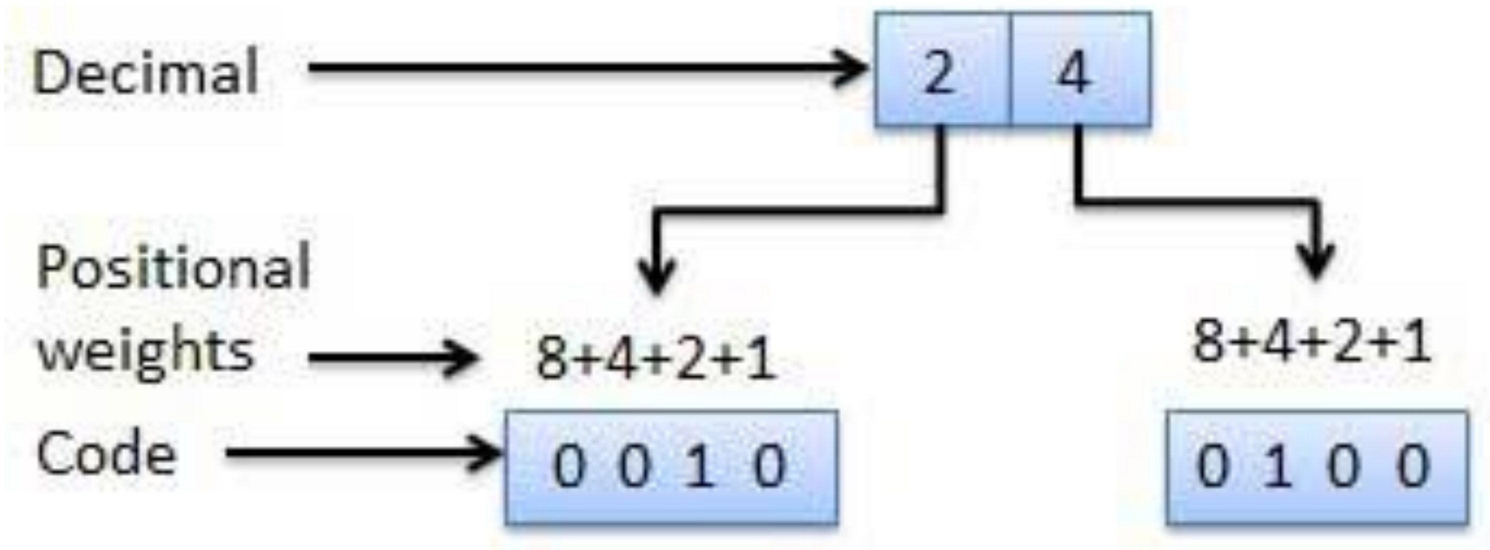
DIGITAL ELECTRONICS

Chapter 4 : Codes

Reference:

1. Malvino and Leach, Digital Principles & applications, 7th edition, TMH, 2010
2. Morris Mano, "Digital design", Prentice Hall of India, Third Edition.

Weighted Codes



Weighted codes

- Weighted binary codes are those binary codes which obey the positional weight principle.
- Each position of the number represents a specific weight.
- There exists a fixed weight associated with each bit position in the binary representation of the code character.

Binary coded decimal codes

Binary Coded Decimal code (BCD)

Consider the number $(16.85)_{10}$

$(16.85)_{10} = (0001\ 0110\ .\ 1000\ 0101)$

Binary coded decimal codes

Non-Weighted Code is one in which the positions in the code do not have a specific weight. Examples are Excess-3. And Gray.

- EXCESS-3 CODE
- GRAY CODE

Binary coded decimal codes

Decimal to BCD, Excess-3 and Gray code

Decimal	BCD = 8421	Excess-3	Gray
0	0000	0011	0000
1	0001	0100	0001
2	0010	0101	0011
3	0011	0110	0010
4	0100	0111	0110
5	0101	1000	0111
6	0110	1001	0101
7	0111	1010	0100
8	1000	1011	1100
9	1001	1100	1101

Error Detection and Correction

- Introduction
- Single bit Error detection using parity bit
- Single bit error correction using (7,4) Hamming code

Error Detection Codes

- **Parity**: Number of ones in the given code word.

- **Even & Odd parity**:

Example: 0000 $(1)_{\text{odd-parity}}$ $(0)_{\text{even-parity}}$

Example: 0100 $(0)_{\text{odd-parity}}$ $(1)_{\text{even-parity}}$

Error Correction code

- Principle of error correction
- Consider a (7,4) Hamming code
- Let i_1 i_2 i_3 i_4 be information symbols
- Let $p_1 p_2$ p_4 be check symbols
- The parity equations:

$$p_1 = i_3 \oplus i_5 \oplus i_7$$

$$p_2 = i_3 \oplus i_6 \oplus i_7$$

$$p_4 = i_5 \oplus i_6 \oplus i_7$$

Can write the equations as follows (easy to remember)

p_1	p_2	i_1	p_4	i_2	i_3	i_4
1	0	1	0	1	0	1
0	1	1	0	0	1	1
0	0	0	1	1	1	1
1	2	3	4	5	6	7

This encodes a 4-bit information word into a 7-bit code word