

LAB EXERCISE - 2

Write a Program in C/ C++ for hamming code generation for error detection/correction

Objective:

To Detect and Correct Single bit errors using Hamming Code.

Instructions:

Hamming Code is used to detect and correct single bit error. The key to Hamming Code is the use of extra parity bits. Hamming code consists of k information bits and n-k check bits, where n is the total number of bits in the codeword. Parity bits are placed in positions having power of 2.

IMPLEMENTATION (7,4) HAMMING CODE:

) The Hamming Code for 4-bits of data uses 3 redundant bits.

Hamming Code for 4 data bits

d4	d3	d2	d1
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is

d4	d3	d2	r3	d1	r2	r1
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b7	b6	b5	b4	b3	b2	b1...(position of bits in code)
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where r1 r2 and r3 are redundant bits.

PROCEDURE FOR DETERMINING REDUNDANT BITS:

The ability of detecting and correcting errors of Hamming Code comes with the cost of redundant bits. These 3-bits are used to take care of all the 8 different possible states of transmitted 7-bits.

) The r-bits are determined using following equations:

$$\begin{array}{lcl} d1 = r1 + r2 & | & \\ d2 = r1 + r3 & | & \text{modulo-2 arithmetic} \\ d3 = r2 + r3 & | & \\ d4 = r1 + r2 + r3 & | & \end{array}$$

These equations are further solved to calculate r-bits:

$$r1 = d1 + d2 + d4$$

$$r2 = d1 + d3 + d4$$

$$r3 = d2 + d3 + d4$$

PROCEDURE FOR ERROR DETECTION AND CORRECTION:

) On the receiver side 3 position bits(p1-p3) are calculated:

$$p1 = r1 + d1 + d2 + d4$$

$$p2 = r2 + d1 + d3 + d4$$

$$p3 = r3 + d2 + d3 + d4$$

) These values indicate one of the eight possible states of received code:

p3 p2 p1	state	Action for correction
0 0 0	No error	--
0 0 1	Error in b1 bit	Flip b1
0 1 0	Error in b2 bit	Flip b2
0 1 1	Error in b3 bit	Flip b3
1 0 0	Error in b4 bit	Flip b4
1 0 1	Error in b5 bit	Flip b5
1 1 0	Error in b6 bit	Flip b6
1 1 1	Error in b7 bit	Flip b7

And d4-d1 bits after this operation are the actual transferred data bits.

Steps to execute the program

At Sender: Code Formation:

1. Get 4-bit(d4-d1) input
2. Determine r-bits(r3-r1) using above equations
3. Form the 7-bit Code by placing r-bits and d-bits in appropriate positions.
4. Send the Code to Receiver

At receiver: Error Detection and Correction:

1. Determine position bits(p3-p1) using above equations
2. Use the Table to find the position of error (if present) and to take corrective action.