50.012 Networks (2020 Term 6)

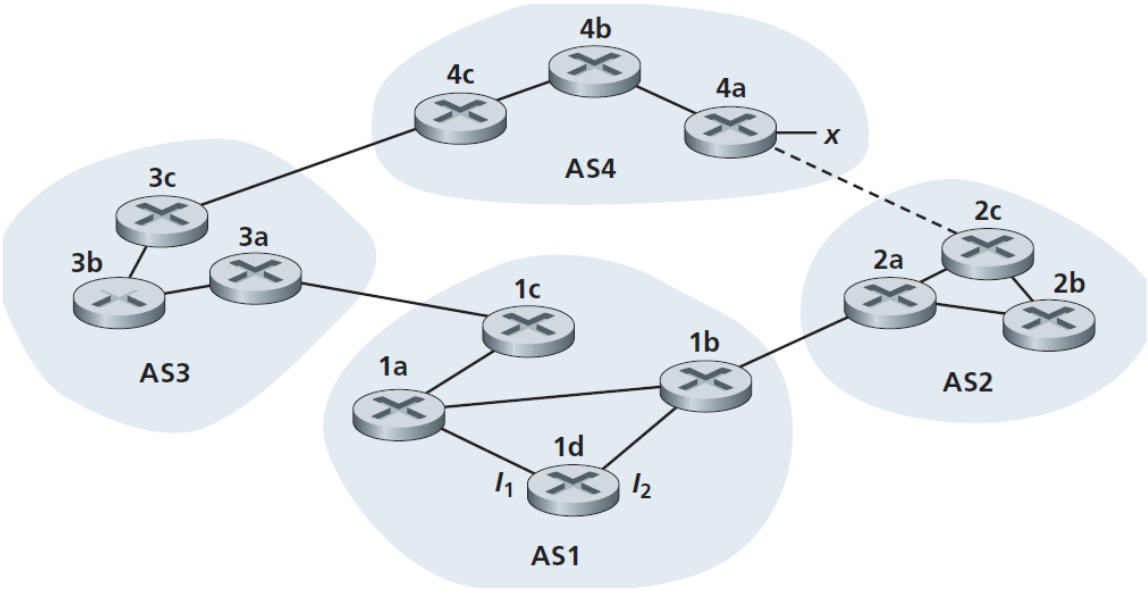
Homework 5

Hand-out: 3 Dec

Due: 10 Dec 23:59

Name: _____ Student ID: _____

1. (textbook chapter 5, adapted from problem P14 and P15): Consider the network shown below. Suppose all the four ASes are running OSPF for their intra-AS routing protocol and assume the cost for every link in the graph is 1. Suppose eBGP and iBGP are used for the inter-AS routing protocol. Initially suppose there is no physical link between AS2 and AS4.



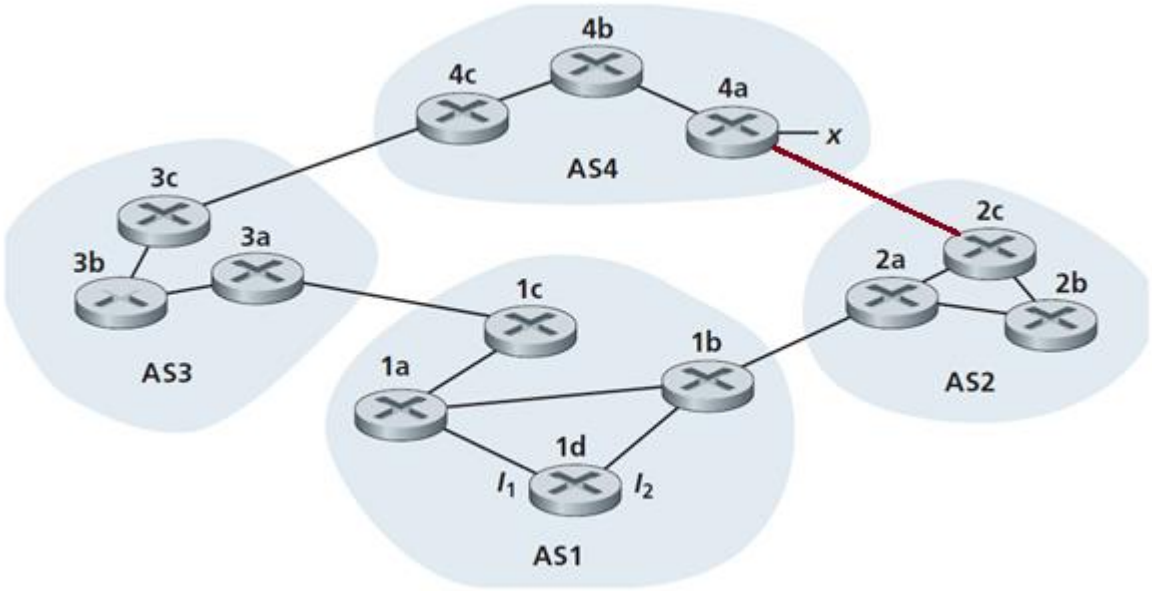
a. Router 3c learns about prefix x from which routing protocol? **Answer: eBGP**

b. Router 3a learns about x from? **Answer: iBGP**

c. Router 1c learns about x from? **Answer: eBGP**

d. Router 1d learns about x from? **Answer: iBGP**

e. Once router 1d learns about x it will put an entry (x, I) in its forwarding table. Will I be equal to I_1 or I_2 for this entry? **Answer: I_1, because this interface begins the least cost path from 1d towards the gateway router 1c.**

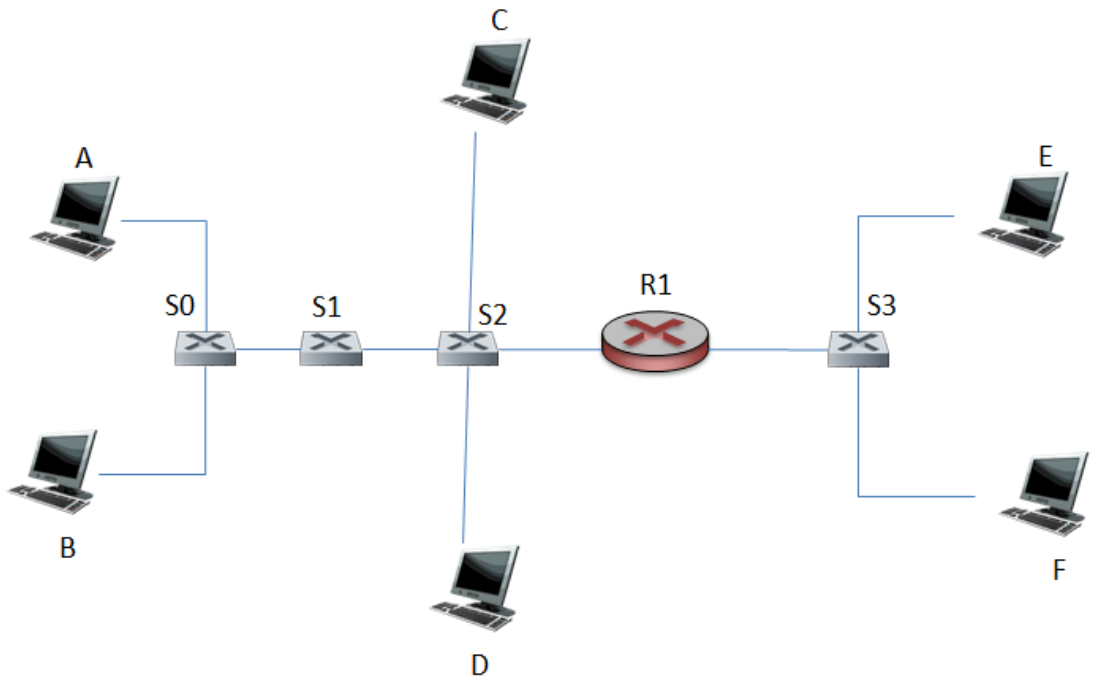


f. Now suppose that there is a physical link between AS2 and AS4, shown by the dotted line. Suppose router 1d learns that x is accessible via AS2 as well as via AS3. Will I be set to I_1 or I_2? **Answer:** I_2. Both routes have equal AS-PATH length but I2 begins the path that has the closest NEXT-HOP router.

g. Now suppose there is another AS, called AS5, which lies on the path between AS2 and AS4 (not shown in diagram). Suppose router 1d learns that x is accessible via AS2 AS5 AS4 as well as via AS3 AS4. Will I be set to I_1 or I_2?

Answer: I_1, as it begins the path that has the shortest AS-PATH.

2. (textbook chapter 6, adapted from problem P15): Consider the following network:



Where S0, S1, S2, and S3 are switches and R1 is a router. Note that the hosts at different side of R1 belong to different subnets.

a. Consider sending an IP datagram from Host E to Host F. Will Host E ask router R1 to help forward the datagram? Why? In the Ethernet frame containing the IP datagram, what are the source and destination IP and MAC addresses?

Answer: No. E can check the subnet prefix of Host F's IP address, and then learn that F is on the same LAN. Thus, E will not send the packet to the default router R1.

Ethernet frame from E to F:

Source IP = E's IP address, Destination IP = F's IP address

Source MAC = E's MAC address, Dest. MAC = F's MAC address

b. Suppose host E would like to send an IP datagram to host B, and assume that E's ARP cache does not contain B's MAC address. Will E perform an ARP query to find B's MAC address? Why? In the Ethernet frame (containing the IP datagram destined to B) that is delivered to router R1, what are the source and destination IP and MAC addresses?

Answer: No, because they are not on the same LAN. E can find this out by checking B's IP address.

Ethernet frame from E to R1:

Source IP = E's IP address, Destination IP = B's IP address

Source MAC = E's MAC address, Dest. MAC = The MAC address of R1's interface connecting to S3

c. Suppose Host A would like to send an IP datagram to Host B, and neither A's ARP cache contains B's MAC address nor does B's ARP cache contain A's MAC address. Further suppose that the switch S1's forwarding table contains entries for Host B and router R1 only. Thus, A will broadcast an ARP request message. What actions will switch S1 perform once it receives the ARP request message? Will router R1 also receive this ARP request message? If so, will R1 forward the message? Once Host B receives this ARP request message, it will send back to A an ARP response message. But will it send an ARP query message to ask for A's MAC address? Why? Will switch S1 receive the ARP response message from B?

Answer: Switch S1 receives the Ethernet frame from its left interface and will forward it to the right interface as the received ARP frame's destination MAC address is a broadcast address. And it also learns that A resides on the left interface of S1 and S1 will update its forwarding table to include an entry for Host A.

Yes, router R1 also receives this ARP request message, but R1 won't forward the message.

B won't send ARP query message asking for A's MAC address, as this address can be obtained from A's query message.

As ARP reply is a unicast message with destination MAC = A's MAC address and switch S0 already has A's entry in its switch table, it will only forward to A. Hence, switch S1 will not receive B's response message.