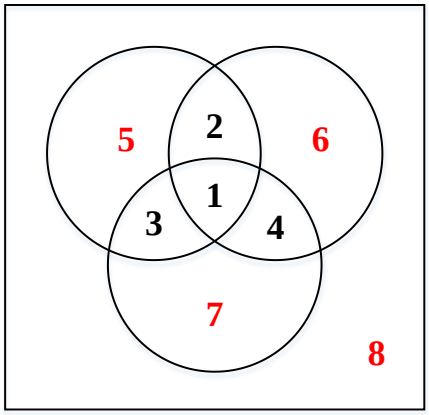
Communication Principles and Wireless Networks
Homework assignment 1

Due date: 2023/3/26 (Sunday) 23:59 pm

Note: 請線上繳交作業/Online submission

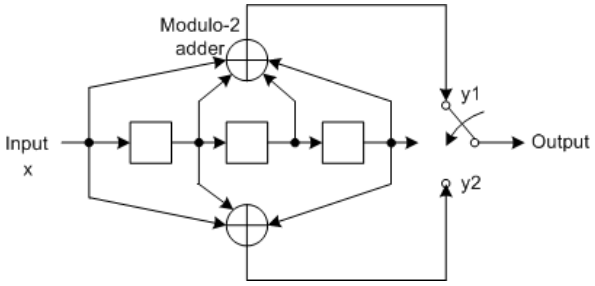
1. Consider the (7,4) Hamming code defined by the generator polynomial $g(X) = 1 + X + X^3$. The codeword 0111001 is sent over a noisy channel, producing the received word 0011001 that has a single error. Determine the syndrome polynomial $s(X)$ for this received codeword, and show that it is identical to the error polynomial $e(X)$.

2. If a 2-bit error occurs, the (7,4) Hamming code will interpret the event as an apparent single-bit error to be corrected, and thus induces the third error bit. If an additional parity bit is appended to the Hamming code as shown in the diagram at right, the resulting (8,4) codewords in the Extended Hamming Code will have distance (d=4).



   (a) According to the figure, how to compute the new parity bit?
   (b) Using the information bits 1101 as an example, please illustrate how this extended Hamming code performs error correction/error detection.

3. The figure at right shows the encoder for a rate $r = \frac{1}{2}$.



   (a) Determine the encoder output produced by the message sequence 10101.
   (b) If the received binary sequence is 1110111101, what's the estimated input?
   (c) What's the corresponding bit error rate?

4. For Cyclic Redundancy Code (CRC), assume message bits are 11100110, and generator polynomial is $g(X)=X^4+X^3+1$. What's the CRC code bits?

5. Based on the simplified performance analysis of GBN and selective repeat (SR), in what situation (or parameter configuration) that GBN will outperform SR? Please justify your answer.