R (2)	C (3)	V (3)	T (02)	Dated Sign

Assignment Group-A_3

Problem Definition:
Write a Program for Error Detection & correction for 7 Bit Ascii using Hamming Codes.

3.1 Prerequisite:

1. Data Communication
2. Basic Logical Operations.

3.2 Learning Objectives:

1. Understand the concept Error Analysis.
2. Detection of Error at Reciever Side.

3.3 New Concepts:

1. Even Parity
2. Odd Parity

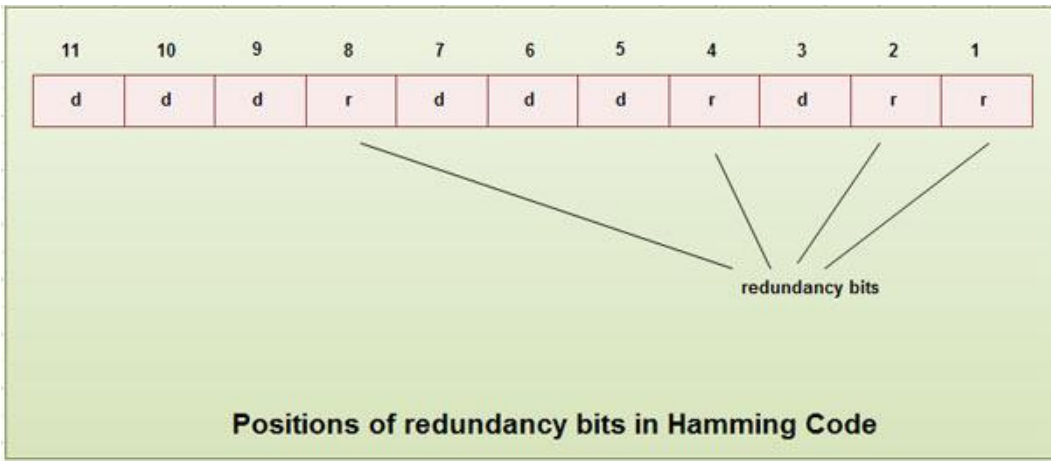
3.4 Theory

3.4.1 Introduction

- Hamming code is technique developed by R.W. Hamming for error correction. This method corrects the error by finding the state at which the error has occurred.

Determining the positions of redundancy Bits

- Till now, we know the exact number of redundancy bits required to be embedded with the particular data unit. We know that to detect errors in a 7 bit code, 4 redundant bits are required. Now, the next task is to determine the positions at which these redundancy bits will be placed within the data unit.
- These redundancy bits are placed at the positions which correspond to the power of2.
- For example in case of 7 bit data, 4 redundancy bits are required, so making total number of bits as 11. The redundancy bits are placed in position 1, 2, 4 and 8 as shown in fig.



Generating parity information

• In Hamming code, each r bit is the VRC for one combination of data bits. r_1 is the VRC bit for one combination of data bits, r_2 is the VRC for another combination of data bits and so on.

•Each data bit may be included in more than one VRC calculation.

• r_1 bit is calculated using all bits positions whose binary representation includes a 1 in the rightmost position.

• r_2 bit calculated using all the bit positions with a 1 in the second position and so on.

• Therefore the various r bits are parity bits for different combination of bits.

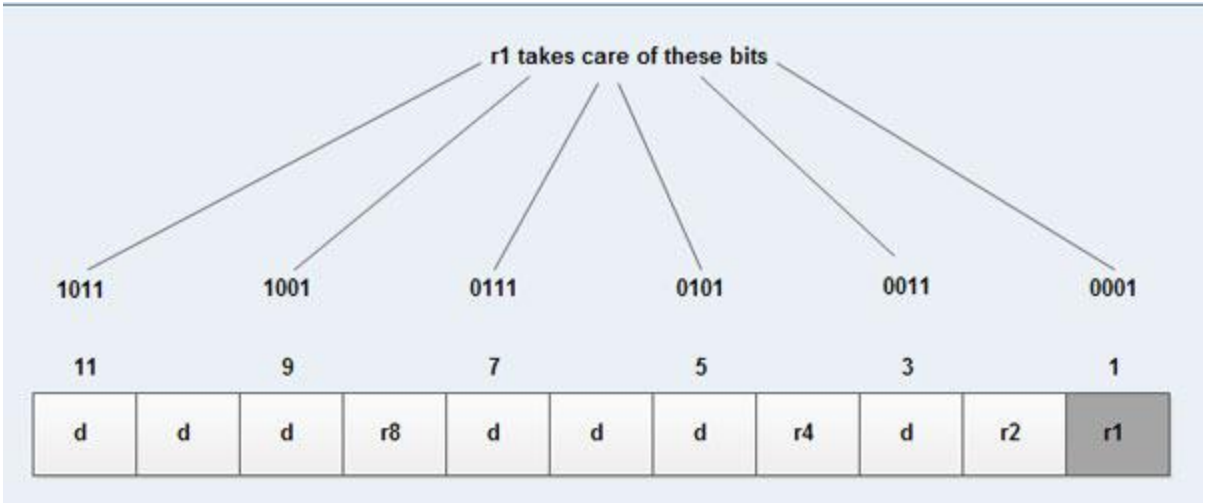
The various combinations are:

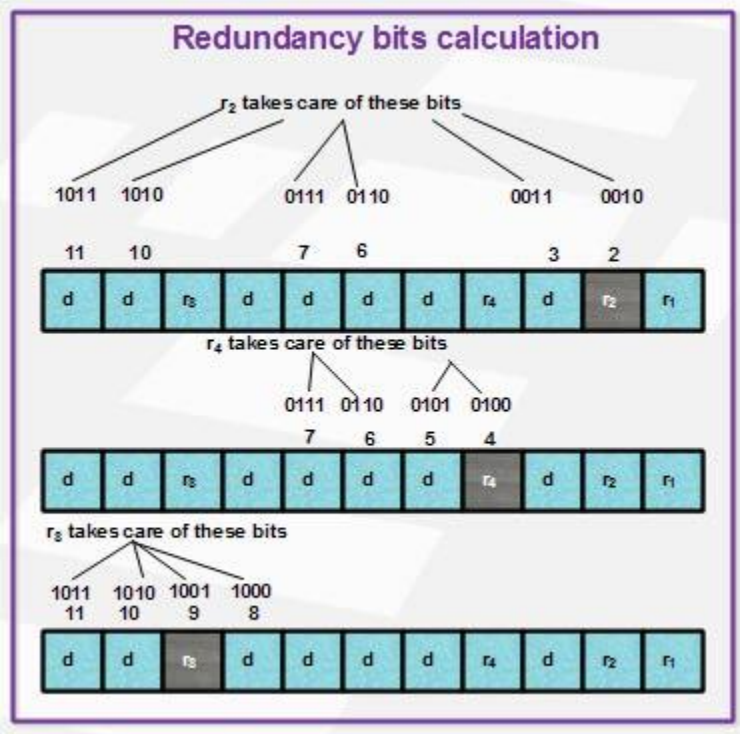
r_1 : bits 1,3,5, 7, 9, 11

r_2 : bits 2, 3, 6, 7, 10, 11

r_4 : bits 4, 5, 6, 7

r_8 : bits 8, 9, 10, 11





Example of Hamming Code Generation

Suppose a binary data 1001101 is to be transmitted. To implement hamming code for this, following steps are used:

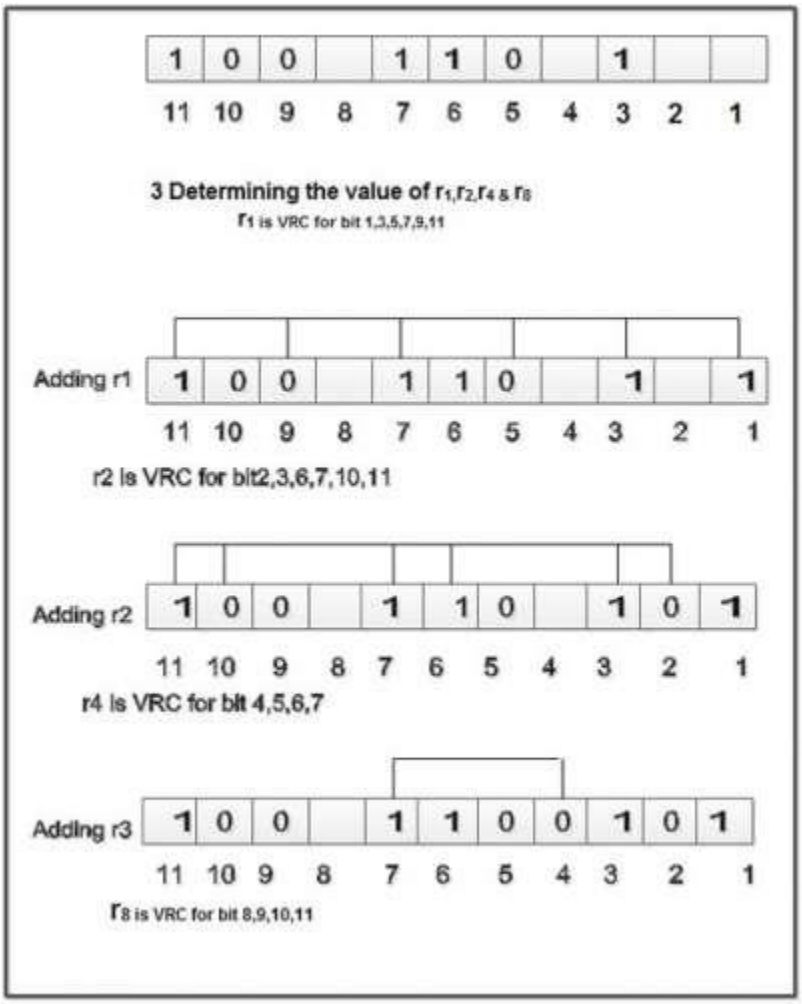
1. Calculating the number of redundancy bits required. Since number of data bits is 7, the value of r is calculated as

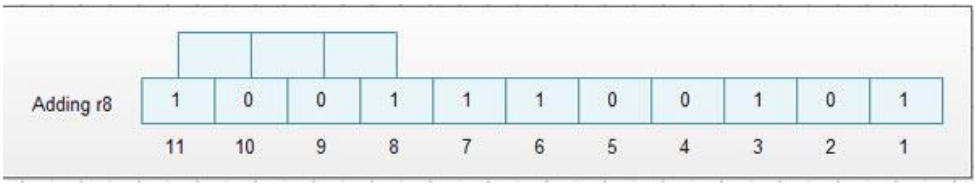
$$2^r \geq m + r + 1$$

$$2^4 \geq 7 + 4 + 1$$

Therefore no. of redundancy bits = 4

2. Determining the positions of various data bits and redundancy bits. The various r bits are placed at the position that corresponds to the power of 2 *i.e.* 1, 2, 4, 8

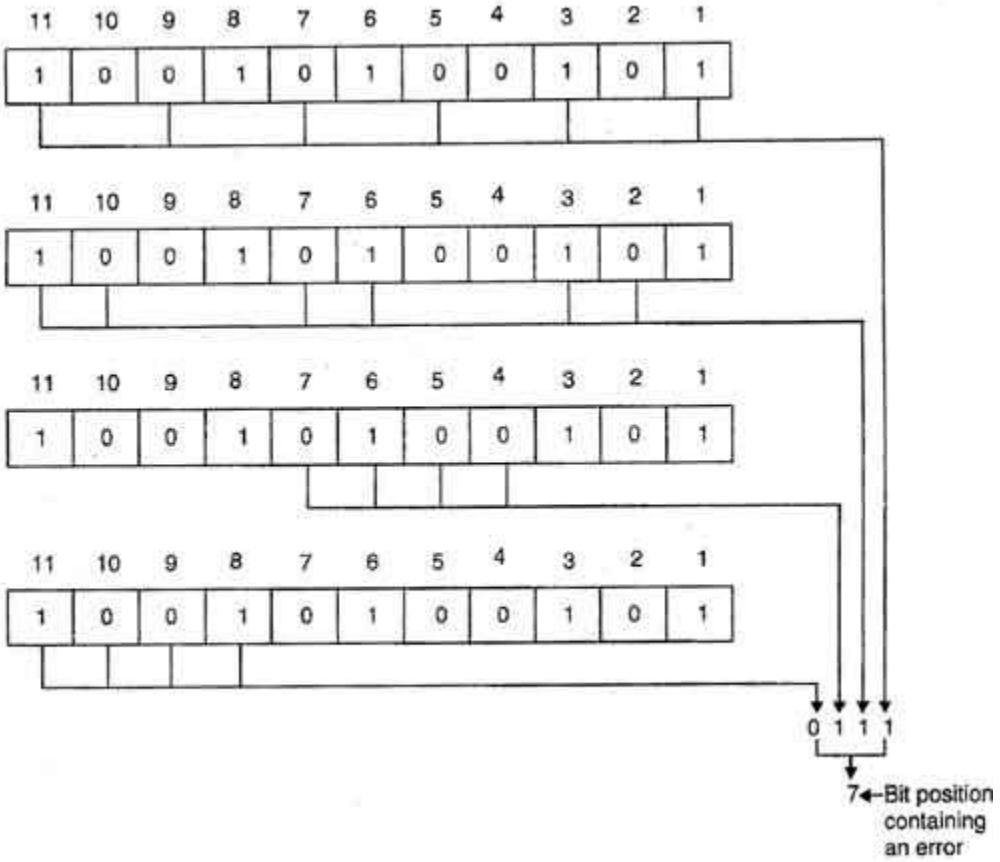




4. Thus data 1 0 0 1 1 1 0 0 1 0 1 with be transmitted.

Error Detection & Correction

Considering a case of above discussed example, if bit number 7 has been changed from 1 to 0.The data will be erroneous.



3.5 Assignment Questions:

1. What is importance of Hamming Code?.
2. What is the Difference between Even & Odd parity?
3. Write Down Formula for Hammnig Code ?

Conclusion:

Here we conclude that Message can be Detected & corrected using Hamming Code.