Q1 T/F (no need for justification)
10 Points

Q1.1
2 Points

Packets flowing through virtual circuit (VC) networks (after VC has been setup) use VC identifiers instead of IP addresses.

- ○ True
- ○ False

Q1.2
2 Points

Routers in VC networks do not maintain any state.

- ○ True
- ○ False

Q1.3
2 Points

Routing happens more frequently than forwarding.

- ○ True
- ○ False

Q1.4
2 Points

VC identifiers are used in VC networks because IP addresses are in shortage.

- ○ True
- ○ False

Q1.5
2 Points

A packet is flowing from your laptop to a Youtube server. When the packet flows through routers, say R5 to R6, the packet header contains the IP address of R6.

- ◯ True
- ◯ False

Q2 Choose all the correct answer(s)

8 Points

Imagine IP addresses are 4 bit addresses, from 0000 to 1111.
Now, consider the following scenario at a router: of the 16 addresses, the first 5 must be forwarded to interface 1, the second 4 to interface 2, the third 2 to interface 3, and the final 5 to interface 4.
Create the most optimal (7 row) forwarding table with 2-column forwarding table (column 1 = Prefix, and column 2 = interface number) that the router should use.
Answer the following questions with respect to the forwarding table:

Q2.1

2 Points

What will the entry/entries in the prefix column be for Interface 1?

- [ ] 010
- [x] 0100
- [x] 00
- [ ] 01
- [ ] 000
- [ ] 001

Q2.2
2 Points

What will the entry/entries in the prefix column be for Interface 2?

- [x] 01
- [ ] 011
- [ ] 0101
- [ ] 011
- [x] 1000
- [ ] 100

Q2.3
2 Points

What will the entry/entries in the prefix column be for Interface 3?

- [ ] 1001
- [ ] 1010
- [x] 10
- [ ] 101
- [ ] 100
- [ ] 1

Q2.4
2 Points

What will the entry/entries in the prefix column be for Interface 4?

- [ ] 101
- [x] 1011
- [ ] 111
- [x] 11
- [ ] 110
- [ ] 10

Q3 Choose the correct answer
4 Points

Assume that 6 nodes are placed on a straight line as follows:
A–B–C–D–E–F.
Assume that the distance between adjacent nodes is equal and denoted by r and that the pathloss index is α. Assuming A is transmitting to B, C to D, and F to E, and that they all use the same transmit power, compute the SINR at D as a function of r and α. Assume noise is zero.

- [x] $6^\alpha/(2^\alpha + 3^\alpha)$
- [ ] $3^\alpha/(1 + 3^\alpha)$
- [ ] $(6r)^\alpha/(2^\alpha + 3^\alpha)$
- [ ] $1/r^\alpha$

Q4 Choose all the correct answer(s)
12 Points

Q4.1
3 Points

A switch without a routing function (L2 switch)

- [ ] gets its IP by DHCP when it's connected to the internet.
- [ ] normally broadcasts all the packets it received to all the ports except for the incoming port.
- [ ] serves as the gateway and DHCP server for the LAN devices.
- [x] forwards the packets to the corresponding port according to the MAC table

Q4.2
3 Points

Alice and Bob wanted to share files with each other by setting up a socket connection. Both of them typed ifconfig on their Linux machine to obtain their IP addresses. Alice's IP address is 130.126.255.1. Bob's IP address is 192.168.34.102. Assume they both have access to the Internet. Can they set up the socket connection without requiring other external servers?

- [ ] Yes. Bob needs to set up the server and wait for Alice to connect.
- [x] Yes. Alice needs to set up the server and wait for Bob to connect.
- [ ] No. Their IP addresses are not in the same subnet so they cannot communicate.
- [ ] No. One of them is using a local IP address so the socket cannot be established.

Q4.3
3 Points

(Continuing Q4.2) When they both log on to https://www.iplocation.net/ to check their IP address, what should they observe?

- [x] Alice will see the same address as ifconfig result.
- [ ] Alice will see a different address from ifconfig result.
- [ ] Bob will see the same address as ifconfig result.
- [x] Bob will see a different address from ifconfig result.

Q4.4
3 Points

(Continuing Q4.2 and 4.3) Now Carol came in. She typed ifconfig and saw her IP address is 192.168.34.101, but she cannot ping Bob's IP address. You are told that the network condition is normal, and there are not any firewalls blocking etc. Assume Carol also has access to internet, and both of Bob and Carol's subnet masks are 255.255.255.0. Which of the following statements are correct?

- [ ] There are some ways to directly set up socket and send files between Carol and Bob without any external server.
- [ ] They cannot share files even using the external server because they cannot ping each other.
- [ ] The scenario described should not happen because Bob and Carol are in the same subnet, then they should be able to ping each other.
- [x] They might be able to communicate with each other through an external server.

Q5 Choose the correct answer
9 Points

For every IP in the sub-questions, please select the correct forwarding rule according to the routing table as shown in the choices:

Q5.1
3 Points

192.168.1.1

- [ ] 192.168.0.0/17 to port A
- [x] 192.168.0.0/23 to port B
- [ ] 192.168.2.0/24 to port C
- [ ] 0.0.0.0/0 to port D

Q5.2
3 Points

192.168.255.255

- [ ] 192.168.0.0/17 to port A
- [ ] 192.168.0.0/23 to port B
- [ ] 192.168.2.0/24 to port C
- [x] 0.0.0.0/0 to port D

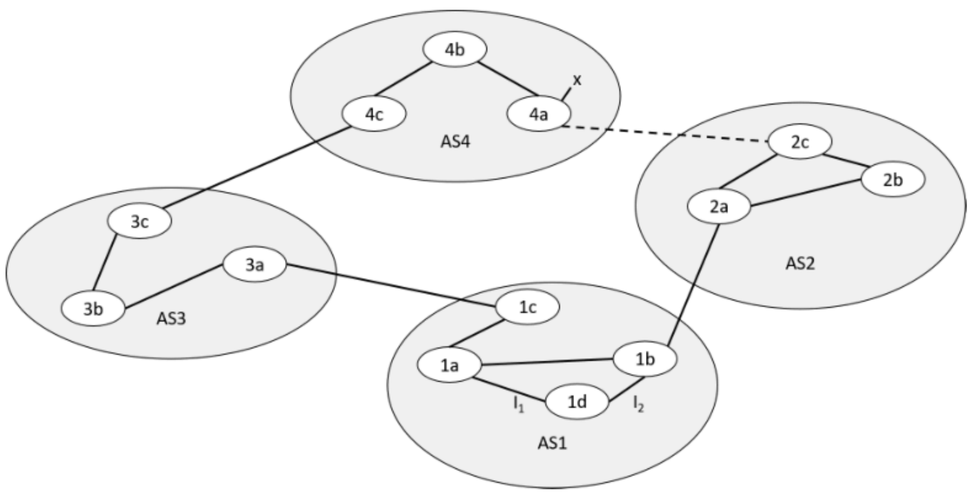
Q5.3
3 Points

10.0.0.1

- [ ] 192.168.0.0/17 to port A
- [ ] 192.168.0.0/23 to port B
- [ ] 192.168.2.0/24 to port C
- [x] 0.0.0.0/0 to port D

Q6 AS Routing
10 Points

Consider the network shown above. Suppose AS3 and AS2 are running OSPF for their intra-AS routing protocol. Suppose AS1 and AS4 are running RIP for their intra-AS routing protocol. Suppose eBGP and iBGP are used for the inter-AS routing protocol. Suppose there is no physical link between AS2 and AS4 (ignore the dashed line).



Q6.1
2 Points

Router 3c learns about prefix x from which routing protocol?

- OSPF
- RIP
- eBGP
- iBGP

Q6.2
2 Points

Router 3a learns about x from which routing protocol?

- OSPF
- RIP
- eBGP
- iBGP

Q6.3
2 Points

Router 1c learns about x from which routing protocol?

- OSPF
- RIP
- eBGP
- iBGP

Q6.4
2 Points

Router 1d learns about x from which routing protocol?

- OSPF
- RIP
- eBGP
- iBGP

Q6.5
2 Points

Router 4c learns about x from which routing protocol?

- ○ OSPF
- ○ RIP
- ○ eBGP
- ○ iBGP

Q7 Subnet
4 Points

IlliNet has a CIDR address of 220.34.12.0/26.

Q7.1
2 Points

IlliNet can support at most ________ computers.

Prompt : Enter an integer

64

Q7.2
2 Points

If IlliNet decides to divide its CIDR address to 4 subnets. Please select all the possible subnets.

- [x] 220.34.12.16/27
- [ ] 220.34.13.0/25
- [x] 220.34.12.0/31
- [ ] 220.34.12.64/28

Q8 Switch
13 Points

A Slotted ALOHA network of N = 24 nodes gets separated into 3 smaller networks using a switch. Each smaller network now contains N/3 nodes.

Q8.1
5 Points

Before the switch was installed, calculate the probability of collisions in the network at a time slot. Assume that each node attempts transmission in a given slot with a probability p = 0.3.

Prompt : Enter only a numeric value rounded to 5 decimal places ex: 1.23441

0.99785

Q8.2
5 Points

After the switch was installed, assume that sender-receiver pairs are always within a smaller network (i.e., traffic does not cross the switch). Calculate the probability of collisions in the whole network, i.e, probability that collision occurs in any of the three smaller networks at a time slot.

Prompt : Enter only a numeric value rounded to 5 decimal places ex: 1.23441

0.98336

Q8.3
3 Points

The advantages of a switch include (choose 2):

- [ ] Increase the collision probability
- [x] Decrease the collision probability
- [x] Increase the throughput
- [ ] Decrease the throughput

Q9 Choose the correct answer
12 Points

Q9.1
3 Points

Using VC identifiers to create the flow is more efficient than IP address-based forwarding because

- ○ Number of bits needed to track flows is much fewer than the size of IP addresses.
- ○ Two IP flows may have the same (source IP, destination IP) tuple.
- ○ VC identifiers allow a flow to change the route easily.
- ○ Packets belong to the same flow may not have the same (source IP, destination IP) tuple.

Q9.2
3 Points

Poison reverse is needed to

- ○ make the initial shortest path converges faster.
- ○ guarantee DV algorithm will find the shortest path.
- ○ break the tie in the shortest algorithm.
- ○ prevent unnecessary ping pong of message exchanges.

Q9.3
3 Points

Collision detection is possible in a wired network because (choose 2)

- [ ] Packets are of the same length
- [x] The signal does not decay much throughout the wire
- [x] Each node can simultaneously listen and transmit at the same time
- [ ] Transmitter and receiver operates at the same transmission rate.

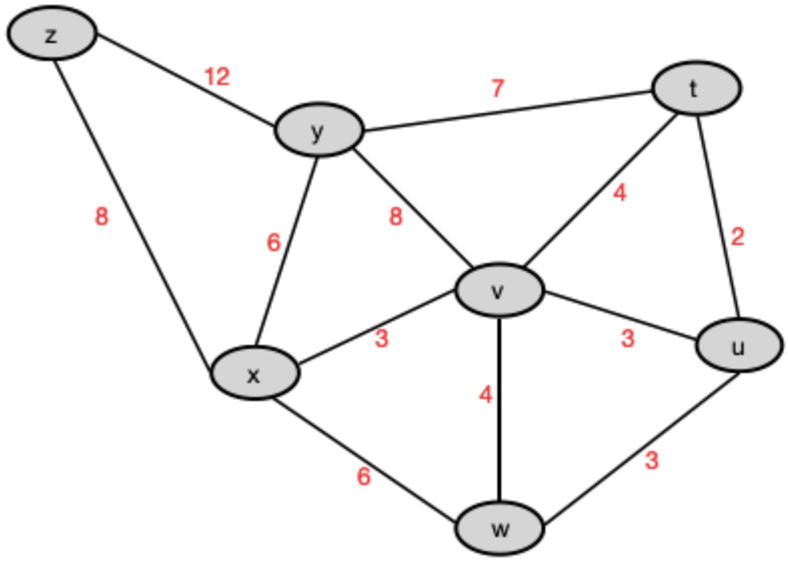
Q9.4
3 Points

Assuming the transmit and receive ranges are the same for all nodes, RTS/CTS

- ○ can completely solve the hidden terminal problem.
- ○ can alleviate the hidden terminal problem.
- ○ cannot alleviate the hidden terminal problem.

Q10 Link State Routing
8 Points

The figure below represents different nodes in a network; they run Dijkstra's algorithm for Link State (LS) Routing.



Consider node t running the Dijkstra's Algorithm to calculate the shortest path to all nodes in the shown network. Answer the following questions with regards to the given information.

Q10.1
2 Points

(T/F) Assume link states have been exchanged, and node t now begins to run the routing algorithm. At this point, node t is not aware about the existence of nodes x, z and w, and will find out about their existence by running the algorithm.

- True
- False

Q10.2
2 Points

The shortest path to z is determined at step/iteration number (Assume that the algorithm begins with the determined={t} at step/iteration = 0):

Prompt : Enter an integer length

6

Q10.3
2 Points

The cost of shortest path to z determined by t after running the algorithm is

Prompt : Enter an integer

15

Q10.4
2 Points

And z's predecessor along the shortest path from t is:

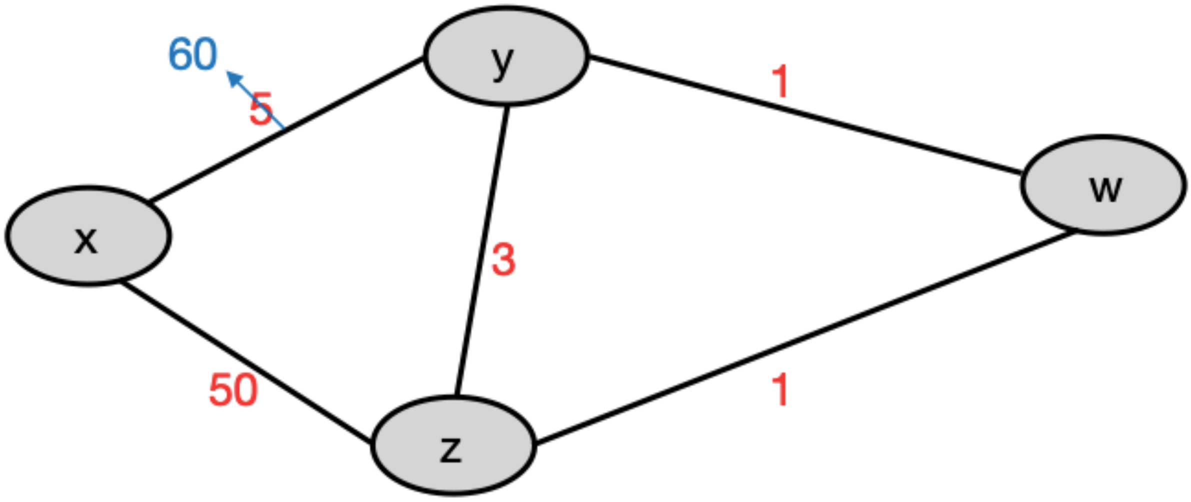
Prompt : Enter an alphabet only in lower case ex: y

x

Q11 Distance Vector Routing and Poisoned Reverse

10 Points

Given below is a diagram of a network that uses Distance Vector Routing along with poisoned reverse.



Initially, the cost of different links are:
$c(x,y) = 5, c(x,z) = 50, c(y,z) = 3, c(y,w) = 1, c(z,w) = 1$

When distance vector routing has stabilized (by starting with the initial costs specified above), routers w, y, and z communicate to each other their distance vectors to router x (i.e., $D_w(x)$, $D_y(x)$, $D_z(x)$).

What are the values of these distance vectors?
Fill in the following blanks (i.e, blanks in Q14.1, Q14.2 and Q14.3). "$D_a(b)$ to c" denotes the value of router a's distance vector to router b, which is sent to router c.

Q11.1

1 Point

$D_y(x)$ to z

$\textbf{Prompt}$: Enter an integer. If the answer is infinity enter inf.

5

Q11.2
1 Point

$D_y(x)$ to w

$\mathbf{Prompt}$: Enter an integer. If the answer is infinity enter inf.

5

Q11.3
1 Point

$D_z(x)$ to y

$\mathbf{Prompt}$: Enter an integer. If the answer is infinity enter inf.

7

Q11.4
1 Point

$D_z(x)$ to w

$\mathbf{Prompt}$: Enter an integer. If the answer is infinity enter inf.

inf

Q11.5
1 Point

$D_w(x)$ to y

$\mathbf{Prompt}$: Enter an integer. If the answer is infinity enter inf.

inf

Q11.6
1 Point

$D_w(x)$ to z

$\textbf{Prompt}$: Enter an integer. If the answer is infinity enter inf.

6

Q11.7
1 Point

Now, when the link cost between x and y increases to 60, as shown in the diagram, y is the first router to send out updates. What will be the value of distance vector $D_y(x)$ shared with router z?($D_y(x)$ to z)

$\textbf{Prompt}$: Enter an integer. If the answer is infinity enter inf.

inf

Q11.8
1 Point

Now, when the link cost between x and y increases to 60, as shown in the diagram, y is the first router to send out updates. What will be the value of distance vector $D_y(x)$ shared with router w? ($D_y(x)$ to w)

$\textbf{Prompt}$: Enter an integer. If the answer is infinity enter inf.

10

Q11.9
2 Points

Will there be a count-to-infinity problem in this case? Answer yes or no.

- ○ Yes
- ○ No

Hint:
The order of distance vector updates after link cost $c(x, y)$ changes to 60 will be as follows:
$D_y(x) \rightarrow D_w(x) \rightarrow D_z(x)$
This means that $D_y(x)$ updates first and z, w are informed about this update. $D_w(x)$ updates next and z, y are informed about it. Following this, $D_z(x)$ is updated and y, w are informed about this update.