CS A342
HW #5, 46 points total
**Due Thursday, Dec. 6, by 10 AM before class (will go over solutions)**

1. (2 pts) It turns out that the depth in the ocean to which airborne electromagnetic signals can be detected grows with the wavelength. Therefore, the military got the idea of using very long wavelengths corresponding to about 80 Hz to communicate with submarines throughout the world. It is desirable to have an antenna that is about one-half wavelength long. How long would that be? Your answer might suggest it would not be possible to communicate with submarines below water but there is a way!

2. (4 pts) Two-way data over geosynchronous satellites incurs about a 0.5 second round-trip latency.

   a. If your app could run over either UDP or TCP, which would
      give better performance over a geosynchronous satellite and why?
   b. What modifications could you make to TCP/IP to increase
      performance under these conditions?

3. (3 pts) Encode the bit pattern 1110101001 using Manchester Encoding.

4. (4 pts) Draw how the bit pattern 0110 would be sent using:
   a) Single bit Amplitude Modulation
   b) Single bit Frequency Modulation
   c) Two-bit AM (i.e. four amplitude levels)
   d) Single-bit AM combined with single-bit FM

5. (9 pts) Computers A,B,C, and D are connected via a bus-based LAN that uses CSMA/CD as the media access control protocol (e.g., Ethernet).
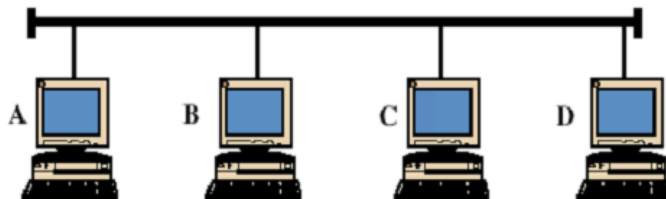
a) A and C decide to transmit at the same time and each detects a collision. What does A and C do to resolve the collision?

b) A and C decide to transmit at the same time and each detects a collision. What is the probability that A and C decide to retransmit at the same time, producing another collision?

c) A, B and C decide to transmit at the same time and each detects a collision. What is the probability that there will be another collision in A, B, and C's attempts to retransmit their data?

6. (6 pts) Computers A, B, and C are connected wirelessly using the IEEE 802.11 protocol (not using RTS/CTS) and want to send data at the same time. How does the protocol address this issue?

7. (4 pts) The hidden station problem in 802.11 is avoided by using RTS and CTS frames so the access point can grant access to only one station to send. But what happens if two stations hidden from each other both send a RTS at the same time?

8. (14 pts) The following LAN is initially started up and the switches have not learned anything. The IP address of each machine is given along with its link layer address (e.g. AB-01).
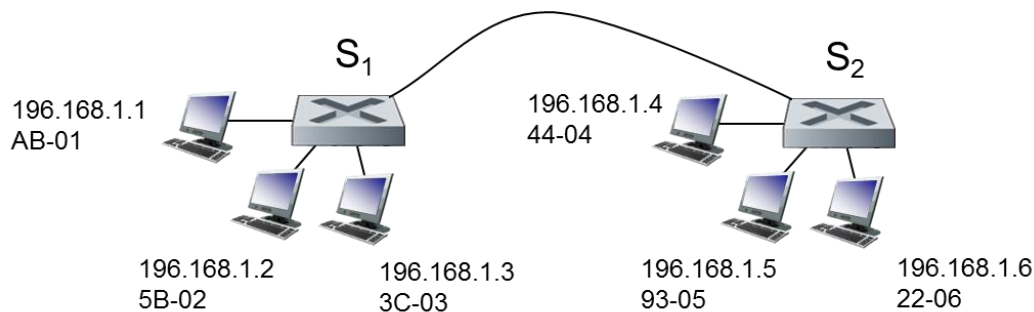
196.168.1.1 sends an ARP to learn which computer the MAC address for 196.168.1.3.
   a. Which computers receive the ARP request?
   b. Which computers see the ARP reply?
   c. After the ARP reply is received have both switches S1 and S2 learned in their switching table?

Next, 196.168.1.1 (AB-01) sends an Ethernet frame to 196.168.1.3 (3C-03).
   d. Which computers see the Ethernet frame?

Next, 196.168.1.4 (44-04) sends an Ethernet frame to 196.168.1.3 (3C-03). 196.168.1.4 doesn't send an ARP because it has cached the MAC address.
   e. Which computers see the Ethernet frame?
   f. After steps A through E what have both switches S1 and S2 learned in their switching tables?