Problem Set #2

Due Wednesday October 11th by 3:00 PM

Problem 1 (6 points)

(a) Is 20.20.0.255/255.255.254.0 a valid IP address for a host? **[1pt]**
(b) Divide the 20.20.0.0/16 subnets into 10 large networks of 4096 IPs each, 16 medium-sized networks of 1024 IPs each, and 10 small sized networks of 128 IPs each. **[4pt]**
(c) Is 192.168.2/23 and 192.168.3/23 representing the same subnet? Please justify your answer. **[1pt]**

Problem 2 (5 points)

An organization has been assigned the prefix 212.1.0.0/23 and wants to form subnets for 4 departments which have the following number of hosts:

Department A:	140 hosts
Department B:	124 hosts
Department C:	62 hosts
Department D:	31 hosts

(a) Give a possible arrangement of subnet masks to make this possible. **[4pt]**
(b) Suggest what the organization might do if department C grows to 65 hosts. **[1pt]**

Problem 3 (12 points)

For the network given below in Figure. 1, give global distance-vector tables like those on textbook(Computer Networks Fifth Edition by Larry Peterson) Table 3.10, 3.13 **WHEN:**

(a) Each node knows only the distance of its immediate neighbors. **[4pt]**
(b) Each node has reported the information it had in the preceding step to its immediate neighbors. **[4pt]**
(c) Repeat step (b) one more time. **[4pt]**

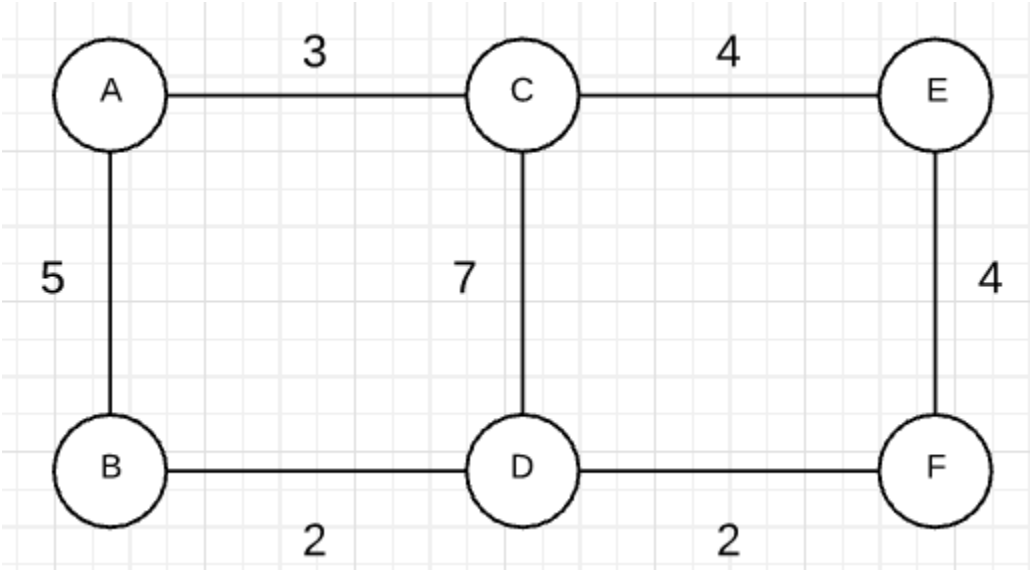


Figure. 1

Problem 4 (6 points)

Again for the network graph in Figure. 1. Show how the link-state algorithm builds the **routing table for node D.**

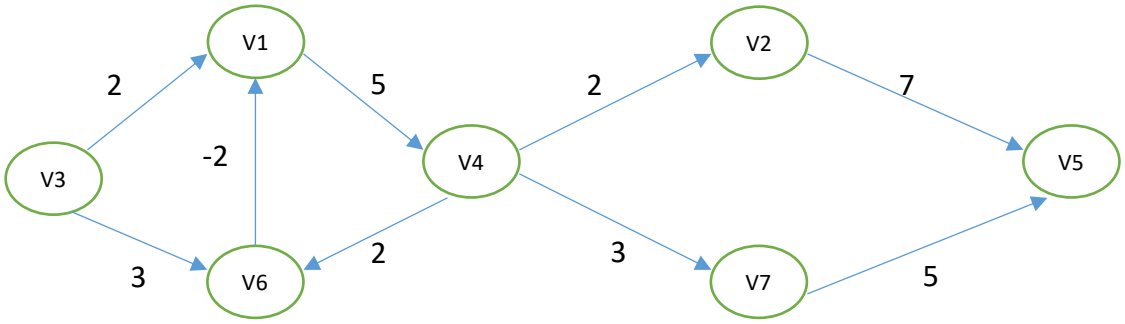
(a) Show the detailed link-state algorithm. **[4pt]**
(b) Show the final routing table of node D. **[2pt]**

Problem 5 (10 points)

(a) Give Names of two Distance Vector Routing Protocols **[1pt]**
(b) Give names of two link-state routing protocols. **[1pt]**
(c) What is the main difference between these two types of protocols. **[2pt]**
(d) Comment on scalability, convergence time, computation overhead of these two types. **[2pt]**
(e) Which type do you think is more suitable for the scale of Internet level network, explain your answer. Give name of the popular protocol that is used by the Internet routers. **[4pt]**

Problem 6 (5 points)

Consider this directional graph below in Figure 4. Use Dijkstra's algorithm to find the shortest path from node v3 to v5. Write down the **steps**. Do you have any comments on the result?



Problem 7 (7 points)

(a) Describe what are CSMA/CD, CSMA/CA and their difference. **[3pt]**

(b) Why is collision detection more complex in wireless networks such as 802.11 compare to wired networks such as Ethernet. **[2pt]**

(c) How can hidden terminals be detected in 802.11 networks? Explain how it works. **[2pt]**

Problem 8 (8 points)

The network graph is shown in Figure. 2.

(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. **[2pt]**

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

(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. **[3pt]**

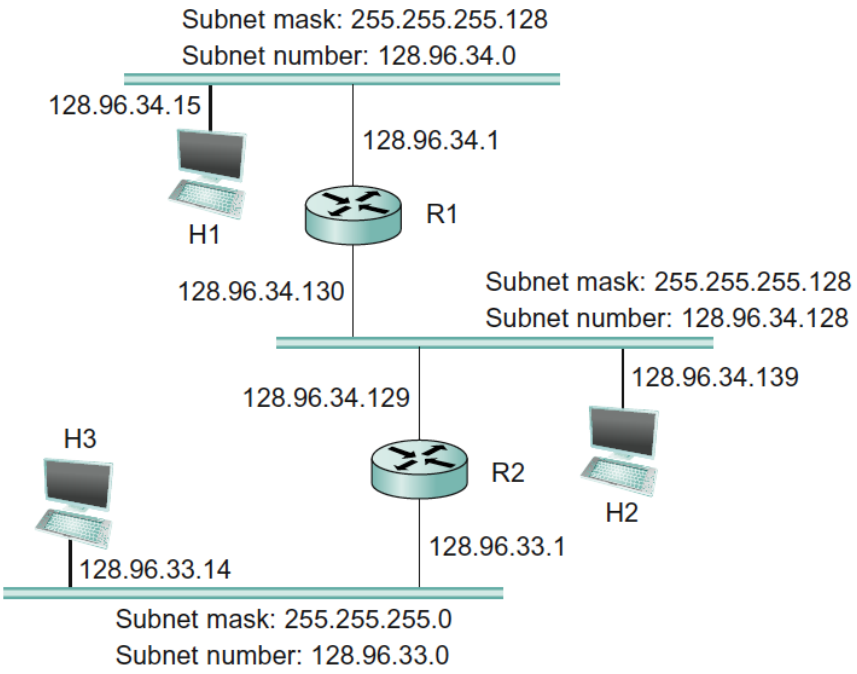


Figure 2.

Problem 9 (8 points)

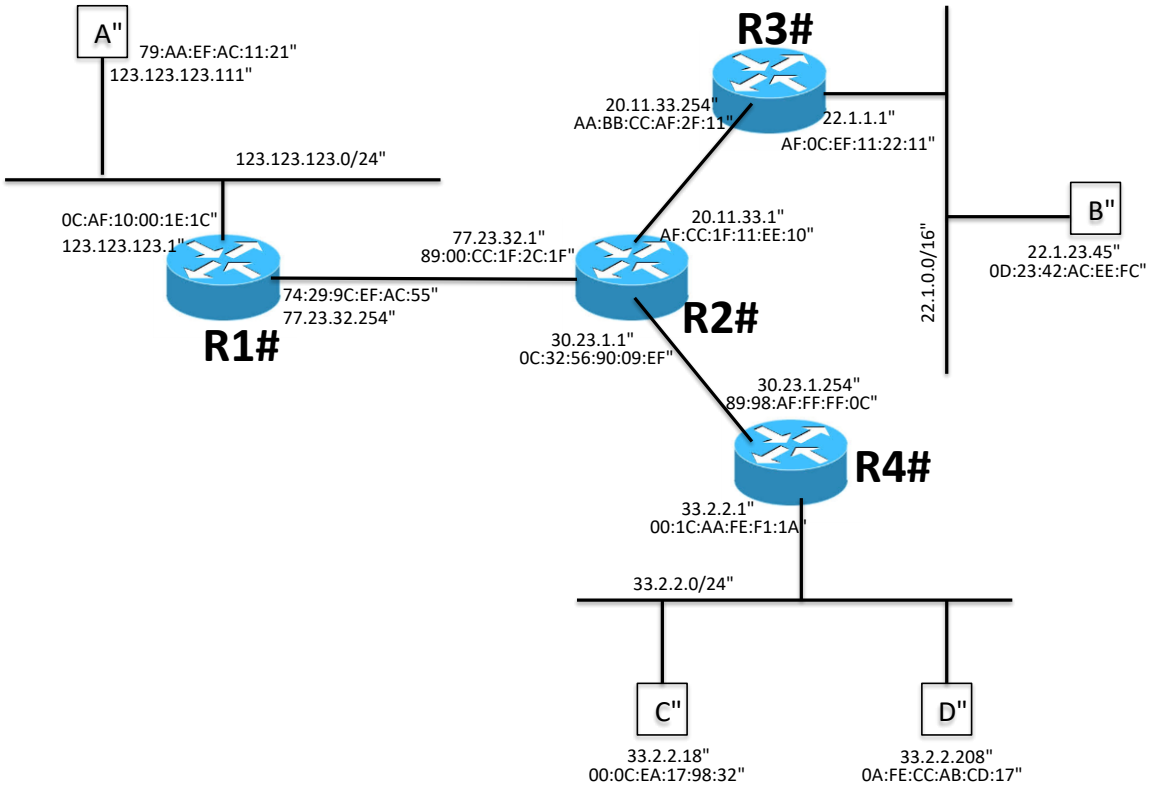


Figure. 3

Above in Figure 3 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 A send an IP packet to D 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: **[8pt]**

	src MAC	dst MAC	src IP	dst IP
A -> R1				
R1 -> R2				
R2 -> R4				
R4 -> D				

Table. 1

Problem 10 (5 points)

Suppose a router has built up the routing table shown in the Table 2 shown below. The router can deliver packets directly over interfaces 0 and 1, or it can forward packets to routers R2, R3, or R4. Assume the router does the longest prefix match. Describe what the router does with a packet addressed to each of the following destinations:

(a) 128.96.171.92.

(b) 128.96.167.151.

(c) 128.96.163.151.

(d) 128.96.169.192

(e) 128.96.165.121

Table 3

SubnetNumber	**SubnetMask**	**NextHop**
128.96.170.0	255.255.254.0	Interface 0
128.96.168.0	255.255.254.0	Interface 1
128.96.166.0	255.255.254.0	R2
128.96.164.0	255.255.252.0	R3
default		R4

Problem 11 (8 points)

Consider the simple network in Figure 5 below, X, Y and Z are switches and link cost as specified. Assume Distance Vector algorithm is used and have converged. Now Y's and Z's Routing table will look like Table. 3.

(a) Now Let assume the cost of link X-Y suddenly changed to 60. 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 to Y. **[2pt]**

(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. **[2pt]**

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

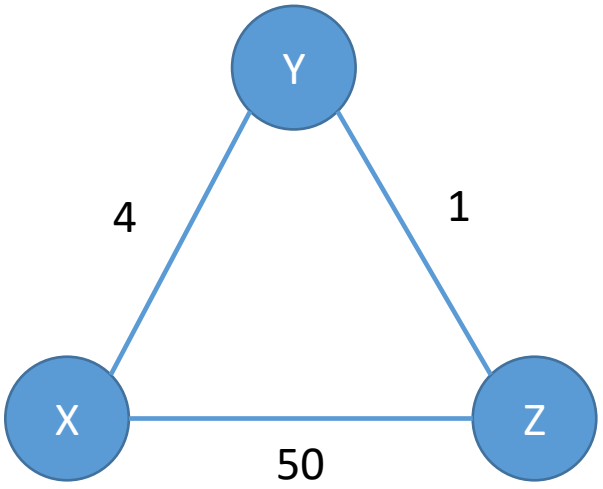


Figure. 5

Node Y/Distance	Via X	Via Z
X	4	6
Node Z/Distance	Via X	Via Y
X	50	5

Table. 3

Problem 12: (20 Points) Wireshark Exercise.

Objective of this exercise is to understand the different protocols used during the basic Internet access through packets captured in Wireshark. Follow the instructions below and capture the traffic. Analyze the traffic to provide answers for the questions asked. (If you are submitting the problem set as a hard copy in the class, please attach the print out of this page which includes your screenshots)

Download and Install Wireshark:

- https://www.wireshark.org/

User guide (for professional reference, not to memorize!)

- https://www.wireshark.org/download/docs/user-guide-us.pdf

Watch these videos if you are not familiar with the Wireshark.

- https://www.youtube.com/watch?v=6X5TwvGXHP0
  - **HakTip - How to Capture Packets with Wireshark - Getting Started**
- https://www.youtube.com/watch?v=r0l_54thSYU
  - **Wireshark Packet Sniffing Usernames, Passwords, and Web Pages**

Capture DHCP, ARP and DNS in action

1. After you confirm Wireshark is operational, stop your capture (don't close Wireshark)
2. Then close all online applications running on your system (from web browsers, email clients, skype.. and so on)
3. Disable your wireless Interface (via network adapter page and/or physical button)
4. Wait 5-7 minutes for IP/ Arp cache to timeout.
5. Then start capture on Wireshark
6. Turn on wireless adapter
7. Open a new web browser window (with no tabs)
8. Go to www.colorado.edu
9. Stop capture.

(a) If everything went correctly, your Wireshark capture should have a copy of all protocols mentioned before. Using Wireshark answer the following questions by inserting a small screenshot of your findings for each: **[10 points]**

- What is the MAC address of your PC?
- What is the IP address of your Default gateway? What is its MAC address?
- What is the IP address was given to your PC via DHCP?

- Who is your DNS Server?
- What protocol is used by your web browser? What port numbers it uses?
- What is the IP address of the server hosting www.colorado.edu?
- What other application protocols did Wireshark captured? (Other than http)

(b) Following question is very important from a job interview perspective. Write the answer in your own words. We do not need detailed explanation here, just a high-level overview. However, knowing detailed information about each step will certainly help.

Explain the steps involved after you turn on the adapter till the web page for e.g. www.yahoo.com is rendered on the browser. What is the order of operation between all protocols? What happened first, second, third and so on? (hint: Wireshark captures them sequentially). Explain what did each one of the protocols do to serve your basic web browsing request? **[10 Points]**