

# CSE 123: Computer Networks

Homework 1 Solution (Due 10/12 in class)

Total Points: 30

Student Name:

PID:

UCSD email:

Instructions:

Turn in a **physical copy** at the beginning of the class on 10/10.

Problems:

## 1. True or False (6 Points) **One point each**

Circle TRUE or FALSE for the following statements. No explanations are required.

- a. The payload of an IP packet could contain a TCP or UDP header.

TRUE

FALSE

- b. Compared with Checksums, Cyclic Remainder Check (CRC) is a better error detection algorithm for detecting burst errors in frames.

TRUE

FALSE

- c. If an encoding scheme has a Hamming Distance of 5, it can detect up to 4 bit flips.

TRUE

FALSE

- d. If {000, 0001, 0010, 1000} is the entire set of codewords in an encoding over 4-bit strings, the resulting code is efficient.

TRUE

FALSE

- e. Round Trip Time (RTT) is an important indicator of network bandwidth.

TRUE

FALSE

- f. One bit is enough to encode the sequence number of a data frame in a Stop-and-Wait ARQ protocol.

TRUE

FALSE

## 2. Two-Dimensional Parity (7 Points)

A network device receives the following 64-bit two-dimensional parity data. Bits “1111 0000” in Row “a” represent the first 8-bit received data, and Row “h” is the parity byte (last byte of the data). Assume the sender correctly computes the two-dimensional parity data, and **odd parity is followed**.

Row \ Column	A	B	C	D	E	F	G	H
a (first byte)	1	1	1	1	0	0	0	0
b	1	0	1	0	1	1	1	0
c	0	0	0	1	0	0	0	0
d	1	1	0	0	1	1	1	0
e	1	0	1	0	1	1	0	1
f	0	0	1	0	0	0	1	1
g	1	1	1	1	1	1	1	0
h (last byte)	0	0	0	1	1	1	1	1

a. Assume the above data has ONE BIT flipped due to communication error.

(i) Which row(s) (from a to h) has incorrect parity, if applicable? (1 Point)

Row a

(ii) Which column(s) (from A to H) has incorrect parity, if applicable? (1 Point)

Column D

(iii) Can the flipped bit be corrected? If yes, circle that bit from the table above. If no, please give explanations. (1 Point)

Yes. The flipped bit is at Row a, Column D.

b. Could the above data results from TWO BIT FLIP of the original data, due to communication errors? **Circle One:** YES **NO** (1 Point)  
Please explain why. (1 Point)

There are three scenarios of two-bit flip.

(1) Two flipped bits are in the same row. In this case, the row that has two bit flipped still has the correct parity, other rows are unaffected. However, two columns should have incorrect parity, since one bit is flipped in each one of them.

(2) Two flipped bits are in the same column. In this case, the column that has two bit flipped still has the correct parity, other columns are unaffected. However, two rows should have incorrect parity, since one bit is flipped in each one of them.

(3) Two flipped bits are from neither the same row, nor the same column. In this case, there should be two rows and two columns that have incorrect parity data.

None of the above three cases will produce the data in part a, which has incorrect parity in one column and one row.

- c. Could the above data results from THREE BIT FLIP of the original data due to communication errors? **Circle One:** YES NO (1 Point)  
Please explain why. (1 Point)

Many combinations of three-bit flip can produce incorrect parity in Row a and Column D. One possible solution is bit flip at:

Row a, Column A  
Row h, Column A  
Row h, Column D

### 3. The HDLC protocol (6 Points)

Given our understanding of the HDLC protocol, assume that the following bit stream arrives at the receiver at a particular instant of time:

0111 1110 1110 1100 0111 1111 0000 1100 0011 1110 0111 0111 1100 0001  
0111 1101 1011 1001 0111 0000 1011 1111 0110 0000 1100 1111 1100 0010  
0111 1100 0000 0011 1110 0111 0101 0111 0111 1110 0011 0001 0110 1001

Calculate the total number of:

- a. Frame delimiters (2 Points)  
4  
b. Stuffed 0's (2 Points)  
5  
c. Received errors (2 Points)  
1

#### 4. Error Checking using CRC (7 Points)

- a. Suppose a sender uses the CRC polynomial  $X^8 + X^2 + X + 1$  to send a bit stream D. The actual data received by a receiver is "10 0010 1101 1110 1001".

(1) How many bits does the original bit stream D have? (1 Point)

10

(2) Does the received data get corrupted? **Circle One:** YES

**NO** (1 Point)

Please show your work.

Generator g is 100000111. (1 Point)

$$\begin{array}{r} 100000111 \mid 100010110111101001 \\ \underline{100000111} \\ 100011111 \\ \underline{100000111} \\ 110000100 \\ \underline{100000111} \\ 100000111 \\ \underline{100000111} \\ 0 \end{array}$$

Since the remainder is 0 (1 Point), the received data is NOT corrupted.

- b. Suppose a sender wants to send binary data "1010 1010" using the CRC polynomial  $X^5 + X^3 + X + 1$ . What are the actual bits that get transmitted? Please show your work.

Generator g is 101011. (1 Point)

$$\begin{array}{r} 101011 \mid 1010101000000 \\ \underline{101011} \\ 110000 \\ \underline{101011} \\ 110110 \\ \underline{101011} \\ 111010 \\ \underline{101011} \\ 10001 \end{array}$$

Therefore,  $r = 10001$  (1 Point), and the actual data transmitted is:

1 0101 0101 0001 (1 Point)

### 5. The Automatic Repeat Request (ARQ) Protocol (4 Points)

A client and a server are transmitting data frames using the stop-and-wait ARQ protocol. Assume Round Trip Time (RTT) is 6 ms; The client timeout is 8 ms; The server drops every fourth transmission received from the client (server will not send acknowledgement for that data frame); Sequence number is correctly encoded in every data and acknowledgement frame; The client transmits the first frame at time 0.

- a. How many frames has the client already transmitted when it receives an acknowledgement of the 10th frame from the server? (2 Points)

13 frames. The 4<sup>th</sup>, 7<sup>th</sup> and 10<sup>th</sup> frame are transmitted twice.

- b. Compute the time (in ms) when the client receives an acknowledgement of the 10th frame from the server. (2 Points)

$$\begin{aligned}\text{Total Time} &= \text{RTT} * \text{Acknowledged Frames} + \text{Timeout} * \text{Retransmitted Frames} \\ &= 6 * 10 + 8 * 3 \\ &= 84 \text{ ms}\end{aligned}$$