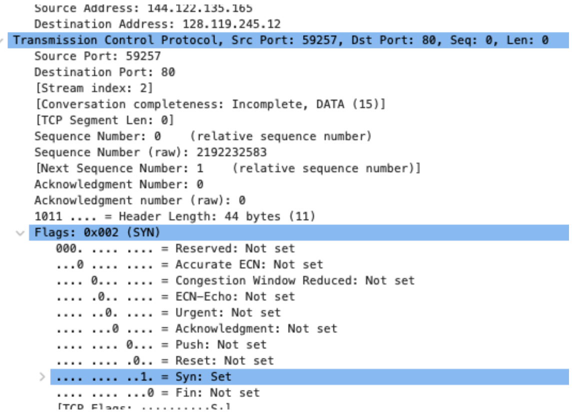
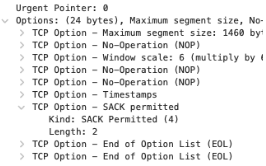
Derya Tınmaz - 2380947

Wireshark Lab: TCP

1.1 - Source Address: 144.122.135.165
1.2 - Source Port: 59257
2.1 - Destination Address: 128.119.245.12
2.2 - Destination Port: 80
3.1 - Sequence Number (raw): 2192232583
3.2 - Flags: 0x002 (SYN)

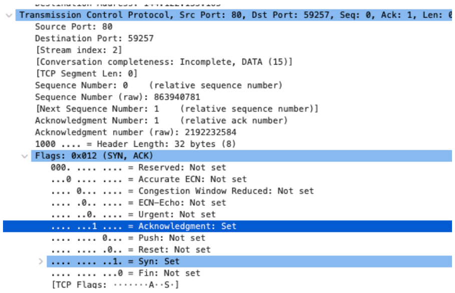


```
    Source Address: 144.122.135.165
    Destination Address: 128.119.245.12
v Transmission Control Protocol, Src Port: 59257, Dst Port: 80, Seq: 0, Len: 0
    Source Port: 59257
    Destination Port: 80
    [Stream index: 2]
    [Conversation completeness: Incomplete, DATA (15)]
    [TCP Segment Len: 0]
    Sequence Number: 0    (relative sequence number)
    Sequence Number (raw): 2192232583
    [Next Sequence Number: 1    (relative sequence number)]
    Acknowledgment Number: 0
    Acknowledgment number (raw): 0
    1011 .... = Header Length: 44 bytes (11)
  v 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·]
```

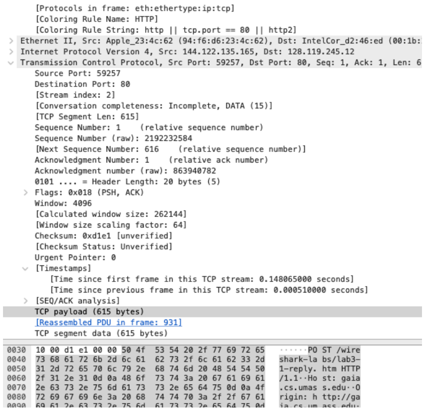


```
    Urgent Pointer: 0
  v Options: (24 bytes), Maximum segment size, No-
    > TCP Option - Maximum segment size: 1460 by
    > TCP Option - No-Operation (NOP)
    > TCP Option - Window scale: 6 (multiply by
    > TCP Option - No-Operation (NOP)
    > TCP Option - No-Operation (NOP)
    > TCP Option - Timestamps
    v TCP Option - SACK permitted
        Kind: SACK Permitted (4)
        Length: 2
    > TCP Option - End of Option List (EOL)
    > TCP Option - End of Option List (EOL)
```

3.3 - Yes, it will, because TCP Option - SACK permitted field is set.
4.1 - Sequence Number (raw): 863940781
4.2 - 1 = Acknowledgment: Set
4.3 - The value of the ACK number field is the sequence number of the next expected byte of data to be received at the server on the client-to-server direction of this connection -- one higher that the sequence number used as the sequence number in the initial SYN segment sent from client to server.



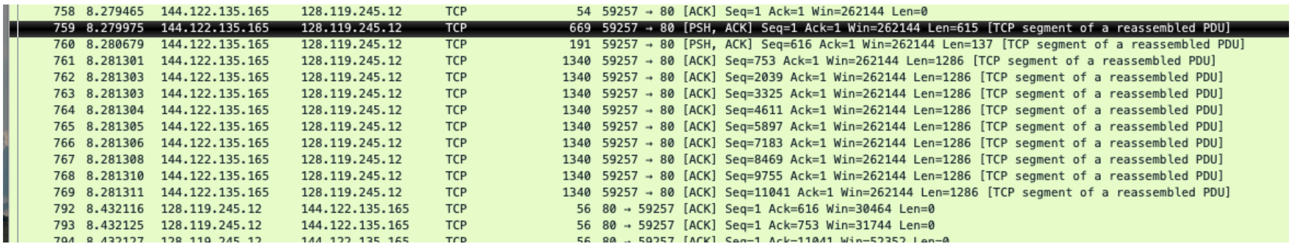
```
v Transmission Control Protocol, Src Port: 80, Dst Port: 59257, Seq: 0, Ack: 1, Len: 0
    Source Port: 80
    Destination Port: 59257
    [Stream index: 2]
    [Conversation completeness: Incomplete, DATA (15)]
    [TCP Segment Len: 0]
    Sequence Number: 0    (relative sequence number)
    Sequence Number (raw): 863940781
    [Next Sequence Number: 1    (relative sequence number)]
    Acknowledgment Number: 1    (relative ack number)
    Acknowledgment number (raw): 2192232584
    1000 .... = Header Length: 32 bytes (8)
  v 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·]
```



```
    [Protocols in frame: eth:ethertype:ip:tcp]
    [Coloring Rule Name: HTTP]
    [Coloring Rule String: http || tcp.port == 80 || http2]
> Ethernet II, Src: Apple_23:4c:62 (94:f6:d6:23:4c:62), Dst: IntelCor_d2:46:ed (00:1b:
> Internet Protocol Version 4, Src: 144.122.135.165, Dst: 128.119.245.12
v Transmission Control Protocol, Src Port: 59257, Dst Port: 80, Seq: 1, Ack: 1, Len: 6
    Source Port: 59257
    Destination Port: 80
    [Stream index: 2]
    [Conversation completeness: Incomplete, DATA (15)]
    [TCP Segment Len: 615]
    Sequence Number: 1    (relative sequence number)
    Sequence Number (raw): 2192232584
    [Next Sequence Number: 616    (relative sequence number)]
    Acknowledgment Number: 1    (relative ack number)
    Acknowledgment number (raw): 863940782
    0101 .... = Header Length: 20 bytes (5)
  > Flags: 0x018 (PSH, ACK)
    Window: 4096
    [Calculated window size: 262144]
    [Window size scaling factor: 64]
    Checksum: 0xd1e1 [unverified]
    [Checksum Status: Unverified]
    Urgent Pointer: 0
  v [Timestamps]
      [Time since first frame in this TCP stream: 0.148065000 seconds]
      [Time since previous frame in this TCP stream: 0.000510000 seconds]
  > [SEQ/ACK analysis]
    TCP payload (615 bytes)
    [Reassembled PDU in frame: 931]
    TCP segment data (615 bytes)

0030  10 00 d1 e1 00 00 50 4f  53 54 20 2f 77 69 72 65   ······PO ST /wire
0040  73 68 61 72 6b 2d 6c 61  62 73 2f 6c 61 62 33 2d   shark-la bs/lab3-
0050  31 2d 72 65 70 6c 79 2e  68 74 6d 20 48 54 54 50   1-reply. htm HTTP
0060  2f 31 2e 31 0d 0a 48 6f  73 74 3a 20 67 61 69 61   /1.1··Ho st: gaia
0070  2e 63 73 2e 75 6d 61 73  73 2e 65 64 75 0d 0a 4f   .cs.umas s.edu··O
0080  72 69 67 69 6e 3a 20 68  74 74 70 3a 2f 2f 67 61   rigin: h ttp://ga
0090  69 61 2e 63 73 2e 75 6d  61 73 73 2e 65 64 75 0d   ia.cs.um ass.edu·
```

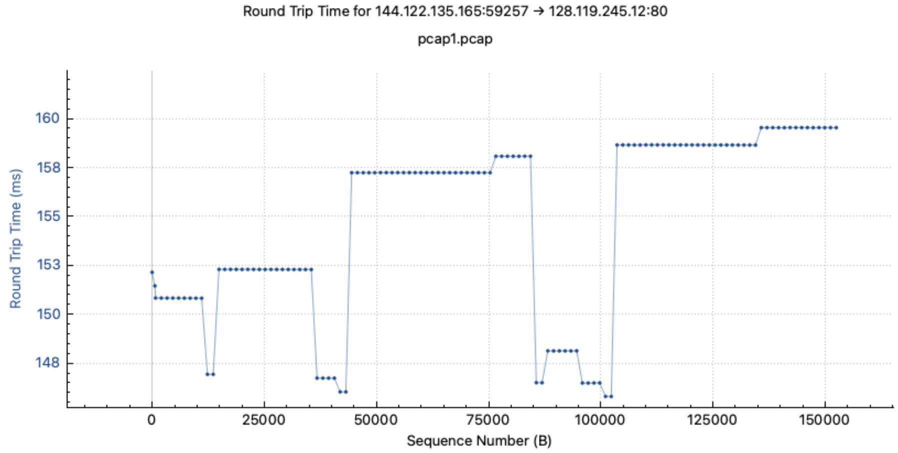
5.1 - Sequence Number (raw): 2192232584 (frame 759)
5.2 - TCP payload (613 bytes). No, it did not. It reassembled into 931 segments.

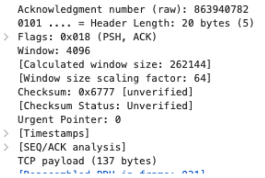


```
758 8.279465  144.122.135.165  128.119.245.12   TCP    54 59257 → 80 [ACK] Seq=1 Ack=1 Win=262144 Len=0
759 8.279975  144.122.135.165  128.119.245.12   TCP   669 59257 → 80 [PSH, ACK] Seq=1 Ack=1 Win=262144 Len=615 [TCP segment of a reassembled PDU]
760 8.280679  144.122.135.165  128.119.245.12   TCP   191 59257 → 80 [PSH, ACK] Seq=616 Ack=1 Win=262144 Len=137 [TCP segment of a reassembled PDU]
761 8.281301  144.122.135.165  128.119.245.12   TCP  1340 59257 → 80 [ACK] Seq=753 Ack=1 Win=262144 Len=1286 [TCP segment of a reassembled PDU]
762 8.281303  144.122.135.165  128.119.245.12   TCP  1340 59257 → 80 [ACK] Seq=2039 Ack=1 Win=262144 Len=1286 [TCP segment of a reassembled PDU]
763 8.281303  144.122.135.165  128.119.245.12   TCP  1340 59257 → 80 [ACK] Seq=3325 Ack=1 Win=262144 Len=1286 [TCP segment of a reassembled PDU]
764 8.281304  144.122.135.165  128.119.245.12   TCP  1340 59257 → 80 [ACK] Seq=4611 Ack=1 Win=262144 Len=1286 [TCP segment of a reassembled PDU]
765 8.281305  144.122.135.165  128.119.245.12   TCP  1340 59257 → 80 [ACK] Seq=5897 Ack=1 Win=262144 Len=1286 [TCP segment of a reassembled PDU]
766 8.281306  144.122.135.165  128.119.245.12   TCP  1340 59257 → 80 [ACK] Seq=7183 Ack=1 Win=262144 Len=1286 [TCP segment of a reassembled PDU]
767 8.281308  144.122.135.165  128.119.245.12   TCP  1340 59257 → 80 [ACK] Seq=8469 Ack=1 Win=262144 Len=1286 [TCP segment of a reassembled PDU]
768 8.281310  144.122.135.165  128.119.245.12   TCP  1340 59257 → 80 [ACK] Seq=9755 Ack=1 Win=262144 Len=1286 [TCP segment of a reassembled PDU]
769 8.281311  144.122.135.165  128.119.245.12   TCP  1340 59257 → 80 [ACK] Seq=11041 Ack=1 Win=262144 Len=1286 [TCP segment of a reassembled PDU]
792 8.432116  128.119.245.12   144.122.135.165  TCP    56 80 → 59257 [ACK] Seq=1 Ack=616 Win=30464 Len=0
793 8.432125  128.119.245.12   144.122.135.165  TCP    56 80 → 59257 [ACK] Seq=1 Ack=753 Win=31744 Len=0
794 8.432127  128.119.245.12   144.122.135.165  TCP    56 80 → 59257 [ACK] Seq=1 Ack=11041 Win=52352 Len=0
```

6.1 - Arrival Time: Nov 7, 2023 23:43:43.59142000, [Time since reference or first frame: 8.279975000 seconds] (frame 759)
6.2 - Arrival Time: Nov 7, 2023 23:43:43.743561000, [Time since reference or first frame: 8.432116000 seconds] (frame 792-760)
6.3 - 8.432116000-8.280679000=0.151437 (frame 792-760)
6.4 - 8.432125000 - 8.281301000 = 0.150824 (frame 793-761)

6.5 - EstimatedRTT = 0.875*EstimatedRTT + 0.125*SampleRTT = 0.875*0.151437+ 0.125*0.150824 = 0.151360375





```
  Acknowledgment number (raw): 863940782
  0101 .... = Header Length: 20 bytes (5)
> Flags: 0x018 (PSH, ACK)
  Window: 4096
  [Calculated window size: 262144]
  [Window size scaling factor: 64]
  Checksum: 0x6777 [unverified]
  [Checksum Status: Unverified]
  Urgent Pointer: 0
> [Timestamps]
> [SEQ/ACK analysis]
  TCP payload (137 bytes)
  [Reassembled PDU in frame: 931]
```

7 - First segment data 137+20(header)=157 bytes (frame 760), the rest 3 are 1286 byte +20 header = 1306 bytes (frames 761-762-763)

8.1 - same for all [Calculated window size: 262144]

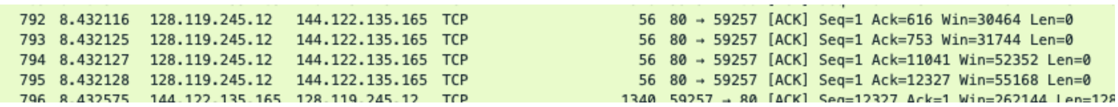
8.2 - No. The receiver advertised window is always larger than the amount of buffering needed for more than twenty 1500 byte segments.

9.1 - No.

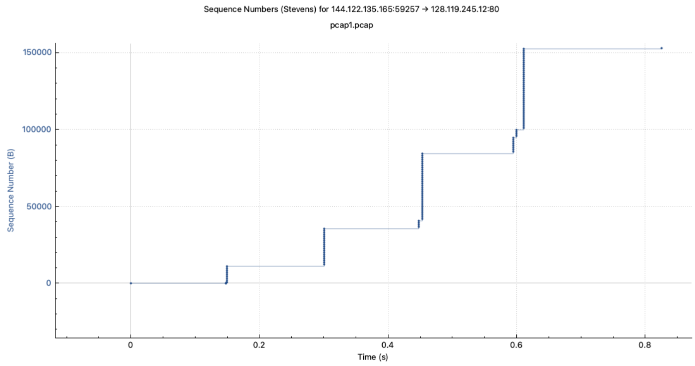
9.2 - I checked the sequence numbers for segments sent from the client to gaia.cs.umass.edu and found that they were all increasing, with no repeats.

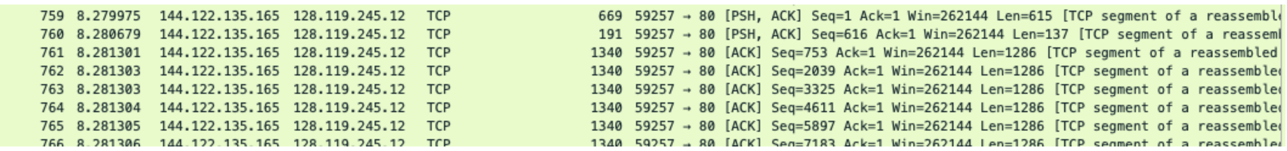
10.1 - 616, 137, 1286, 1286, 1286(rest is same)

10.2 - After the first ACK every remaining ACK acknowledges two segments' worth of payload data



```
792  8.432116   128.119.245.12   144.122.135.165  TCP                   56  80 → 59257 [ACK] Seq=1 Ack=616 Win=30464 Len=0
793  8.432125   128.119.245.12   144.122.135.165  TCP                   56  80 → 59257 [ACK] Seq=1 Ack=753 Win=31744 Len=0
794  8.432127   128.119.245.12   144.122.135.165  TCP                   56  80 → 59257 [ACK] Seq=1 Ack=11041 Win=52352 Len=0
795  8.432128   128.119.245.12   144.122.135.165  TCP                   56  80 → 59257 [ACK] Seq=1 Ack=12327 Win=55168 Len=0
796  8.432575   144.122.135.165  128.119.245.12   TCP                 1340  59257 → 80 [ACK] Seq=12327 Ack=1 Win=262144 Len=128
```





```
759  8.279975  144.122.135.165  128.119.245.12   TCP         669  59257 → 80 [PSH, ACK] Seq=1 Ack=1 Win=262144 Len=615 [TCP segment of a reassembl
760  8.280679  144.122.135.165  128.119.245.12   TCP         191  59257 → 80 [PSH, ACK] Seq=616 Ack=1 Win=262144 Len=137 [TCP segment of a reassem
761  8.281301  144.122.135.165  128.119.245.12   TCP        1340  59257 → 80 [ACK] Seq=753 Ack=1 Win=262144 Len=1286 [TCP segment of a reassembled
762  8.281303  144.122.135.165  128.119.245.12   TCP        1340  59257 → 80 [ACK] Seq=2039 Ack=1 Win=262144 Len=1286 [TCP segment of a reassemble
763  8.281303  144.122.135.165  128.119.245.12   TCP        1340  59257 → 80 [ACK] Seq=3325 Ack=1 Win=262144 Len=1286 [TCP segment of a reassemble
764  8.281304  144.122.135.165  128.119.245.12   TCP        1340  59257 → 80 [ACK] Seq=4611 Ack=1 Win=262144 Len=1286 [TCP segment of a reassemble
765  8.281305  144.122.135.165  128.119.245.12   TCP        1340  59257 → 80 [ACK] Seq=5897 Ack=1 Win=262144 Len=1286 [TCP segment of a reassemble
766  8.281306  144.122.135.165  128.119.245.12   TCP        1340  59257 → 80 [ACK] Seq=7183 Ack=1 Win=262144 Len=1286 [TCP segment of a reassemble
```

11.1 - last acknowledged sequence number = 152937 means 152937 bytes were acknowledged = 152937 * 8 bits = 1223496 bits = 1.223496 = Mbits

whole transmission time = 8.957328000(last)- 8.280679000 (first) = 0.676649

1.223496 Mbits / 0.676649 seconds = 1.8081693 Mbps

11.2 - I figured out how many bytes were transferred during the amount of time between when the client sent the first segment containing the first bytes of data in alice.txt and when the last segment in the connection containing the last bytes of data in alice.txt was sent.

12- we can take the average 0.01/ 4 = 0.0025