

①  $\Theta = \begin{bmatrix} 1 & 0 & 0 & 0 & 1 & 1 & 0 \\ 0 & 1 & 0 & 0 & 1 & 1 & 1 \\ 0 & 0 & 1 & 0 & 1 & 0 & 1 \\ 0 & 0 & 0 & 1 & 0 & 1 & 1 \end{bmatrix}$

$$1 \cdot 1 \oplus 0 \cdot 0 \oplus 1 \cdot 0 \oplus 1 \cdot 0 = 1$$

$$\frac{1 \cdot 0 \oplus 0 \cdot 1 \oplus 1 \cdot 0 \oplus 1 \cdot 0}{0} = 0$$

a)  $i = [1011]$

$$i \cdot \Theta = c$$

$\underbrace{[1 \ 0 \ 1 \ 1]}_i \cdot \begin{bmatrix} 1 & 0 & 0 & 0 & 1 & 1 & 0 \\ 0 & 1 & 0 & 0 & 1 & 1 & 1 \\ 0 & 0 & 1 & 0 & 1 & 0 & 1 \\ 0 & 0 & 0 & 1 & 0 & 1 & 1 \end{bmatrix} = \underbrace{[1 \ 0 \ 1 \ 1]}_i \cdot \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} = c$

b).

$H = \begin{bmatrix} 1 & 1 & 1 & 0 & 1 & 0 & 0 \\ 1 & 1 & 0 & 1 & 0 & 1 & 0 \\ 0 & 1 & 1 & 1 & 0 & 0 & 1 \end{bmatrix}$   
 $\underbrace{\hspace{10em}}_{I_{3 \times 3}}$

c)  $R = 1010111$

$$1 \cdot 1 + 1 \cdot 0 + 1 \cdot 1 + 0 \cdot 0 +$$

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

$\underbrace{\begin{bmatrix} 1 \\ 0 \\ 0 \end{bmatrix}}_z = \underbrace{\begin{bmatrix} 1 & 1 & 1 & 0 \\ 1 & 1 & 0 & 1 \\ 0 & 1 & 1 & 1 \end{bmatrix}}_H \cdot \underbrace{\begin{bmatrix} 1 \\ 0 \\ 1 \\ 1 \end{bmatrix}}_{R^T} = \underbrace{\begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}}_{H \cdot I} \cdot \begin{bmatrix} 1 \\ 0 \\ 0 \\ 0 \end{bmatrix}$

$z \neq 0$  error

e	$z^T$
$[10000000]$	$[110]^T$
$01000000$	$111$
$\vdots$	$\vdots$
$0000100$	$[100]$

$\Rightarrow$  error at pos 5  
 $C = 101011$   
 $i = 1010$