COMP3234B Computer and Communication Networks
ELEC3443B Computer Networks

Problem Set Assignment Three

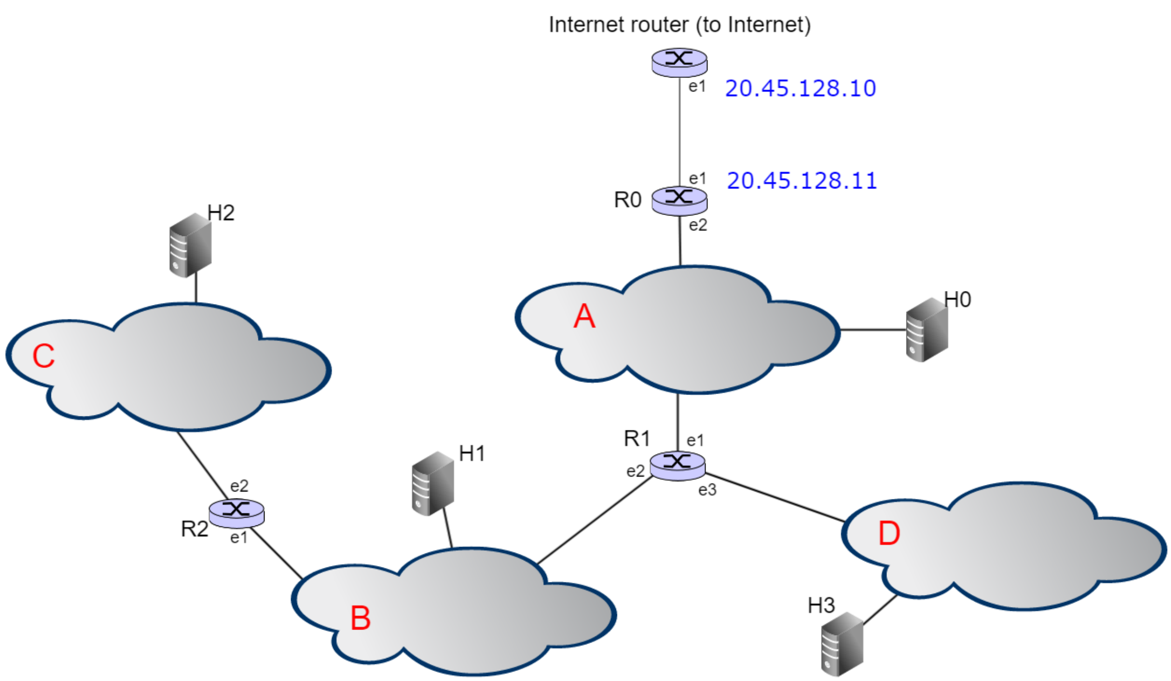
Total 7 points

Due date: 17:00 April 30, 2022

Answer all questions. Hand in the assignment via the Moodle System.

Question 1 (2 points) (This question is related to ILO2b – "be able to comprehend and explain the principles behind IP technology and IP addressing" and ILO5 – "be able to plan for IP networks and properly assign IP addresses to interfaces in given networks.")

The following figure shows an organization with four subnets.



Assume you are the network administrator of this organization. You are going to

i. (0.8 points) assign a **contiguous block of IP addresses** to each subnet and label each subnet with the corresponding subnet address and mask,
ii. (0.1 points) find and list the remaining IP addresses, i.e., show the first and last unallocated IP addresses.
iii. (0.3 points) assign IP addresses to the interfaces of routers R0, R1, & R2 and hosts H0, H1, H2, & H3,
iv. (0.6 points) construct the forwarding table for the routers R0, R1, & R2,

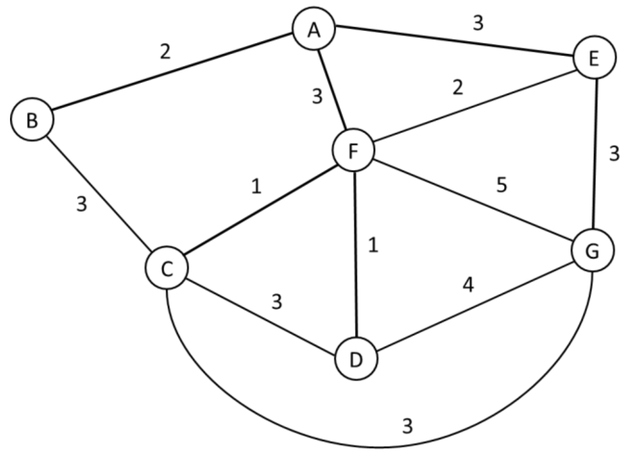
with following constraints:

1. The expected number of hosts in each subnet is:
    a. Subnet A: 80
    b. Subnet B: 200
    c. Subnet C: 500
    d. Subnet D: 500
2. The organization is allocated with the network address: 147.8.176.0/21.
3. Allocate address blocks contiguously such that no unallocated address block exists between subnets.
4. When allocating an IP address to a router's interface, always allocate the smallest usable IP address available in that subnet associated with that interface. If there are two routers associated with the same subnet, always assign an IP address to the router with a smaller ID first.
5. When allocating an IP address to a host's interface, always allocate the largest usable IP address available in that subnet associated with that interface.
6. You are expected to use the least amount of routing entries to represent all the subnets of this site in each forwarding table.
7. Present the routing table with the following information:
   Destination address/mask, Nexthop, Interface.
   where
   Nexthop gives the target IP address of the nexthop router along the path to the destination; if the destination network is the ultimate destination of the packet, leave Nexthop field as empty;
   Interface gives the network interface of the router that leads to the nexthop router or the ultimate destination.

7. Each router has a default routing entry for forwarding all packets destined to other Internet addresses that are not covered by existing entries.

Question 2 (1.2 points) (This question is related to ILO 2b – "be able to comprehend and explain the principle behind link-state and distance-vector routing" and ILO3 – "be able to carry out routing algorithms".)

a) (0.8 points) Given the following weighted network graph, find the least cost route from **Node G** to all other nodes by using Dijkstra's shortest-path algorithm. Present your calculation in a format similar to Table 4.3 (6^{th} Ed.) or Table 5.1 (7^{th} Ed.) of the textbook. Also, present the forwarding table of **Node G**. (Each entry of the forwarding table includes {destination, cost, nexthop}. Nexthop in is this context referred to the router id of the next hop to which packets for the entry should be forwarded to.)



b) (0.4 points) Using the concept of control flooding, with the above network, find the total number of packets that will be transmitted in the network if a LSA packet originates at **Node G** with a network hop limit (TTL) of three and a SeqNo of 11 (which is a new SeqNo)?

Question 3 (1 point) (This question is related to ILO2 – "be able to describe the working principles behind key protocols used in modern computer networks - CRC".)

a) (0.4 points) Suppose we want to transmit the message 1011000011101010 and protect it from errors using the CRC polynomial $x^4 + x^2 + x + 1$. Determine the message *T(x)* that should be transmitted.

b) (0.3 points) Suppose the channel introduces a burst error that affects the 2nd, 4th, 5th & 6th bits of *T(x)* (counting from the left). What is received? Can the error be detected?

c) (0.3 points) Repeat part (b) with a burst error that affects the 1st, 2nd, 4th & 5th bits (counting from the left).

Question 4 (1.2 points) (This question is related to ILO2 – "be able to describe the working principles behind key network technologies and protocols used in modern computer networks.")

A user on Host A, requests the web page http://datatracker.ietf.org/doc/html/rfc1071. Below shows the network configuration of Host A:

Physical Address (eth_A):	00-22-5F-64-32-AB
IP Address (IP_A):	54.18.103.238
Subnet Mask:	255.255.255.0
Default Gateway:	54.18.103.2
DNS Server:	8.8.8.8

Assume that:

- Host A does not use proxy server or local Web cache.
- Host A's ARP cache and DNS cache are empty.

The table below shows a number of packets sent/received in servicing this request (this is not necessarily a complete list of all packets). The packets are presented in temporal order (by the *step* column). The *protocol* column identifies the protocol contained in the packet that is related to the content (carried in the packet). The columns *SRC MAC* and *DST MAC* contain the link-layer source and destination addresses (appeared in the frame) while the columns *SRC IP* and *DST IP* contain the IP source and destination addresses (appeared in the datagrame) where applicable. The *Contents* column gives a short description of the event/information related to that network protocol.

For each packet, identify the protocol and complete the table by filling in corresponding information.

Step	SRC MAC	DST MAC	SRC IP	DST IP	Protocol	Contents
1						Who has 202.189.103.2?
2						202.189.103.2 is at 00-22-5E-00-01-F5
3						Query A datatracker.ietf.org
4						Query response datatracker.ietf.org is 104.16.45.99
5						SYN
6						SYN + ACK
7						GET /doc/html/rfc1071 HTTP/1.1
8						HTTP 1.1 200 OK

Question 5 (1.6 points) (This question is related to ILO2c – "be able to comprehend the challenges and explain the principles in providing medium access control in shared link-layer network".)

a) Consider a CSMA/CD network running at 20 Mb/s over 3-km cable with no repeaters. The signal speed in the cable is 2×10^8 m/s. Suppose station A starts transmitting a frame of size 400 bytes at time T.
   i. (0.3 points) Can it happen that station A detects a collision at time T+10 μs (micro seconds) if there was no collision detected between time T and T+10 μs? Justify your answer.
   ii. (0.3 points) Can it happen that the station detects a collision at time T+20 μs, if there was no collision detected between time T and T+20 μs? Justify your answer.
   iii. (0.3 points) Can it happen that the station detects a collision at time T+33 μs, if there was no collision detected between time T and T+33 μs?? Justify your answer.

b) Suppose your notebook is connecting to the Internet by WiFi using 802.11g (54 Mb/s).
   i. (0.4 points) Suppose your notebook and the AP are using the RTS/CTS sequence to reserve the channel. If your notebook wants to transmit a 802.11 frame of size 1034

bytes, and all other stations are idle at this time. Given that the size of the frames that carry RTS, CTS, and ACK is 20 bytes, and the waiting times of SIFS and DIFS are 10µs and 28µs respectively. Assuming no bit errors and ignoring propagation delay, calculate the time required to transmit the frame and receive the acknowledgment.

ii. (0.3 points) Suppose the above WiFi network is using the standard CSMA/CA scheme (i.e., without RTS/CTS), with the same operational parameters, calculate the time required for transmitting the frame and receiving the acknowledgment.