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ex: Let $H = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 1 \\ 1 & 1 & 1 \\ 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$

be a parity check matrix. Determine the group code $e_H : B^3 \to B^6$.

$\Rightarrow$ we have $B^3 = \{000, 001, 010, 011, 100, 101, 110, 111\}$ then

$e(000) = 000\, x_1 x_2 x_3$

where $x_1 x_2 x_3$ are determined using

$x_1 = 0.1 + 0.0 + 0.1 = 0$

$x_2 = 0.0 + 0.1 + 0.1 = 0$

$x_3 = 0.0 + 0.1 + 0.1 = 0$

$e(000) = 000000$

$e(001) = 001\, x_1 x_2 x_3$

$x_1 = 0.1 + 0.0 + 1.1 = 1$

$x_2 = 0.0 + 0.1 + 1.1 = 1$

$x_3 = 0.0 + 0.1 + 1.1 = 1$

$e(001) = 001111$

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$e(010) = 010\ X_1X_2X_3$

$X_1 = 0 \cdot 1 + 1 \cdot 0 + 0 \cdot 1 = 0$

$X_2 = 0 \cdot 0 + 1 \cdot 1 + 0 \cdot 1 = 1$

$X_3 = 0 \cdot 0 + 1 \cdot 1 + 0 \cdot 1 = 1$

$e(010) = 010011$

$e(011) = 011\ X_1X_2X_3$

$X_1 = 0 \cdot 1 + 1 \cdot 0 + 1 \cdot 1 = 1$

$X_2 = 0 \cdot 0 + 1 \cdot 1 + 1 \cdot 1 = 0$

$X_3 = 0 \cdot 0 + 1 \cdot 1 + 1 \cdot 1 = 0$

$e(011) = 011100$

$e(100) = 100\ X_1X_2X_3$

$X_1 = 1 \cdot 1 + 0 \cdot 0 + 0 \cdot 1 = 1$

$X_2 = 1 \cdot 0 + 0 \cdot 1 + 0 \cdot 1 = 0$

$X_3 = 1 \cdot 0 + 0 \cdot 1 + 0 \cdot 1 = 0$

$e(100) = 100100$

$e(101) = 101\ X_1X_2X_3$

$X_1 = 1 \cdot 1 + 0 \cdot 0 + 1 \cdot 1 = 0$

$X_2 = 1 \cdot 0 + 0 \cdot 1 + 1 \cdot 1 = 1$

$X_3 = 1 \cdot 0 + 0 \cdot 1 + 1 \cdot 1 = 1$

$e(101) = 101011$

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$e(110) = 110 X_1 X_2 X_3$

$X_1 = 1 \cdot 1 + 1 \cdot 0 + 0 \cdot 1 = 1$

$X_2 = 1 \cdot 0 + 1 \cdot 1 + 0 \cdot 1 = 1$

$X_3 = 1 \cdot 0 + 1 \cdot 1 + 0 \cdot 1 = 1$

$e(110) = 110111$

$e(111) = 111 X_1 X_2 X_3$

$X_1 = 1 \cdot 1 + 1 \cdot 0 + 1 \cdot 1 = 0$

$X_2 = 1 \cdot 0 + 1 \cdot 1 + 1 \cdot 1 = 0$

$X_3 = 1 \cdot 0 + 1 \cdot 1 + 1 \cdot 1 = 0$

$e(111) = 111000$

$e_H = \beta^3 \rightarrow \beta^6$ is

$e(000) = 000000$

$e(001) = 001111$

$e(010) = 010011$

$e(011) = 011100$

$e(100) = 100100$

$e(101) = 101011$

$e(110) = 110111$

$e(111) = 111000$