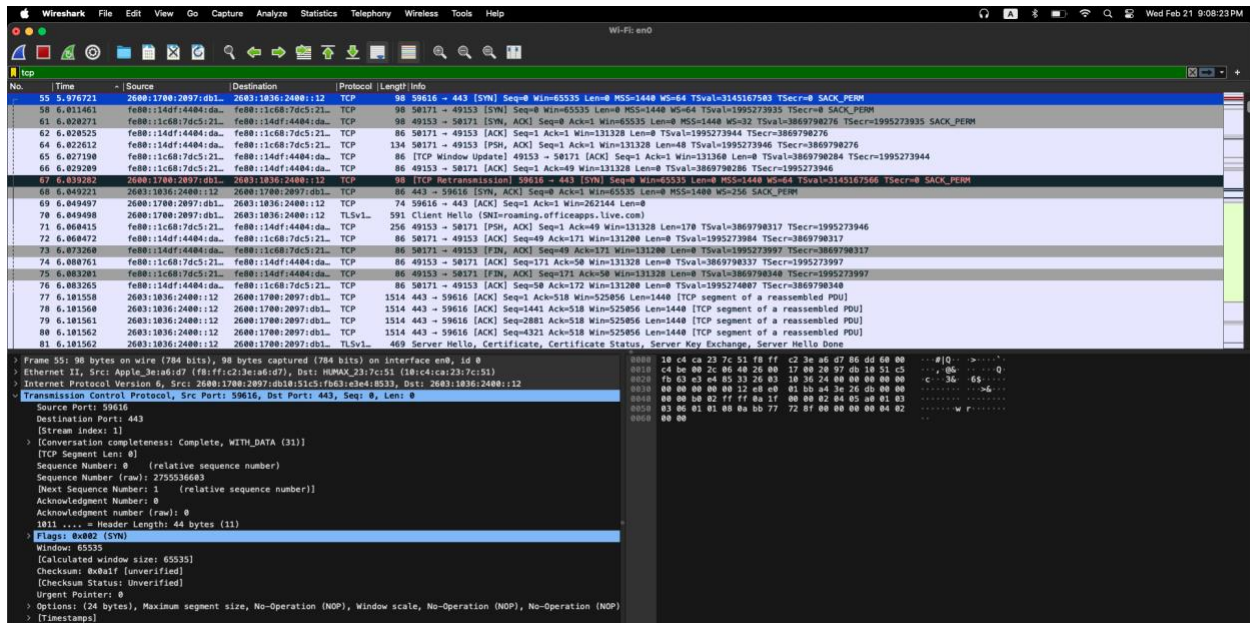
3)
What is the *sequence number* of the TCP SYN segment that is used to initiate the TCP connection between the client computer and gaia.cs.umass.edu?
- Sequence Number (raw): 2755536603

What is it in this TCP segment that identifies the segment as a SYN segment?

- There is a SYN flag message under TCP which indicates that it is a SYN segment.

Will the TCP receiver in this session be able to use Selective Acknowledgments?

- The TCP receiver in this session will not be able to use Selective Acknowledgements.



4)

What is the *sequence number* of the SYNACK segment sent by gaia.cs.umass.edu to the client computer in reply to the SYN?

- The sequence number of the SYNACK segment sent by gaia.cs.umass.edu to the client computer in reply to the SYN is: Sequence Number (raw): 2383925913

What is it in the segment that identifies the segment as a SYNACK segment?

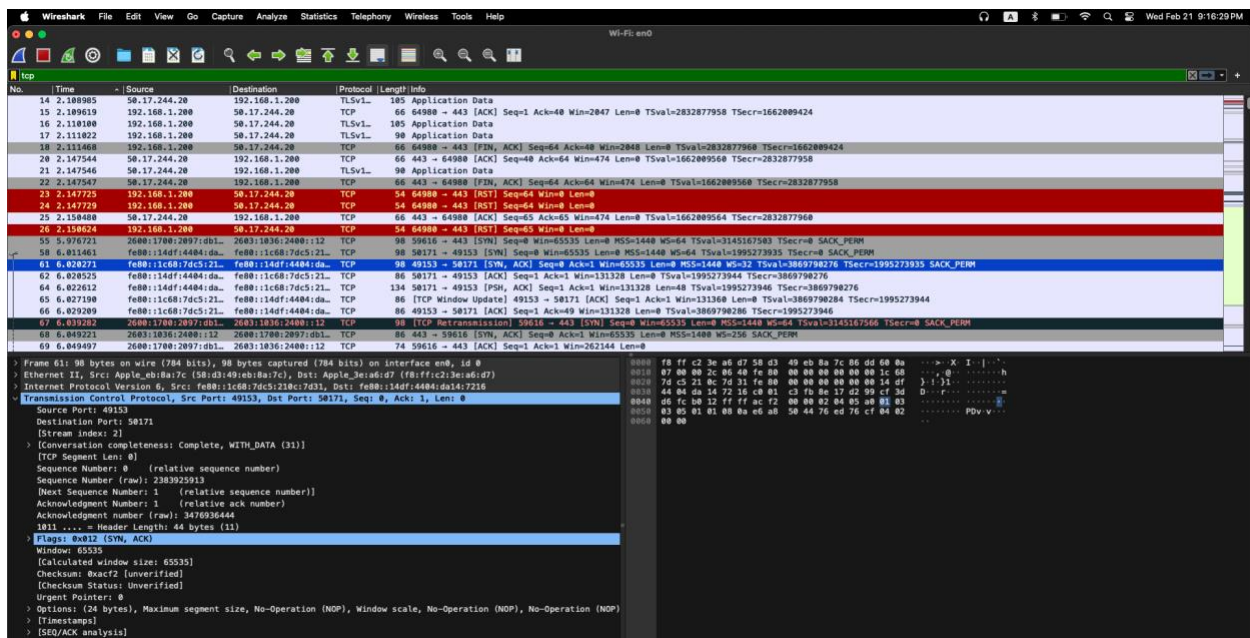
- There is a SYNACK flag message under TCP which indicated that it is a SYN segment.

What is the value of the Acknowledgement field in the SYNACK segment?

- Acknowledgement Number: 1 (relative ack number)
- Acknowledgement (raw): 3476936444

How did gaia.cs.umass.edu determine that value?

- Gaia.cs.umass.edu determined that value by adding one to the initial sequence number.



5) What is the sequence number of the TCP segment containing the header of the HTTP POST command?

- Sequence Number (raw): 741254490

How many bytes of data are contained in the payload (data) field of this TCP segment?

- TCP payload: 617 bytes.

Did all of the data in the transferred file alice.txt fit into this single segment?

- Yes, all the data in the transferred file alice.txt was fit into this single segment.

- RTT for this first data-containing segment = Receive Time – Sent Time = 17.513873 – 17.447363 = 0.06651

No.	Time	Source	Destination	Protocol	Length	Info
278	17.111868	2688:1788:2897:db1::	2688:1836:2488::12	TCP	74	59618 → 443 [ACK] Seq=13848 Ack=7678 Win=262144 Len=0
281	17.396888	192.168.1.200	128.119.245.12	TCP	78	64986 → 80 [SYN] Seq=0 Win=65535 Len=0 MSS=1460 WS=64 TSval=3481351676 TSecr=0 SACK_PERM WS=128
282	17.446848	128.119.245.12	192.168.1.200	TCP	66	80 → 64986 [SYN, ACK] Seq=0 Ack=1 Win=29288 Len=0 MSS=1460 SACK_PERM WS=128
283	17.447133	192.168.1.200	128.119.245.12	TCP	54	64986 → 80 [ACK] Seq=1 Ack=1 Win=262144 Len=0
284	17.447363	192.168.1.200	128.119.245.12	TCP	671	64986 → 80 [PSH, ACK] Seq=1 Ack=1 Win=262144 Len=617 [TCP segment of a reassembled PDU]
285	17.447627	192.168.1.200	128.119.245.12	TCP	191	64986 → 80 [PSH, ACK] Seq=618 Ack=1 Win=262144 Len=137 [TCP segment of a reassembled PDU]
286	17.448807	192.168.1.200	128.119.245.12	TCP	1514	64986 → 80 [ACK] Seq=2215 Ack=1 Win=262144 Len=1460 [TCP segment of a reassembled PDU]
287	17.448809	192.168.1.200	128.119.245.12	TCP	1514	64986 → 80 [ACK] Seq=3675 Ack=1 Win=262144 Len=1460 [TCP segment of a reassembled PDU]
288	17.448810	192.168.1.200	128.119.245.12	TCP	1514	64986 → 80 [ACK] Seq=5135 Ack=1 Win=262144 Len=1460 [TCP segment of a reassembled PDU]
289	17.448811	192.168.1.200	128.119.245.12	TCP	1514	64986 → 80 [ACK] Seq=6595 Ack=1 Win=262144 Len=1460 [TCP segment of a reassembled PDU]
290	17.448812	192.168.1.200	128.119.245.12	TCP	1514	64986 → 80 [ACK] Seq=8055 Ack=1 Win=262144 Len=1460 [TCP segment of a reassembled PDU]
291	17.448813	192.168.1.200	128.119.245.12	TCP	1514	64986 → 80 [ACK] Seq=9515 Ack=1 Win=262144 Len=1460 [TCP segment of a reassembled PDU]
292	17.448814	192.168.1.200	128.119.245.12	TCP	1514	64986 → 80 [ACK] Seq=10975 Ack=1 Win=262144 Len=1460 [TCP segment of a reassembled PDU]
293	17.448815	192.168.1.200	128.119.245.12	TCP	1514	64986 → 80 [ACK] Seq=12435 Ack=1 Win=262144 Len=1460 [TCP segment of a reassembled PDU]
294	17.448816	192.168.1.200	128.119.245.12	TCP	1514	64986 → 80 [ACK] Seq=13895 Ack=1 Win=262144 Len=1460 [TCP segment of a reassembled PDU]
295	17.513873	128.119.245.12	192.168.1.200	TCP	54	80 → 64986 [ACK] Seq=1 Ack=618 Win=38464 Len=0
296	17.513874	128.119.245.12	192.168.1.200	TCP	54	80 → 64986 [ACK] Seq=1 Ack=755 Win=31744 Len=0
297	17.513875	128.119.245.12	192.168.1.200	TCP	54	80 → 64986 [ACK] Seq=1 Ack=8055 Win=66336 Len=0
298	17.513876	128.119.245.12	192.168.1.200	TCP	54	80 → 64986 [ACK] Seq=1 Ack=13895 Win=57984 Len=0
299	17.514337	192.168.1.200	128.119.245.12	TCP	1514	64986 → 80 [ACK] Seq=13895 Ack=1 Win=262144 Len=1460 [TCP segment of a reassembled PDU]

What is the RTT value the second data-carrying TCP segment and its ACK?

- The time the second segment (the one containing the HTTP POST) in the data transfer part of the TCP connection sent is 17.447627.
- The time the ACK for this second data-containing segment received is 17.513874.
- RTT value the second data-carrying TCP segment and its ACK: Receive Time – Sent Time = 0.066247

What is the EstimatedRTT value (see Section 3.5.3, in the text) after the ACK for the second data-carrying segment is received? Assume that in making this calculation after the received of the ACK for the second segment, that the initial value of EstimatedRTT is equal to the measured RTT for the first segment, and then is computed using the EstimatedRTT equation on page 242, and a value of $\alpha = 0.125$.

- The Estimated RTT after the ACK for the second data-carrying segment is received: $(1 - \alpha) * \text{EstimatedRTT} + \alpha * \text{SampleRTT} = (1 - 0.125) * 0.06651 + 0.125 * 17.447627 = 2.239149625$

No.	Time	Source	Destination	Protocol	Length	Info
281	17.396008	192.168.1.200	128.119.245.12	TCP	78	64986 → 80 [SYN] Seq=0 Win=65535 Len=0 MSS=1460 WS=64 TSval=3481351676 TSecr=0 SACK_PERM
282	17.446848	128.119.245.12	192.168.1.200	TCP	66	80 → 64986 [SYN, ACK] Seq=0 Ack=1 Win=29200 Len=0 MSS=1460 SACK_PERM WS=128
283	17.447133	192.168.1.200	128.119.245.12	TCP	54	64986 → 80 [ACK] Seq=1 Ack=1 Win=262144 Len=0
284	17.447363	192.168.1.200	128.119.245.12	TCP	671	64986 → 80 [PSH, ACK] Seq=1 Ack=1 Win=262144 Len=617 [TCP segment of a reassembled PDU]
285	17.447627	192.168.1.200	128.119.245.12	TCP	191	64986 → 80 [PSH, ACK] Seq=618 Ack=1 Win=262144 Len=137 [TCP segment of a reassembled PDU]
286	17.448007	192.168.1.200	128.119.245.12	TCP	1514	64986 → 80 [ACK] Seq=755 Ack=1 Win=262144 Len=1460 [TCP segment of a reassembled PDU]
287	17.448009	192.168.1.200	128.119.245.12	TCP	1514	64986 → 80 [ACK] Seq=2215 Ack=1 Win=262144 Len=1460 [TCP segment of a reassembled PDU]
288	17.448010	192.168.1.200	128.119.245.12	TCP	1514	64986 → 80 [ACK] Seq=3675 Ack=1 Win=262144 Len=1460 [TCP segment of a reassembled PDU]
289	17.448011	192.168.1.200	128.119.245.12	TCP	1514	64986 → 80 [ACK] Seq=5135 Ack=1 Win=262144 Len=1460 [TCP segment of a reassembled PDU]
290	17.448012	192.168.1.200	128.119.245.12	TCP	1514	64986 → 80 [ACK] Seq=6595 Ack=1 Win=262144 Len=1460 [TCP segment of a reassembled PDU]
291	17.448013	192.168.1.200	128.119.245.12	TCP	1514	64986 → 80 [ACK] Seq=8055 Ack=1 Win=262144 Len=1460 [TCP segment of a reassembled PDU]
292	17.448014	192.168.1.200	128.119.245.12	TCP	1514	64986 → 80 [ACK] Seq=9515 Ack=1 Win=262144 Len=1460 [TCP segment of a reassembled PDU]
293	17.448015	192.168.1.200	128.119.245.12	TCP	1514	64986 → 80 [ACK] Seq=10975 Ack=1 Win=262144 Len=1460 [TCP segment of a reassembled PDU]
294	17.448016	192.168.1.200	128.119.245.12	TCP	1514	64986 → 80 [ACK] Seq=12435 Ack=1 Win=262144 Len=1460 [TCP segment of a reassembled PDU]
295	17.513873	128.119.245.12	192.168.1.200	TCP	54	80 → 64986 [ACK] Seq=1 Ack=618 Win=38464 Len=0
296	17.513874	128.119.245.12	192.168.1.200	TCP	54	80 → 64986 [ACK] Seq=1 Ack=755 Win=31744 Len=0
297	17.513875	128.119.245.12	192.168.1.200	TCP	54	80 → 64986 [ACK] Seq=1 Ack=8055 Win=46336 Len=0

> Frame 285: 191 bytes on wire (1528 bits), 191 bytes captured (1528 bits) on interface e...
 > Ethernet II, Src: Apple_3e:a6:d7 (f8:ff:c2:3e:a6:d7), Dst: HUMAN_23:17:c:51 (10:c4:ca:23:17:c:51)
 > Internet Protocol Version 4, Src: 192.168.1.200, Dst: 128.119.245.12
 > Transmission Control Protocol, Src Port: 64986, Dst Port: 80, Seq: 618, Ack: 1, Len: 137
 > Source Port: 64986
 > Destination Port: 80
 > [Stream index: 7]
 > [Conversation completeness: Complete, WITH_DATA (31)]
 > [TCP Segment Len: 137]
 > Sequence Number: 618 (relative sequence number)
 > Sequence Number (raw): 741255107
 > [Next Sequence Number: 755 (relative sequence number)]
 > Acknowledgment Number: 1 (relative ack number)
 > Acknowledgment number (raw): 2723697928
 > 0101 = Header Length: 20 bytes (5)
 > Flags: 0x018 (PSH, ACK)
 > Window: 4096
 > [Calculated window size: 262144]
 > [Window size scaling factor: 64]
 > Checksum: 0x4359 [unverified]
 > [Checksum Status: Unverified]
 > Urgent Pointer: 0
 > [Timestamps]

7)
What is the length (header plus payload) of each of the first four data-carrying TCP segments?

First: 617
Second: 137
Third: 1460
Fourth: 1460

No.	Time	Source	Destination	Protocol	Length	Info
272	17.063510	2000:1700:2097:db1...	2603:1036:2400::12	TCP	74	59618 → 443 [ACK] Seq=13762 Ack=7669 Win=201120 Len=0
273	17.065697	2000:1700:2097:db1...	2603:1036:2400::12	TLSv1_	120	Application Data
274	17.066109	2000:1700:2097:db1...	2603:1036:2400::12	TLSv1_	105	Encrypted Alert
275	17.066473	2000:1700:2097:db1...	2603:1036:2400::12	TCP	74	59618 → 443 [FIN, ACK] Seq=13839 Ack=7669 Win=262144 Len=0
276	17.111645	2603:1036:2400::12	2000:1700:2097:db1...	TCP	74	443 → 59618 [ACK] Seq=7669 Ack=13840 Win=525312 Len=0
277	17.111647	2603:1036:2400::12	2000:1700:2097:db1...	TCP	74	443 → 59618 [FIN, ACK] Seq=7669 Ack=13840 Win=525312 Len=0
278	17.111868	2000:1700:2097:db1...	2603:1036:2400::12	TCP	74	59618 → 443 [ACK] Seq=13840 Ack=7670 Win=262144 Len=0
281	17.396008	192.168.1.200	128.119.245.12	TCP	78	64986 → 80 [SYN] Seq=0 Win=65535 Len=0 MSS=1460 WS=64 TSval=3481351676 TSecr=0 SACK_PERM
282	17.446848	128.119.245.12	192.168.1.200	TCP	66	80 → 64986 [SYN, ACK] Seq=0 Ack=1 Win=29200 Len=0 MSS=1460 SACK_PERM WS=128
283	17.447133	192.168.1.200	128.119.245.12	TCP	54	64986 → 80 [ACK] Seq=1 Ack=1 Win=262144 Len=0
284	17.447363	192.168.1.200	128.119.245.12	TCP	671	64986 → 80 [PSH, ACK] Seq=1 Ack=1 Win=262144 Len=617 [TCP segment of a reassembled PDU]
285	17.447627	192.168.1.200	128.119.245.12	TCP	191	64986 → 80 [PSH, ACK] Seq=618 Ack=1 Win=262144 Len=137 [TCP segment of a reassembled PDU]
286	17.448007	192.168.1.200	128.119.245.12	TCP	1514	64986 → 80 [ACK] Seq=755 Ack=1 Win=262144 Len=1460 [TCP segment of a reassembled PDU]
287	17.448009	192.168.1.200	128.119.245.12	TCP	1514	64986 → 80 [ACK] Seq=2215 Ack=1 Win=262144 Len=1460 [TCP segment of a reassembled PDU]
288	17.448010	192.168.1.200	128.119.245.12	TCP	1514	64986 → 80 [ACK] Seq=3675 Ack=1 Win=262144 Len=1460 [TCP segment of a reassembled PDU]
289	17.448011	192.168.1.200	128.119.245.12	TCP	1514	64986 → 80 [ACK] Seq=5135 Ack=1 Win=262144 Len=1460 [TCP segment of a reassembled PDU]
290	17.448012	192.168.1.200	128.119.245.12	TCP	1514	64986 → 80 [ACK] Seq=6595 Ack=1 Win=262144 Len=1460 [TCP segment of a reassembled PDU]
291	17.448013	192.168.1.200	128.119.245.12	TCP	1514	64986 → 80 [ACK] Seq=8055 Ack=1 Win=262144 Len=1460 [TCP segment of a reassembled PDU]

8)
What is the minimum amount of available buffer space advertised to the client by gaia.cs.umass.edu among these first four data-carrying TCP segments?
- 262144 bytes

Does the lack of receiver buffer space ever throttle the sender for these first four data-carrying segments?

- No, because segment length is less than window size.

No.	Time	Source	Destination	Protocol	Length	Info
272	17.065516	2600:1700:2097:db1...	2603:1036:2400::12	TCP	74	59618 → 443 [ACK] Seq=13762 Ack=7669 Win=202120 Len=0
273	17.065697	2600:1700:2097:db1...	2603:1036:2400::12	TLSv1	120	Application Data
274	17.066109	2600:1700:2097:db1...	2603:1036:2400::12	TLSv1	105	Encrypted Alert
275	17.066473	2600:1700:2097:db1...	2603:1036:2400::12	TCP	74	59618 → 443 [FIN, ACK] Seq=13839 Ack=7669 Win=262144 Len=0
276	17.111645	2603:1036:2400::12	2600:1700:2097:db1...	TCP	74	443 → 59618 [ACK] Seq=7669 Ack=13840 Win=525312 Len=0
277	17.111647	2603:1036:2400::12	2600:1700:2097:db1...	TCP	74	443 → 59618 [FIN, ACK] Seq=7669 Ack=13840 Win=525312 Len=0
278	17.111868	2600:1700:2097:db1...	2603:1036:2400::12	TCP	74	59618 → 443 [ACK] Seq=13840 Ack=7670 Win=262144 Len=0
281	17.396008	192.168.1.200	128.119.245.12	TCP	78	64986 → 80 [SYN] Seq=0 Win=65535 Len=0 MSS=1460 WS=64 TSval=3481351676 TSecr=0 SACK_PERM
282	17.446848	128.119.245.12	192.168.1.200	TCP	66	80 → 64986 [SYN, ACK] Seq=0 Ack=1 Win=29200 Len=0 MSS=1460 SACK_PERM WS=128
283	17.447133	192.168.1.200	128.119.245.12	TCP	54	64986 → 80 [ACK] Seq=1 Ack=1 Win=262144 Len=0
284	17.447363	192.168.1.200	128.119.245.12	TCP	671	64986 → 80 [PSH, ACK] Seq=1 Ack=1 Win=262144 Len=617 [TCP segment of a reassembled PDU]
285	17.447627	192.168.1.200	128.119.245.12	TCP	191	64986 → 80 [PSH, ACK] Seq=618 Ack=1 Win=262144 Len=137 [TCP segment of a reassembled PDU]
286	17.448007	192.168.1.200	128.119.245.12	TCP	1514	64986 → 80 [ACK] Seq=755 Ack=1 Win=262144 Len=1460 [TCP segment of a reassembled PDU]
287	17.448009	192.168.1.200	128.119.245.12	TCP	1514	64986 → 80 [ACK] Seq=2215 Ack=1 Win=262144 Len=1460 [TCP segment of a reassembled PDU]
288	17.448010	192.168.1.200	128.119.245.12	TCP	1514	64986 → 80 [ACK] Seq=3675 Ack=1 Win=262144 Len=1460 [TCP segment of a reassembled PDU]
289	17.448011	192.168.1.200	128.119.245.12	TCP	1514	64986 → 80 [ACK] Seq=5135 Ack=1 Win=262144 Len=1460 [TCP segment of a reassembled PDU]
290	17.448012	192.168.1.200	128.119.245.12	TCP	1514	64986 → 80 [ACK] Seq=6595 Ack=1 Win=262144 Len=1460 [TCP segment of a reassembled PDU]
291	17.448013	192.168.1.200	128.119.245.12	TCP	1514	64986 → 80 [ACK] Seq=8055 Ack=1 Win=262144 Len=1460 [TCP segment of a reassembled PDU]

9) Are there any retransmitted segments in the trace file?

- No there isn't.

What did you check for (in the trace) in order to answer this question?

- I checked the sequence number for each of the segments and the number increases without repeating. This means that no retransmitted segments occur.

No.	Time	Source	Destination	Protocol	Length	Info
272	17.065516	2600:1700:2097:db1...	2603:1036:2400::12	TCP	74	59618 → 443 [ACK] Seq=13762 Ack=7669 Win=202120 Len=0
273	17.065697	2600:1700:2097:db1...	2603:1036:2400::12	TLSv1	120	Application Data
274	17.066109	2600:1700:2097:db1...	2603:1036:2400::12	TLSv1	105	Encrypted Alert
275	17.066473	2600:1700:2097:db1...	2603:1036:2400::12	TCP	74	59618 → 443 [FIN, ACK] Seq=13839 Ack=7669 Win=262144 Len=0
276	17.111645	2603:1036:2400::12	2600:1700:2097:db1...	TCP	74	443 → 59618 [ACK] Seq=7669 Ack=13840 Win=525312 Len=0
277	17.111647	2603:1036:2400::12	2600:1700:2097:db1...	TCP	74	443 → 59618 [FIN, ACK] Seq=7669 Ack=13840 Win=525312 Len=0
278	17.111868	2600:1700:2097:db1...	2603:1036:2400::12	TCP	74	59618 → 443 [ACK] Seq=13840 Ack=7670 Win=262144 Len=0
281	17.396008	192.168.1.200	128.119.245.12	TCP	78	64986 → 80 [SYN] Seq=0 Win=65535 Len=0 MSS=1460 WS=64 TSval=3481351676 TSecr=0 SACK_PERM
282	17.446848	128.119.245.12	192.168.1.200	TCP	66	80 → 64986 [SYN, ACK] Seq=0 Ack=1 Win=29200 Len=0 MSS=1460 SACK_PERM WS=128
283	17.447133	192.168.1.200	128.119.245.12	TCP	54	64986 → 80 [ACK] Seq=1 Ack=1 Win=262144 Len=0
284	17.447363	192.168.1.200	128.119.245.12	TCP	671	64986 → 80 [PSH, ACK] Seq=1 Ack=1 Win=262144 Len=617 [TCP segment of a reassembled PDU]
285	17.447627	192.168.1.200	128.119.245.12	TCP	191	64986 → 80 [PSH, ACK] Seq=618 Ack=1 Win=262144 Len=137 [TCP segment of a reassembled PDU]
286	17.448007	192.168.1.200	128.119.245.12	TCP	1514	64986 → 80 [ACK] Seq=755 Ack=1 Win=262144 Len=1460 [TCP segment of a reassembled PDU]
287	17.448009	192.168.1.200	128.119.245.12	TCP	1514	64986 → 80 [ACK] Seq=2215 Ack=1 Win=262144 Len=1460 [TCP segment of a reassembled PDU]
288	17.448010	192.168.1.200	128.119.245.12	TCP	1514	64986 → 80 [ACK] Seq=3675 Ack=1 Win=262144 Len=1460 [TCP segment of a reassembled PDU]
289	17.448011	192.168.1.200	128.119.245.12	TCP	1514	64986 → 80 [ACK] Seq=5135 Ack=1 Win=262144 Len=1460 [TCP segment of a reassembled PDU]
290	17.448012	192.168.1.200	128.119.245.12	TCP	1514	64986 → 80 [ACK] Seq=6595 Ack=1 Win=262144 Len=1460 [TCP segment of a reassembled PDU]
291	17.448013	192.168.1.200	128.119.245.12	TCP	1514	64986 → 80 [ACK] Seq=8055 Ack=1 Win=262144 Len=1460 [TCP segment of a reassembled PDU]

10) How much data does the receiver typically acknowledge in an ACK among the first ten data-carrying segments sent from the client to gaia.cs.umass.edu?

- 1460 bytes

Can you identify cases where the receiver is ACKing every other received among these first ten data-carrying segments?

- No

11)

What is the throughput (bytes transferred per unit time) for the TCP connection? Explain how you calculated this value.

- The first TCP segment is 1 byte.
- The last segment is 152939 bytes.
- Total data: $152939 - 1 = 152938$ bytes
- Transmission time for first segment = 17.447363 seconds
- Transmission time for last segment = 17.717163 seconds
- Difference $17.717163 - 17.447363 = 0.2698$ seconds
- Throughput = $152938 / 0.2698 = 566856.9311$ MB/sec

No.	Time	Source	Destination	Protocol	Length	Info
418	17.699289	128.119.245.12	192.168.1.200	TCP	56	80 → 64986 [ACK] Seq=1 Ack=123395 Win=179584 Len=0
419	17.699289	128.119.245.12	192.168.1.200	TCP	56	80 → 64986 [ACK] Seq=1 Ack=126315 Win=182528 Len=0
420	17.717162	128.119.245.12	192.168.1.200	TCP	56	80 → 64986 [ACK] Seq=1 Ack=133615 Win=179584 Len=0
421	17.717162	128.119.245.12	192.168.1.200	TCP	56	80 → 64986 [ACK] Seq=1 Ack=140915 Win=197888 Len=0
422	17.717163	128.119.245.12	192.168.1.200	TCP	56	80 → 64986 [ACK] Seq=1 Ack=148215 Win=212480 Len=0
423	17.717163	128.119.245.12	192.168.1.200	TCP	56	80 → 64986 [ACK] Seq=1 Ack=152595 Win=221184 Len=0
424	17.717163	128.119.245.12	192.168.1.200	TCP	56	80 → 64986 [ACK] Seq=1 Ack=152939 Win=224128 Len=0
425	17.717164	128.119.245.12	192.168.1.200	HTTP	831	HTTP/1.1 200 OK (text/html)
426	17.717319	192.168.1.200	128.119.245.12	TCP	54	64986 → 80 [ACK] Seq=152939 Ack=778 Win=261312 Len=0
551	22.798039	128.119.245.12	192.168.1.200	TCP	54	80 → 64986 [FIN, ACK] Seq=778 Ack=152939 Win=224128 Len=0
552	22.798288	192.168.1.200	128.119.245.12	TCP	54	64986 → 80 [ACK] Seq=152939 Ack=779 Win=262144 Len=0
553	22.798543	192.168.1.200	128.119.245.12	TCP	54	64986 → 80 [FIN, ACK] Seq=152939 Ack=779 Win=262144 Len=0
554	22.849982	128.119.245.12	192.168.1.200	TCP	54	80 → 64986 [ACK] Seq=779 Ack=152940 Win=224128 Len=0
589	25.133991	2600:1700:2097:db1...	2603:1036:2400::12	TCP	98	59619 → 443 [SYN] Seq=0 Win=65535 Len=0 MSS=1440 WS=64 TSval=3295922592 TSecr=0 SACK_PERM
590	25.180250	2603:1036:2400::12	2600:1700:2097:db1...	TCP	86	443 → 59619 [SYN, ACK] Seq=0 Ack=1 Win=65535 Len=0 MSS=1400 WS=256 SACK_PERM
591	25.181293	2600:1700:2097:db1...	2603:1036:2400::12	TCP	74	59619 → 443 [ACK] Seq=1 Ack=1 Win=262144 Len=0
592	25.181294	2600:1700:2097:db1...	2603:1036:2400::12	TLSv1	591	Client Hello (SN1=roaming.officeapps.live.com)