Problem Set 2: Kiran Jojare

Problem Set #2

Problem 1 (10 points)

(a) Is 10.72.0.255/255.255.254.0 a valid IP address for a host? **[2pts]**
Yes, it is a valid IP address as it lies in the same subnet between 10.72.0.0 and 10.72.1.255.

(b) Divide the 10.72.0.0/16 subnets into five large networks of 8192 IPs each, 8 medium-sized networks of 2048 IPs each, and 10 small sized networks of 128 IPs each. **[6pts]**

$2^{13} = 8192$

Hence 32-13 = 19

The 10.72.0.0/16 subnet divided into 5 8192 IP's is:

10.72.0.0/19	-	10.72.31.255/19 (8192)
10.72.32.0/19	-	10.72.63.255/19(8192)
10.72.64.0/19	-	10.72.95.255/19 (8192)
10.96.0.0/19	-	10.72.127.255/19 (8192)
10.72.128.0/19	-	10.72.159.255/19 (8192)

$2^{11} = 2048$

Hence 32-11 = 21

The 10.72.0.0/16 subnet divided into 8 2048 IP's is:

10.71.160.0/21	-	10.72.167.255/21 (2048)
10.71.168.0/21	-	10.72.175.255/21 (2048)
10.71.176.0/21	-	10.72.183.255/21 (2048)
10.71.184.0/21	-	10.72.191.255/21 (2048)
10.71.192.0/21	-	10.72.199.255/21 (2048)
10.71.200.0/21	-	10.72.207.255/21 (2048)
10.71.208.0/21	-	10.72.215.255/21 (2048)
10.71.216.0/21	-	10.72.223.255/21 (2048)

$2^7 = 128$

Hence 32-7 = 25

The 10.72.0.0/16 subnet divided into 10 128 IP's is:

10.72.244.0/25	-	10.72.244.127/25 (128)
10.72.244.128/25	-	10.72.244.255/25 (128)
10.72.255.0/25	-	10.72.255.127/25 (128)
10.72.255.128/25	-	10.72.255.255/25 (128)
10.72.266.0/25	-	10.72.266.127/25 (128)
10.72.266.128/25	-	10.72.266.255/25 (128)
10.72.277.0/25	-	10.72.277.127/25 (128)
10.72.277.128/25	-	10.72.277.255/25 (128)
10.72.288.0/25	-	10.72.288.127/25 (128)
10.72.288.128/25	-	10.72.288.255/25 (128)

(c) Is 192.168.2/23 and 192.168.3/23 representing the same subnet? Please justify your answer. **[2pts]**
Yes 192.168.2/23 and 192.168.3/23 representing the same subnet. ./23 represents interval between 192.168.2.0/23 – 192.168.3.255/23 indicates that given IP is under the range.

Problem 2 (8 points)

An organization has been assigned the prefix 192.168.1.0/23 and wants to form subnets for 4 departments which have the following number of hosts:

Department A:	130 hosts
Department B:	120 hosts
Department C:	60 hosts
Department D:	31 hosts

(a) Give a possible arrangement of subnet masks to make this possible. **[5pts]**

Department A: 192.168.0.0/24 (130 Hosts)
Department B: 192.168.1.0/25 (120 Hosts)
Department C: 192.168.1.128/26 (60 Hosts)
Department D: 192.168.1.192/27 (31 Hosts)

(b) Suggest what the organization might do if department C grows to 65 hosts. **[3pts]**
C grows to host 65 hosts.

- Allocate two /26 subnets as follows 192.168.1.64/26 and 192.168.1.128/26. This indicted total $2*(2^6 -2) = 124$ Hosts can be allocated to department C
- In other case, C need a 128 subnet, but there are no enough IP to do this, so the organization either can apply for more IP addresses or use private IP address space.

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Problem 3 (12 points)

For the network given below in Figure 3, give global distance-vector tables for each node when**:**

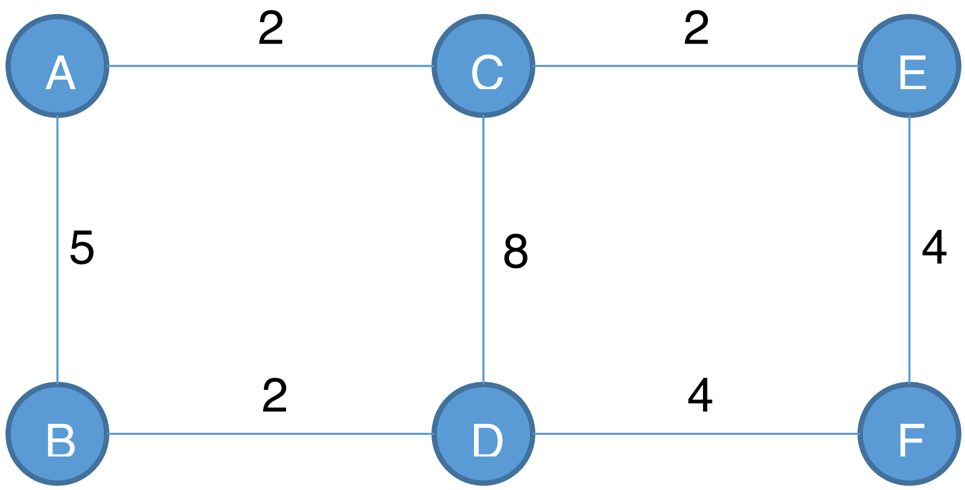

Figure 3

(a) Each node knows only the distance of its immediate neighbors. **[4pts]**

Distance	A	B	C	D	E	F
A	0	5	2	Inf	Inf	Inf
B	5	0	Inf	2	Inf	Inf
C	2	Inf	0	8	2	Inf
D	Inf	2	8	0	Inf	4
E	Inf	Inf	2	Inf	0	4
F	Inf	Inf	Inf	4	4	0

(b) Each node has reported the information it had in the first step (a) to its immediate neighbors. **[4pts]**

	A	B	C	D	E	F
A	0	5	2	7	4	Inf
B	5	0	7	2	Inf	6
C	2	7	0	8	2	6
D	7	2	8	0	8	4
E	4	Inf	2	8	0	4
F	Inf	6	6	4	4	0

(c) Repeat step (b) one more time. **[4pts]**

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	A	B	C	D	E	F
A	0	5	2	7	4	8
B	5	0	7	2	9	6
C	2	7	0	8	2	6
D	7	2	8	0	8	4
E	4	9	2	8	0	4
F	8	6	6	4	4	0

Problem 4 (10 points)

Again, for the network graph in Figure. 3. Show how the link-state algorithm builds the routing table for node D.

(a) Show the detailed steps with the link-state algorithm. **[5pts]**

Using link state algorithm for Node D

Iteration 0:

D is starting node, so N' = {D}

Neighbors are B C and F

d(A, B,C,D,E,F) = (INF,2,8,0,INF,4);

Iteration 1:

d(B) = 2 was smallest. Adding B to N'= {B,D}

d(A, B,C,D,E,F) = (7,2,8,0,INF,4);

Iteration 2:

d(F) = 2 was smallest. Adding F to N' = {B,D,F}

d(A, B,C,D,E,F) = (7,2,8,0,8,4);

Iteration 3:

d(A) = 7 was smallest. Adding A to N' = {A,B,D,F}

d(A, B,C,D,E,F) = (7,2,8,0,8,4);

Iteration 4:

d(E) = 8.was smallest. Adding D to n' = {A,B,D,E,F}

d(A, B,C,D,E,F) = (7,2,8,0,8,4);

Iteration 5:

d(C) = 8 was last remaining. Adding C to N' = {A,B,C,D,E,F}

d(A, B,C,D,E,F) = (7,2,8,0,8,4);

N' contains all nodes and hence algorithm is completed.

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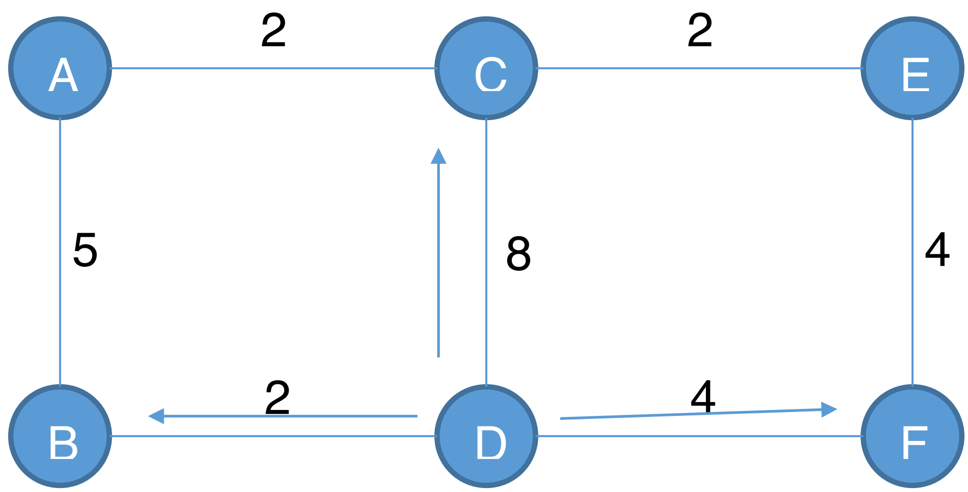

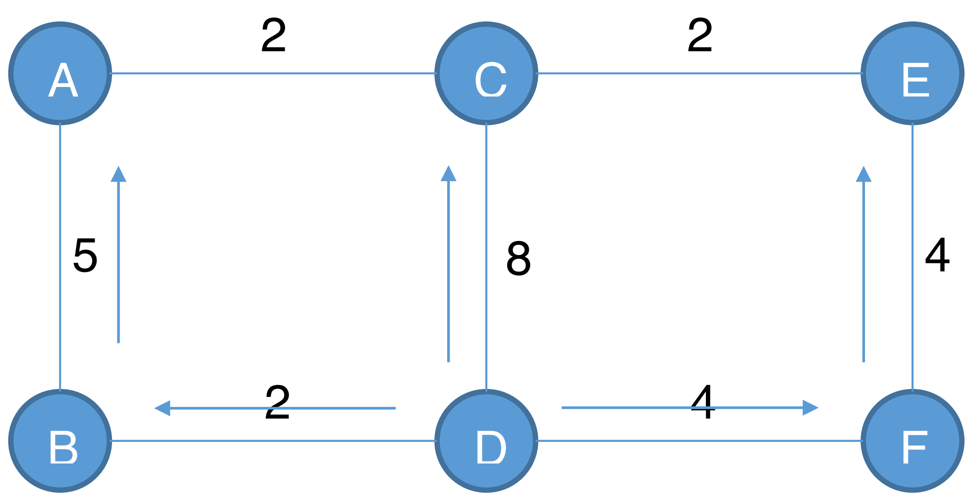

(b) Show the final routing table of node D. **[5pts]**

Nodes	Link
A	{D,B}
B	{D,B}
C	{D,C}
E	{D,F}
F	{D,F}

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Problem 5 (10 points)

The network graph is shown in Figure. 4.

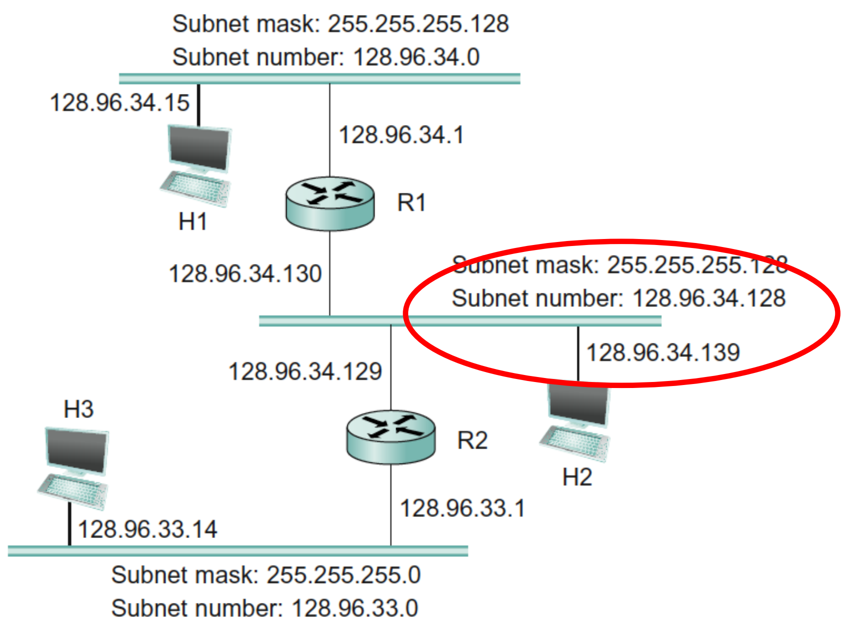


Figure 4

(a) Host H1 sends a packet to the destination 128.96.34.126. Explain how this packet traverses in the network described below. You need to describe who received the packet and what are their reactions. **[3pts]**

Host H1 will use ARP to transfer the packet because the destination IP address and subnet mask are the same. During ARP transmission, the packet is encapsulated and sent to the destination MAC address. If the destination MAC is unknown, the message will be broadcast throughout the network. All hosts receive the packet during flooded transmission, but only the destination host reacts and sends back the acknowledgement.

In our case, the host IP does not belong to the network, so we will not receive a response from any of the hosts during the ARP process. Eventually, all of the hosts will drop the packets and cease to respond.

(b) Host H3 sends a packet to the destination 128.96.34.250. Explain how this packet traverses in the network. **[3pts]**

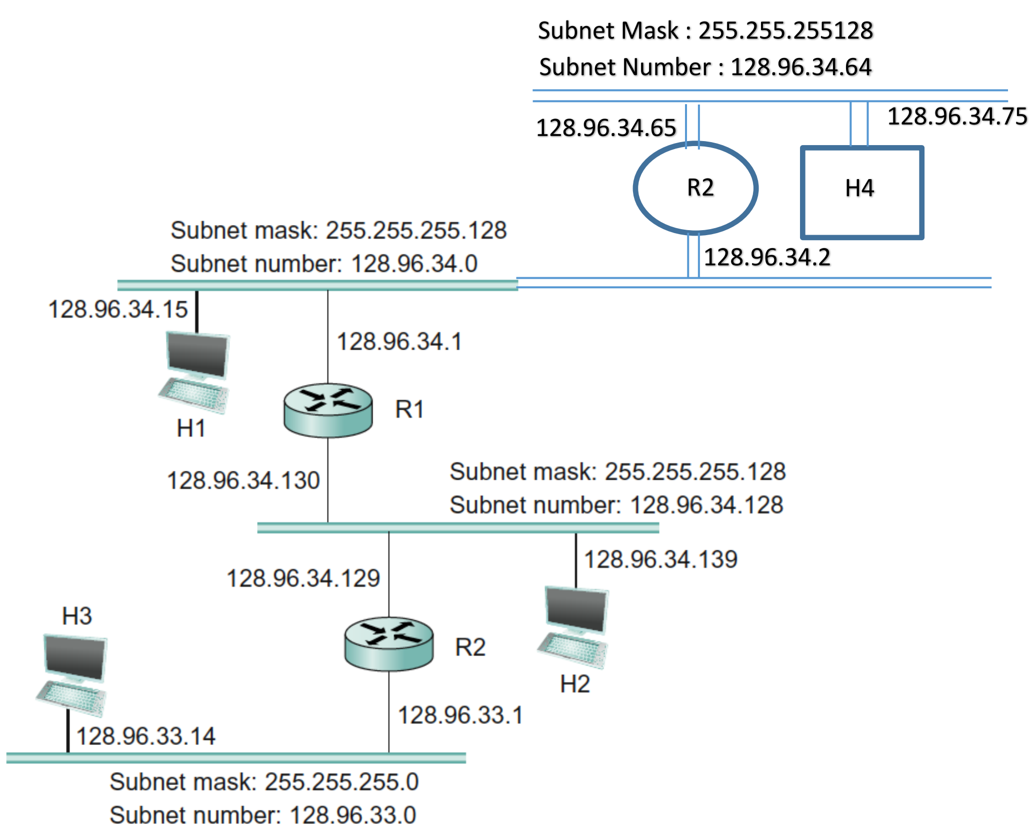
128.96.34.250 address belongs to the highlighted network (H2) different from host H1. H3 will initiate packet transfer via router R2. H3 will send out the ARP request to destination IP using ARP default gateway which is R2

From R2, packet will be forwarded to port in highlighted red circle. Once that's done, MAC address exchange will take place between packets source MAC and R2's MAC.

Once destination MAC address is obtained packet will be forwarded and packet will reach the destination in subnet mask highlighted by red circle.

(c) The subnet of H1 has now two different teams and would like to split it into two subnets. Please add one more subnet and add R3 and change the network configurations as you need. Note that you are allowed to modify the network as least disruptive as possible. **[4pts]**

The subnet of H1 will change to 128.93.34.0/255.255.255.192 Another Router R3 will connect the Ethernet with 128.93.34.0<IP<128.93.34.64 On the other side of R3 will have 128.93.34.65<ip<128.93.34.128 and with subnet 128.93.34.64/255.255.255.192 connected.



Problem 6 (12 points)

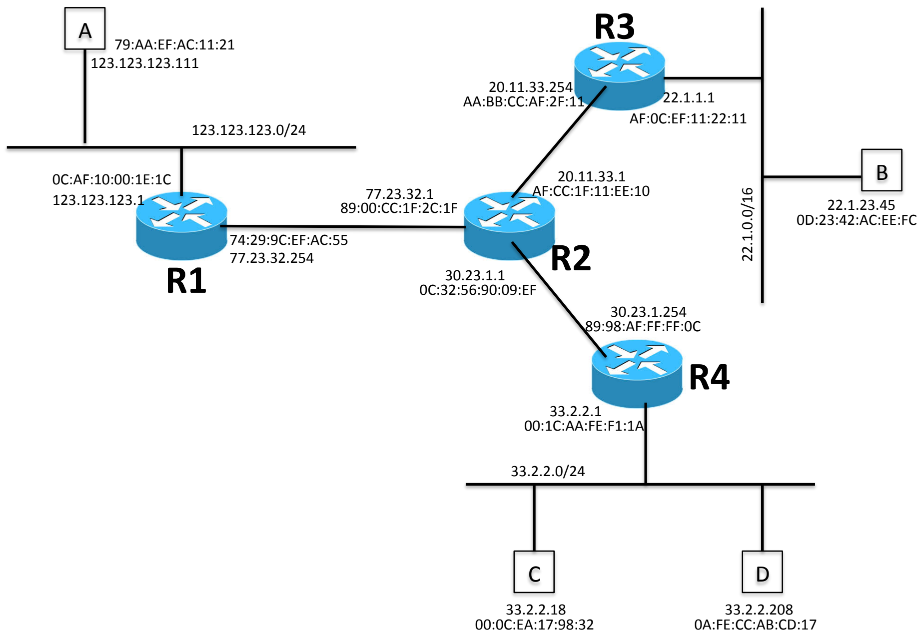


Figure. 5

Above in Figure 5 is the network graph with 4 routers (R1, R2, R3, R4) and 4 hosts (A, B, C, D). Each router interfaces and hosts are labeled with both IP and MAC address, Routing is enabled so that any two hosts can communicate with each other and also the default gateway of each host is set to its gateway router.

(a) Suppose that B send an IP packet to C through R3, R2, R4. Write down the IP packet's content (src MAC, dst MAC, src IP, dst IP) along the path in the Table given below: **[4pts]**

	src MAC	dst MAC	src IP	dst IP
B -> R3	B's MAC 0D:23:42:AC:EE:FC	R3's MAC AF:0C:EF:11:22:11	B's IP 22.1.23.45	R3's IP 33.2.2.18
R3 -> R2	R3's MAC AA:BB:CC:AF:2F:11	R2's MAC AF:CC:1F:11:EE:10	R3's IP 22.1.23.45	R2's IP 33.2.2.18
R2 -> R4	R2's MAC 0C:32:56:90:09:EF	R4's MAC 89:98:AF:FF:FF:0C	R2's IP 22.1.23.45	R4's IP 33.2.2.18
R4 -> C	R4'c MAC 00:1C:AA:FE:F1:1A	C's MAC 00:0C:EA:17:98:32	R4's IP 22.1.23.45	C's IP 33.2.2.18

Table. 1

(b) When A sends out an ARP query for its default gateway, what is the reply to that query? **[4pts]**

When A sends out an ARP query it sends out MAC address as a reply:

Source IP:	123.123.123.1
Source MAC:	0C:AF:10:00:1E:1C
Destination IP:	123.123.123.111
Destination MAC:	79:AA:EF:AC:11:21

(c) Suppose the routers use link-state routing protocol, what will be R3's routing table entries? **[4pts]**

Route	Direction	Destination Subnet
R3 - > B	Towards B	22.1.0.0/16
R3 - > R2	Towards A	123.123.123.0/24
R3 - > R2	Towards C and D	33.2..2.0/24

Problem 7 (6 points)

Suppose a computer just boot up, connected to wireless network and successfully obtained IP, gateway and DNS address. Now it wants to access www.yahoo.com from its browser. Describe the sequence of packets exchanged to and from this computer until the webpage starts to load. (Include what kind of protocol is used and what is the content of the packets)

If computer is just booted up, and there was no internet activity apart from system wanting to access www.yahoo.com, one can see entire process starting from ARP, TCP handshake all the way up to DNS queries.

Frame 1: ARP
Initially the ARP Broadcast frame, broadcast data to figure out the default router gateways MAC address. Before computer can send first packet to the router it needs to resolve the default gateway IP address to the interface MAC address.

Frame 2: ARP Response
In response second frame is going to be routers reply. It shows the computer MAC address for the first ever ethernet interface.

Frame 3: DNS Query
DNS query will be third frame. DNS query from computer to DNS server. This packet attempts to figure out domain name www.yahoo.com and resolve it to appropriate web servers IP address. Once DNS connection is established, data transfer can be initiated to the web server.

Frame 4: DNS Query Response
DNS server will replay back and that will result as fourth frame. DNS server will reply back with IP address of the domain server www.yahoo.com.

Frame 5: TCP 3-Way Handshaking
The last frame to be observed has to be TCP three-way handshake taking place [SYN]. The client sends a SYN packet to the server inquiring whether it is available for new connections. Server responds to the client by sending a SYN/ACK packet corresponding to the SYN packet acknowledging the same. When the client receives the SYN/ACK packet from the server, it responds by sending an ACK packet to acknowledge it. This completes the establishment of the TCP connection. Finally, after establishing the TCP connection, the browser sends the GET request for www.yahoo.com and returns the data with an ACK.

Problem 8 (12 points)

Consider the simple network in Figure 5 below. X, Y and Z are routers and their link costs are as specified. Assume the network uses a Distance Vector algorithm is used. Y's and Z's routing tables are look like Table 2.

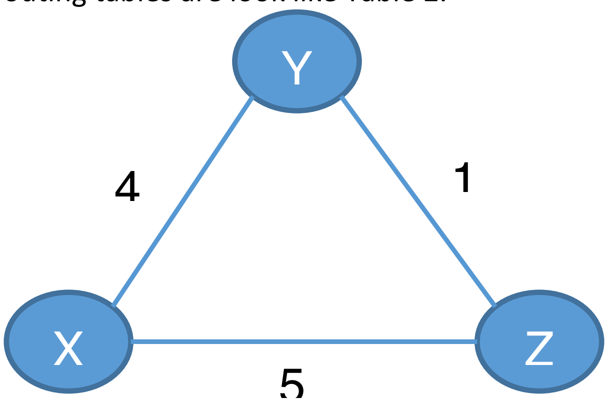


Figure. 5

Node Y/Distance	Via X	Via Z
X	4	6

Node Z/Distance	Via X	Via Y
X	50	5

Table. 2

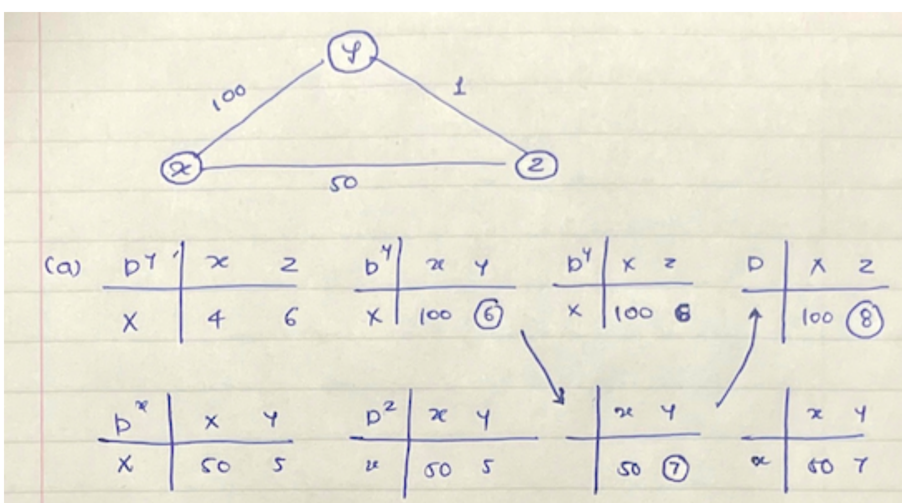
(a) Now Let assume the cost of link X-Y suddenly changed to 100. Please write down the Y's and Z's routing table regarding distance to X, after Y updates this information to Z and then Z updates its information back. **[4pts]**

Routing Table for Y :

Node Y/Distance	Via X	Via Z
X	100	6

Routing Table Z :

Node Z/Distance	Via X	Via Y
X	50	7



(b) Please write down the Y's and Z's routing table regarding X after Y updates this information to Z again and then Z updates back again. **[4pts]**

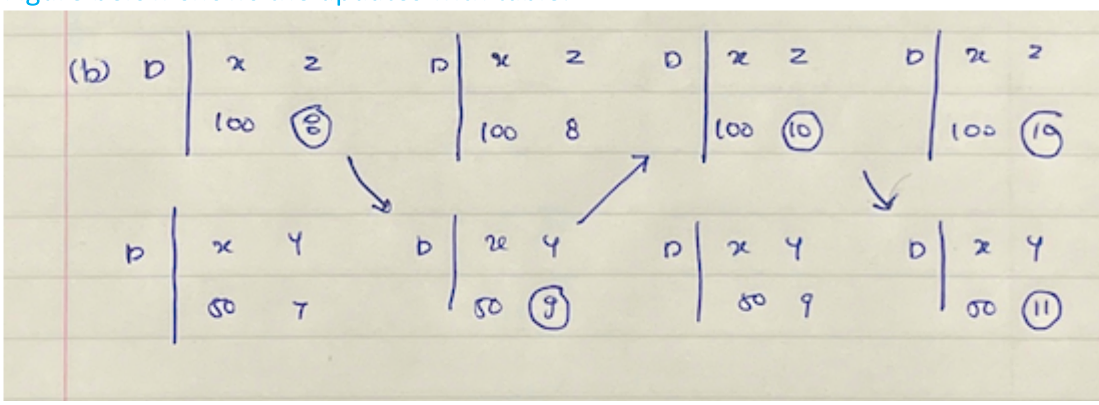
Routing Table for Y :

Node Y/Distance	Via X	Via Z
X	100	8

Routing Table Z :

Node Z/Distance	Via X	Via Y
X	50	9

Figure below shows the updates with table:



(c) How many updates did Y get until its distance to X have converged with Distance Vector algorithm? **[4pts]**

In total Y will get 23 updates until its distance to X have converged with Distance vector algorithm.

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Problem 10 (10pts)

Consider a network with MPLS enabled routers as shown in Figure 1 below. We would like to perform traffic engineering using MPLS so that traffic from R1 to R6 will be routed as R1->R3->R5->R6->A and traffic from R2 to R6 will be routed as R2->R3->R4->C.

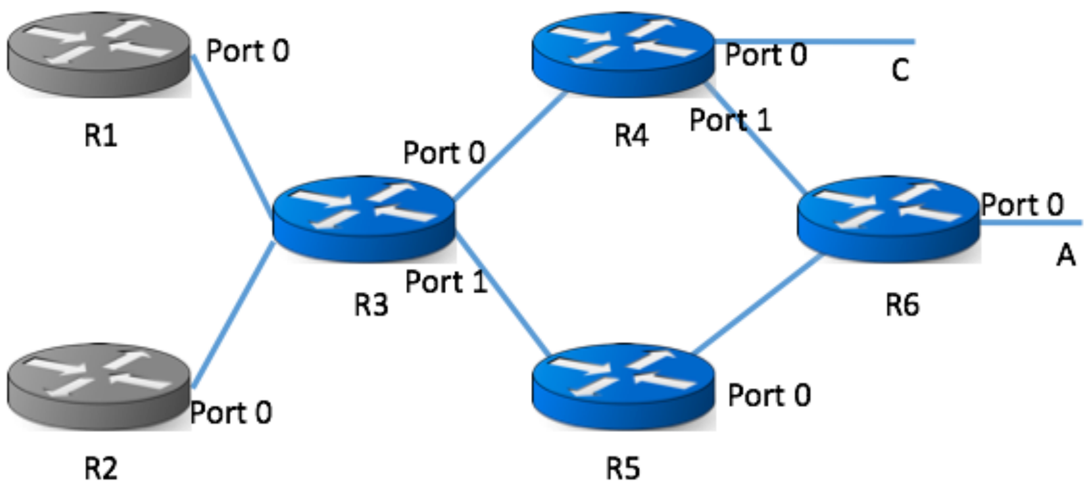

Figure 1. MPLS enabled network for Problem 1

Please fill in the following tables of MPLS entries for each router.

R1			
In label	Out label	Dst	Out interface
-	1	A	0

R2			
In Label	Out Label	Dst	Out interface
-	2	C	0

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R3			
In label	Out label	Dst	Out interface
1	4	A	1
2	2	C	0

R4			
In label	Out label	Dst	Out interface
3	-	C	0
3	6	A	1

Yellow highlighted is a dead connection.

R5			
In label	Out label	Dst	Out interface
4	5	A	0

R6			
In label	Out label	Dst	Out interface
5	-	A	0