CS 421 HW#2, due Jan. 6, 2022

1)

i) Divide the network with CIDR prefix 139.179.0.0/17 into /20 subnetworks. Show each subnetwork in CIDR format.

ii) Suppose the following four subnetworks are aggregated into a single subnetwork: 139.179.192.0/20, 139.179.208.0/20, 139.179.224.0/20, 139.179.240.0/20. Find the CIDR prefix that should be used in order to advertise this aggregated subnetwork.

2) You are given the assignment of setting subnet addresses for 4 buildings of your company. The number of Internet connected PCs in each building is given in the following table. Assume that the 148.64.64.0/18 address block is given to you for this purpose.

i) Use the following table to show the addresses of the four subnets that you have created.

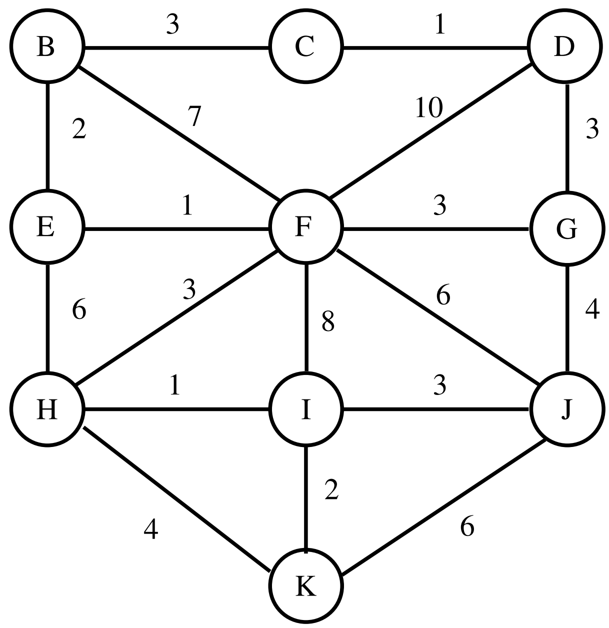
Building	# of PCs	Subnet address (CIDR format)
1	3300	
2	2200	
3	1000	
4	600	

ii) What is the size of the **largest single** CIDR address block that you can assign from the unassigned addresses in the address block 148.64.64.0/18 remaining after you assigned the addresses to these four buildings?

3) Suppose a host transmits a 3500 byte IP packet over a link with an MTU of 500 bytes. Assuming that IP header does not contain any options, indicate the length (in bytes), more flag, and offset field values **(specify the offset values in units of 8 bytes)** of the fragments transmitted over the link in the table below.

Fragment	Length	Offset	Flag
1			
2			
3			
4			
5			
6			
7			
8			

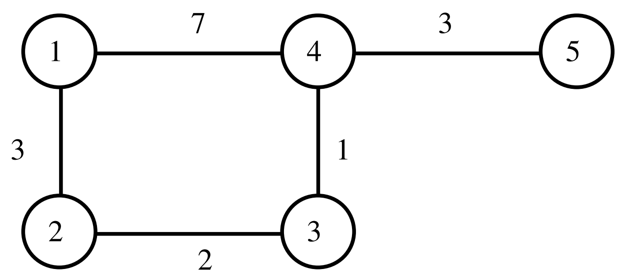
4) Execute the Dijkstra algorithm **at node C** for the network shown below by filling in the following table. In the table, you need to give both the distance *D(v)* and the previous node *p(v)*.



step	***N***	***D(B), p(B)***	***D(D), p(D)***	***D(E), p(E)***	***D(F), p(F)***	***D(G), p(G)***	***D(H), p(H)***	***D(I), p(I)***	***D(J), p(J)***	***D(K), p(K)***

5) The network below uses the distance-vector routing algorithm. Assume the following:

- Links have the same cost in both directions.
- Nodes exchange their routing info once every second, in perfect synchrony and with negligible transmission delays. Specifically, at every t = k, k = 0, 1, 2, 3,..., each node sends and receives routing info instantaneously, and updates its routing table; the update is completed by time t=k+0.1.
- At time t = 0, the link costs are as shown below and the routing tables have been stabilized. At time t = 0.5, the link (4,5) becomes 10. There are no further changes in the link costs.
- Route advertisements are **only exchanged periodically**, i.e., there are no immediate route advertisements after a link cost change. Hence the first route advertisement after the link cost change at t = 0.5 occurs at t = 1.0. *Note:* However, whenever a link cost change occurs, two nodes at the endpoints of this link immediately make corresponding changes in their distance tables.



i) Assume that the distance vector algorithm **does not use poisoned reverse**. Give the evolution of the distance tables with respect to destination 5. Specifically, give the distance table entries for destination 5 at nodes 1-3, for t = 0.1, 0.5, 1.1, 2.1, ..., **until** all distance vectors stabilize. Present your final answer in the table given below where $D^i(j)$ is the distance vector denoting the distance from i to j .

Time, t	$D^1(5)$ via		$D^2(5)$ via		$D^3(5)$ via		$D^4(5)$ via		
	2	4	1	3	2	4	1	3	5
0.1									
1.1									
2.1									
3.1									
4.1									
5.1									
6.1									
7.1									
8.1									
9.1									
10.1									
11.1									
12.1									

ii) Redo part i. assuming that the distance vector algorithm **uses poisoned reverse**.

Time, t	$D^1(5)$ via		$D^2(5)$ via		$D^3(5)$ via		$D^4(5)$ via		
	2	4	1	3	2	4	1	3	5
0.1									
1.1									
2.1									
3.1									
4.1									
5.1									
6.1									
7.1									
8.1									

iii) Using the forwarding tables valid at t=3.5, find the paths followed by a packet sourced at node 1 and destined to node 5 for both parts i and ii above, i.e., with and without poisoned reverse.

6) Suppose the data sequence 101110 is transmitted using the generator sequence 1001. Compute the CRC bits and the transmitted bit sequence. If the 1st and 6th bits starting from the highest order (leftmost) bit in the received sequence are errored, determine whether this error can be detected by the receiver.
7) Suppose that nodes A, B and C are connected to the same Ethernet. Assume that each of these three nodes is trying to retransmit a frame. These frames have already experienced 2 and 3 and 4 collisions, respectively, i.e., collision counters are 2, 3 and 4 for nodes A, B and C. Assume further that all other nodes on the Ethernet are inactive.
    i) Assume that all three nodes detected the last collision simultaneously. Node C chooses 5 as the random number according to the exponential backoff algorithm. What is the probability that A will be the first node initiating a retransmission attempt?
    ii) Consider part i. if node C chooses 2 as the random number (instead of 5). What is the probability that B will be the first node initiating a retransmission attempt?
8) Consider a 100 Mb/s 100BaseT Ethernet network with a star topology composed of 5 nodes where each node has a point-to-point connection with a hub in the middle. The distances from the 5 nodes to the hub are given by 100m, 200m, 500m, 900m and 1000 m, respectively. Calculate the minimum frame size that this LAN can support so that the CSMA/CD protocol will function correctly. Assume that the speed of propagation is $2x10^5$ m/s.