Final Exam

Name: _____

Exam time: 2:30 pm – 4:30 pm, Dec. 11, 2020. Late submission will result in either 0 pt or late penalty.

Total: 76 pts, extra credit (feedback): 4 pts

1. List at least four features introduced in the RDT protocols which are used also in the TCP protocol. (4 pts)

2. Calculate the checksum (as in UDP) of the following two 8-bit integers (1 1 1 0 1 0 1 1) and (1 1 0 1 1 1 0 1). (6 pts)

3. Go-back-N vs. Selective Repeat: (1) Which one sends individual ACKs for all packets? (2) Which one's receiver buffers out-of-order packets? (3) Which one maintains timers for only the oldest unACKed packet? (2 pts/each)

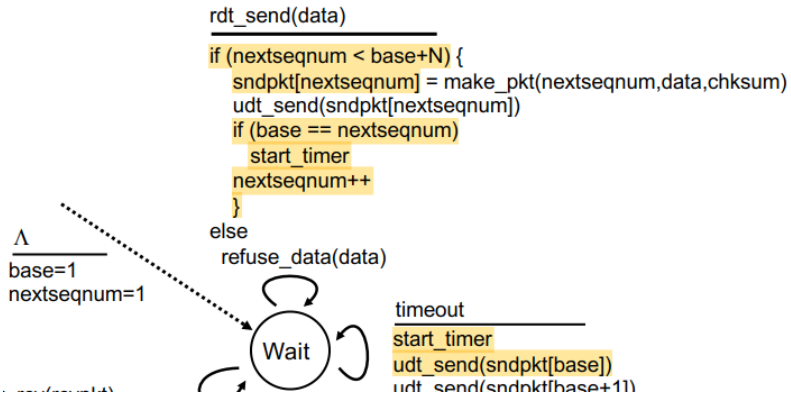
4. How does TCP handle out-of-order segments? (2 pts)

5. Given the following SampleRTTs where R_0 is also the initial Estimated RTT). The EstimatedRTT formula has the ratio $\alpha = 0.25$. (a) Calculate all EstimatedRTT values. (6 pts) (b) Would you choose a larger or smaller α value if you want to further reduce the effect of the new Sample RTT to the Estimated RTT? (2 pts)

Sample RTT	R_0	R_1	R_2	R_3
Sample RTT Value	8	32	52	4
Estimated RTT	8			

6. (TCP) Draw the diagram showing the *SYN/ACK bits and the sequence/acknowledge numbers* for the following communications. (1) The sender has an initial sequence number 44. (2) The receiver has an initial sequence number 22. (3) After handshaking, the sender sends out a message "HAPPY" to the receiver. (4) After receiving the message "GO", the receiver sends out a message "BRAVES". (10 pts) Note: show all the messages – including the handshaking part and the message exchange part after handshaking for full credit.

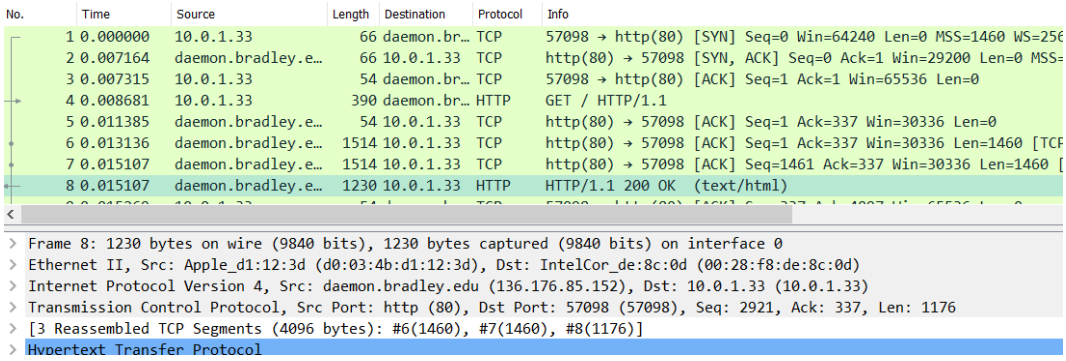
7. Given the following (partial) finite state machine of the sender implementing Go-back-N. (1) Why it refuses the data if the $nextseqnum$ is not less than $base + N$? (2) Why the timer is started when $(base == nextseqsum)$? (2 pts/each)



8. (IPv4) In classful addressing, what are the classes for the following addresses? (a) 140.113.33.44 (b) 12.8.56.11. (c) 193.168.257.1 (3 pts)

9. A maximum transmission unit (MTU) is the largest packet or frame size, specified in octets (eight-bit bytes) that can be sent in a packet- or frame-based network such as the Internet. TCP uses the MTU to determine the maximum size of each packet in any transmission. MTU is usually associated with the Ethernet protocol, where a 1500-byte packet is the largest allowed in it (and hence over most of the Internet).

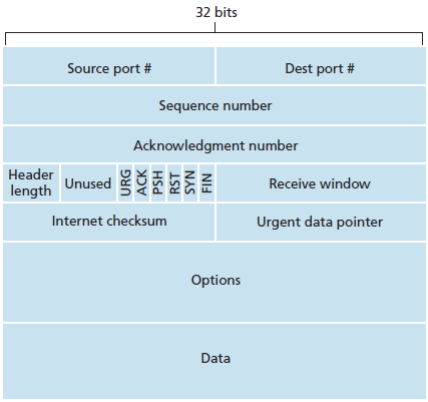
   In the following Wireshark capture for the HTTP request (GET / HTTP/1.1), it shows that in order to download the index.html page (size: 4096 bytes) from the HTTP server, the content of the page is divided into three TCP segments (#6, #7, #8) which carry 1460, 1460, and 1176 bytes, respectively. What are occupying the remaining 40 bytes? (4 pts)



10. If you are to divide the 20.20.20.0/23 network into four equal-size subnets, what are the four subnetworks' (1) network addresses represented by the slash notation (2) range of valid IP addresses (3) subnet mask? (4 pts/each for the first two, 2 pts for the third).

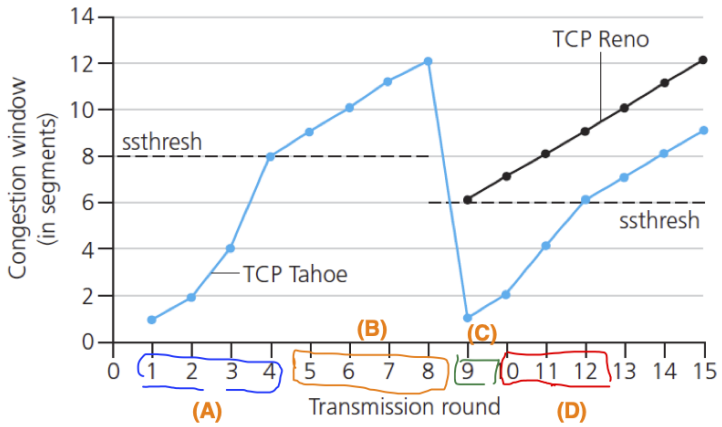
11. Assume that you are the network operator at Bradley University overlooking a network 136.176.0.0/16, and you are now planning to allocate *consecutive* IPv4 addresses for three new student service offices which require at least 100, 50, and 30 IP address, respectively. Do your job wisely as (1) the blocks of IP addresses should not overlap, and (2) the IP addresses should be continuous. (8 pts)

12. (TCP) Given the TCP segment structure below, where the header length is 4-bit. What should be these four bits when we sent out a TCP segment with 23 bits in the "Options" field. (3 pts)



13. Given cwnd = 12 MSS, ssthresh = 14 MSS, dupACKcount=2 in TCP Reno. Assuming that it is now under the congestion avoidance state. (1) If the incoming packet is a duplicated ACK, what would be the ssthresh and cwnd values? (2) If we encounter timeout after receiving the previous packet, what would be the ssthresh value? (4 pts).

14. In TCP, congestion control has three states: slow start, congestion avoidance, and fast recovery. (1) Which period is in slow start? (2) Which period is in congestion avoidance? Answer the questions using (A) – (D). (4 pts)



Feedback: (1) Is there any materials introduces in class that you think should be improved? (2) Which part of the materials you would prefer the instructor to spend more time on? (3) Which part of the assignments should be improved? How? (4) Anything else you would like to communicate with the instructor? (4 pts/extra credit) Your comments will be taken seriously to further improve the future classes. Thank you.