Homework 5 Due Date*: 10:00am 03/09/2020 Cutoff Deadline: 10:00am 03/11/2020**
***Late penalty will apply for past-due late submission; **Submission will NOT be accepted after the cutoff deadline**
Submission: handwritten hardcopy at the beginning at the class (email to wzhu1@msudenver.edu must be used for late submission and the submission time is the moment when the email arrives at the instructor's inbox.)

PLEASE ORGANIZE YOUR WORK IN THE SEQUENCE GIVEN IN THE ASSIGNMENT!!!

Problem A. Fill in the following blanks using ***root DNS server***, ***TLD DNS server***, ***authoritative DNS server***, ***local DNS server***, ***msudenver.edu***, ***google.com***, **.edu** or **.com**.

(a) When a host within the msudenver.edu domain needs to visit a webserver within the google.com domain, the host needs to contact the _____ within the _____ domain to resolve the ip address of the webserver.
(b) When a webserver within the google.com domain changes its ip address, the _____ within the _____ domain needs to be notified to update its database.
(c) When an authoritative DNS server within the google.com domain changes its ip address, the _____ in charge of the _____ domain needs to be notified to update its database.
(d) When a local DNS server does not have the ip address that it is asked to resolve in its cache, it needs to contact _____ FIRST, but EVENTUALLY, gets such ip address from the _____.

Problem B. Use ONLY the Domain Names and IPs in the following table to answer the questions. You may always use TTL to represent the value to be included in a RR (Resource Record).

	Domain Name	**IP**
root DNS server	root.dns.net	A1.B1.C1.D1
TLD DNS server for the .edu domain	tldX.dns.edu	A2.B2.C2.D2
TLD DNS server for the .com domain	tldA.dns.com	A3.B3.C3.D3
Authoritative DNS server in the .msudenver.edu domain	primary.dns.msudenver.edu	A4.B4.C4.D4
Authoritative DNS server in the .google.com domain	primary.dns.google.com	A5.B5.C5.D5
Local DNS server in the .msudenver.edu domain	localPri.dns.msudenver.edu	A6.B6.C6.D6
Local DNS server in the .google.com domain	localPri.dns.google.com	A7.B7.C7.D7
Web server in the .msudenver.edu domain	www.msudenver.edu	A8.B8.C8.D8
Email Server in the .msudenver.edu domain*	smtpVM1.msudenver.edu	A10.B10.C10.D10
The alias name of the Web server in the .google.com domain	www.google.com	
The real name of a Web server in the .google.com domain	w2Denver.google.com	A11.B11.C11.D11

(a) Write all the RRs (Resource Records) possibly stored in the DNS database on the root DNS server.
(b) Write all the RRs possibly stored in the DNS database on the TLD DNS server for the .edu domain
(c) Write all the RRs possibly stored in the DNS database on the authoritative DNS server for the .msudenver.edu domain (hint: don't forget the MX record and a relevant type A record for the email service.)
(d) Write all the RRs possibly **cached** on the local DNS server for the .msudenver.edu domain assuming that it does NOT cache any TLD or authoritative DNS server's information. (hint: the information on the root DNS server is in the system configuration instead of in the cache).

Textbook, Page 286, R7. Suppose a process in Host C has a UDP socket with port number 6789. Suppose both Host A and Host B each send a UDP segment to Host C with destination port number 6789. Will both of these segments be directed to the same socket at Host C? If so, how will the process at Host C know that these two segments originated from two different hosts?

Textbook, Page 286, R8. Suppose that a Web server runs in Host C on port 80. Suppose this Web server uses persistent connections, and is currently receiving requests from two different Hosts, A and B. Are all of the requests being sent through the same socket at Host C? If they are being passed through different sockets, do both of the sockets have port 80? Discuss and explain.

Problem C. It is assumed that there are at least 40 packets buffered in the queue to be sent out by the sender, the network is stable (i.e., the propagation time between the sender and the server is roughly the same for every data packet and ack if it is not lost), the total transmission delay of 3 data packets are much smaller than RTT, 8-bit sequence numbers are used, window size N = 3, and initial send_base = 15.

(a) Draw a diagram similar to PPT slide 21 titled "GBN in action" of Chapter 3 for the **Go-Back-N** approach to illustrate the interaction between the sender and the receiver between the moment **when pkt15** is sent the first time by the sender and the moment **when pkt21 is sent out the first time** by the sender. During the interaction, only three abnormal events occur: pkt16 is lost on the way when it is sent to the receiver the FIRST time, the timer for pkt16 expires after ack#15 is received by the sender the SECOND time,

and ack17 is lost on the way when it is sent to the sender the FIRST time. Please include all the details as given in PPT slide 21 in your diagram.

(b) Draw the Sender Window similar to the one in PPT slide 20 titled "Go-Back-N: Sender" for the moment *right after ack15 is received the first time and right before pkt18 is sent by the sender* in the scenario described in (a). The same COLOR code must be used. You only need to place four bars before and after the Window. What are the values of send_base, nextseqnum, and N in this particular case?

Problem D. It is assumed that It is assumed that there are at least 40 packets buffered in the queue to be sent out by the sender, the network is stable (i.e., the propagation time between the sender and the server is roughly the same for every data packet and ack if it is not lost), the total transmission delay of 3 data packets are much smaller than RTT, 8-bit sequence numbers are used, window size N = 3, and initial send_base = 15.

(a) Draw a diagram similar to PPT slide 25 titled "Selective repeat in action" of Chapter 3 for the **Selective-Repeat** approach to illustrate the interaction between the sender and the receiver between the moment **when pkt15 is sent** the first time by the sender and the moment **when pkt 23 is sent out the first time** by the sender. During the interaction, only four abnormal events occur: pkt16 is lost on the way when it is sent to the receiver the FIRST time, the timer for pkt16 expires a little while after **ack#17** is received by the sender the FIRST time, **ack18** is lost on the way when it is sent to the sender the FIRST time, and the timer for **pkt18** expires **right after the pkt(s) with newly available sequence number(s) are sent out due to the event of receiving ack#16 by the sender the FIRST time**. Please include all the details as given in PPT slide 25 in your diagram.

(b) Draw the Sender Window similar to the sender view given in PPT slide 23 titled "Selective repeat: sender, receiver windows" for the moment *right after ack17 is received the first time and before the timer for pkt16 expires on the sender's side* in the scenario described in (a). The same COLOR code must be used. You only need to place four bars before and after the Window. What are the values of send_base, nextseqnum, and N in this particular case?

(c) Draw the Receiver Window similar to the receiver view given in PPT slide 23 titled "Selective repeat: sender, receiver windows" for the moment *right after ack17 is sent the first time on the receiver's side* in the scenario described in (a). The same COLOR code must be used. You only need to place four bars before and after the Window. What are the values of rcv_base and N in this particular case?