

第三次作业: (英文版教材第三章 1, 2, 4, 6, 7, 9, 11, 14, 15, 16, 补充题 1)

1. (Cost of No Error Control) An upper-layer packet is split into 10 frames, each of which has an 80% 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?
2. (Byte stuffing) 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?
4. (Error detection of checksum) When bit stuffing is used, is it possible for the loss, insertion, or modification of a single bit to cause an error not detected by the checksum? If not, why not? If so, how? Does the checksum length play a role here?
6. (Hamming distance) To provide more reliability than a single parity bit can give, an error-detecting coding scheme uses one parity bit for checking all the odd-numbered bits and a second parity bit for all the even-numbered bits. What is the Hamming distance of this code?
7. (Hamming code) An 8-bit byte with binary value 10101111 is to be encoded using an even-parity Hamming code. What is the binary value after encoding?
9. (Error detection) One way of detecting errors is to transmit data as a block of  $n$  rows of  $k$  bits per row and add parity bits to each row and each column. The bit in the lower-right corner is a parity bit that checks its row and its column. Will this scheme detect all single errors? Double errors? Triple errors? Show that this scheme cannot detect some four-bit errors.
11. (Error correction vs. retransmission) Suppose that data are transmitted in blocks of sizes 1000 bits. What is the maximum error rate under which error detection and retransmission mechanism (1 parity bit per block) is better than using Hamming code? Assume that bit errors are independent of one another and no bit error occurs during retransmission.
14. (CRC) What is the remainder obtained by dividing  $x^7 + x^5 + 1$  by the generator polynomial  $x^3 + 1$ ?
15. (CRC) A bit stream 10011101 is transmitted using the standard CRC method described in the text. The generator polynomial is  $x^3 + 1$ . Show the actual bit string transmitted. Suppose that the third bit from the left is inverted during transmission. Show that this error is detected at the receiver's end. Give an example of bit errors in the bit string transmitted that will not be detected by the receiver.
16. (Frame trailer) Data link protocols almost always put the CRC in a trailer rather than in a header. Why?

补充题 1: 已知数据位流为 1101 0110, 采用 CRC 校验,  $G(x)=x^3+1$ , 计算出校验位。