National University of Computer & Emerging Sciences, Karachi
FAST School of Computing
Final Examination, Spring 2021
15th June 2021, 09:00 am – 12:00 pm

Course Code: CS-307	Course Name: Computer Networks
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Student Roll No:	Section No:

Instructions:

- Return the question paper.
- **All questions must be answered in answer script and according to the sequence given in the question paper.**
- In case of any ambiguity, you may make an assumption, however, your assumption should not contradict any statement in the question paper.

Time: 120 minutes. **Max Points**: 100

Question 1: Please calculate the LAN and Access link utilization in following scenario. **[10 points]**

a. Average object size is 450 Kilo Bytes
b. Average request rate from the browsers to origin server is 17 requests/seconds
c. Cache Hit ratio is 0.37

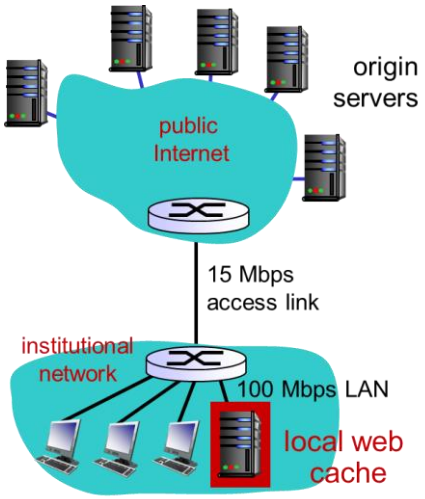

Figure 1

Question 2: Systemslabs.com is registered and hosted with GoDaddy. Both the web server and mail server of Systemslabs are associated with 10.11.21.13 and 10.11.21.14 respectively. The primary authoritative name server of GoDaddy is dns1.GoDaddy.com which is mapped to 192.168.10.1. List down all the resource records (RRs) that will be inserted into the authoritative name server and .com's TLD (top level domain) server. **[10 points]**

Question 3: SDN provides a programmable control plane, however, it network infrastructure needs changes as we studied in chapter # 5 of our textbook. Now, answer the following questions. **[10 points]**

a) How the data plane is different while using SDN? Explain.
b) What is the key role of OpenFlow in SDN?
c) Setup a flow table entry which prefers traffic from an IP telephone. Make suitable assumptions.
d) How SDN controller (explain in a step-by-step way) make use of different network application to provide link state routing in the SND setup? Explain.

Question 4: Because of the connection-oriented nature of TCP, a connection setup phase is required at the beginning of each session, as well as a connection tear-down phase at the end of the session. Enumerate the events below in the order they occur as host A opens a TCP connection to host B, transmits data and then closes the connection. Write a 1 next to the event that occurs first and continue like that until all occurring events are enumerated (the first event has been enumerated for you). You may assume that no segments are lost. Also indicate at which host the event happens. Please note that there might be events listed below that are not a part of the above data transfer and hence should not be enumerated. **[10 points]**

Event	Host	Order
Send an ACK segment		
Do the rest of the data exchange		
Close the connection		
Send an ACK segment		
Send a FIN segment		
Send a SYN segment	A	1
Send a FIN segment		
Send a RST segment		
Send a SYN-ACK segment		
Enter the TIME-WAIT state		
Send an ACK+DATA segment		
Close the connection		

Question 5: The Transmission Control Protocol uses a method called congestion control to regulate the traffic entering the network. The behavior of TCP congestion control can be represented as a graph in which the x-axis indicates the time, and the y-axis indicates congestion window size. Please use the graph shown below to the answer the following questions. Note that the graph does not explicitly show timeouts, but you should be able to figure out when timeouts happened based on the events shown. **[10 points]**

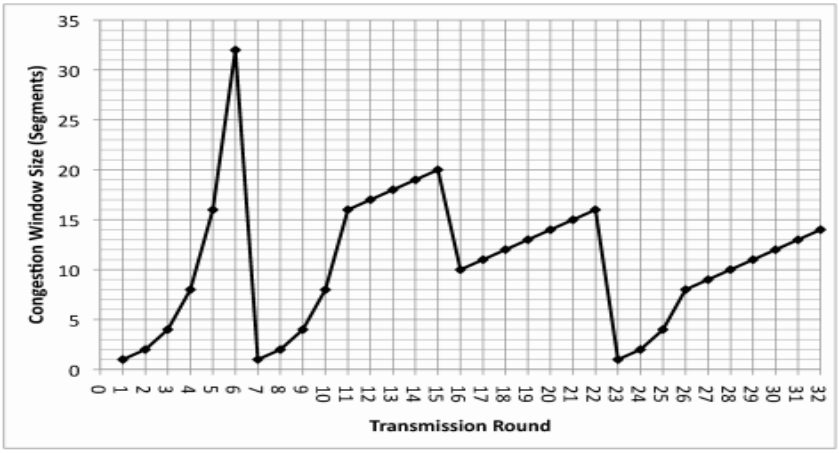

Figure 2

a) **Slow Start:** identify the intervals of time when TCP slow start is operating.
b) **Congestion Avoidance:** identify the intervals of time when TCP congestion avoidance is operating.
c) **Fast Retransmission**: identify the intervals of time when TCP fast retransmission is used.
d) **Fast Recovery:** identify the intervals of time when TCP fast recovery is operating.

Question 6: A provider has been assigned the network **209.118.127.0/23** and wants to divide it among three customers. **Ufone** needs to accommodate up to 250 hosts, **Zong** needs to accommodate up to 48 hosts and **Telenor** needs to accommodate up to 120 hosts. Fill the following table in your answer script with the details of the sub-networks that the provider can create to fit its customers' needs. **[10 points]**

Subnet No.	Network Addr	Netmask	Host Range	No. Of Hosts
Ufone				
Zong				
Telenor				

Question 7: Consider the network shown in Figure 3. Suppose AS3 and AS2 are running OSPF for their intra-AS routing protocol. Suppose AS1 and AS4 are running RIP for their intra-AS routing protocol where weight of l1 < l2 both connected to router 1d. Suppose eBGP and iBGP are used for inter-AS routing protocol. Initially suppose there is no physical link between AS2 and AS4. **[10 points]**

a) Router 3c learns about prefix x from which routing protocol: OSPF, RIP, eBGP, or iBGP?
b) Router 3a learns about x from which routing protocol?

Now suppose that the link between AS2 and AS4 has been restored.

c) Router 1c learns about x from which routing protocol?
d) Router 1d learns about x from which routing protocol?

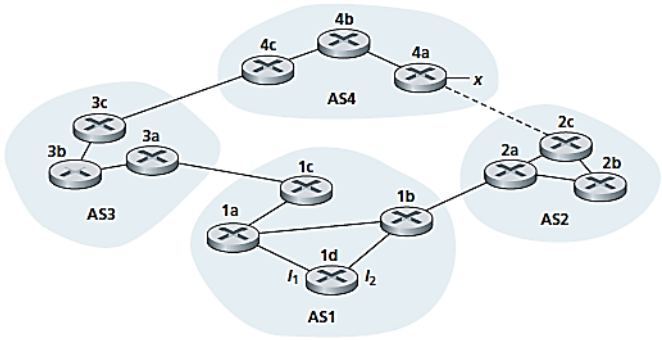

Figure 3

Question 8: Consider the following network with the indicated link costs. **[20 points]**

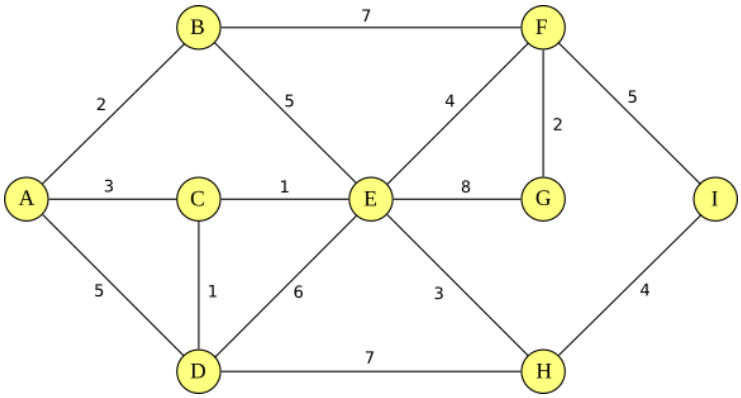

Figure 4

a) Use Dijkstra's shortest-path algorithm to compute the shortest path from **A** to all network nodes. State of Initial routing table is shown below.

Step	Node (N')	D(B), p(B)	D(E), p(E)	D(F), p(F)	D(C), p(C)	D(G), p(G)	D(I), p(I)	D(D), p(D)	D(H), p(H)
0	A	∞	∞	∞	∞	∞	∞	∞	∞

b) Recalculate the routing table for Node **A** if the link between Node C to Node E is failed.

Question 9: Consider a two LAN connected by a router as shown in Figure 5. **[10 points]**

a) Host A transmits a packet to host D. Which Layer 2 and Layer 3 addresses are contained in the protocol data units that are transmitted from host B to the router?
b) Host A wants to get the MAC address of Host C, which protocol Host A will use to find the C's MAC address? What is the purpose of that protocol?
c) Host B issues an ARP request because it want to send a packet to Host D. what will happen next?

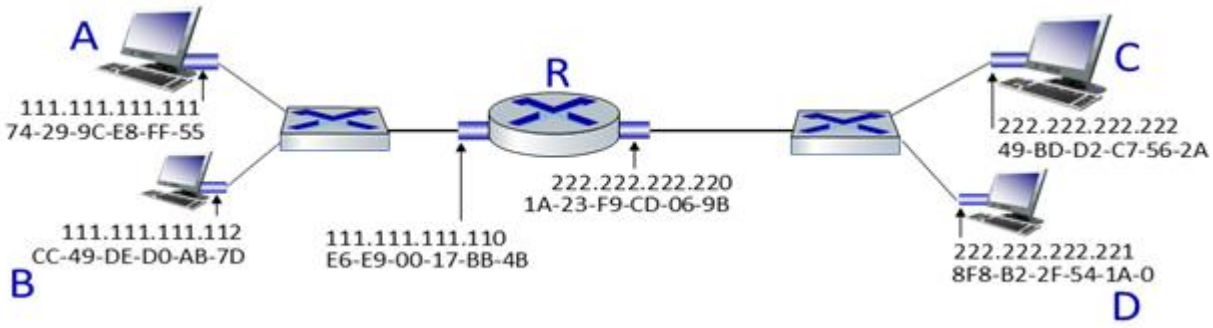

Figure 5

BEST OF LUCK!