Computer Communication Networks, Fall 2010
Homework 1 (Due 12:30pm Oct 5)

1. (Chapter 1, Problem P11) What are two reasons for using layered protocols?
2. (Chapter 1, Problem P13) What is the principal difference between connectionless communication and connection-oriented communication?
3. (Chapter 1, Problem 18) Which of the OSI layers handles each of the following:
   (a) Dividing the transmitted bit stream into frames.
   (b) Determining which route through the subnet to use.
4. (Chapter 1, Problem 20) A system has n-layer protocol hierarchy. Applications generate messages of length M bytes. At each of the layers, and h-byte header is added. What fraction of the network bandwidth is filled with headers?
5. (Chapter 1, Problem 21) List two ways in which the OSI reference model and TCP/IP reference model are the same. Now list two ways in which they differ.
6. (Chapter 2, Problem 1) Compute the Fourier coefficients for the function $f(t) = t$ $(0 <= t <=1)$.
7. (Chapter 2, Problem 2) A noiseless 4-kHz channel is sampled every 1 msec. What is the maximum data rate?
8. (Chapter 2, Problem 4) If a binary signal is sent over a 3-kHz channel whose signal-to-noise ratio is 20dB, what is the maximum achievable data rate?

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Homework 2 (Due 12:30pm Oct 28)

9. (Chapter 2, Problem 5) What is the signal-to-noise ratio is needed to put a T1 carrier on a 50-kHz line?
10. (Chapter 2, Problem 8) It is desired to send a sequence of computer screen images over an optical fiber. The screen is 480 × 640 pixels, each pixel being 24-bits. There are 60 screen images per second. How much bandwidth is needed, and how many microns of a wavelength are needed to for this band at 1.30 microns?
11. (Chapter 2, Problem 11) Radio antennas often work best when the diameter of the antenna is equal to the wavelength of the radio wave. Reasonable antennas range from 1 cm to 5 meters in diameter. What frequency range does this cover?
12. (Chapter 2, Problem 17) Using only the data given in the text, what is the maximum number of telephones that the existing U.S. system can support without changing the numbering plan or adding additional equipment? Could this number of telephones actually be achieved? For purposes of this problem, a computer or fax machine counts as a telephone. Assume there is only one device per subscriber line.
13. (Chapter 2, Problem 19) A regional telephone company has 10 million subscribers. Each of their telephone is connected to a central office by copper twisted pair. The average length of these twisted pairs is 10 km. How much is the copper in the local loop worth? Assume that the cross section of each section of each stand is a circle 1 mm diameter, the specific gravity of copper is 9.0, and the copper sells for 3 dollars per kilometer.
14. (Chapter 1, Problem 41) Three packet-switching networks each contain n node. The first network has a star topology with a central switch, the second is (bidirectional) ring, and the third is fully interconnected, with a wire form every node to every other node. What are best, average, and worst case transmission paths in hops.
15. (Chapter 3, Problem 1) An upper-layer packet is split into 10 frames, each of which has an 80 percent chance of arriving undamaged. If no error control is done by the data link protocol, how many times must the message be sent on average to get the entire thing through?
16. (Chapter 3, Problem 5) A bit string. 0111101111101111110, needs to be transmitted at the data link layer. What is the string actually transmitted after bit stuffing?

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Homework 3 (Due 12:30pm, NOV 4)

1. (Chapter 3, Problem 2) The following character encoding is used in a data link protocol:
   A:01000111; B:11100011; FLAG:01111110; ESC:11100000
   Show the bit sequence transmitted (in binary) for the four-character frame: A B ESC FLAG when each of the following framing methods are used:
   (a) Character count.
   (b) Flag bytes with byte stuffing.
   (c) Starting and ending flag bytes, with bit stuffing.
2. (Chapter 3, Problem 3) The following data fragment occurs in the middle of a data stream for which the byte-stuffing algorithm described in the text is used: A B ESC C ESC FLAG FLAG D. What is the output after stuffing?
3. (Chapter 3, Problem 9) Sixteen-bit messages are transmitted using a Hamming code. How many check bits are needed to ensure that the receiver can detect and correct single bit errors? Show the bit pattern transmitted for the message 1101001100110101. Assume that even parity is used in the Hamming code.
4. (Chapter 3, Problem 11) A 12-bit Hamming code whose hexadecimal value is 0xE4F arrives at a receiver. What was the original value in hexadecimal? Assume that not more than 1 bit is in error.
5. (Chapter 3, Problem 14) What is the remainder obtained by dividing $x^7 + x^5 + 1$ by the generator polynomial $x^3 + 1$?
6. (Chapter 3, Problem 19) In protocol 3, is it possible that the sender starts the timer when it is already running? If so, how might this occur? If not, why is it impossible?
7. (Chapter 3, Problem 20) Imagine a sliding window protocol using so many bits for sequence numbers that wraparound never occurs. What relations must hold among the four window edges and the window size, which is constant and the same for both the sender and the receiver.
8. (Chapter 3, Problem 33) Suppose that we model protocol 4 using the finite state machine model. How many states exist for each machine? How many states exist for the communication channel? How many states exist for the complete system (two machines and the channel?) Ignore the checksum errors.

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Homework 4 (Due Dec 2, 12:30pm)

1. (Chapter 4, Problem 2) A group of Nstations share a 56-kbps pure ALOHA channel. Each station outputs a 1000-bit frame on an average of once every 100 sec, even if the previous one has not yet been sent (e.g., the stations can buffer outgoing frames). What is the maximum value of N ?
2. (Chapter 4, Problem 3) Consider the delay of pure ALOHA versus slotted ALOHA at low load. Which one is less? Explain your answer.
3. (Chapter 4, Problem 4) Ten thousand airline reservation stations are competing for the use of a single slotted ALOHA channel. The average station makes 18 requests/hour. A slot is 125 μsec. What is the approximate total channel load?
4. (Chapter 4, Problem 8) How long does a station, s, have to wait in the worst case before it can start transmitting its frame over a LAN that uses
   (a) the basic bit-map protocol?
   (b) Mok and Ward's protocol with permuting virtual station number?
5. (Chapter 4, Problem 9) A LAN uses Mok and Ward's version of binary countdown. At a certain instant, the ten stations have the virtual station numbers 8, 2, 4, 5, 1, 7, 3, 6, 9 and 0. The next three stations to send are 4, 3 and 9, in that order. What are the new virtual station numbers after all three have finished their transmissions?
6. (Chapter 4, Problem 13) What properties do the WDMA and GSM channel access protocols have in common? See Chap. 2 for GSM.
7. (Chapter 4, Problem 14) Six stations, A through F, communicate using the MACA protocol. Is it possible that two transmissions take place simultaneously? Explain your answer.
8. (Chapter 4, Problem 16) What is the baud rate of the standard 10-Mbps Ethernet?