# Hamming code

Determine which bit ,if any is an error in the even parity. Hamming coded character 1100111. Decode the message

$2^p \geq n+p+1 = 7$ Hamming code Length = 7 bits, $p=3$, $n=4$

| Bit Designation | $D_7$ | $D_6$ | $D_5$ | $P_4$ | $D_3$ | $P_2$ | $P_1$ |
|---|---|---|---|---|---|---|---|
| Bit location | 7 | 6 | 5 | 4 | 3 | 2 | 1 |
| Bit location number | 0111 | 0110 | 0101 | 0100 | 0011 | 0010 | 0001 |
| Received code | 1 | 1 | 0 | 0 | 1 | 1 | 1 |
| Correct hamming code | 1 | 1 | 0 | 0 | 1 | 1 | 0 |

Parity $P_1$ = 1,3,5,7 = 1101 = 1

Parity $P_2$ = 2,3,6,7 = 1111 = 0

Parity $P_4$ = 4,5,6,7 = 0011 = 0

(LSB) ↑ (MSB)

$(001)_2 = (1)_{10}$

$(001)_2 = (1)_{10} \Rightarrow$

Hamming length = no. of information bits + no. of parity bits

4 + 3 = 7 bits

Determine which bit ,if any is an error in the ~~even~~ odd parity. Hamming coded character 1001001.Decode the message

7 bits = (4) + (3) parity bits

(4) → Data bits

| Bit Designation | $D_7$ | $D_6$ | $D_5$ | $P_4$ | $D_3$ | $P_2$ | $P_1$ |
|---|---|---|---|---|---|---|---|
| Bit location | 7 | 6 | 5 | 4 | 3 | 2 | 1 |
| Bit location number | 111 | 110 | 101 | 100 | 011 | 010 | 001 |
| Received code | 1 | 0 | 0 | 1 | 0 | 0 | 1 |
| Correct hamming code | 1 | 0 | 1 | 1 | 0 | 0 | 1 |

Parity $P_1$ = 1, 3, 5, 7 ⇒ 1, 0, 0, 1 = 1 (LSB)

Parity $P_2$ = 2, 3, 6, 7 = 0, 0, 0, 1 = 0

Parity $P_3$ = 4, 5, 6, 7 = 1, 0, 0, 1 = 1 (MSB)

$(101)_2 = (5)_{10}$

③ Encode the information character 0111 0111 0101 according to 15 bit even Hamming Code.

n = information

$n = 11$

$P = ?$

$2^P \geq n + P + 1$

let = 4 $\quad 2^4 > 11 + P + 1$

$16 > 15$ ✓ $\quad P = 4$.

Hamming Code length = $n + P = 11 + 4 = 15$

| Bit desig | $D_{15}$ | $D_{14}$ | $D_{13}$ | $D_{12}$ | $D_{11}$ | $D_{10}$ | $D_9$ | $P_8$ | $D_7$ | $D_6$ | $D_5$ | $P_4$ | $D_3$ | $P_2$ | $P_1$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Bit loc | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |
| Location | 1111 | 1110 | 1101 | 1100 | 1011 | 1010 | 1001 | 1000 | 0111 | 0110 | 0101 | 0100 | 0011 | 0010 | 0001 |
| Hamming | 0 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | 0 |

excluded

Parity $P_1$ ⇒ ~~$P_1$~~ 3, 5, 7, 9, 11, 13, 15 ⇒ 1001110 = 0

excluded

Parity $P_1$ $\Rightarrow$ ($P_1$) 3, 5, 7, 9, 11, 13, 15 $\Rightarrow$ 1 0 0 1 1 1 0 = 0

Parity $P_2$ = ($P_2$) 3, 6, 7, 10, 11, 14, 15 $\Rightarrow$ 1 1 0 1 1 1 0 = 1

Parity $P_4$ = ($P_4$) excluded 5, 6, 7, 12, 13, 14, 15 $\Rightarrow$ 0 1 0 0 1 1 0 = 1

Parity $P_8$ = ($P_8$) excluded 9, 10, 11, 12, 13, 14, 15 $\Rightarrow$ 1 1 1 0 1 1 0 = 1

Determine error if any for the given Received even parity Hamming code as 0 1 1 0 1 1 1 0 0 1 0 1 1 1 0

$P_8$

$P_1$ 0 (LSB)

$P_2$ 0

$P_4$ 0

$P_8$ 1 (MSB)

$(1000)_2 = (8)_{10}$