

CNT3004: Computer Network Concepts (Summer 2012)

Homework 2: Chapter 9,10,11

(assigned 06/22; due: 07/02 midnight in webcourse)

Name: _____ PID: _____

Note: You need to compute the final numerical results for all computing questions (i.e., you cannot just list the formula as the final result).

1. If an error detection code set has the minimum hamming distance of $d_{\min} = 7$, up to how many bit errors can the code detect? Up to how many bit errors can the code correct?
2. Apply the XOR operation on the following pair of patterns:
 - a. 100011 XOR 100110
 - b. 011001 XOR 100110
 - c. 000101 XOR 101010
 - d. 111100 XOR 110001
3. What is the polynomial representation of 101110? What is the polynomial representation of the output after shifting 101110 three bits to the left (i.e., add three 0 at the right)?
4. For the CRC coding, given the dataword 1010011110 and the divisor 10111,
 - a. Show the generation of the codeword at the sender site (using binary division). *Hint: because the divisor is 5 bits, so the CRC code has 4 bits. In the division calculation, the remainder will be the 4 bits CRC code.*
 - b. Show the checking of the codeword at the receiver site (assume no error).
5. For a CRC coding that has the divisor 10101 and 4 bits of error detection code, please design the hardware circuit (similar to the example and illustration figures shown in Page 49,50 in ch10.ppt).
6. A sender has three data items to send: 0x3456, 0xABCC, 0x02BC. (0x is a hexadecimal representation that each symbol (0-9, A-E) represents 4 bits binary within the value of 0-15. For more details see: <http://en.wikipedia.org/wiki/Hexadecimal>)
 - a. Write out the binary value of these three 16-bit data items.
 - b. Find the checksum at the sender site (the checksum has the same number of bits as each data item).
 - c. Find the checksum at the receiver site if there is no error.
 - d. Find the checksum at the receiver site if the second data item is changed to 0xABCE.
7. Byte stuffing and bit stuffing:
 - a. Byte-stuff the data shown in the following (all bytes are data bytes):

ESC			Flag		ESC	ESC	ESC		Flag
-----	--	--	------	--	-----	-----	-----	--	------

- b. Bit-stuff the data shown in the following. In your answer please show clearly which bits are your added bits (by highlight, or bold font, etc). Space is added after every four bits in the data stream solely for the purpose of easy-of-reading:

0001 1111 1100 1111 1010 0111 1111 1000 0

8. Refer to Figure 11.11 on lecture slides ch11.ppt Page 33. It is a stop-and-wait ARQ protocol and shows the transmission of 3 data frames. Suppose the sender (node A) needs to make sure that 3 data frames (denoted as A1, A2, A3) need to be received and acked by receiver (node B). Assume that each data frame needs 1 ms to transmit and each ack frame needs no time to transmit. The time-out value is set to be 6ms.
- Assume that the round trip time RTT is always 4 ms (i.e., each direction takes 2ms. See slides ch11.ppt Page 34, RTT) and there is no frame loss or error. Draw the flow diagram similar to Figure 11.11 for the complete transmission of the 4 data frames. You must show the time when each data frame is sent out, and the time when each ack frame is sent out on the flow diagram (hint: I have provided example in lecture slide Ch11-ARQ-Review.ppt).
 - Repeat the exercise in 8.a) if we assume that the second data frame is lost and no other data frames or ack frames have lost or error. Round-trip-time is always 4ms.
 - Repeat the exercise in 8.a) if we assume that due to network congestion the round-trip-time for the second data frame and its corresponding ack frame takes 6ms (i.e., each direction takes 3ms). The round-trip-time for the other frames is still 4ms. The network congestion event only happens once. No frame loss or error could happen.

Assume that if the ACK packet arrives at the same time of the timeout event, the sender will recognize the ACK without resending packet.

