CN Lab Assignment-3

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Aim: To write a program for error detection and correction codes using Hamming code.

Objectives:

1. To encode and decode original data bits with the help of parity bits.
2. To demonstrate the use of error control protocols.

Theory:

1. Types of errors.

There are mainly 3 types of errors:

(a) Single bit errors →

1011 0011 ⇒ 1011 0111

Data sent Data Received.

(b) Multiple bits error →

1011 0011 ⇒ 1010 0111

Data sent Data Received.

(c) Burst error →

1011 0011 ⇒ 1000 0111

Data sent Data Received.

2. Concept of Parity bits.

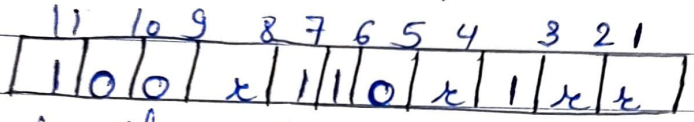
A parity bit is a check bit, which is added to a block of data for error detection purposes.

It is used to validate the integrity of the data. The value of the parity bit is assigned 0 or 1, dependent or whether its odd or even parity.

3. Hamming Code example.

Data to be transmitted → 1001101 m = 7, i.e., total no. of bits in the data redundant places (r) from the formula. $2^r \geq m + r + 1$ come to 4; so r = 4

So, 1st, 2nd, 4th, 8th places are redundant



leaving the redundant places fill the data bit from right to left, thus, the array will have 11 place (m + r = 7 + 4 = 11)

Let us call the redundant bits r_1, r_2, r_4, r_8 based on their position in the array.

Now,

$r_1 = m_3 \oplus m_5 \oplus m_7 \oplus m_{11}$

$r_1 = 1 \oplus 0 \oplus 1 \oplus 1 \Rightarrow 1 \oplus 1 \oplus 1 \Rightarrow 0 \oplus 1 = 1$

$r_2 = m_3 \oplus m_6 \oplus m_7 \oplus m_{10} \oplus m_{11}$

$r_2 = 1 \oplus 1 \oplus 0 \oplus 1 \Rightarrow 0 \oplus 1 \oplus 0 \oplus 1 \Rightarrow 1 \oplus 0 \oplus 1 \Rightarrow 1 \oplus 1 \Rightarrow 0$

$r_4 = m_5 \oplus m_6 \oplus m_7$

$r_4 = 0$

$r_8 = m_9 \oplus m_{10} \oplus m_{11}$

$r_8 = 1$

Hamming code → 10011100101

FAQ's:

1. What is the difference between error and flow control?

Ans

	Flow control	Error Control
1.	Flow control is meant only for the transmission of data from sender to receiver.	Error control is used for the transmission of error-free data from sender to receiver.
2.	For Flow control, there are 2 approaches: Feedback Based and Rate Based Flow control.	To detect error in data, the approaches are: Checksum, CRC, Parity Checking. To correct error in data, the approaches are: Hamming Code, Binary Convulation codes, Reed-Solomon Code, Low density Parity Check Codes.
3.	It prevents loss in data and avoid over running of receive buffers.	It is used to correct the error occured in data transmission.
4.	Ex → Stop & Wait	Ex → Stop & wait

Protocol and Sliding Window Protocol.	ARQ & Sliding Window ARQ ARQ ⇒ Automatic Repeat Request.

2. Explain in brief, the 2 types of error control mechanism.

Ans There are 2 following mechanisms:

(1) Stop & Wait ARQ → It is also known as alternating bit protocol. In this mechanism, receiver simply indicates its readiness to receive data for each frame. In this, the sender sends data packet or information to the receiver. Sender then stop and waits for the ACK from the receiver. If the ACK does not arrive from the receiver within a given time period, sender then resends the frame & waits for the ACK; then it will send the next frame and wait for the ACK from the receiver. The process will continue until the sender has no more data frames to send.

(2) Sliding Window ARQ → This mechanism is generally used for continuous transmission error control. It is further categorized into 2 categories:

a) Go-Back N ARQ → It is a type of ARQ protocol in which transmission process continues to send total number of frames dictated by window size even without receiving an ACK from the receiver. It uses sliding window flow protocol.

If no error occurs, then operation is identical to sliding window.

b) Selective Repeat ARQ → It is a type of ARQ protocol in which only suspected damage at lost data frames are retransmitted. This technique is similar to Go-Back N ARQ through, much more efficient than Go-Back N ARQ technique due to reason that it reduces number of retransmission. In this, the sender only resends those frames for which no acknowledgement (NAK) is received. But this technique is less frequently used because it increases complexity on senders and receiver's end & each frame must be acknowledged individually.