1. (10pt.)
   a) TCP opens a connection using an initial sequence number of 20,156. The other party opens
      the connection with an initial sequence number of 33,425. Show the three-way hand shaking
      during the connection establishment.
   b) TCP is sending data at 4 mega bytes per second (1 byte = 8 bits). If the sequence number
      starts with 6000 in decimal, how long does it take before the sequence number goes back to
      zero? (hint: in TCP, every byte has a sequence number)

2. (10pt.) Consider two nodes are linked by a 4Mbps channel and RTT is 0.04 sec. Assume the
   size of each packet is 1024 bits. Answer the following questions for ARQ schemes:
   a) Assume that the link is error-free, what is the possible maximum rate of transmission for
      Stop-and-wait, GBN, and SR, respectively? Why?
   b) For GBN and SR, in order to allow sender to continuously send packets without any
      waiting, what is the minimum window size in terms of the number of packets?
   c) For b), what should be the minimum number of bits for the sequence number for GBN
      and SR, respectively?
   d) Suppose that we are continuously transmitting packets end-to-end start from the 1\textsuperscript{st}
      packet, and the 4\textsuperscript{th} packet is lost. Assume there is no other packet lost or ACK lost. For
      stop-and-wait, GBN, and SR, which packets need to be retransmitted?

3. (10pt.) Suppose TCP Tahoe is used over a lossy link that loses one segment in every 7\textsuperscript{th} RTT
   (for example, starting from RTT #1, one segment will be lost during RTT #7, and the
   congestion window and threshold should be adjusted accordingly at RTT #7. The loss will
   repeat during RTT #14, RTT #21, …). Show how congestion window varies over time by
   filling in the following table. Assume that initially the congestion window is 2 segment and
   the threshold is 16. Also, while computing threshold, round it up to the nearest integer. Each
   segment lost will generate a time-out.

   To simply this question, we assume after a burst is sent, the sender will wait for ACKs to all the
   segments before the congestion window is adjusted. In addition, we assume the ACKs will return
   to the sender every RTT time, if not lost.

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4. (10pt) If the following packet is transmitted as a UDP packet, what is the checksum in the packet header?

111100001111000011001100110011001101111101110

5. (10pt) Describe the TCP closing sequence. Please show the closing sequence if the first closing request from client is lost.