CSE 123: Computer Networks
Fall Quarter, 2015
MIDTERM EXAM

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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 explanation is necessary; partial credit will not be awarded.

a) The minimum sampling rate of a broadband channel required at a receiver as defined by Nyquist depends upon the channel's carrier frequency.

False. The carrier frequency determines where in the frequency range the channel is located; the sampling rate is dictated by the channel bandwidth.

b) The optimal transmission probability in Slotted Aloha depends upon the length of the slots.

False; it depends on the number of contending stations.

c) 4B/5B is more efficient than two-bit parity when used over 6 sets of 7 bits.

True. $6 * 7/7 * 8 = 6/8 \leq 4/5$.

d) In sliding window flow control, there can never be more segments in flight than the receive window size.

False. The number of segments in flight is controlled by the send window size.

e) Protocols define how a layer of the networking stack interacts with adjacent layers.

False. Protocols define how senders and receivers of the same layer interact with each other.

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

a) (5 pts) What is the Manchester encoding for the bit sequence 01001010? Show your work.

2 points for getting the NRZ part right.

b) (5 pts) List two reasons why there is a practical limit to the number of hosts a single Ethernet link can support.

Three example reasons are (i) All hosts are in the same collision domain, so MAC efficiency decreases. (ii) The link bandwidth must be shared among all the hosts, and (iii) Need to cap the binary exponential backoff at some point.

c) (5 pts) List the sequence of name servers that must be contacted to resolve `www.ucsd.edu` from a client located outside of `ucsd.edu`. (Presume no entries are cached anywhere.)

The client's local name sever, a root server, the `.edu` TLD, and `ucsd.edu`'s authoritative server.

d) (5 pts) What is the minimum-width channel that could possibly transmit 80 Kbps in the presence of a signal-to-noise ratio of 15:1?

Shannon's formula says $C = B \log(1 + SNR)$. Plugging 15 in for SNR, 80,000 in for C, and solving for B gives 20 KHz.

e) (5 pts) Suppose a 9000-byte IP packet is forwarded across a link with a 1500-byte MTU. How many fragments will be created? What are their lengths?

7. The 9000-byte packet contains 8980 bytes of payload and 20 bytes of header. We will need 6 packets of 1500 bytes each, each containing 1480 bytes of payload, and 1 packet with $8980 - 1480 * 6 = 100$ bytes of payload and a 20-byte header, for a total length of 120 bytes.

f) (10 pts) Suppose a receiver using the CRC generator polynomial $x^4 + x^2 + 1$ receives the sequence of bits 010010101101. Were they received correctly? If so, what was the transmitted message? If not, can you tell how many bit errors occurred? Show your work.

```
10101 | 010010101101
         10101
           11110
           10101
            10111
            10101
               10101
               10101
```

Yes, 01001010.

3. (25 pts) IP Addressing. Consider the IP address 184.86.92.182

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 B.

b) (5pts). If the network administrator had decided to break the network in part a) into 8 different subnets, what would the subnet mask of the subnet to which this IP address belongs be?

11111111.11111111.11100000.000000000 or 255.255.224.0 -3 if right idea but screwed up the bits to decimal conversion. -3 if inverted the bits (i.e., right to left).

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

10111000.01010110.01011100.10110110 & 11111111.11111111.11100000.000000000 = 10111000.01010110.01000000.00000000 = 184.86.64.0.

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 was attached be?

The nextmask in part c) starts with 19 ones, so the prefix length is 19 (The CIDR prefix is 184.86.64/19.) Full points if they count the right number from their answer to b.

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 10111000.01010110.01011111.11111111 or 184.86.95.255.

4. (15 pts) IP forwarding. Consider the forwarding and (partial) ARP tables below taken from a router connected to four different networks on ports eth0, eth1, eth2, and eth3. The router uses the IP addresses 192.168.32.2, 192.168.0.3, 192.168.6.1, and 192.168.7.1, on each of those networks, respectively.

Destination	Next Hop	Interface
127.0.0.1/32	127.0.0.1	lo0
default	192.168.32.1	eth0
192.168.0.0/16		eth0
192.168.0.0/21		eth1
192.168.4.0/22	192.168.0.4	eth1
192.168.6.0/24		eth2
192.168.7.0/24		eth3

IP address	MAC address
192.168.32.1	00:21:56:4a:38:00
192.168.32.2	ba:e8:56:24:88:00
192.168.0.4	78:31:c1:c5:7c:48
192.168.0.3	00:50:56:c0:00:01
192.168.6.1	00:50:56:c0:01:F1
192.168.6.255	FF:FF:FF:FF:FF:FF
192.168.7.1	00:50:56:c0:73:d8

a) (5pts). Suppose the following Ethernet frame arrived at a router with the tables above. (Only a subset of the header fields are shown.) Which entry in the forwarding table would it match?

Eth Src	Eth Dst	IP Src	IP Dst	Payload
00:21:56:4a:38:00	ba:e8:56:24:88:00	10.1.17.23	192.168.5.137	...

192.168.4/22	192.168.0.4	eth1

b) (10pts). Assume that the packet is forwarded according to the tables above. What would the following fields of the frame contain as it leaves the router?

Eth Src	Eth Dst	IP Src	IP Dst	Payload
00:50:56:c0:00:01	**78:31:c1:c5:7c:48**	**10.1.17.23**	**192.168.5.137**	...

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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 MONDAY.

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?