CS 4380 Data Communications **Spring Quarter, 1995**

Final Examination

June 8

Be neat and concise. You may use your calculator and one page cheat sheet. Show all of your work. Good luck!

Name: _____

Problem	Points	Score
1	15	
2	15	
3	15	
4	15	
5	20	
6	15	
7	15	
8	10	
9	10	
Total	130	

1. {Short Answer}

(5) a. Using a diagram and text, explain the relationship between the 802 LLC frame and the 802.3 MAC frame. Why is there a minimum length in MAC but not in LLC?

(5) b. What is the difference between Ethernet and 802.3?

(5) c. What is the purpose of the p in a p-persistent random access scheme?

2. {Channel Modeling} Consider a channel that carries information in tertiary digit (i.e., three possibilities), rather than binary digits. Denote the three possibilities by 0, 1, x. Assume that each digit is transmitted successfully with probability p and in error with probability $1 - p$. If an error occurs, it is equally likely that each of the two incorrect digits is received.

(5) a. Draw a model of this channel, similar to the binary symmetric channel model from class.

(5) b. What is the probability of sending 0011x and receiving 0x011?

(5) c. What is the probability of sending four bits and receiving them all in error?

3. {Maximum Likelihood Decoding} Consider the following set of codewords and frequencies of transmission:

Codeword	Frequency
001	.2
011	.5
111	.3

(5) a. With these codewords and frequencies, is it possible to receive 111 and decode 001? Answer yes or no and provide a brief justification.

(10) b. Assume a bit error rate $p = .1$. Suppose 101 is received. Show the work to determine which is the most likely codeword to have been sent. Clearly indicate which codeword is most likely.

4. {ARQ Protocols} Consider a new ARQ protocol called Go-Back-2. In this protocol, the sender sends two information frames, and then waits for a single ACK that acknowledges both frames. The sender is then allowed to send the next two information frames. Obviously, the receiver waits to successfully receive two information frames and then sends an ACK. If one or both of a pair of frames are received in error, the receiver discards both frames and does nothing.

(5) a. Draw a picture of the normal operation of this protocol, showing the sending and receiving of four information frames.

(5) b. Is a timer needed at the sender? If so, demonstrate a scenario that requires a timer at the sender. If not, justify your answer.

(5) c. Assume a timer at the sender, and an even number of total information frames. Is there a way to break this scheme? Justify your answer.

5. {ALOHA} Consider a slotted-ALOHA random access scheme, in which the slots alternate between high priority and low priority. (i.e., Every other slot is designated high priority and the alternate slots are designated low priority.) Each packet generated at a station is marked either high or low priority. The high priority traffic can only be sent in high priority slots, and the low priority traffic can only be sent in low priority slots. Assume that 25% of the traffic is low priority and 75% of the traffic is high priority.

   In this problem, you will derive an expression for the throughput of the high priority traffic.

   (7) a. Draw a timing diagram for a typical high priority packet, and clearly indicate the vulnerable period.

   (7) b. What are the traffic conditions (at the other stations) that will cause a high priority packet to be corrupted during transmission?

   (8) c. Let $p(i, t, H)$ be the probability of i arrivals of high priority in t time slots, and $p(i, t, L)$ be the probability of i arrivals of low priority in t time slots. Using these variables, give an expression for the throughput of the high priority traffic. (Hint: use your answer to part (b))

6. {Bellman-Ford-Moore Algorithm} Suppose you are finding routes through a network where each link is labeled with a packet size limit. Let $s_{i,j}$ denote the packet size limit on link (i, j). The routing task is to find paths which allow the largest possible packets to be sent.

(10) a. Modify the Bellman-Ford-Moore routing algorithm to find paths that allow the largest possible packets. Give the pseudocode for the new algorithm.

(5) b. Demonstrate the operation of the algorithm on the following network.

7. {Token Ring} Suppose we operate a token ring with a new scheme for managing the token. Specifically, the *destination* of the packets takes the busy token and the data off the ring. The destination puts the idle token on the ring immediately after receiving the busy token.

(7) a. Draw a timing diagram showing the token and data for a three node ring, numbered 1-2-3 in clockwise order. Assume the idle token begins at station 1; station 1 sends 1 packet to station 2 then station 3 sends 2 packets to station 1.

(8) b. Will this scheme always work? If yes, justify your answer. If no, give an example to demonstrate a failure condition.

8. {IP}

(5) a. What is the structure of an IP address?

(5) b. What is the purpose of ARP in IP routing?

9. {Congestion Control}

(5) a. How do choke packets help provide congestion control?

(5) b. What is the effect of choosing a threshold for sending choke packets that is too high? Too low?

Course Survey — Final Round

- How well did this course meet your expectations?

- What were the most interesting aspects of the course?

- What material (or assignments) were less interesting?

- Did you find the animation assignment to be worthwhile?

- Do you have any constructive suggestions to help improve the course?