COMP 445 – Theoretical Assignment 3 (TA3)

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All questions will receive equal points. Please submit your assignment as a pdf file on Moodle. The name of the pdf file must contain your name and student id. Your name and student id must also appear in the header of the pdf document. Please answer the questions in the order used below and indicate the question number before your answer (e.g., **Q1**). Wherever possible, briefly indicate the method used to obtain a numerical value, e.g., mathematical formula. Due date: **April 7, 11:55pm**.

1 Network Layer

Q1 - Briefly describe the two main functions of the network layer, namely forwarding and routing.

Q2 - Explain the primary role of the `identification` field in the IPv4 datagram format.

Q3 - Consider two hosts A and B located in a NAT'ed network. Assume that the IP addresses of A and B are 10.0.0.1 and 10.0.0.2, respectively. Assume that the IP addresses of the NAT router are 10.0.0.3 (LAN side) and 132.205.244.42 (WAN side). What will be the content of the NAT translation table after A and B connected to the Web server at `www.concordia.ca` (132.205.244.70)? Assume that A connected from port 1234 and that B connected from port 1235.

Q4 - The content between the two lines below was captured using Wireshark:


Type: 8 (Echo (ping) request)
Code: 0
Checksum: 0x068c [correct]
Checksum Status: Good
Identifier (BE): 4737 (0x1281)
Identifier (LE): 33042 (0x8112)
Sequence number (BE): 1 (0x0001)
Sequence number (LE): 256 (0x0100)
Response frame: 2
Timestamp from icmp data: Mar 20, 2017 10:58:19.000000000 EDT
Timestamp from icmp data (relative): 0.514140297 seconds

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1. To which protocol does this content correspond to?
2. To which layer in the Internet model does this protocol belong to?
3. What is the meaning of the string in bold face (**Type 8**)?
4. Describe a possible follow-up message for this content, i.e., how a host may respond to this message. Only a high-level description of the message is expected, i.e., you don't have to write the complete message explicitly.

Q5 - Using the Dijkstra algorithm, compute the least-cost paths from A to all the other nodes in the graph below. Your answer will have to detail the successive iterations of the algorithm.
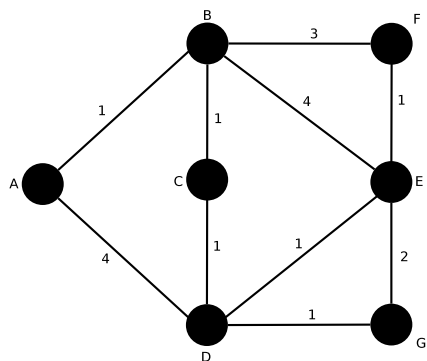
Q6 - Routing Information Protocol (RIP). Starting from the initial RIP table in C shown below, suppose that C receives from A the following advertisement. Will the table in C change? If so how?

– Original RIP table in C:

Destination subnet	Next router	Hops to destination
u	-	1
v	D	3
w	D	4
x	A	3

– Advertisement received by C from A:

Destination subnet	Next router	Hops to destination
u	C	2
v	B	2
w	-	1
x	B	2

2 Link Layer

Q7 - (P2 in Textbook, 6th edition). Give an example showing that two-dimensional parity checks can correct and detect a single bit error. Show a double-bit error that can be detected but not corrected.

Q8 - (R6 in Textbook, 6th edition). In CSMA/CD, after the fifth collision, what is the probability that a node chooses K=4? The result K=4 corresponds to a delay of how many seconds on a 10 Mbps Ethernet?

Q9 - What is the MAC address used for broadcast? Explain when and why such a broadcast address is used in ARP (Address Resolution Protocol).

Q10 - What is the main difference between Pure Aloha and Slotted Aloha? Are there any circumstances where Pure Aloha would perform better than Slotted Aloha? If so, give such circumstances/conditions. If no, explain why Pure Aloha could never perform better that Slotted Aloha.