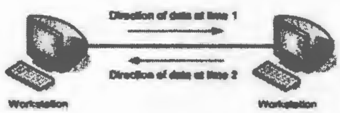
CS/ECE 4457 FALL 2018

Name: Solution

Computing ID:____________________

WARM UP

Question 1: What type of transmission mode is depicted in the photo below:



Simplex ⟶

full duplex ⟷

1) Simplex
2) Full Duplex
3) Half Duplex
4) None of the above

LINK LAYER

Error Detection:

Questions 2: Two Dimensional :

The figure below shows an example of two dimensional bit parity. Does the message contain errors? If the message contains errors, draw the correct version of the message.

1	0	1	0	1	1
1	0	1	1	0	0
0	1	1	1	0	1
0	0	1	0	1	0

⇒

1	0	1	0	1
1	1	1	1	0
0	1	1	1	0

You can assume that only one bit got flipped.

Questions 3: Check Sums:

Given the two 16 bit numbers: ...1010 & 1001 ← assume zero padded

Calculate the check sum for the bits. (Show your work below)

.....1010

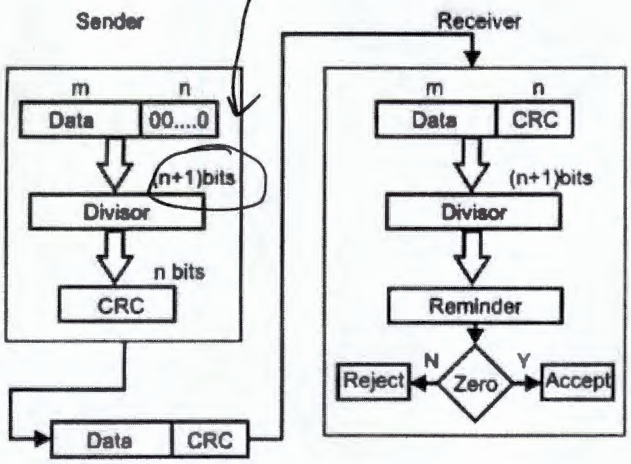
assume zero padded → 1001

10011

→ 01100 check sum

Question 4: Cyclic Redundancy Checks:

the generating function



The figure above provides a quick refresher on how Cyclic Redundancy Checks work.

Part a) The receiver and sender agree to use the generating function 1001. The receiver receives the packet 101110011. Which part of the packet represents the CRC bits?

011 Because the generating function is 4 bits the CRC → is 4-1 = 3 (the last 3)

Part b). Perform the modulo-2 division to determine if the packet is corrupted. Please show your work.

```
        101011
1001 √ 101110011
       ⊕1001
        0010
         0000
          1010
          1001
          0110
          0000
           1101
           1001
           0100
           1001
            000 ✓
```

Good value. Accept.

Question 5:

Sharing a broadcast channel/multiple access

In the lecture we looked at three broad strategies for sharing the communication medium. List one MAC protocol for each category and briefly describe it's disadvantage:

Category	MAC protocol	Disadvantage
Channel partitioning	~~FMA~~ FDM frequency division	Need large frequency range for multiple nodes

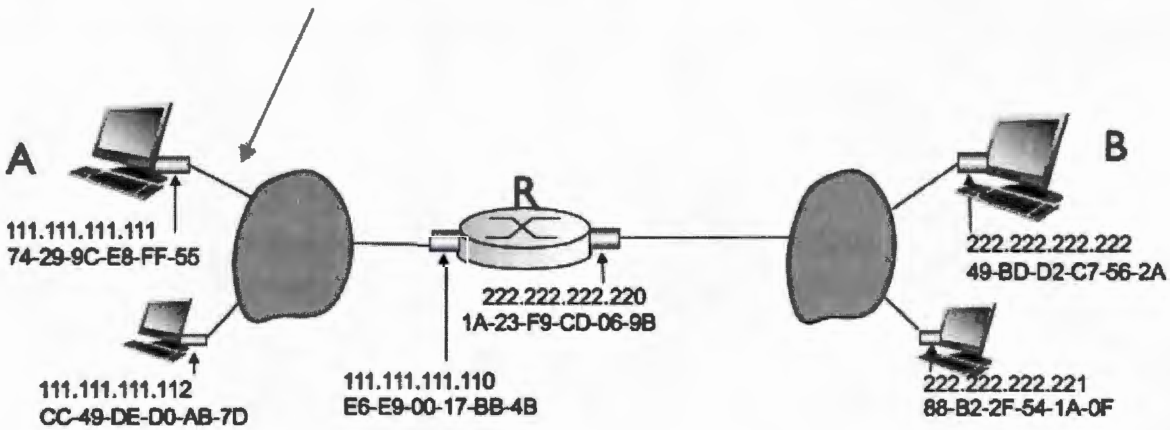
Random access	Unslotted Aloha CSMA	collisions can occur.
Taking turns	Token Master /salve	single point of failure

Link. Layer Addressing:

Questions 6 (MAC address and ARP)

Machine A is sending a packet to machine B. What are the values for the source and destination MAC addresses for packet that is placed on the link indicated by the arrow.

Source MAC address	74-29-9C-E8-FF-55
Destination MAC address	E6-E9-00-17-BB-4B



Question 7 (ARP and MAC)

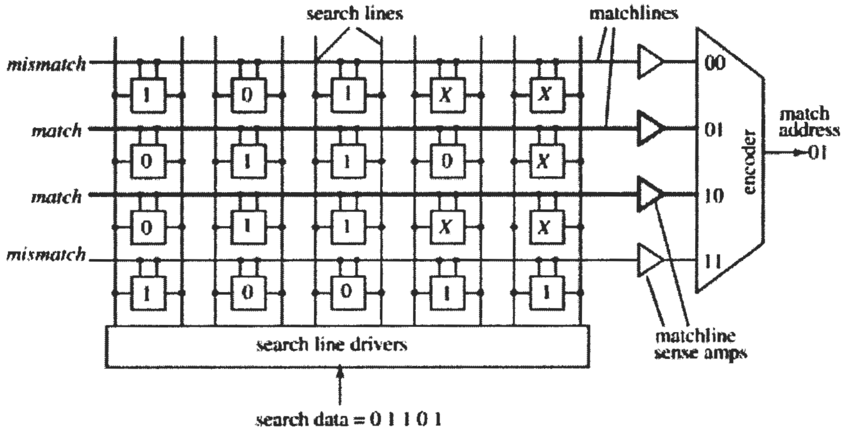
Fill in the ARP tables for Machine A in the previous figure:

	IP-ADDRESS	MAC ADDRESS
1	111.111.111.112	CC-49-DE-D0-AB-7D
2	111.111.111.110	E6-E9-06-17-BB-4B

NETWORKING LAYER:

Question 8 Forwarding

TCAM (ternary content addressable memories) are great because they provide single cycle lookups. Draw the forwarding table that is implemented by the following TCAM:



101*x	00
0110*	01
011xx	10
10011	11

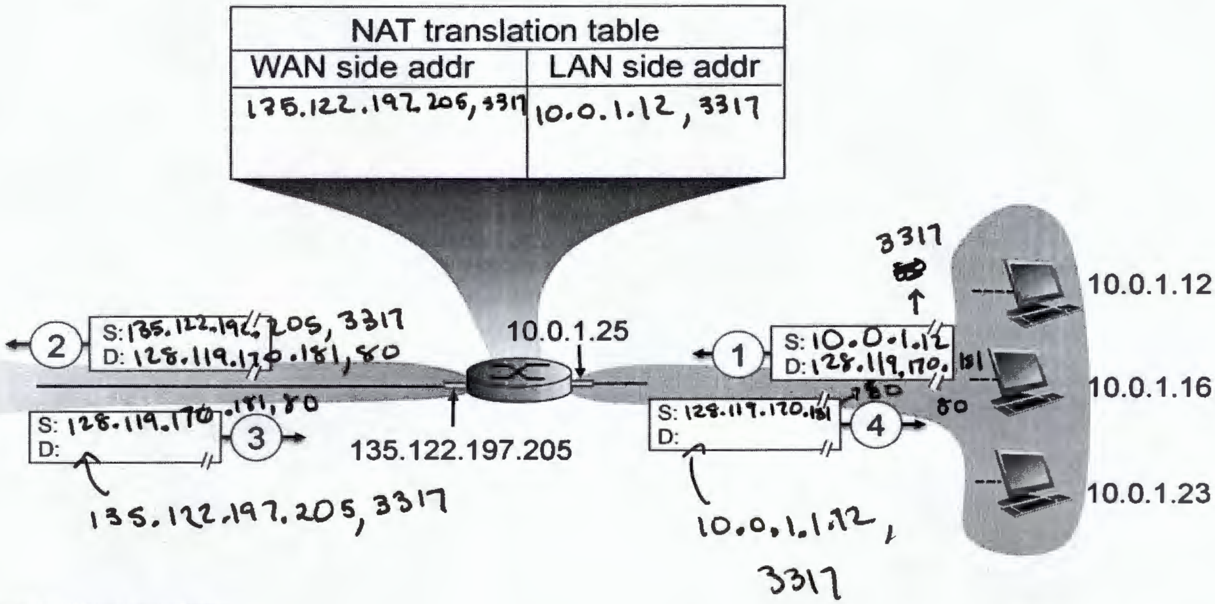
Given the forwarding table that you have drawn above, what port would a packet with header 10100 get forwarded on? (Note: if the packet arrives at the router and nothing matches in its forwarding table, it will simply drop that packet)

10100 → 00

Question 9 Network Address Translation

Given the following scenario, fill in the NAT table

Suppose that the host with IP address 10.0.1.12 sends an IP datagram destined to host 128.119.170.181. The source port is 3317, and the destination port is 80. Assume that the host at 128.119.170.181 sends a response back.



Subnets/Cidar notation:

Question 10

Given the following subnet mask. Which of the following IPs are on the same subnet:

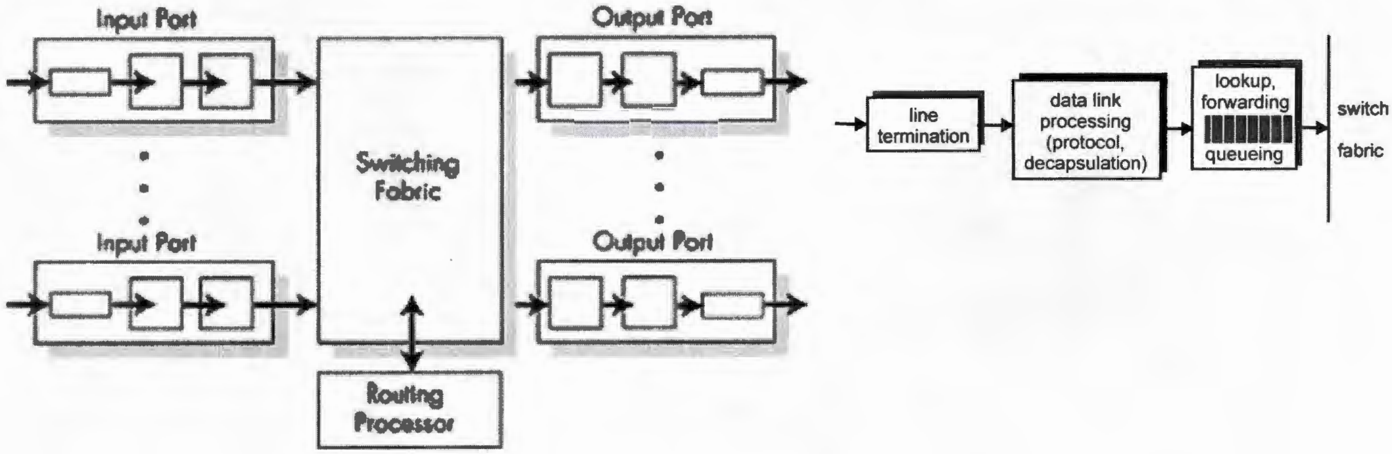
11001000 00010111 00010000 00000000

200.23.16.0/23

IP ADDRESS	BINARY	On The subnet
200.23.16.1	11001000 00010111 00010000	✓
200.23.17.1	00010001	✓
200.23.18.1	00010010	✗
200.23.22.5	00010110	✗

Router Design:

The figure below shows a general view of a router. The second part of the figure shows queues at the input and output ports of the IP router. The router gets to decide how packets are scheduled .



PART A

List 3 scheduling algorithms that can be used to decide which packets get to enter the switching fabric.

FIFO
round robin
weight priority queue

PART B

How does the scheduling algorithm that you select affect fairness in the network? (How does this relate to the net-neutrality debate.)

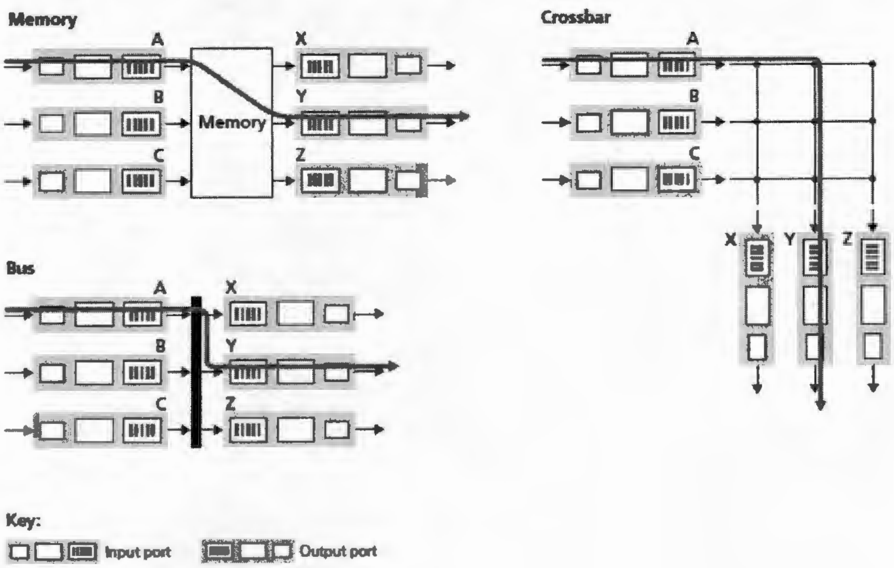
The scheduling algorithms determines which packets get priority to the switching fabric. By allowing packets of ~~[illegible]~~ special class to get access to the fabric you have an unfair scheduler, This means that you can charge people for access/speed.

Router Design:

We are lucky enough to have one of the earliest versions of the crossbar switches, on the 5th floor of Rice. What is the advantage of the cross bar switch over memory based switches and bus based switches. (You can refer to the picture below for reference.)

① memory based switches the packet has to be copied to memory this makes it slower.

② Bus based switches only allow a single pair of port to be connected at a time

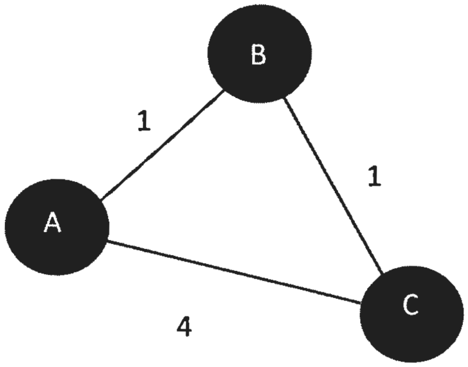


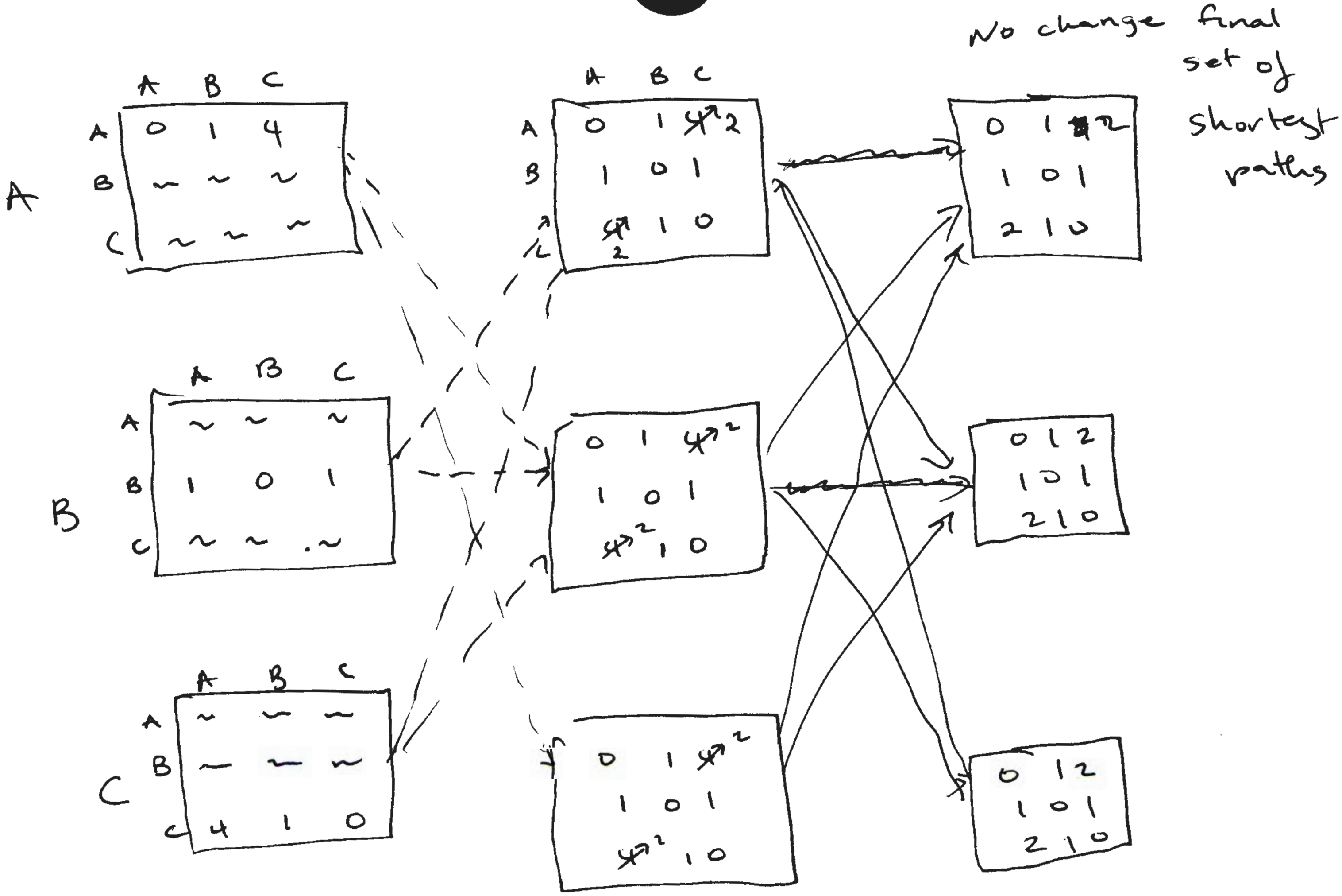
Routing Algorithms:

Question II

In lecture we looked at two routing protocols, the Distance Vector routing protocol and the Link State routing protocol.

Show the steps the Distance Vector Algorithm takes until it converges. Please represent the state of each node in the form of a matrix.





In lecture we discussed the Link state and Distance vector algorithms. Complete the table with a pro and con of each class of algorithm:

	Pro	Con
Distance Vector	Distributed.	Bad news travels slowly
Link State	↑	If a link change

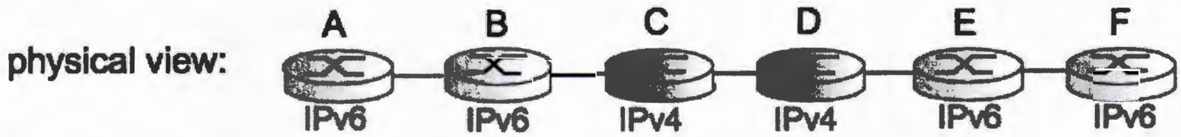
poison Reverse problem

great for network with a central controller SDN

the ~~host~~ whole network has to updated

Question 12. IPV6

As we begin to upgrade routers from IPV4 to IPV6 we will have paths in our network that contain both IPV6 and IPV4 routers. Given the network below, briefly describe how we solve the problem between what happens between IPV6 routers B and E.

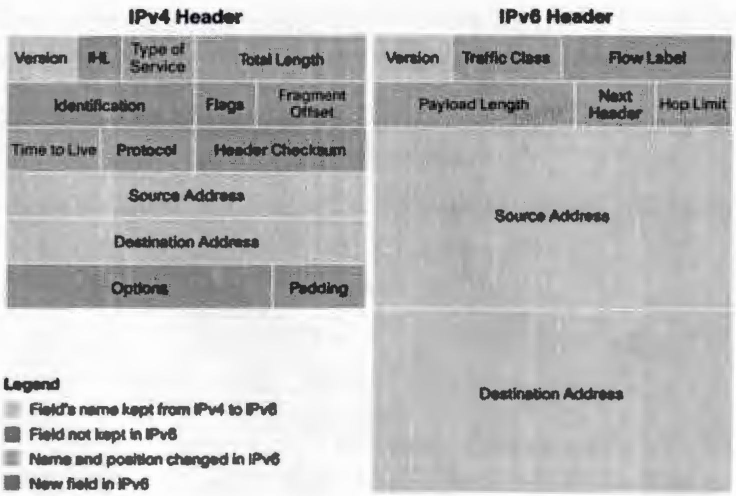


Solution tunnelling

The IPV6 packet gets rapped in an IPV4 packet ~~out~~ and sent.

Question 13.

The figure below shows a side by side comparison between the IPV6 and IPV4 packets. Notice that IPV6 does have a fragmentation flag or offset. These flags were removed due to security concerns associated with fragmentation. Since the fragmentation flag was removed how are packets fragmented to allow for Links with Network Interface Cards that only accommodate MTU 1500.

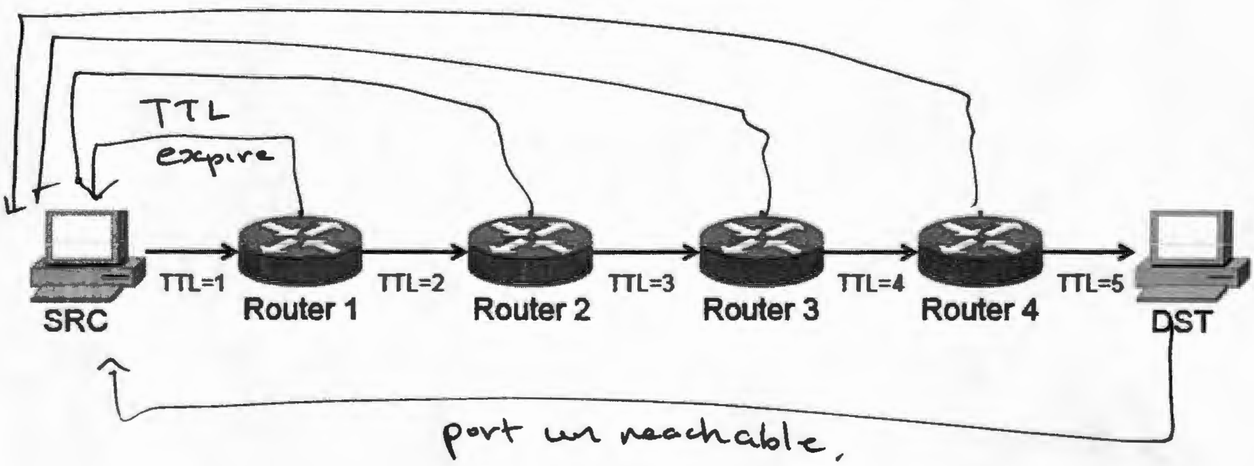


Transport layer

The upper layer ~~of the network~~ (TCP/ UDP) is responsible for fragmenting the packets

Problem 14

ICMP packets can be used for network level communication. The figure below shows some packets associated with a trace route probe. Label the error packets returned at each step of the process.



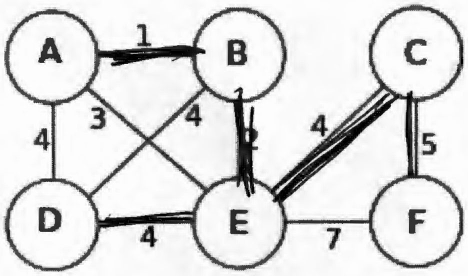
Broadcast/Multicast.

Problem 15:

In lecture we saw that one way to reduce packet duplication for broadcast protocols is to construct a minimum spanning tree and only forwarding packets along that tree. Draw the minimum spanning tree for the figure below. (Feel free to draw on top of the figure)

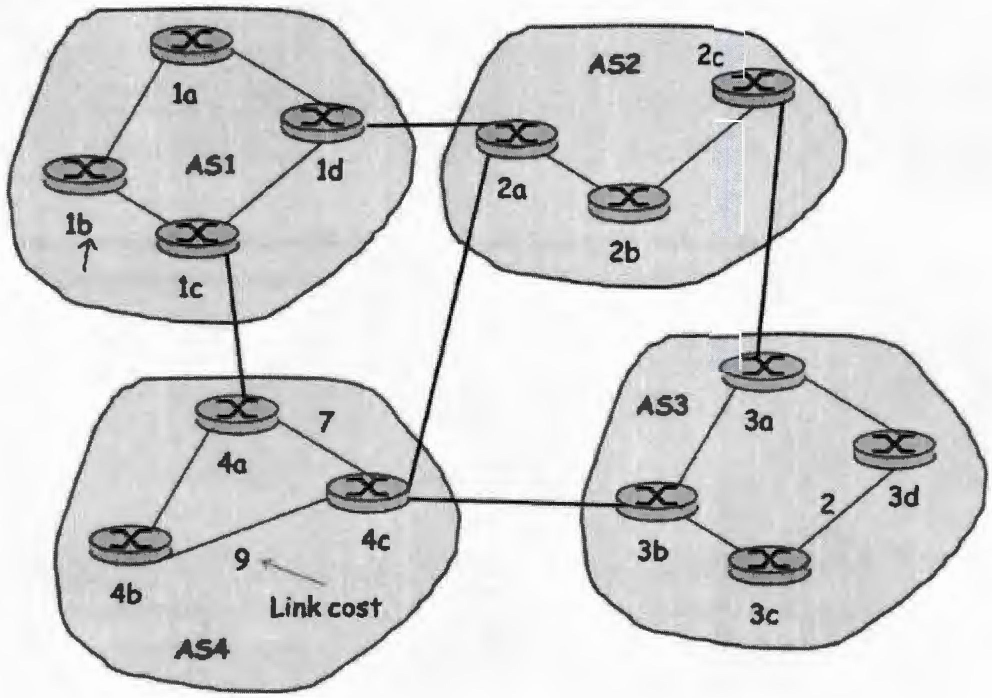
(assume the tree is centered at E)

multiple solutions possible



Autonomous Systems

Problem 16:



The figure above shows an internetwork of four autonomous systems interconnected via inter-domain links. All nodes shown in the internetwork are IP routers. Link costs of some links are shown in the figure (see AS4 and AS3). For all other links, assume a link cost of 1. Recall that intra-AS topologies are not shared with other ASs. Only address reachability information is shared in an inter-AS routing protocol. Let's assume fairness that Lowest AS path length has precedence over hot potato routing in the path-selection process.

a. If a host connected to router 4b sends an IP packet to a host connected to router 4c, what is the next-hop router to which router 4b sends the packet?

4a) Shorter path 1+7=8

b. If a host connected to router 3d sends an IP packet to a host connected to router 4b, what is the next-hop router to which router 3d sends the packet?

3a

c. Consider the forwarding table at router 1b. Assume that there is an IP subnet 128.143.8.0/24 connected to router 3d. What is the next-hop router corresponding to this IP subnet in the forwarding table of router 1b?

1c) Explaination ⇒ same AS length (2) so hot potato

d. What does the forwarding table at router 4a show as the next-hop router to reach an IP subnet connected to a port on router 2c?

4c → Since 2c is only one AS hop away from 4c

Problem 17: Design Problem

Electromagnetic waves do not propagate very well underwater this is why submarines use sonar instead of radar. A group of researchers are interested in constructing an aquatic network that allows them get to access "real-time" data from tags connected to the animals that they are studying.

Propose a layered design for the network: (Discuss the design of your Networking, Link, physical layer)

Networking layer

~~When an~~ ~~The~~ Each research group can have thire own under water ~~switch~~ switch which will connect by gateway router.

Link layer

① Each animal tag is assigned a unique mac address controlled by us

② A. collection ~~of~~ of under water switch / Access points with mics/ speakers

physical layer

FM modulated sound ~~wave~~ waves