Tutorial - 03 - CN

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Q-1 What will be the hamming distance for all the different combination and minimum hamming distance for give code words

→

Data words	Codewords
00	00000
01	01011
10	10111
11	11111

d (00000, 01011) = 3 ; d (01011, 10111) = 3
d (00000, 10111) = 4 ; d (10110, 11111) = 1
d (00000, 11111) = 5 ; d (01011, 11111) = 2

$d_{min} = 1$

Q-2 Find the minimum Hamming distance for
a.) Detection of two errors
b.) Correction of two errors.

→ d_{min} for
a) Detection of two errors :-

$$d_{min} = s + 1$$
$$= 2 + 1$$
$$= 3$$

b) Correction of two errors :-

$$d_{min} = 2t + 1$$
$$= 4 + 1$$
$$= 5$$

Q-3 Check whether the given codewords are linear code or not. Give justification of your answer.

→

Dataword	Codeword
0 0	0 0 0 0 0
0 1	0 1 0 1 1
1 0	1 0 1 1 1
1 1	1 1 1 1 1

→ Linear codeword is a code in which XOR of two valid codewords creates another valid codeword.

$01011 \oplus 10111 = 11100 \neq 11111$

Also, given codeword are not linear.

Q-4 In CRC, given the dataword 1010011110 and the divisor 10111.

a) Show the generation of codeword at sender side

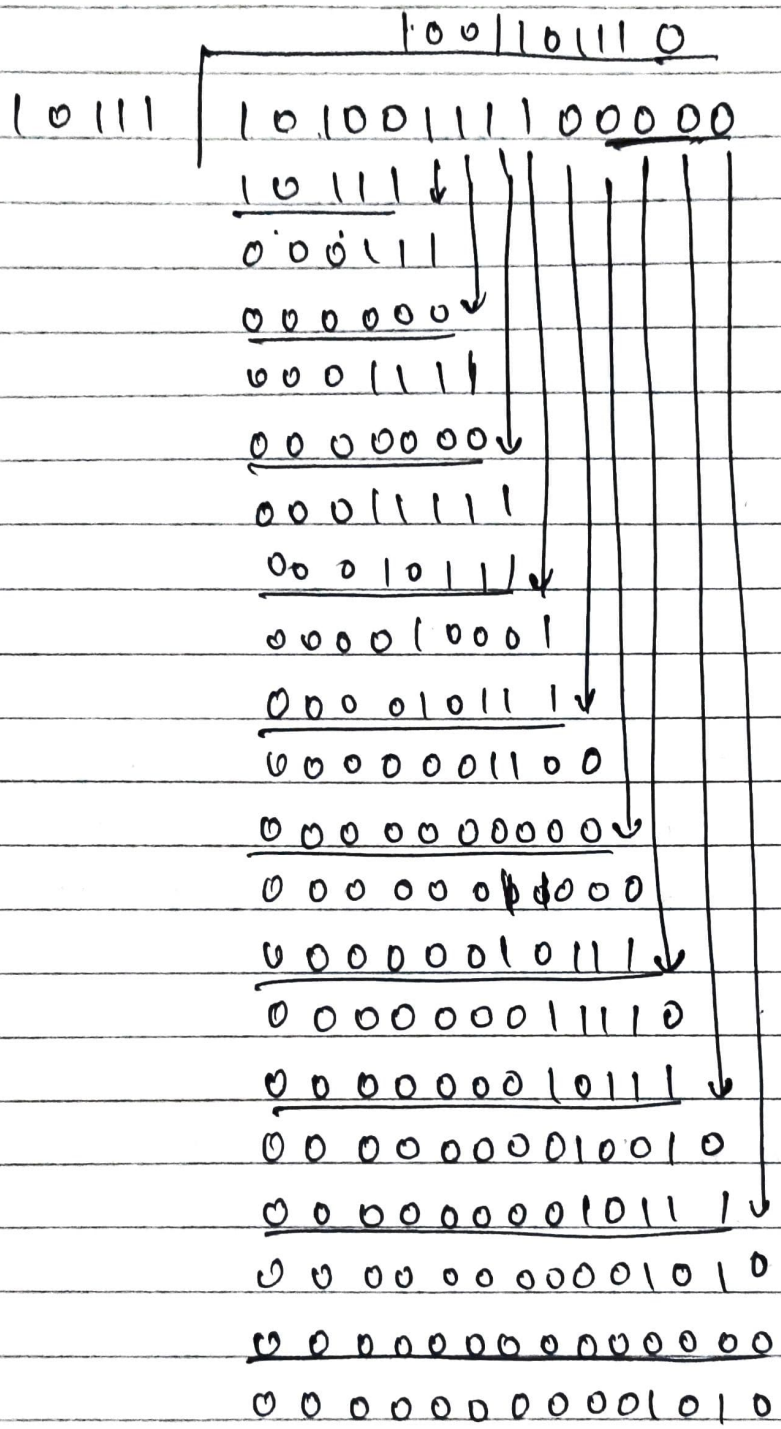
b) Show checking of codewords at the receiver site.

→ given

dataword = 1010011110

divisor = 10111

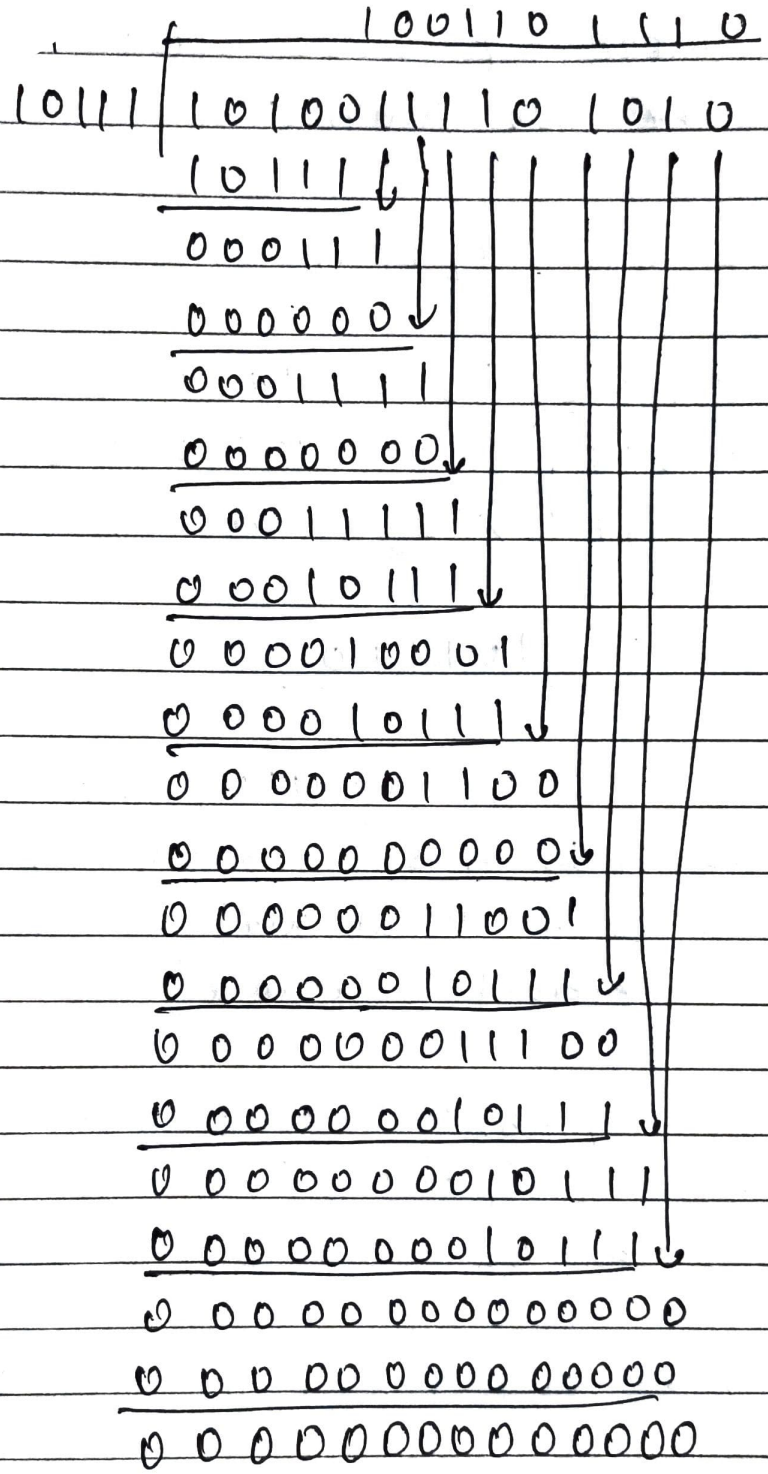
a)



codeword at sender side

10100111101010

b) Checking at receiver side



⇒ Dataword is accepted.

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Q-5 In Hamming code C(7,4).

a) If dataword at sender location is 0101, what will be the code word?

→

codeword = 0101 $r_2 r_1 r_0$

$r_0 = (a_2 + a_1 + a_0) \% 2 = (1+0+1) \% 2 = 0$

$r_1 = (a_3 + a_2 + a_1) \% 2 = (0+1+0) \% 2 = 1$

$r_2 = (a_3 + a_1 + a_0) \% 2 = (0+0+1) \% 2 = 1$

∴ codeword = 0101110

b) If receiver receives 0001110, what will be the syndrome value ($S_2 S_1 S_0$) and which bit is corrupted during transmission? What will be the derived dataword from received codeword?

0001110

$S_0 = (b_2 + b_1 + b_0 + r_0) \% 2 = (0+0+1+0) \% 2 = 1$

$S_1 = (b_3 + b_2 + b_1 + r_1) \% 2 = (0+0+0+1) \% 2 = 1$

$S_2 = (b_3 + b_1 + b_0 + r_2) \% 2 = (0+0+1+1) \% 2 = 0$

∴ syndrome value ($S_2 S_1 S_0$) = (0 1 1) → (3)

⇒ ∴ b_2 needs to be flipped

So 0001 → [0101]

derived dataword.