CSE 123: Computer Networks
Fall Quarter, 2014
MIDTERM EXAM

Instructor: Alex C. Snoeren

Name   **SOLUTIONS**

Student ID

Question	Score	Points
1	15	15
2	35	35
3	25	25
4	15	15
5	10	10
Total	100	100

This exam is **closed book**. You are allowed one 8.5x11-inch (or smaller), double-sided sheet of paper containing whatever you would like (a "crib sheet"). **YOU MUST PUT YOUR NAME ON IT AND TURN THE CRIB SHEET IN WITH THE EXAM.**

The exam contains questions of differing point values. Each question is clearly labeled with its value. Please answer all questions in the space provided. You have 50 minutes to complete this exam. As with any exam, I suggest you read through all the questions first before answering any of them.

You will receive full credit for the final question regardless of your answers, but we would appreciate you taking the time to provide feedback. In order to preserve the anonymity of your responses, please **tear off the last page of the exam.** You may submit it separately at the end of the exam, or bring it to class with you next Wednesday.

GOOD LUCK!

1. (15 pts) True/False. Determine whether each of the following statements is true or false. No explana-
tion is necessary; partial credit will not be awarded.

   a) The bandwidth of a broadband channel is defined by its carrier frequency.

   False. The carrier frequency determines where in the frequency range the channel is located.

   b) A receiver must sample the channel at least twice as fast as the signal's baud rate in order to
   properly decode the signal.

   True.

   c) For a fixed baud rate, Manchester encoding communicates bits twice as fast as NRZ.

   False. For a fixed baud rate, Manchester encoding is half as fast.

   d) Slotted Aloha is more efficient than CSMA/CD.

   False. Channel sensing improves the performance.

   e) Bit stuffing ensures that all frames are the same size.

   **False. Bit stuffing ensures the sentinal pattern does not appear in the paylaod of the frame.
   It may, in fact, expand the size of the frame.**

2. (35 pts) Short Answer. Concisely answer the following questions.

a) (5 pts) Recall that nodes in slotted-Aloha transmit in each slot with probability p. Suppose that a given channel has exactly 8 nodes. What is the probability that there is a collision in a given slot?

A collision occurs (i.e., with probability 1) unless either the channel is used successfully or nobody sends. So $1 - 8p(1-p)^7 - (1-p)^8$.

b) (5 pts) Why does CSMA/CD require nodes to be full duplex?

In CSMA/CD, a node must listen to the channel while it is transmitting to detect collisions.

c) (5 pts) Give two traffic characteristics that are better handled by contention-free MAC protocols than CSMA-based approaches.

Many nodes sending predictiable traffic patterns are better handled by contention-free schemes.

d) (5 pts) What is the maximum effective capacity of a channel with bandwidth 10 Hz and a signal-to-noise ratio of 15:1?

Shannon's formula says $C = 2B \log(1 + SNR)$. Plugging 15 in for SNR gives 40 bps.

e) (5 pts) Suppose a 1500-byte IP packet is forwarded across a link with a 500-byte MTU. How many fragments will be created? What are their lengths?

4. The 1500-byte packet contains 1480 bytes of payload and 20 bytes of header. We will need 3 packets of 500 bytes each, each containing 480 bytes of payload, and 1 packet with $1480 - 480 * 3 = 40$ bytes of payload and a 20-byte header, for a total length of 60 bytes.

f) (10 pts) Consider sending the message 101010101101 with the CRC generator polynomial $x^5 + x^2 + 1$. What sequence of bits would be sent on the wire?

```
100101 | 10101010110100000
         100101
           111110
           100101
            110111
            100101
             100101
             100101
                   0100000
                    100101
                     00101
```

So it sends 10101010110100101.

3. (25 pts) IP Addressing. Consider the IP address 18.26.1.104

   a) (5 pts). Suppose that we were still using class-based addressing. What type of network would this IP address be a part of?

   Class A.

   b) (5pts). If the network administrator had decided to break the network in part a) into 64 different subnets, what would the subnet mask of the subnet to which this IP address belongs be?

   11111111.11111100.00000000.000000000 or 255.252.0.0

   c) (5pts). What is the subnet number (address) of the subnet to which this IP address would be attached?

   00010010.00011010.00000001.01101000 & 11111111.11111100.00000000.000000000 = 00010010.00011000.00000000.00000000 = 18.24.0.0.

   d) (5pts). Now suppose instead that we are using CIDR addressing instead of Class-based addressing and subnets. What would the length of CIDR prefix for the physical network in part c) to which the host were attached be?

   The nextmask in part c) starts with 14 ones, so the prefix length is 14. (The CIDR prefix is 18.24/14.)

   e) (5pts). What would the broadcast address for this network (i.e., the network from parts c) and d) be)?

   The broadcast address is simply the subnet number (or CIDR prefix) prepended to the all-ones host address. So 00010010.00011011.11111111.11111111 or 18.27.255.255.

4. (15 pts) Bridging. Consider the extended LAN shown below.
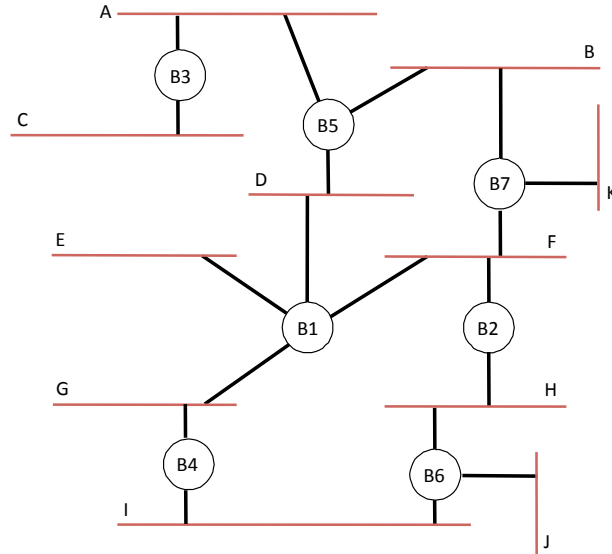
a) (5pts). Indicate which ports are not selected by the spanning tree algorithm.

B7's port to network B and B6's port to network I will be disabled.

b) (10pts). After convergence, what is the configuration message B6 sends? Which network(s) does it send it to?

(B1, 2, B6). It sends it only to the network where it is "best", namely network J.

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PLEASE TEAR OFF THIS PAGE OF THE EXAM. YOU CAN SUBMIT IT AT THE END OF THE PERIOD, OR BRING IT TO CLASS NEXT WEDNESDAY.

5. (10 pts) Feedback. Please provide feedback to allow the Professor to improve your class experience.

   • What is one thing that is going well for you in this class?

   • What is one thing that is not working well for you in this class? What can we do to help?

   • Is there something you would like the staff to do differently?

   • Please estimate the amount of time you spent on each homework and the project.

   • Do you find the assigned readings helpful?