Assignment #9

No late assignments accepted!

ECE 487 (Data Communications Networks) **Section B1** Dr. Hai Jiang
Electrical and Computer Engineering, University of Alberta Winter 2020
Your Last Name: _____ Your Fist Name: _____
Your Student ID: _____

Due: Tuesday, March 31, 2020, 4:00 PM (online submission)

1. Show the shortest form of the following IPv6 addresses. (**2 points**)
a) 0000:00AA:0000:0000:0000:0000:119A:A231
b) 2340:0000:0000:119A:0000:0000:0000:0A01

Solution
a) 0:AA::119A:A231
b) 2340:0:0:119A::A01

2. Show the original (unabbreviated) form of the following IPv6 addresses. (**2 points**)
a) 0:AA::0
b) 123::1:2

Solution:
a) 0000:00AA:0000:0000:0000:0000:0000:0000
b) 0123:0000:0000:0000:0000:0000:0001:0002

3. Consider an IPv4 packet is forwarded by routers in the Internet. For the following fields of the IPv4 header, please select one from "never change", "may change", and "always change". (**5 points**)

Field	Never change?	May change?	Always change?
Total length		X	
Identification	X		
Flags		X	
Time to live			X
Header checksum			X

Total length: may change (e.g., if fragmentation happens at a router)
Identification: never change
Flags: may change (e.g., if fragmentation happens at a router)
Time to live: reduced by one after each router
Header checksum: change after each router (change in any other field will make checksum change)

4. In an IPv4 packet, the M bit is 1, the value of HLEN is 5 (in decimal), the value of total length is 620 (in decimal), and the fragmentation offset value is 300 (in decimal). What are the index of the first (data) byte and the index of the last (data) byte in this packet? Is this the last fragment,

the first fragment, or a middle fragment? (**3 points**)

Solution:
Index of first byte: 300*8=2400
Index of last byte: 2400 + (620 - 5*4) - 1 = 2999.
It is a middle fragment. A nonzero offset means it is not the first fragment. M=1 means it is not the last fragment.

5. For Question 4, consider that the packet is fragmented by a router to three fragments with equal size. For each fragment, give the values of Total Length, M bit, and Fragmentation Offset. (**3 points**)

First fragment: Total Length = 220, M=1, Fragmentation Offset=300
Second fragment: Total Length=220, M=1, Fragmentation Offset=325
Third fragment: Total Length=220, M=1, Fragmentation Offset=350

6. An IPv4 packet arrives at a router with the following information as the first 20 bytes in the packet (in hexadecimal format)

45 04 00 A0 01 02 00 A0 10 01 ?? ?? 0A 0C 0E 05 0C 06 07 09

in which a "?" means a hexadecimal digit to be determined by you. (**5 points**)
a) Are there any options in the header?
b) Is the packet fragmented?
c) What is the size of data in the packet (not including header)?
d) Which higher layer protocol is used for the encapsulated data in the packet?
e) Please fill the four hexadecimal digits marked as "?".

Solution:
VER=4. HLEN=5. Service = 0x04. Total length= 0x00A0 = 160
Identification=0x0102. Flag bits=0b000. Fragmentation offset=160
Time to live = 0x10 = 16. Protocol=1
a) HLEN = 5. No options.
b) Yes, since the fragmentation offset is nonzero
c) 160 - 5*4 = 140 bytes.
d) ICMP
e) 0x4504 + 0x00A0 + 0x0102 + 0x00A0 + 0x1001 +0x0A0C + 0x0E05 + 0x0C06 + 0x0709 = 0x8267
So the checksum is 0x7D98.