

Assignment 5

210010033

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Part 2:

1. IP of the source is 10.200.179.176
The TCP port number is 80
2. IP of gaia.cs.umass.edu is 128.119.245.12
The source port is 80 and destination port is 59128

188	09:05:06.752539	10.200.179.176	128.119.245.12	HTTP	612	POST /wireshark-labs/lab3-1-reply.htm HTTP/1.1 (text/plain)
189	09:05:06.763375	23.223.47.154	10.200.179.176	TCP	66	80 → 59026 [FIN, ACK] Seq=1 Ack=3 Win=501 Len=0 TSval=2884422882 TSecr=127623720
190	09:05:06.763378	23.223.47.154	10.200.179.176	TCP	66	80 → 59024 [FIN, ACK] Seq=1 Ack=3 Win=503 Len=0 TSval=2884422882 TSecr=316719571
191	09:05:06.763660	10.200.179.176	23.223.47.154	TCP	66	59026 → 80 [ACK] Seq=3 Ack=2 Win=2048 Len=0 TSval=1276237229 TSecr=2884422882
192	09:05:06.763732	10.200.179.176	23.223.47.154	TCP	66	59024 → 80 [ACK] Seq=3 Ack=2 Win=2048 Len=0 TSval=3167195742 TSecr=2884422882
193	09:05:07.099181	128.119.245.12	10.200.179.176	TCP	54	80 → 59128 [ACK] Seq=1 Ack=93751 Win=179584 Len=0
194	09:05:07.099186	128.119.245.12	10.200.179.176	TCP	54	80 → 59128 [ACK] Seq=1 Ack=100001 Win=179584 Len=0
195	09:05:07.099187	128.119.245.12	10.200.179.176	TCP	54	80 → 59128 [ACK] Seq=1 Ack=106251 Win=179584 Len=0
196	09:05:07.099188	128.119.245.12	10.200.179.176	TCP	54	80 → 59128 [ACK] Seq=1 Ack=112501 Win=179584 Len=0
197	09:05:07.099189	128.119.245.12	10.200.179.176	TCP	54	80 → 59128 [ACK] Seq=1 Ack=118751 Win=179584 Len=0
198	09:05:07.099189	128.119.245.12	10.200.179.176	TCP	54	80 → 59128 [ACK] Seq=1 Ack=125001 Win=179584 Len=0
199	09:05:07.099190	128.119.245.12	10.200.179.176	TCP	54	80 → 59128 [ACK] Seq=1 Ack=131251 Win=179584 Len=0
200	09:05:07.099191	128.119.245.12	10.200.179.176	TCP	54	80 → 59128 [ACK] Seq=1 Ack=137501 Win=179584 Len=0
201	09:05:07.099191	128.119.245.12	10.200.179.176	TCP	54	80 → 59128 [ACK] Seq=1 Ack=143751 Win=179584 Len=0
202	09:05:07.099192	128.119.245.12	10.200.179.176	TCP	54	80 → 59128 [ACK] Seq=1 Ack=148751 Win=180608 Len=0
203	09:05:07.099193	128.119.245.12	10.200.179.176	TCP	54	80 → 59128 [ACK] Seq=1 Ack=149309 Win=183296 Len=0
204	09:05:07.099193	128.119.245.12	10.200.179.176	HTTP	831	HTTP/1.1 200 OK (text/html)

Part 3:

- 1.

```
Transmission Control Protocol, Src Port: 59128, Dst Port: 80, Seq: 0, Len: 0
  Source Port: 59128
  Destination Port: 80
  [Stream index: 7]
  > [Conversation completeness: Complete, WITH_DATA (31)]
  [TCP Segment Len: 0]
  Sequence Number: 0      (relative sequence number)
  Sequence Number (raw): 869092609
  [Next Sequence Number: 1      (relative sequence number)]
  Acknowledgment Number: 0
  Acknowledgment number (raw): 0
  1011 ... = Header Length: 44 bytes (11)
  > Flags: 0x002 (SYN)
  Window: 65535
  [Calculated window size: 65535]
  Checksum: 0xc157 [unverified]
  [Checksum Status: Unverified]
  Urgent Pointer: 0
```

The raw sequence number of the TCP SYN packet that is 869092609 and the relative sequence number is 0.
The flags in the TCP packet represent that it is an SYN segment.

2.

```
Transmission Control Protocol, Src Port: 80, Dst Port: 59128, Seq: 0, Ack: 1, Len: 0
  Source Port: 80
  Destination Port: 59128
  [Stream index: 7]
  > [Conversation completeness: Complete, WITH_DATA (31)]
  [TCP Segment Len: 0]
  Sequence Number: 0 (relative sequence number)
  Sequence Number (raw): 365568124
  [Next Sequence Number: 1 (relative sequence number)]
  Acknowledgment Number: 1 (relative ack number)
  Acknowledgment number (raw): 869092610
  1000 .... = Header Length: 32 bytes (8)
  > Flags: 0x012 (SYN, ACK)
  Window: 29200
  [Calculated window size: 29200]
  Checksum: 0x2b68 [unverified]
  [Checksum Status: Unverified]
  Urgent Pointer: 0
```

The raw sequence number of the TCP SYNACK packet that is 365568124 and the relative sequence number is 0. The flags in the TCP packet represent that it is an SYNACK segment. The relative acknowledgment is 1 and the acknowledgment number (raw) is 869092610. The value of the acknowledgment number is (sequence number + 1).

3.

The raw sequence number of the TCP segment

```
Transmission Control Protocol, Src Port: 59128, Dst Port: 80, Seq: 148751, Ack: 1, Len: 558
  Source Port: 59128
  Destination Port: 80
  [Stream index: 7]
  > [Conversation completeness: Complete, WITH_DATA (31)]
  [TCP Segment Len: 558]
  Sequence Number: 148751 (relative sequence number)
  Sequence Number (raw): 869241360
  [Next Sequence Number: 149309 (relative sequence number)]
  Acknowledgment Number: 1 (relative ack number)
  Acknowledgment number (raw): 365568125
  0101 .... = Header Length: 20 bytes (5)
  > Flags: 0x018 (PSH, ACK)
  Window: 4096
  [Calculated window size: 262144]
  [Window size scaling factor: 64]
  Checksum: 0xb2d9 [unverified]
  [Checksum Status: Unverified]
  Urgent Pointer: 0
  > [Timestamps]
  > [SEQ/ACK analysis]
  TCP payload (558 bytes)
  TCP segment data (558 bytes)
```

containing the header of the HTTP POST command packet that is 869241360 and the relative sequence number is 0148751. Size is 558 bytes in the payload. No, not all of the data of the alice.txt file was transferred in this single TCP segment.

4.
 - i. 9:05:05.616466 am 7th Feb 2024
 - ii. 9:05:05.878832 am 7th Feb 2024
 - iii. rtt of the first package is 0.26212400 seconds.
 - iv. rtt of the second package is 0.000258000 seconds.
5. The following are the first four data carrying TCP segments:

51	09:05:05.880111	10.200.179.176	128.119.245.12	TCP	1304	59128 → 80 [ACK] Seq=1 Ack=1 Win=262144 Len=1250 [TCP segment of a reassembled PDU]
52	09:05:05.880115	10.200.179.176	128.119.245.12	TCP	1304	59128 → 80 [ACK] Seq=1251 Ack=1 Win=262144 Len=1250 [TCP segment of a reassembled PDU]
53	09:05:05.880117	10.200.179.176	128.119.245.12	TCP	1304	59128 → 80 [ACK] Seq=2501 Ack=1 Win=262144 Len=1250 [TCP segment of a reassembled PDU]
54	09:05:05.880120	10.200.179.176	128.119.245.12	TCP	1304	59128 → 80 [ACK] Seq=3751 Ack=1 Win=262144 Len=1250 [TCP segment of a reassembled PDU]

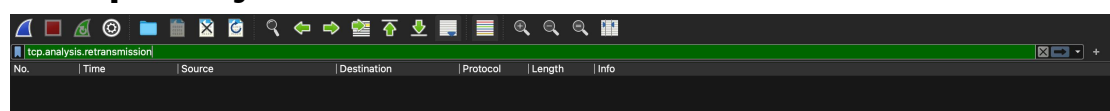
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[ TCP Segment Len: 1250 ]
Sequence Number: 1      (relative sequence number)
Sequence Number (raw): 869092610
[Next Sequence Number: 1251      (relative sequence number)]
Acknowledgment Number: 1      (relative ack number)
Acknowledgment number (raw): 365568125
0101 .... = Header Length: 20 bytes (5)
> Flags: 0x010 (ACK)
Window: 4096
[Calculated window size: 262144]
[Window size scaling factor: 64]
Checksum: 0x421b [unverified]
[Checksum Status: Unverified]
Urgent Pointer: 0
  [Timestamps]
    [Time since first frame in this TCP stream: 0.263645000 seconds]
    [Time since previous frame in this TCP stream: 0.001521000 seconds]
  [SEQ/ACK analysis]
    [iRTT: 0.262124000 seconds]
    [Bytes in flight: 1250]
    [Bytes sent since last PSH flag: 1250]
    TCP payload (1250 bytes)

```

The length (header plus payload) of each of the first four data-carrying TCP is $1250 + 20 = 1270$ bytes.

6. Buffer size is 262144 bytes as advertised. Since it does not change among the first 4 packets, the buffer space never throttles the sender.
7. No, there aren't any retransmitted segments in the trace file. I checked this using **tcp.analysis.retransmission** in the filter.



No.	Time	Source	Destination	Protocol	Length	Info
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8.

51	09:05:05.880111	10.200.179.176	128.119.245.12	TCP	1304	59128 → 80 [ACK] Seq=1 Ack=1 Win=262144 Len=1250 [TCP segment of a reassembled PDU]
52	09:05:05.880115	10.200.179.176	128.119.245.12	TCP	1304	59128 → 80 [ACK] Seq=1251 Ack=1 Win=262144 Len=1250 [TCP segment of a reassembled PDU]
53	09:05:05.880117	10.200.179.176	128.119.245.12	TCP	1304	59128 → 80 [ACK] Seq=2581 Ack=1 Win=262144 Len=1250 [TCP segment of a reassembled PDU]
54	09:05:05.880120	10.200.179.176	128.119.245.12	TCP	1304	59128 → 80 [ACK] Seq=3751 Ack=1 Win=262144 Len=1250 [TCP segment of a reassembled PDU]
55	09:05:05.880122	10.200.179.176	128.119.245.12	TCP	1304	59128 → 80 [ACK] Seq=5001 Ack=1 Win=262144 Len=1250 [TCP segment of a reassembled PDU]
56	09:05:05.880125	10.200.179.176	128.119.245.12	TCP	1304	59128 → 80 [ACK] Seq=6251 Ack=1 Win=262144 Len=1250 [TCP segment of a reassembled PDU]
57	09:05:05.880129	10.200.179.176	128.119.245.12	TCP	1304	59128 → 80 [ACK] Seq=7501 Ack=1 Win=262144 Len=1250 [TCP segment of a reassembled PDU]
58	09:05:05.880131	10.200.179.176	128.119.245.12	TCP	1304	59128 → 80 [ACK] Seq=8751 Ack=1 Win=262144 Len=1250 [TCP segment of a reassembled PDU]
59	09:05:05.880135	10.200.179.176	128.119.245.12	TCP	1304	59128 → 80 [ACK] Seq=10001 Ack=1 Win=262144 Len=1250 [TCP segment of a reassembled PDU]
60	09:05:05.880145	10.200.179.176	128.119.245.12	TCP	1304	59128 → 80 [ACK] Seq=11251 Ack=1 Win=262144 Len=1250 [TCP segment of a reassembled PDU]

The receiver acknowledges 1 byte in the first packet and 1250 byte each in the last 9 packets.

62	09:05:06.178274	128.119.245.12	10.200.179.176	TCP	54	80 → 59128 [ACK] Seq=1 Ack=6251 Win=41728 Len=0
63	09:05:06.178275	128.119.245.12	10.200.179.176	TCP	54	80 → 59128 [ACK] Seq=1 Ack=12501 Win=54272 Len=0

The packet number 62 ACKS packet 55

The packet number 63 ACKS packet 60

Hence, I can find cases where the receiver is ACKing every other received segment among these first ten data-carrying segments

9. The first package acknowledged 1 byte.

51	09:05:05.880111	10.200.179.176	128.119.245.12	TCP	1304	59128 → 80 [ACK] Seq=1 Ack=1 Win=262144 Len=1250 [TCP segment of a reassembled PDU]
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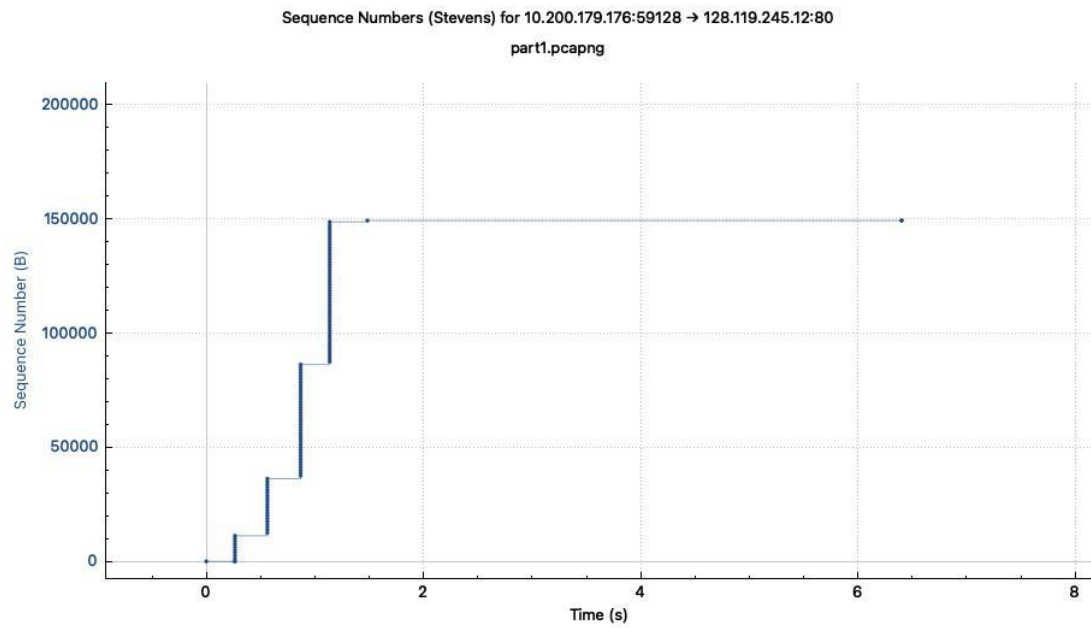
The last package acknowledged 149309 bytes.

287	09:05:12.018861	10.200.179.176	128.119.245.12	TCP	54	59128 → 80 [FIN, ACK] Seq=149309 Ack=779 Win=262144 Len=0
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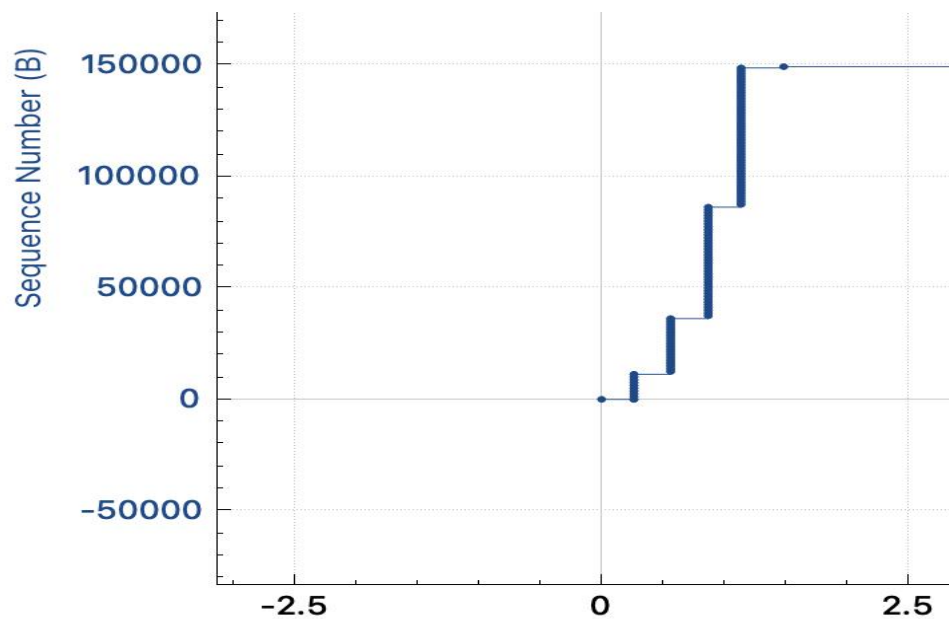
Time between the first and last package is 12.018861 - 5.880111 = 6.13875 seconds

Throughput = 149308 / 6.13875
= 24322.3783 bytes/second

Part 4:



The following figure shows slow start till 0.85 seconds since each vertical grows exponentially in size:



The following figure shows congestion avoidance at about 1.2 second since the difference in successive verticals(no. of bytes sent) at 0.85 and 1.2 seconds is not that much large as the start. :

