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LAB Assignment-4

Title:- Error detection and correction

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

Objectives:-

- 1) To encode & decode original data bits with help of parity bits.
- 2) To demonstrate use of error control protocol.

Theory:-

1) Types of errors:-

Errors can be of three types, namely single bit errors, multiple bit errors, & burst errors.

2) Concept of parity bits:-

It is a single bit that can be appended to a binary string. It is a set to either 1 or 0 to make the total number of 1-bits either even or odd. The purpose of a parity bit is to provide a simple way to check for errors later.

3) Hamming code example:-

Hamming codes are family of linear error correcting codes invented by Richard Hamming in 1950. Can correct upto two-bit errors & correct one-bit errors without detection of uncorrected errors.

eg. data 100 00 01

no. of data bits = $m = 7$

to calculate parity bits

$$2^r \geq m + r + 1$$

$$2^r \geq 7 + r + 1$$

$$r = 4 \text{ (by hit & trial)}$$

total no. of bits to be considered is $r + m = 11$

$$r = 4 = R_1, R_2, R_3, R_4$$

$$\begin{array}{cccc} 2^0 & 2^1 & 2^2 & 2^3 \\ 1 & 2 & 4 & 8 \end{array}$$

position of
iteration.

m	D_0	D_1	D_2	D_3	D_4	D_5	D_6	D_7	D_8	D_9	D_{10}	D_{11}	R_1	R_2	R_3	R_4
1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1
11	10	9	8	7	6	5	4	3	2	1						

(Alternate 1 bit) $R_1 = D_0, D_2, D_4, D_6, D_8, D_{10} \Rightarrow 1 + 0 + 0 + 0 + 1 \Rightarrow 0$

(2 bit) $R_2 = D_1, D_3, D_5, D_7, D_9, D_{11} \Rightarrow 1 + 0 + 0 + 0 + 1 \Rightarrow 0$

(4-bit) $R_4 = D_5, D_6, D_7 \Rightarrow 0 + 0 + 0 \Rightarrow 0$

(8-bit) $R_8 = D_8, D_{10}, D_{11} \Rightarrow 0 + 0 + 1 \Rightarrow 1$

5-bit get flipped when received on transmission line from sender.

1	0	0	1	0	0	1	0	1	0	0
11	10	9	8	7	6	5	4	3	2	1

$$R_1 = R_1, D_3, D_5, D_7, D_9, D_{11} \Rightarrow 0 + 1 + 1 + 0 + 0 + 1 \Rightarrow 1$$

$$R_2 = R_2, D_3, D_5, D_7, D_{10}, D_{11} \Rightarrow 0 + 1 + 0 + 0 + 0 + 1 \Rightarrow 0$$

$$R_4 = R_{11}, D_5, D_6, D_7 \Rightarrow 0 + 1 + 0 + 0 = 1$$

$$R_8 = R_8, D_9, D_{10}, D_{11} \Rightarrow 1 + 0 + 0 + 1 \Rightarrow 0$$

Now getting corrupted bit position.

$$\Rightarrow (R_4, R_4, R_2, R_1)$$

$$\Rightarrow (0, 1, 0, 1)_2$$

$$\Rightarrow (5)_{10}$$

as found position of error bit that bit can be swapped from 0 to 1 or if its 1 then 0 to 0.

Students Observation:

Thus we have successfully written a program for error detection and correction using Hamming codes.

* FAQs.

1) What is the difference b/w flow & error control?

→

Flow control	Error control
1) It is only meant for transmission of data	It is meant for transmission of error free data
2) There are 2 approaches:- Feedback based & rate based.	Approaches are:- checksum Hamming code, cyclic Redundancy check. It is used
3) It prevents loss of data	It is used to detect & correct data.

Q.2] Explain in brief 2 types of error control mechanism.

→ Error - Detection: This simply means identification of errors.

Error - Correction: It means solving or fixing errors. It is a very costly & is long procedure.