CSE 123: Computer Networks
Fall Quarter, 2013
MIDTERM EXAM

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Name **SOLUTIONS**

Student ID ____________________________

Question	Score	Points
1	21	21
2	30	30
3	40	40
4	9	9
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 on Friday.

GOOD LUCK!

1. (21 pts) True/False. Determine whether each of the following statements is true or false. No explanation is necessary; partial credit will not be awarded.

   a) Each station in an FDMA system can use only a portion of the channel bandwidth.

   True

   b) If a code has sufficient Hamming distance to correct n errors, it can detect at least n more.

   True

   c) Manchester encoding is more efficient than NRZI.

   False

   d) A bridge responds to an ARP query.

   False; a bridge is invisible to the MAC layer.

   e) A checksum and CRC of equal length (e.g., 32 bits) can detect the same number of bit errors.

   False

   f) Clock-based framing can avoid the need for sentinels.

   True

   g) The .edu TLD name server knows the IP address of the authoritative name server for ucsd.edu.

   True

2. (30 pts) Short Answer. Concisely answer the following questions.

a) (5 pts) Why does CSMA out-perform Aloha? Give a specific example.

CSMA senses the channel to see if it is idle before transmitting, while a node using Aloha simply transmits any time it has data to send. Hence, CSMA will avoid a collision if a node is already using the channel.

b) (5 pts) What is the purpose of the Ethernet jamming signal?

In order to inform the other sender(s) of the colliding packets of the collision in a timely fashion. It ensures all nodes using the channel are aware their transmission(s) failed.

c) (5 pts) Consider a slotted Aloha network with 7 stations. For a given slot, each station transmits with probability p. What is the probability that some node successfully transmits a packet in that slot?

$\mathbf{7p(1-p)^6}$

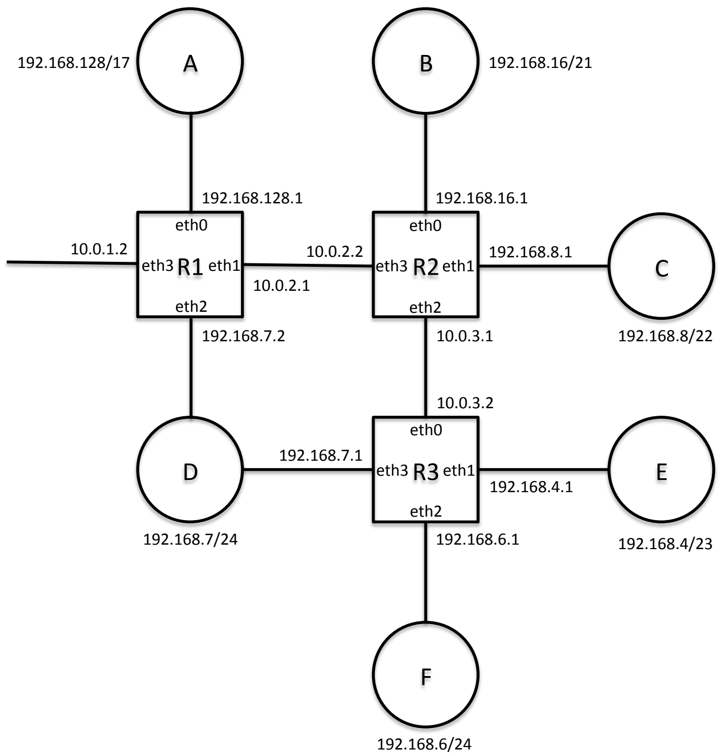
d) (5 pts) Consider the CRC generator function $x^{13} + x^7 + x^3 + x^1 + 1$. How many bits will the resulting frame check sequence be?

13 bits. The generator is 14 bits, so the remainder cannot be larger than 13.

e) (10 pts) For a channel of a given bandwidth, with a signal-to-noise ratio of 3:1, how much larger a signal-to-noise ratio is required to double the effective capacity? Show your work.

Recall Shannon's law that the capacity of a channel (C**) is equal to** $B * \log_2(1+S/N)$**. Here, the bandwidth (**B**) is fixed, so you need to double** $\log_2(1+S/N)$**. Since** $S/N = 3$**, this is equivalent to doubling** $\log_2(4)$**. Using the identity that** $2\log_2(X) = \log_2(X^2)$**, this implies you need** $1 + S/N = 16$**, or a new signal-to-noise ratio of 15, which is 5 times larger than 3.**

3. (40 pts) IP forwarding. Consider the network diagram below. Each router (a square in the figure) is labeled with the names of its interfaces (e.g., eth0) and the IP addresses assigned to each. Each network (a circle) is labeled with its network name and prefix length.



a) (10 pts) The machine I'm typing this on has an IP address 192.168.9.12. To which of the networks above am I connected? What is the subnet mask my machine should use?

C, or 192.168.8.0. Note that 192.168.8/22 is the prefix or CIDR block; network addresses are always expressed as full, 32-bit quantities. The netmask is 255.255.252.0

b) (10 pts) What is the most concise CIDR block $R2$ can use to describe the networks reachable through $R3$?

192.168.4/22

c) (20 pts) Suppose R1 and R3 contain the following forwarding tables, respectively:

Destination	Next Hop	Interface
127.0.0.1/32	127.0.0.1	lo0
default	10.0.1.1	eth3
10.0.1/24		eth3
10.0.2/24		eth1
192.168.0/17	10.0.2.2	eth1
192.168.7/24		eth2
192.168.128/17		eth0

Destination	Next Hop	Interface
127.0.0.1/32	127.0.0.1	lo0
default	10.0.3.1	eth0
10.0.3/24		eth0
192.168.4/23		eth1
192.168.6/24		eth2
192.168.7/24		eth3

What path would a packet from my machine follow to a host on network F? Explain how the packet is forwarded by showing the rows in each forwarding table that would be invoked. If the packet is forwarded by R2, please list the forwarding table entries in R2's table that would be used.

Recall from above that my machine is connected to network C, so the first-hop router is R2. From above, we know that R2 will contain an entry for 192.168.4/22 with a next hop router of R3 using IP address 10.0.3.2.

192.168.4/22	10.0.3.2	eth2

It must also have an entry for R3 (10.0.3.2) in some network, say 10.0.3.0/31, on port eth2:

10.0.3/31		eth2

The tables above show that R3 has an entry for network F (192.168.6.0) out of eth2, so it will forward it directly to the destination host over eth2.

192.168.6/24		eth2

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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 ON FRIDAY.

4. (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?