

CSE 123: Computer Networks
Spring Quarter, 2016
MIDTERM EXAM

Instructor: Alex C. Snoeren

Name _____ **SOLUTIONS** _____

Student ID _____

Question	Score	Points
1	15	15
2	35	35
3	15	15
4	40	40
5	10	10
Total	115	115

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!

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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) According to Shannon, the capacity of a bandwidth-limited channel depends upon its carrier frequency.

False. Capacity is a function only of the bandwidth.

- b) One way to overcome intersymbol interference (ISI) is to increase signalling power, i.e., SNR.

False; ISI occurs when the baud rate exceeds the Nyquist limit.

- c) Clock recovery is needed to successfully decode both asynchronous and synchronous encodings.

True. Synchronous encodings simply attempt to keep the clocks synchronized longer by leveraging transitions in the message itself.

- d) A root nameserver can return an authoritative response for any domain name.

False. The root nameservers simply point clients to the appropriate TLD server to continue the lookup process.

- e) Cut-through switches decrease forwarding latency.

True. Cut-through switches begin forwarding a frame as soon as the destination is known.

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

- a) (5 pts) 10-Gbps Ethernet supports “jumbo frames” that are 9000 KB long. How many such frames could be “in flight” at one time over a link with a one-way propagation delay of $720\mu\text{s}$?

The bandwidth delay product of this link is $720 \times 10^{-6}\text{s} \cdot 10 \times 10^9\text{b/s} = 7.2 \times 10^6$ bits. Each frame is $\approx 9000 \times 10^3 \cdot 8 = 7.2 \times 10^7$ bits, so ≈ 0.1 . Note, this was a typo: Jumbo frames are actually 9000 bytes long, leading to a more reasonable answer of precisely 100 frames. We did not intend to trip you up regarding KB being 2^{10} as opposed to 10^3 , nor to make you do painful long division. Sorry.

- b) (5 pts) Why do Ethernet nodes not need to know how many other nodes are sharing the network to make effective use of CSMA/CD?

Binary exponential backoff ensures they will eventually select an appropriate transmission probability.

- c) (5 pts) Give an example of a code over 3-bit codewords with a Hamming distance of exactly 2. (Please just list the codewords rather than trying to explain how you constructed them.)

000, 011, 110, and 101.

- d) (5 pts) Draw the NRZI encoding of 01101010.

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 ___:___| : |_:___:___| : : |_:___

- e) (5 pts) Suppose a 1500-byte IPv4 packet with IP ID x and DF=0 arrives at a router that needs to forward it out a link with a 500-byte MTU. What should the IP ID, length, offset, and flags (i.e., MF and DF) fields of the header of the 3rd fragment contain?

x , 500, 960, 1, and 0.

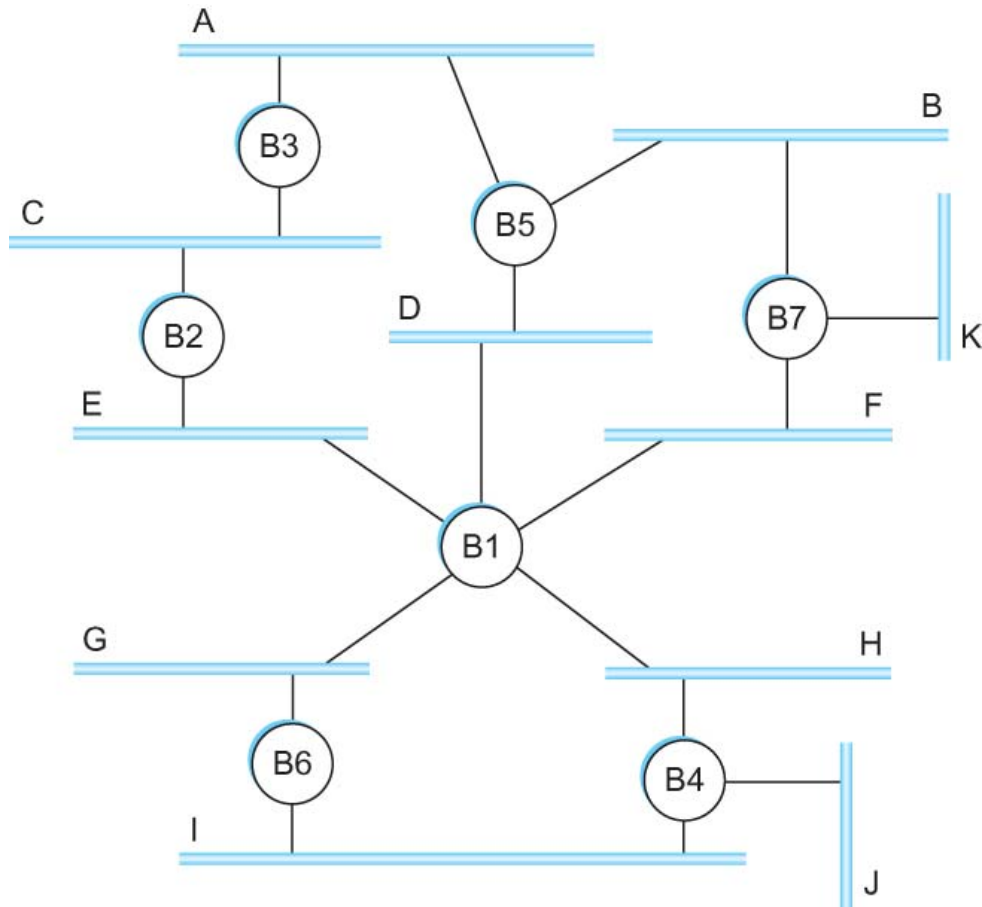
- f) (10 pts) Suppose a receiver using the CRC generator polynomial x^4+x+1 receives the sequence of bits 110110101100. Were they received correctly? If so, what was the transmitted message? If not, can you tell how many bit errors occurred? Show your work.

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10011 | 110110101100
      10011
      10000
      10011
          11101
          10011
          11101
          10011
          11100
          10011
          11110
  
```

No, and no.

3. (15 pts) Bridging. Consider the extended LAN shown below.



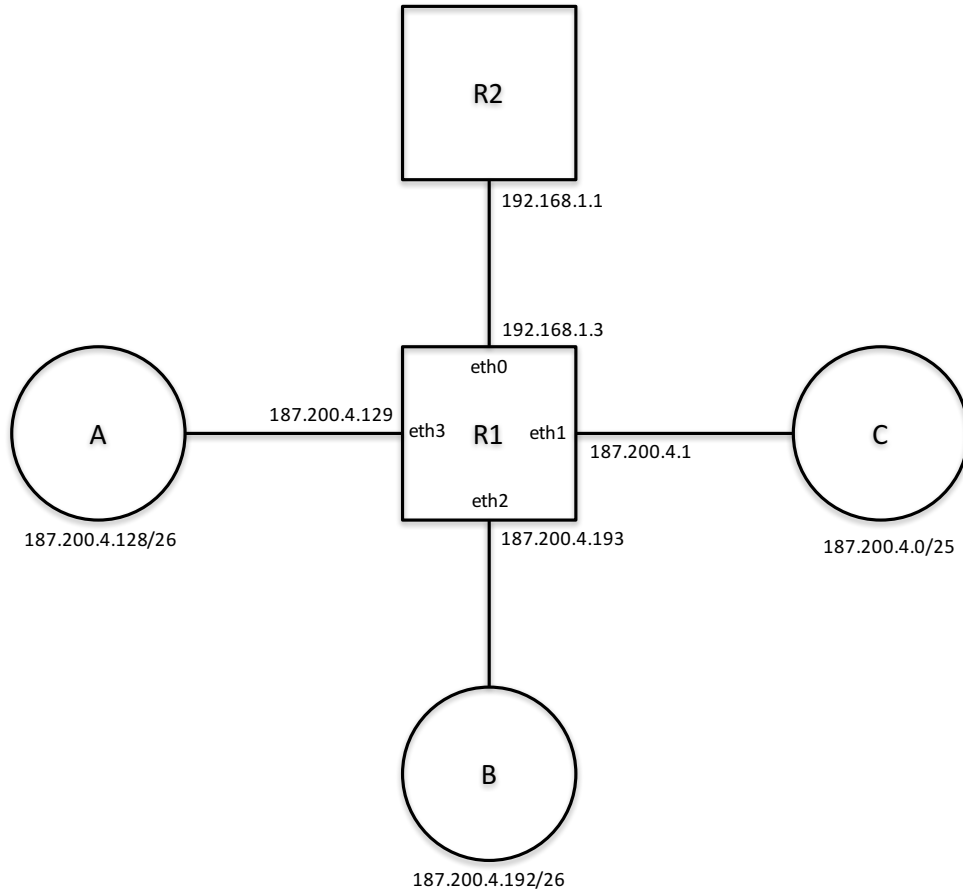
a) (5pts). Indicate which ports are not selected by the spanning tree algorithm.

B7's port to network B, B3's ports to network A and C, and B6's ports to I and G will be disabled.

b) (10pts). What happens if bridge B2 fails? Why (i.e., what messages will/will not be exchanged)?

B3's ports will be re-enabled because B3 will stop receiving announcements from B2 and instead will become "best" for network C.

4. (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.



The forwarding table at R1 contains the following entries:

Destination	Next Hop	Interface
127.0.0.1/32	127.0.0.1	lo0
default	192.168.1.1	eth0
192.168.1.0/24		eth0
187.200.4.0/25		eth1
187.200.4.192/26		eth2
187.200.4.128/26		eth3

- a) (5pts). Suppose the following IP packet arrived at a router R1. (Only a subset of the header fields are shown.) Which entry in the forwarding table would it match?

IP Src	IP Dst	Payload
187.200.4.165	187.200.4.83	...

187.200.4.0/25 eth1

- b) (5pts). On which port on R1 must the packet above have arrived?

eth3

- c) (10pts). How many hosts can network *C* accomodate (assuming unique IP addresses were the only constraint)?

$2^7 - 3 = 125$; as the all-zeros address is reserved for the network name, the all-ones address is reserved for broadcast, and one address is used by the router's interface.

- d) (10pts). What is a legal IP address for a host on network *B*?

Any address between 187.200.4.194 and 187.200.4.254 is fine (187.200.4.193 is used by the router).

- e) (10pts). Imagine *R2* uses aggregation to maintain precisely one entry in its forwarding table to describe networks *A*, *B*, and *C*. What would that entry look like? (Give both the network name including prefix length and the next hop.)

Destination	Next Hop	Interface
187.200.4.0/24	192.168.1.3	...

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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?