CS 421: Computer Networks **SPRING 2006**

MIDTERM II
April 27, 2006
120 minutes

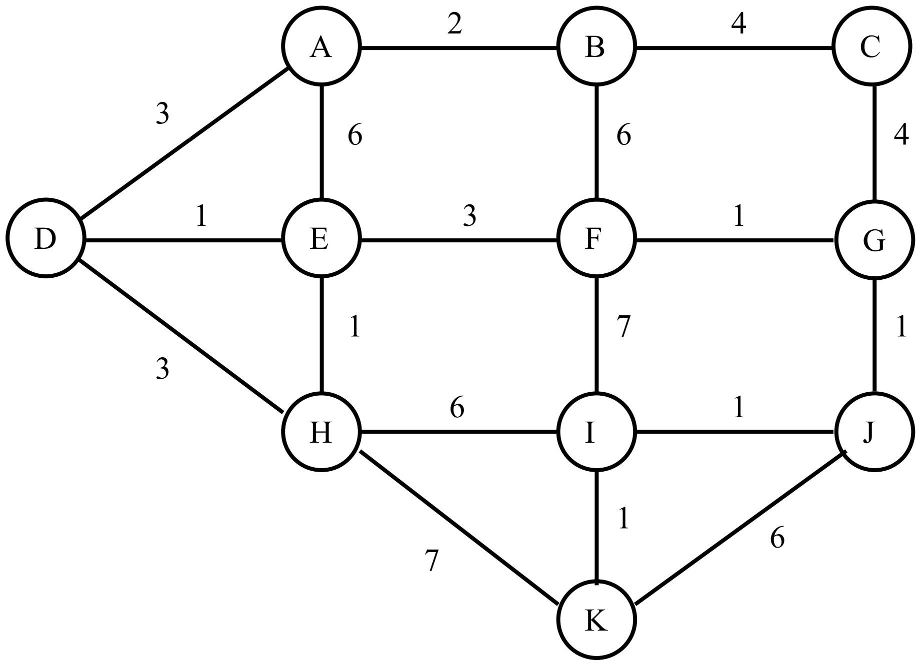
Name: ______________________________

Student No: ___________________________

Show all your work very clearly. Partial credits will only be given if you carefully state your answer with a reasonable justification.

1)

a) (10 pts) Execute the Dijkstra algorithm at node A 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)*.



iter.	***N***	***D(B), p(B)***	***D(C), p(C)***	***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)***

b) 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 = i, i = 0, 1, 2, 3,..., each node sends and receives routing info instantaneously, and updates its routing table; the update is completed by time t=i+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 cost of the link (3,4) becomes 13. 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.

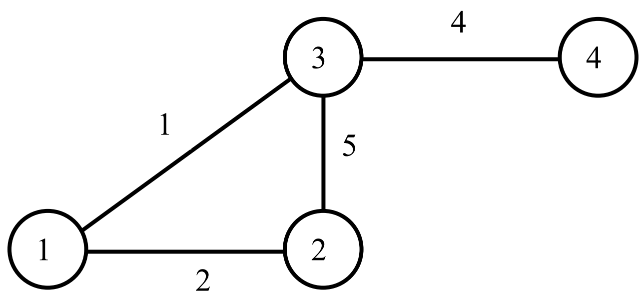
i. (12 pts) Assume that the distance vector algorithm **does not use poisoned reverse**. Give the evolution of the distance tables with respect to destination 4. Specifically, give the distance table entries for destination 4 at nodes 1-3, for t = 0.1, 0.5, 1.1, 2.1, ..., **until** all distance vectors 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	$D^1(4)$ via		$D^2(4)$ via		$D^3(4)$ via		
	2	3	1	3	1	2	4
0.1							
0.5							
1.1							
2.1							
3.1							
4.1							
5.1							
6.1							
7.1							
8.1							
9.1							
10.1							
11.1							

ii. (10 pts) Redo part i. assuming that the distance vector algorithm **uses poisoned reverse**.

Time, t	$D^1(4)$ via		$D^2(4)$ via		$D^3(4)$ via		
	2	3	1	3	1	2	4
0.1							
0.5							
1.1							
2.1							
3.1							
4.1							
5.1							
6.1							

iii. (5 pts) A packet is generated at t=1 by node 1 which is destined for node 4. Assume that the packet has a maximum lifetime of 1, i.e., it will be dropped if it is still in the network at t=2. Assume that the distance vector algorithm **uses poisoned reverse**. Will the packet arrive at its destination before its lifetime expires? Explain your reasoning.



2)

a) (10 pts) The following is a forwarding table at router R, which uses Classless Interdomain Routing (CIDR).

Destination Network	**Next Hop**
139.179.222.0 / 25	R1
139.179.128.0 / 17	R2
139.179.120.0 / 21	R3
139.179.216.0 / 21	R4
139.179.0.0 / 16	R5

Suppose packets with the following destination IP addresses arrive at router R. Determine to what next hop each of these packets will be delivered (Give **only one** answer for each destination.)

(i) 139.179.60.1
(ii) 139.179.226.4
(iii) 139.179.124.55
(iv) 139.179.223.18
(v) 139.179.127.222

b)

i) (6 pts) You are given the assignment of setting three different computer labs at BCC. Each lab is configured with a file server, a network printer and each lab has 30,32 and 60 PCs, respectively. You are given the 139.179.198.0/24 address block by Can Uğur Ayfer for assigning addresses to these three labs. Use the following table to show the addresses of the three subnets that you have created.

Lab	Subnet address (CIDR format)
1	
2	
3	

ii) (4 pts) What is the size of the **largest single** CIDR address block that you can assign from the unassigned addresses in the 139.179.198.0/24 address block remaining after you assigned the addresses to these three labs?

c) (6 pts) List the set of CIDR addresses (in the format a.b.c.d/e) that a router will use to advertise the following six address blocks if the router wants to send the **minimum** number of prefixes to its neighbors.

139.179.146.0/24
139.179.147.0/24
139.179.148.0/24
139.179.149.0/24
139.179.150.0/24
139.179.151.0/24

3)

a) (6 pts) What are the two different techniques used in IP for making the Internet routing more scalable (i.e., applicable to very large networks) than simply using link state or distance vector routing algorithms?

b) (6 pts) Consider the fragments of a fragmented datagram. How does the destination host for these fragments determine that a fragment it received is the first fragment of the original datagram? How does the destination host determine that a fragment it received is the last fragment of the original datagram?

c) (6 pts) Write 5 fields in the IPv4 header that can be changed by an intermediate router assuming that the router **does not** perform fragmentation.

d) (6 pts) What are the main differences of IPv6 compared to IPv4. Explain the motivations for each of the changes.

e) (5 pts) What does a router do when it discards a packet for which TTL has expired?

f) (8 pts) Consider an N node network ($N \geq 5$), with node 1 as the source node. Can you find a network topology such that both Dijkstra's (link state) and Bellman-Ford (distance vector) algorithms require exactly the same number of iterations until the shortest distances are correctly calculated. Note that iterations in Dijkstra's algorithm are defined as in Question 1.a.