COMP 3721: Assignment #4

General Instruction

- To receive any credit, the answers for this assignment must be **handwritten** and need to be legible by the grader.
- When you solve a problem, show all the steps and add comments as necessary to make sure your answers are clear and unambiguous to the grader.
- You may discuss questions in broad terms with others but ultimately your answers should demonstrate your own individual thought process and effort.
- All work submitted is subject to the standards of conduct as specified in BCIT Policy 5104.

Submission

- This assignment is due on **Apr 8, 2020** at **1730** for all sets (Burnaby and DTC).
- Submit using the filename ***lastname_firstname.pdf*** to BCIT Learning Hub (Assignment Submission | Assignment 4). You are allowed only one submission and no late assignments will be accepted.
- Your submissions must include a **cover page** clearly specifying your **name**, **student number** and **set**.

Marking

- This assignment consists of **5 questions** totaling **49 marks**.

  Note: You are encouraged to work on Question 6, but it is not required for submission.

Problems

(1) [8 marks] Consider an IP datagram with the following attributes:

Size of IP header:	48 bytes
Total length of IP datagram:	2240 bytes
D (do not fragment) flag:	0
M (more fragment) flag:	0
Fragmentation offset:	0

Suppose this IP datagram is transmitted in a network where the total length of a fragment is 688 bytes and hence, this IP datagram needs to be fragmented. [Note: The total length of an IP datagram includes both the header and the payload.]

a) [2 marks] Determine the number of fragments that will be created as this IP datagram travels through the network.

b) [6 marks] Determine the value of the following fields for each fragment and present your answer in a table as shown.

- Total Length
- M Flag
- Fragmentation Offset

	Fragment 1	**Fragment 2**	**...**
Total Length (in decimal, in units of 1-byte)			
M Flag			
Fragmentation Offset (in decimal, in units of 8-bytes)			

(2) [16 marks] Suppose a router has the following entries in its forwarding table.

Network Address/Prefix Length	Interface
135.46.56.0/22	A
135.46.60.0/22	B
135.46.32.0/19	C
192.53.40.0/23	D
192.48.0.0/13	E
Default	F

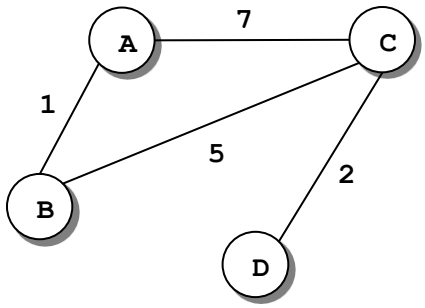
For each of the following destination IP addresses, determine (i) all the entries of the forwarding table that match the destination IP address and (ii) the interface that the packet will be sent out to. Show all steps.

a) [4 marks] 135.46.63.10
b) [4 marks] 192.39.7.67
c) [4 marks] 135.46.57.14
d) [4 marks] 192.53.41.7

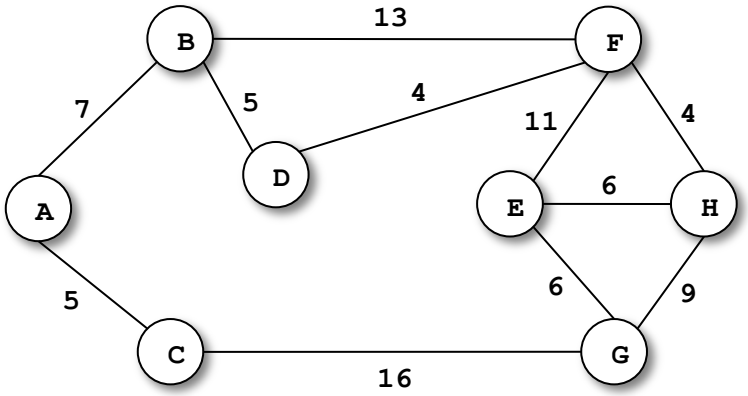
(3) [9 marks] An organization is granted a block of IP addresses starting with 204.17.160.0/19. The network administrator has been requested to create 10 subnets, each with an equal number of IP addresses. You may assume that there are no restrictions on the IP addresses that can be allocated.

a) [1 mark] Determine the maximum number of IP addresses that can be assigned in this block.
b) [4 marks] Determine the first and last IP addresses that are allocated to the 1st subnet. Specify the IP addresses in both binary and dotted decimal notations.
c) [4 marks] Determine the first and last IP addresses that are allocated to the 6th subnet. Specify the IP addresses in both binary and dotted decimal notations.

(4) [7 marks] Apply the distance-vector routing algorithm to the network shown below and determine the stable distance vector for each node after convergence. Show all intermediate steps and provide a summary of your answer.



(5) [9 marks] Apply Dijkstra's algorithm to the network shown below. Determine and list the shortest paths and costs from node A to all other nodes. Show all intermediate steps and provide a summary of your answer.



(6) [15 marks] Wireshark: Internet Protocol and Transmission Control Protocol

In this question of the assignment, you will use Wireshark, a packet sniffer, to investigate the behaviors of the IP and TCP protocols. You will analyze a trace that contains TCP segments logged during the transfer of a file containing the text of *Alice's Adventure in Wonderland* by Lewis Carroll. Note that you do not need to read the full text to answer the following questions. If you require an introduction to the Wireshark tool, read the "Introduction to Wireshark" document, adapted from Forouzan, B.A., Data Communications and Networking, 5th Ed. New York, NY: McGraw-Hill, 2013.

- Download the Wireshark trace file, ***assignment4.pcapng***, from BCIT Learning Hub | Content | Assignment.
- View the trace in Wireshark by selecting *File* | *Open* from the pull down menu in Wireshark and select ***assignment4.pcapng***.

What you should see is series of TCP and HTTP messages between your computer and the server including the initial TCP three-way handshake.

Answer the following questions using the provided Wireshark trace file.

a) [1 mark] What is the IPv4 address and port number of the client used to send the HTTP GET request to the server?

b) [1 mark] What is the IPv4 address and port number of the server used to receive the HTTP GET request from the client?

c) [1 mark] What is the header length of the IP packet containing the HTTP response (HTTP/1.1 200 OK) returned by the server?

d) [3 marks] For the IP packet in part (c), extract the IP header information and calculate the IP header checksum. Show all steps of your calculation and verify against the checksum reported in Wireshark.

e) [2 marks] What is the absolute sequence number (i.e., not relative), in decimal (not hexadecimal), of the SYN segment that is used to initiate the TCP connection between the client and server? How is this SYN segment identified? [Hint: The absolute sequence number can be found by exploring the contents of the SYN segment in the packet byte pane.]

f) [3 marks] Depict the TCP connection establishment between the client and the server using three-way handshaking as shown in Figure 24.10 in Forouzan, B.A., Data Communications and Networking, 5th Ed. New York, NY: McGraw-Hill, 2013. For each segment, indicate the absolute sequence/acknowledgement numbers in decimal (not hexadecimal) and the control flags that are set in the TCP header.

g) [4 marks] Depict the TCP data transfer of the first four *TCP segments of a reassembled PDU* and associated acknowledgements between the client and the server (i.e., not including the HTTP GET request and associated acknowledgement) after the initial three-way handshaking as shown in Figure 24.11 in Forouzan, B.A., Data Communications and Networking, 5th Ed. New York, NY: McGraw-Hill, 2013. For each segment, indicate the TCP segment length and the absolute sequence/acknowledgement numbers in decimal (not hexadecimal).