CS 421: COMPUTER NETWORKS **SPRING 2012**

FINAL
May 24, 2012
150 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.

Q1	
Q2	
Q3	
TOT	

1)

a) (7 pts) Assume that the bandwidth of a connection is 10 Mbits/sec ($10x10^6$ bits/sec) and the round-trip propagation delay for the connection is 20 msec. Each data segment is 1500 Bytes long including the headers and the ACK packets are 40 Bytes long. Assuming that no packets are lost, what should be the **minimum window size (in data segments)** in order to achieve full bandwidth utilization for this connection?

b) (6 pts) Suppose that the TCP congestion window, CongWin, at a TCP sender is currently 6 KB and the slow start threshold, ssthresh, is 10 KB (assume for simplicity that 1KB=1000 Bytes). The maximum segment size, MSS, is 1000 Bytes. After the sender sends 6 segments for a total of 6 KB of data and receives all the ACKs for the transmitted segments, what will be the final values of **CongWin** and **ssthresh** in units of KB?

c) (6 pts) There are two loss events in TCP: timeout and fast retransmission. TCP congestion control algorithm reacts differently in response to these two loss events. What is the rationale behind this difference?

d) (5 pts) What is the difference between flow control and congestion control?

e) An application is using a UDP socket in order to transfer data to another application running on a remote host. Suppose the sending application calls the send() method of the DatagramSocket 5 times.

   i. (4 pts) Is it possible that the underlying network layer at the sending host, e.g., IPv4, transmits more than 5 data packets?

   ii. (4 pts) Is it possible that the underlying network layer at the sending host, e.g., IPv4, transmits less than 5 data packets?

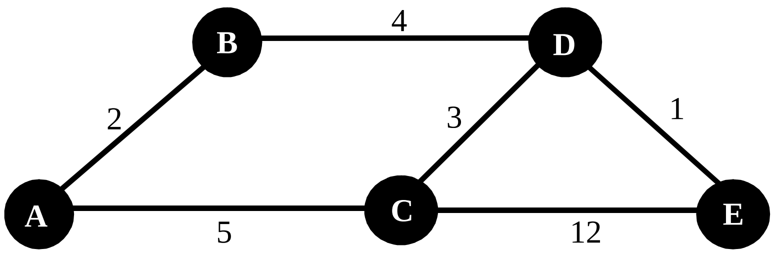
   Justify your answers by giving an example scenario if the given event is possible or by explaining why it is not possible.

2)

a) (10 pts) The network below uses the distance-vector routing algorithm **without poisoned reverse**. 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 cost of the link (D,E) 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.

Give the evolution of the distance tables with respect to destination E. Specifically, give the distance table entries for destination E at nodes A, B, C, D 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* .



t	$D^A(E)$, via		$D^B(E)$, via		$D^C(E)$, via			$D^D(E)$, via		
	B	C	A	D	A	D	E	B	C	E
0.1										
0.5										
1.1										
2.1										
3.1										
4.1										
5.1										
6.1										

b) (8 pts) Suppose host A transmits a 2100 Byte IP packet (including the 20 Byte IP header) over a 2-hop path to host B. The MTU of the first link (A to router) is 740 Bytes (IP header plus data), and the MTU of the second link (router to B) is 500 Bytes (IP header plus data). 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 fragment(s) transmitted over each link in the tables below.

First link

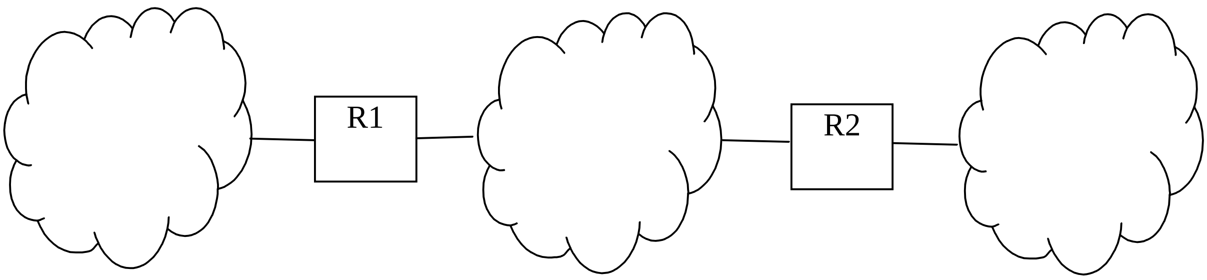
Fragment	Length	Offset	Flag
1			
2			
3			
4			
5			
6			

Second link

Fragment	Length	Offset	Flag
1			
2			
3			
4			
5			
6			

c) (8 pts) An IP packet carrying an HTTP request is going from a home network into the Internet through a NAT router. Name **all header fields** in the transport and network layer headers that the NAT router needs to change in the given packet.

d) (8 pts) Consider the following network composed of 3 subnets, A, B and C, interconnected via two routers, R1 and R2. For each of the address assignments, 1-4, to subnets A, B, C given in the following table, determine whether the given assignment is feasible or infeasible. If the address assignment is infeasible, explain the reason why it is not feasible.



Ass.	CIDR Blocks / Subnets A	CIDR Blocks / Subnets B	CIDR Blocks / Subnets C	Feasible or infeasible	Reason if not feasible
1	139.179.128.0/18	139.179.160/19	139.179.64.0/18		
2	139.179.72.0/21	139.179.0.0/16	139.179.96.0/19		
3	139.179.0.0/18	139.179.128.0/18	139.179.64.0/18		
4	139.179.0.0/24	139.179.1.0/24	139.179.16.0/20		

3)

a) (7 pts) Given the following 8-bit data sequence 11001010 and the generator sequence 10001001, compute the CRC bits and the transmitted bit sequence.

b) (6 pts) Consider an Ethernet LAN with four nodes, A, B, C and D, using CSMA/CD running at 100 Mbits/sec. The propagation speed for the signal is $2x10^8$ m/sec and the distances, in meters, between adapter pairs on the Ethernet LAN are given in the following table. Calculate the minimum Ethernet frame size such that the CSMA/CD algorithm will work properly.

	A	B	C	D
A	-	150	350	150
B	150	-	400	200
C	350	400	-	400
D	150	200	400	-

c) 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 collided frame. The frames have already experienced 1, 2 and 3 collisions, respectively, i.e., collision counters are 1, 2 and 3 for nodes A, B and C. Assume further that all other nodes on the Ethernet are inactive and all three nodes detected the last collision simultaneously.

i. (5 pts) What is the probability that the first retransmission attempt after the last collision is a successful transmission?

ii. (5 pts) What is the probability that the first retransmission attempt after the last collision is another collision?

iii. (5 pts) Given that the first retransmission attempt after the last collision is a successful transmission, what is the probability that this successful transmission is made by node A?

d) (6 pts) Since nearly all Ethernet networks carry IP traffic today, a networking expert makes a proposal for changing the Ethernet standard by eliminating the MAC address and using only the IP address to refer to network interfaces. List two advantages of this proposal.