Problem 1. Wenxuan Liu 805152602

1. B
2. C
3. BC
4. D
5. BD
6. C
7. B
8. D
9. A
10. C

Problem 2. Wenxuan Liu 805152602

(1) ① No, the receiver cannot be absolutely sure that bit error occured in data payload, because there could be bit error in the checksum while no bit error in the payload, which could also cause checksum's mismatch.

② No, receiver cannot be absolutely sure that no bit errors have occured, because the checksum and the first two 16-bit integers might coincidentally have bit errors (possibly flipped at the same bit position), which could also lead to matched value in checksum.

(2) No. Because after the sender initiates a FIN request, the receiver enters the CLOSE-WAIT state when receiving this FIN request, and receiver cannot always immediately close the socket at this state because it may still have some ACKs needed to be sent to the sender. Then, receiver need to first sends an ACK for the FIN to sender, and then sends FIN to sender after sending all the ACKs for previous segments, and sender needs to response with an ACK, so at least 4 times of handshake in total.

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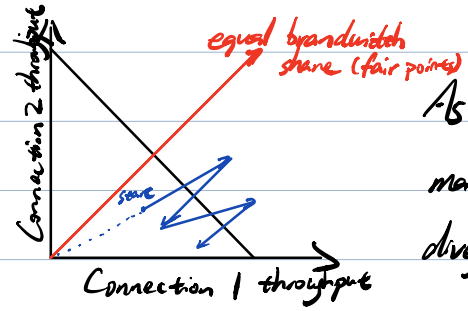
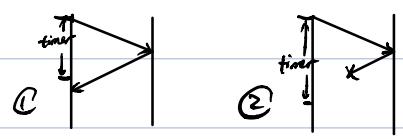
(3)



As shown in the figure, MIAD would make the throughputs of two connections diverge from the fair points, and makes one connection be increasingly high in throughput while starving the other one connection.

(4) ① The first scenario is premeture of timer when the timeout interval is too short (and cwnd is small), so before the arrival of three dup ACKs, the timeout already occured.

② The second scenario is that all of the inflight pakets are lost, and no ACKs can arrive at the sender to move on the transmition, so timeout would also occur.



(5)

The sequence number size is $16+1=17$ for GBN protocol. since $2^4=16<17$ and $2^5=32>17$, we need at least 5 bits for the sequence number field

Problem 3 Wenxuan Liu 805152602

(1) The sender will retransmit the packet immediately for the packet is the packet with corrupted ACK.

(2) The sender will be notified that 900B and all the previous data segments before 900B are correctly received, since it is cumulative ACK. So, sender would move the sender window forward if not all data have been transmited, and transmit the data segements if the above calls segments in the window.

(3) The sender retransmit all the segements in the sender window, because the timeout happens before the third dup ACK. so GBN retransmission is trigered immediately before TCP fase retransmission

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(4) No, it will not affect the correctness.
Because premature only makes the sender waits too short for the ACK returned from the receiver, and would lead to unnecessary retransmissions, and receive dup ACKs later, and it only leads to congestion issues. However, the ACK for the timeout packet will still arrive at the sender, so the correctness of reliable transfer protocol will NOT be affected with no failure in lost packet retransmission, detection of bit error or disorder.

Problem 4 Wenxuan Liu 805152602

(1) Source IP: 2.2.2.2 Source port: 80

Dest IP: 1.1.1.1 Dest port: 9157

(2) B: 3 sockets C: 2 sockets

(3) (a) Connection establishment procedure (three-way handshakes)

(b)

	sequence #	ACK #
First message	41	
Second message	78	42
Third message	45	80

(c)

80								9157
78								
45								
5	Unused	0	1	0	0	0	0	Rw

Problem 5 Wenxuan Liu 805152602

(1) ① After 160ms seg:

EstimateRTT = 0.125 × 160 + 0.875 × 80 = 150 ms

DevRTT = 0.25 × (160 − 15) + 0.75 × 40 = 17.5 ms

RTO = 150 ms + 4 × 17.5 ms = 220 ms

② RTO = 220 ms due to retransmission.

③ RTO = 220 ms due to retransmission

(2) 2 × 220 ms = 440 ms because TCP retransmission need to double RTO.

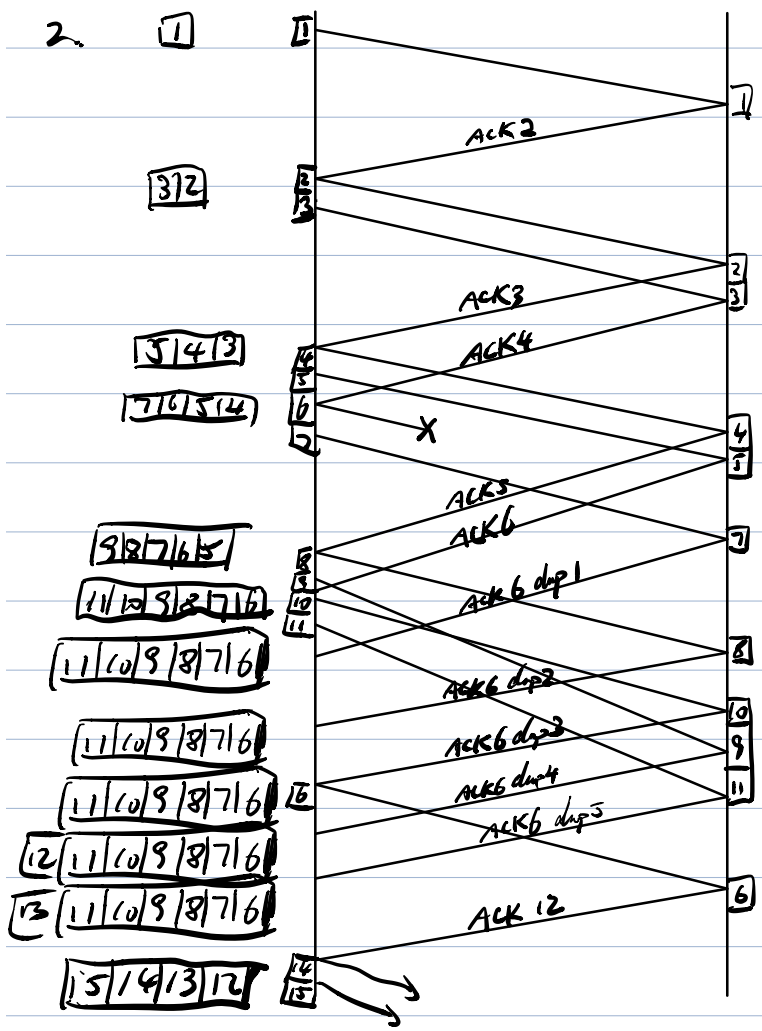
Problem 6 Wenxuan Liu 805152602

1. (a) cwnd is set to 1 segment

(b) $ssthresh = \max(\lfloor \frac{cwnd}{2} \rfloor, 2) = \max(4, 2) = 4$

(c) No, because the cwnd after timeout is 1, and the sender needs to retransmit the timeouted segment first, and then retransmit other segments after receiving the ACK for this segment.

2.



Algorithm	ssth	cwnd
SS	7	1
SS	7	2
SS	7	3
SS	7	4
SS	7	5
SS	7	6
Dorothy	7	6
Dorothy	7	6
FR	$\lfloor \frac{7}{2} \rfloor = 3$	6
FR	3	7
FR	3	8
FR → SS	3	3+1=4

Problem 6 Wenxuan Liu 805152602

(a) Slow start cwnd = 6 ssthresh = 7

(b) Fast retransmission cwnd = 6 ssthresh = 3

(c) Fast recovery cwnd = 7 ssthresh = 3

(d) ACK = 12 cwnd = 4 ssthresh = 3

First fast recovery, then slow start.