

## Assignment A2

Title: Hamming codes and CRC

Problem Statement:

Write a program in C/C++ for error detection and correction for 7/8 bits ASCII codes using Hamming codes or CRC. Demonstrate the packets captured traces using Wireshark Packet Analyzer tool for peer to peer mode.

Software Requirements:

Wireshark Packet Analyzer, C++ compiler.

Hardware Requirements:

Monitor, desktop, core i7 processor

Theory:

In digital systems, the analog signals will change to digital sequence called "Data stream". The change in position of bits also leads to catastrophic error in data output.

What is error?

The data can be corrupted during transmission (from source to receiver). It may be affected by external noise or some other physical imperfections. In this case, the input data is not same as the received output data. This mismatched data is called "Error".

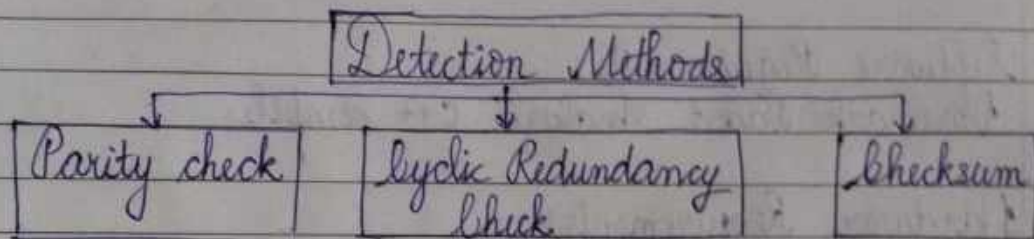
### Types of Errors:

In data sequence if 1 is changed to 0, or vice versa it is called "Bit error"

There are generally 3 types of errors:

1. Single bit error
2. Multiple bit error
3. Burst error

### Detection methods:



### Hamming code correction:

The difference between number of bits of the actual data sequence and the transmitted bits is called redundancy.

In hamming code the redundancy bits are placed at certain calculated positions in order to eliminate errors. The distance between the two redundancy bits are called 'Hamming distance'.

### Cyclic Redundancy check:

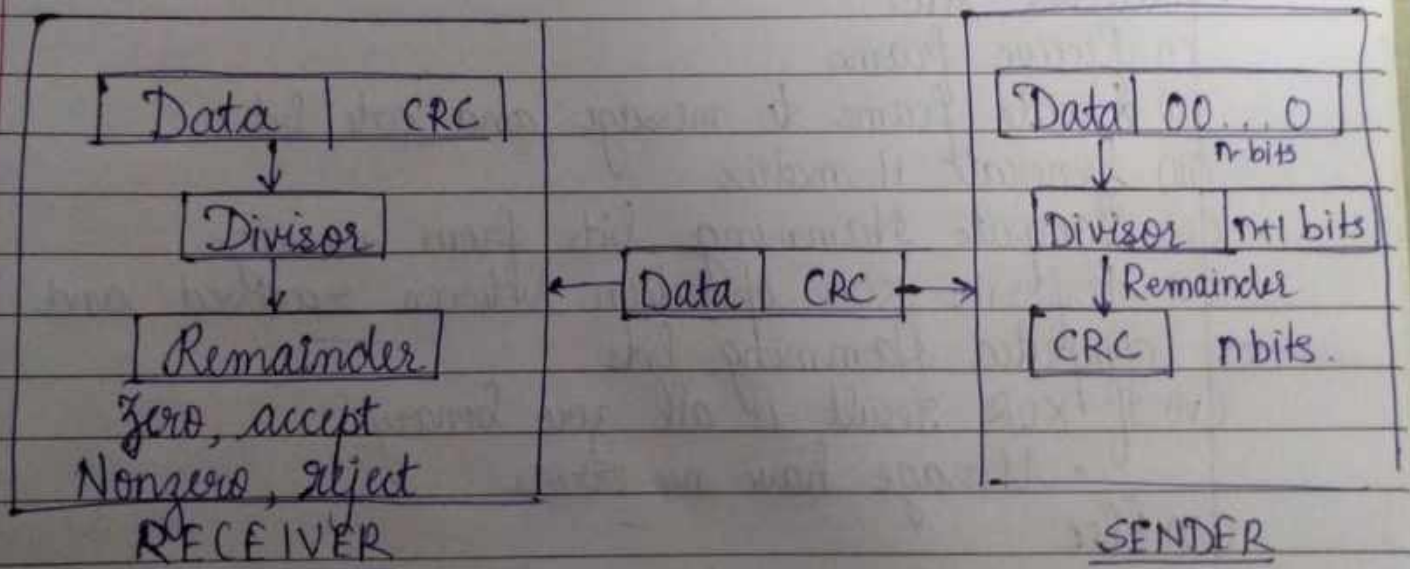
A cyclic code is linear  $(n, k)$  block code with the property that every cyclic shift of a codeword results in another code word. Here  $k$  indicates the length of the message at transmitter (the number of information bits)  $n$  is the total length.



of the message after adding check bits (actual data and check bits)  $n-k$  is the number of check bits.

The code used for cyclic redundancy check there by error detection are known as CRC codes (cyclic redundancy code check) cyclic redundancy check codes are shortened cyclic codes.

CRC generator and checker:



They are easily implemented using shift operators with feedback connections. That is why they are widely used for error detection on digital communication. CRC codes will provide effective and high level of protection.

## General algorithm:

### \* Sender site:

- (i) Get message and convert it to binary string
- (ii) Create H matrix
- (iii) Compute redundant Hamming bits
- (iv) Concatenate message and Hamming bits
- (v) Send frame.

### \* Receiver site:

- (i) Receive frame
- (ii) Divide frame to message and code bits
- (iii) Generate H matrix
- (iv) Compute Hamming bits from message
- (v) Perform XOR operation between received and computed Hamming bits
- (vi) If XOR result is all zero binary  
• Message have no errors
- (vii) Else

- generate H matrix with identity
- Perform on matrix columns XOR operation with previous XOR result

- If some result is all zero bit

1. The column number is faulty bit position
  2. Change frame bit on found position to opposite
  3. Compute Hamming bits for frame message part
  4. If corrected frame Hamming bits equals computed Message is corrected
- else

If there is more than one bit error cannot correct.  
If there is more than one bit error cannot correct.



Conclusion:

Thus, after successfully completing this assignment you will learn about error detection and correction for 7/8 bits ASCII codes.



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