Digital Systems HW#3

1. **Write the following message in code ascii + parity bit: "good luck!!"**
   011001111, 011011110, 011011110, 011001001, 001000001, 011011000, 011101011, 011000110, 011010111, 001000010, 001000010
2. **Given a 10-bit code word representing 600 different characters, how many errors can be detected and how many corrected?**
   None. The distance must be 1.
3. **Given the following code words:**
   011011011011
   101101101101
   110110110110
   a. **Determine the distance between them.**
      8
   b. **Find a new word with distance 4 from the code.**
      111111111111
   c. **Find a new word with distance 8 from the code.**
      000000000000
   d. **How many errors can be detected in the original code? How many errors can be corrected?**
      8=2*c+d+1, correct=c, detect=c+d
      correct=0, detect=7
      correct=1, detect=6
      correct=2, detect=5
      correct=3, detect=4
4. **The following message was received in code Hamming over a very noisy channel, with each word corrupted with one error. Decrypt the original message: 1101000 0010001 1110110 0011011**
   1101001 0011001 1100110 0011001
5. **General literacy in Chinese requires about 3000 characters. What is the minimal number of bits required to represent them in code Hamming (allowing for 1-bit error correction)?**
   3000 <= 2^m

$m >= \log_2(3000)$

$\log_2(3000) = 11.55$

$m = 12$

$2^k > m + k$

$k = 5$

Total bits = m + k = 17

6. **Two numbers are given and represented in two-dimensional code. In this code, the rightmost column holds the parity bit for each row, while the bottom row holds the parity bit for each column. For each number, determine if there are any errors. If possible, make the appropriate corrections. If not, explain why it can't be corrected.**

1	0	0	1	1
1	0	0	0	0
0	1	1	0	1
1	0	1	0	0

0	0	0	1	1	1	1
0	0	0	1	1	1	0
0	0	0	0	0	0	0

The first code has at least 3 errors and cannot be corrected because we don't know which incorrect horizontal parity bit matches which incorrect vertical parity bit.

The second code has at least 1 error which is the rightmost middle bit is supposed to be a 1.

7. **Given the following words:**
   011011011011, 101101101101, 110110110110
   a. **Convert them from binary to Gray.**
      010110110110, 111011011011, 101101101101
   b. **Convert the words from Gray to binary.**
      010010010010, 110110110110, 100100100100