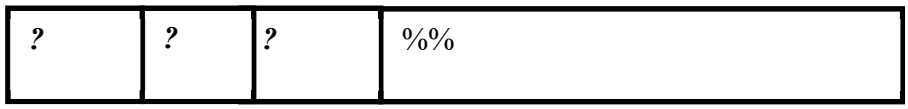
Assignment 4: CMPT 371
To be completed in groups of 1 or 2

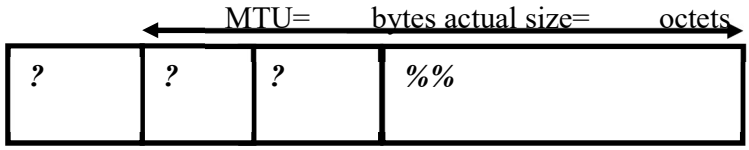
1) **[19 points]** A source host sends a packet with an MTU of 1500 octets in an Ethernet frame. The MTU or maximum transmission unit indicates the length of the data field in the Ethernet frame (the length of the IP packet). The length of the IPv4 header is 32 octets. The length of the TCP header is 24 octets. On its way to the destination the packet passes through a network with a MTU of 920 octets. Explain how the packet is fragmented by filling in the requested information in the diagram below. You should create a copy of the diagram below including the information requested in your solution. The data you are to fill in is indicated in two ways
    a. A space after an = needs to be filled with a numeric value
    b. A ? needs to be replaced with a label indicating the type of header and its length in octets
    c. A %% indicates that the field should hold the length of the application data (without any encapsulating headers). In addition to the final answer you should provide an equation showing how that length was calculated (either words or just an expression showing how you combined the supplied values to determine the length.).

    Remember the payload of the IP datagram for each fragment (except the last) must be a multiple of 8.
    Consider what would change in your calculation if the MTU was increased to 927. Does the amount of data and / or the offset in the first fragment change when the MTU is increased from 920 to 927? Give an explanation, including a calculation, of why the amount of data changes (or does not change) and why the offset changes (or does not change).

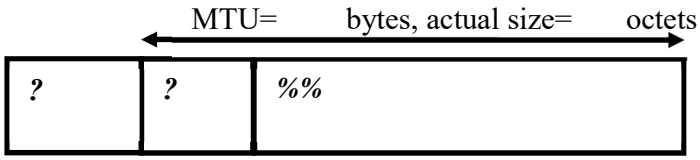
Original Ethernet frame before fragmentation



Ethernet frames containing IP fragments after fragmentation



More=
Offset= octets



More=
Offset= octets
= ***(value in header field)***

2) Consider routing within an AS (autonomous system). Answer the following questions regarding routing protocols. Each answer should be no more than two sentences per point.

a) [2 points] What is an AS?

b) [1 point] Where is an internal routing protocol used?

c) **[1 point]** Where is an external routing protocol used?

d) [2 points] What is a distance vector?

e) [1 point] When using a link state type protocol what routing information is exchanged?

f) [2 points] Consider a router A in an AS. When using a link state type protocol which routers send routing information to Router A? Which routers does Router A send routing information to?

g) **[2 points]** One of the problems with distance vector based routing is slow convergence. What is slow convergence?

h) [3 points] Is RIP a link state routing protocol? How does RIP mitigate (reduce) the effects of slow convergence?

i) [2 points] What problem does RIP use triggered updates to mitigate? Briefly explain how triggered updates mitigate this problem.

j) **[1 point]** When using a link state protocol what routing information is exchanged?

k) [4 points] Give an example of a link state protocol discussed in class. What method does this protocol used to share routing information between routers? Give a two to three sentence summary of this method.

3) **[14 points]** Consider the distributed Bellman-Ford algorithm used in the first generation internet. At station A, new routing tables have just arrived from A's nearest neighbors B and D. The cost from A to B is 6 and the cost from A to D is 4. These newly received distance vectors are given below. Based on these newly received distance vectors calculate a new distance vector for node A.

	from B		from D	
	Cost	Next	Cost	Next
A	6	A	2	A
B	-	-	7	G
C	3	C	6	G
D	8	A	-	-
E	2	E	5	G
F	10	C	13	G
G	3	E	4	G
H	7	E	8	G

			New table	
	Cost	***Cost***	***Cost***	***Next***
A	-	-	-	-
B				
C				
D				
E				
F				
G				
H				

4) **[20 points]** Consider a system using flooding with a hop counter. Suppose that the hop counter is originally set to the diameter of the network. When the hop count reaches zero, the packet is discarded except at its destination. Does this always insure that a packet will reach its destination if the case that there exists at least one operable path? Why or why not? Give an example or counter example.

5) A CRC is constructed to generate a 8 bit Frame Check sequence for a 19 bit message. The generator polynomial is $P(X) = X^8 + X^7 + X^4 + X^3 + X + 1$, The message bits for a particular message are

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

a) **[4 points]** Draw a shift register circuit to perform the calculation of the CRC bits.

b) [4 points] List four examples of the types of errors an FCS can detect.

a) **[6 points] [6 points]** Can the errors represented by each of the following error polynomials *E*(*X*) be detected by the CRC? Why or why not?

0010000100000010000
0000000010101100000
0001000111111000000

c) [7 points] Determine the FCS using polynomial division. Show your work

d) [9 points] Determine the FCS using your shift register circuit. Show your work.