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DEPT. OF COMPUTER ENGINEERING

CE 472 Data Communications and Networks
Spring 2014, Laboratory Assignment II

Due: 11/05/2014 Sunday, 23:59

1 General Information

This laboratory assignment is concerned with error correction coding. You will implement the Hamming (8,4) code and apply it to a binary file.

Your program will consist of three modules.

(i) **Encoder**: This will read a binary file (could be ASCII or UTF text), encode it according to Hamming(8,4) and produce a binary output file containing the encoded data to be transmitted.

(ii) **Corrupter**: This will simulate the communication channel by randomly corrupting bits in the encoded data. The bit error rate (BER) will be input to your program, and the corruptor will flip each bit with this probability.

(iii) **Decoder**: This module will act as the receiver. It will decode (and correct within its capability) the corrupted file and produce the final message.

2 Methodology

The Hamming (8,4) code produces an 8-bit codeword from a 4-bit data block as follows.

$$\begin{array}{c}\text{Data block}\\ \mathrm{d_1 d_2 d_3 d_4}\end{array} \xrightarrow{\text{encoded into}} \begin{array}{c}\text{Codeword}\\ \mathrm{p_1 p_2 d_1 p_3 d_2 d_3 d_4 p_4}\end{array}$$

Here, the following parity check equations hold:

$$\begin{aligned} \mathrm{p_1 + d_1 + d_2 + d_4} &= 0 \\ \mathrm{p_2 + d_1 + d_3 + d_4} &= 0 \\ \mathrm{p_3 + d_2 + d_3 + d_4} &= 0 \\ \mathrm{p_1 + p_2 + d_1 + p_3 + d_2 + d_3 + d_4 + p_4} &= 0 \end{aligned}$$

Alternatively, you can write the generator equation as

$$\begin{bmatrix} p_1 \\ p_2 \\ d_1 \\ p_3 \\ d_2 \\ d_3 \\ d_4 \\ p_4 \end{bmatrix} = \begin{bmatrix} 1 & 1 & 0 & 1 \\ 1 & 0 & 1 & 1 \\ 1 & 0 & 0 & 0 \\ 0 & 1 & 1 & 1 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \\ 1 & 1 & 1 & 0 \end{bmatrix} \begin{bmatrix} d_1 \\ d_2 \\ d_3 \\ d_4 \end{bmatrix}.$$

Note that each byte you read from the input will include two data blocks. Therefore, you will produce two bytes (two codewords) for each byte of the input.

3 Deliverables

Your program should display the following statistics:

- Number of input bits,
- Number of corrupted bits,
- Number of corrected bits,
- Number of undetected/uncorrected bit errors.

Each student is required to submit:

(i) the source code of his/her program,

(ii) the executable, and

(iii) will demonstrate the program with sample runs. (You may also submit the text file you used as the input.)

There will be three inputs to the program:

(i) the text file, and

(ii) the bit error rate (BER).

There is no restriction on the programming language.

4 Resources

`en.wikipedia.org/wiki/Hamming_code`
`en.wikipedia.org/wiki/Hamming(7,4)`