

CSE 123: Computer Networks
Fall Quarter, 2023
QUIZ 2

Instructor: Alex C. Snoeren

Name _____ **SOLUTIONS**
Student ID _____

Question	Score	Points
1	10	10
2	20	20
3	25	25
4	35	35
5	10	10
Total	100	100

This quiz 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 QUIZ.**

The quiz 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 quiz. As with any quiz, 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 quiz**. You may submit it separately at the end of the exam, or bring it to class with you on Monday.

GOOD LUCK!

1. (10 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) Split horizon prevents all routing loops.

False; split horizon can only prevent routing loops of length two.)

b) Virtual circuits are a form of destination-based forwarding.

False; when forwarding based on virtual circuits, decisions are based on the packet tag or ID.

c) If a device does not have a matching entry in its ARP cache for a given IP, it sends an ARP request for that IP address to the link-layer (MAC) broadcast address of the appropriate LAN.

True.

d) The DHCP protocol allows hosts to resolve domain names into IP addresses.

False, that is a function of the Domain Name Service (DNS).

e) OSPF is a form of link-state routing protocol.

True.

2. (20 pts) Short Answer. Concisely answer the following questions.

- a) Suppose a NAT (pNAT) is connecting a private 10.0.0.0/8 network to the Internet with a public IP address 235.4.3.17. If the NAT receives a packet destined to 1.2.3.4:80 from 10.9.3.12:3456, what will be the source and destination addresses in the IP packet when it leaves the NAT? (Make sure to specify the ports; feel free to pick an arbitrary port if the NAT needs to assign one.) Similarly, if that packet receives a response that the NAT forwards back towards the sender, what will the source and destination addresses (including ports) of the response packet be when it leaves the NAT?

**Source: 235.4.3.17:####, Destination 1.2.3.4:80, where #### is any number between 1–65K.
Source: 1.2.3.4:80 Destination: 10.9.3.12:3456**

- b) List the DNS servers that would be queried to lookup the hostname `www.stackoverflow.com`. Presume no records are currently cached anywhere in the system, and your host is configured to use 100.99.88.77 as its local DNS server.

100.99.88.77, Root server, Authoritative server for .com, Authoritative server for .stackoverflow.com

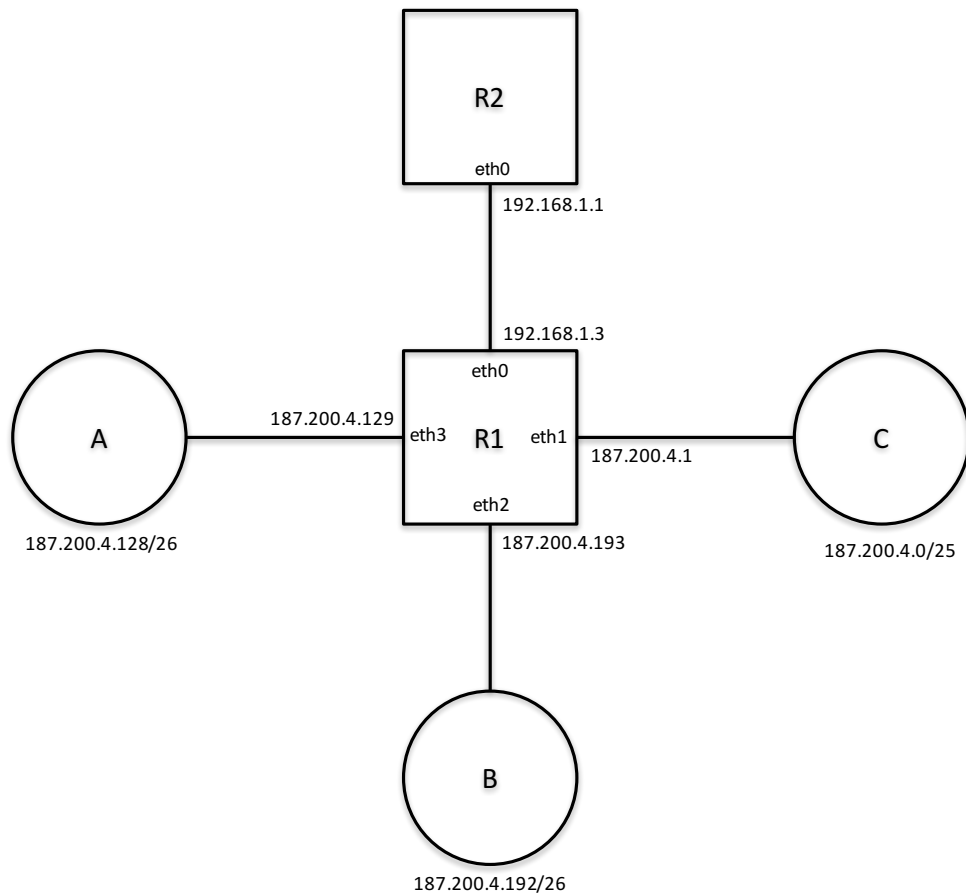
- c) List two reasons why intra-domain routing protocols are not suitable for inter-domain routing.

Possible answers include poor scaling, need to agree on edge metrics, information disclosure, slow convergence, potentially others.

- d) Compare and contrast link-state and distance-vector routing. Give one way in which link-state is superior to distance vector, and one way in which distance vector improves upon link state.

Link state will never create long-lived routing loops, but distance vector can minimize communication during topology changes.

3. (25 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) 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) On which port on R1 must the packet above have arrived?

eth3

- c) How many hosts can network *C* accommodate (assuming unique IP addresses were the only constraint), after accounting for the network and broadcast addresses?

$2^7 - 3 = 125$; 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) What is a legal IP address for a host on network *B*? (Any one example will do.)

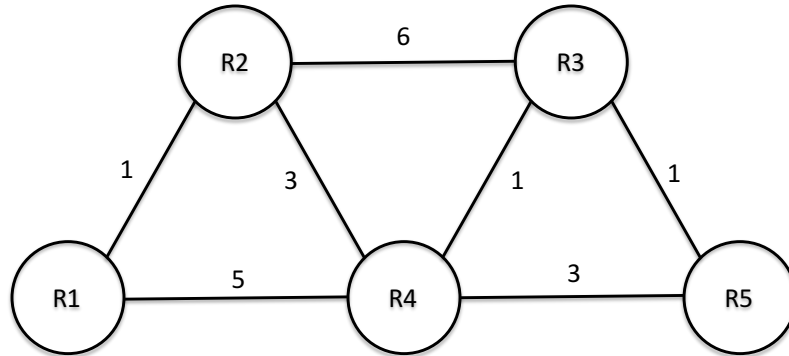
Any address between 187.200.4.194 and 187.200.4.254 is fine (187.200.4.193 is used by the router).

- e) 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	eth0

4. (35 pts) Routing.

a) (10 pts) Consider the network of five routers below, with edge weights labeled.



Show the step-by-step operation of Dijkstra's algorithm for $R1$ using the table below. (You may use either the compact notation from lecture and discussion or the multi-step notation from the book.) The first step is done for you.

Step	Confirmed	Tentative	Comments
0	(R1, 0, -)		
1	(R1, 0, -)	(R2, 1, R2), (R4, 5, R4)	
2	(R1, 0, -), (R2, 1, R2)	(R4, 4, R2), (R3, 7, R2)	
3	(R1, 0, -), (R2, 1, R2), (R4, 4, R2)	(R3, 5, R2), (R5, 7, R2)	
4	(R1, 0, -), (R2, 1, R2), (R4, 4, R2), (R3, 5, R2)	(R5, 6, R2)	
5	(R1, 0, -), (R2, 1, R2), (R4, 4, R2), (R3, 5, R2), (R5, 6, R2)		

- b) (9 pts) Now consider a Bellman-Ford-based distance-vector protocol. Assume that the protocol has converged. First, give the global distance-vector tables as in lecture and the homework (i.e., show the information stored at each node) after convergence. No need to show your work.

	R1	R2	R3	R4	R5
R1	0	1	5	4	6
R2	1	0	4	3	5
R3	5	4	0	1	1
R4	4	3	1	0	2
R5	6	5	1	2	0

- c) (8 pts) Assuming that the network employs Split Horizon with Poison Reverse, show only the distance vectors that *R3* knows about (i.e., *R3*'s own distance vector and the ones it receives from its neighbors).

	R1	R2	R3	R4	R5
R3	5	4	0	1	1
R2	1	0	4	3	5
R4	4	3	∞	0	∞
R5	∞	∞	∞	∞	0

- d) (8 pts) Now, assume that the *R3* – *R4* link fails and *R3* recomputes its own distance vector. Show the updated distance vectors that *R3* advertises to *R2* and *R5*. (Split Horizon with Poison Reverse remains employed.)

	R1	R2	R3	R4	R5
R3	7	6	0	9	1
To R2	∞	∞	0	∞	1
To R5	7	6	0	9	∞

PLEASE TEAR OFF THIS PAGE OF THE QUIZ. YOU CAN SUBMIT IT AT THE END OF THE PERIOD, OR BRING IT TO CLASS ON MONDAY

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

- How are you feeling regarding your progress in this course? Better, worse, or about the same as of Quiz 1?
- Did you appreciate having two quizzes spaced three weeks apart, or would you have rather had just one midterm (during week 5)?
- Is there something you would like the staff to do differently?
- Please compare your experience with Project 2a as opposed to Project 1a. Did you find it any more or less challenging to get started on?