LBC error detection and correction

Error detection and Correction Capability of Linear Block Code

Step-1 - Identify dmin [Minimum Hamming distance]

Error detection Capacity of Linear block code

$\Rightarrow d_{min} \geq s+1$

→ where, s = error detection capacity

Error Correction Capacity of Linear block code

$\Rightarrow d_{min} \geq 2t+1$

→ where, t = error correction capacity

- If minimum hamming dist.^{n} of Linear block code is 3. Find LBC code ~~detection~~ & correction capability.

→ $d_{min} = 3$

→ for error detection

⇒ $d_{min} \geq s+1$

⇒ $3 \geq s+1$

⇒ $2 \geq s$

⇒ $s \leq 2$

→

- If minimum hamming dist.^{n} of Linear block code is 3. Find LBC code detection & correction capability.

→ $d_{min} = 3$

→ for error detection

⇒ $d_{min} \geq s+1$

⇒ $3 \geq s+1$

⇒ $2 \geq s$

⇒ $s \leq 2$

→ this code can detect 2 bit error.

→ For error correction

- If m... hamming dist. ...

Find L... code detection & correction capability.

→ $d_{min} = 3$

→ for error detection

⇒ $d_{min} \geq s+1$

⇒ $3 \geq s+1$

⇒ $2 \geq s$

⇒ $s \leq 2$

→ this code can detect 2 bit error.

→ For error correction

⇒ $d_{min} \geq 2t+1$

⇒ $3 \geq 2t+1$

⇒ $2 \geq 2t$

⇒ $t \leq 1$

→ this code can correct 1 bit error

Error syndromes and Error correction

Error Syndromes in Linear block Codes with Example.

- If Received Codeword is $[Y]$
- then error Syndromes

$$[S] = [Y][H^T]$$

- Here, Received Codeword $[Y]$

$$[Y] = [C] + [e]$$

where, $[C]$ = Codeword
$[e]$ = error

- If error $[e] = 0$, $[Y] = [C]$

Error Syndromes in Linear block Codes with Example.

- If Received Codeword is [Y]
- then error Syndromes

$$[S] = [Y][H^T]$$

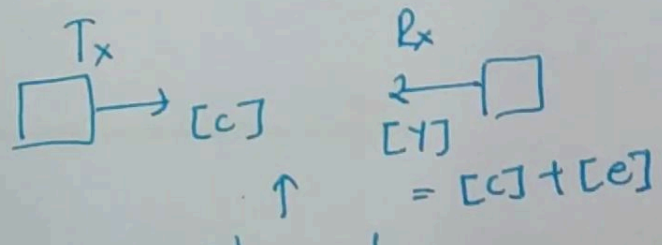
- H... ...eiv... Codeword [Y]

$$[\ ] = [C] + [e]$$

... where ... Codeword

... error

error ...



Find the error syndromes of $V_1 = (1101101)$. for

$$H^T = \begin{bmatrix} 1 & 0 & 1 \\ 1 & 1 & 1 \\ 1 & 1 & 0 \\ 0 & 1 & 1 \\ 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

, where V is received codeword.
also Calculate the errored bit

→ Rec

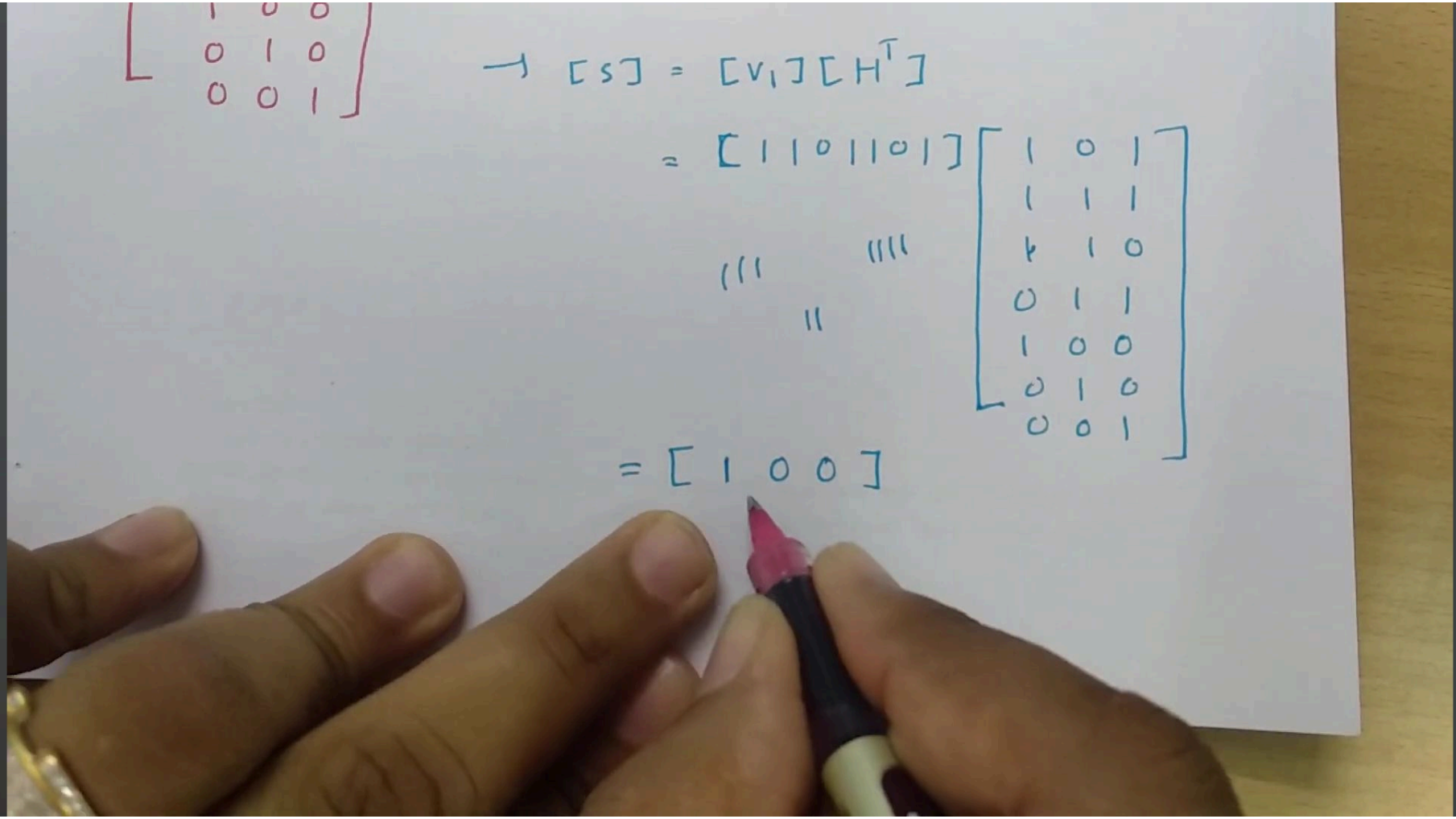
$$\begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

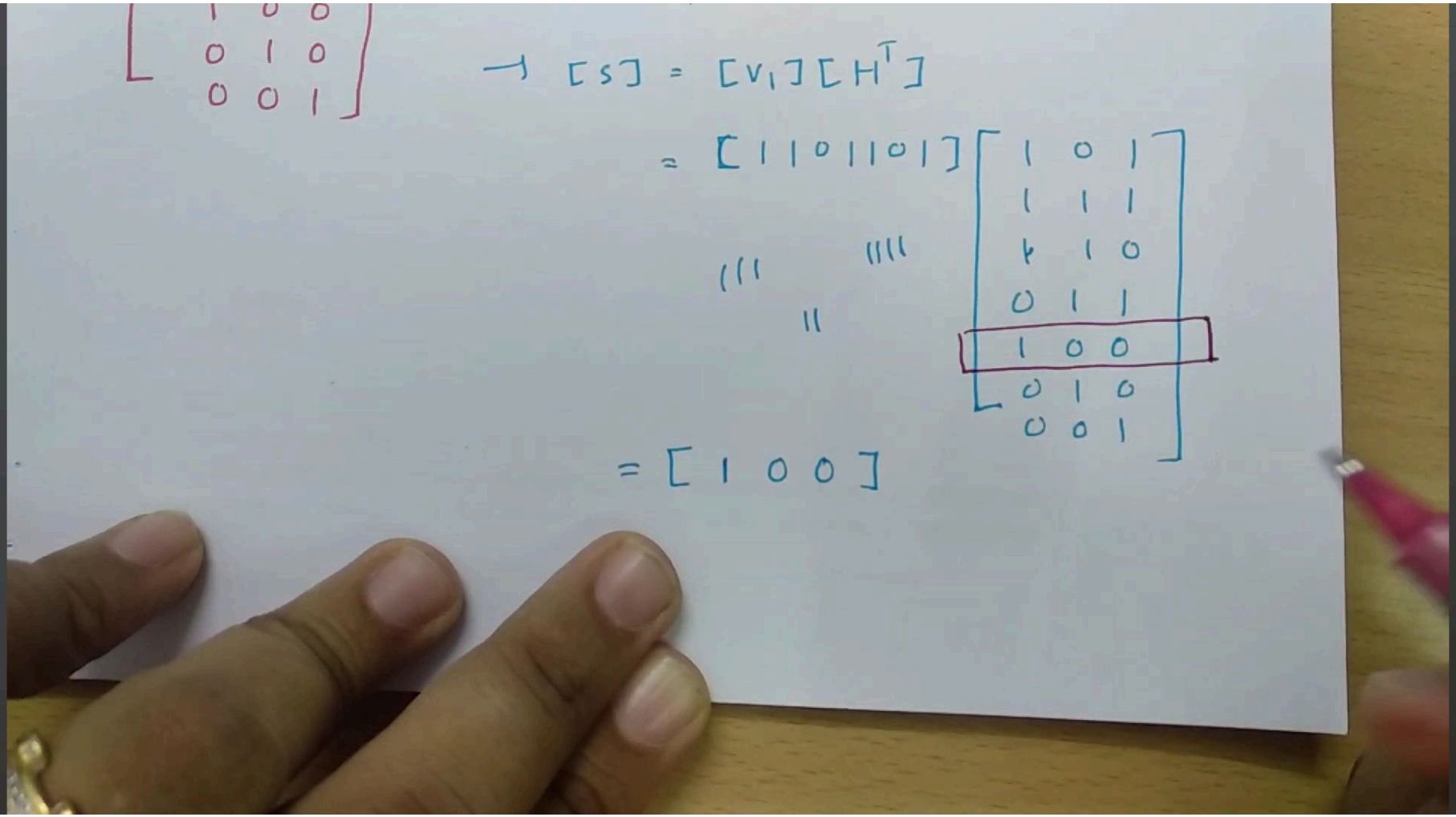
$$\rightarrow [S] = [V_1][H^T]$$

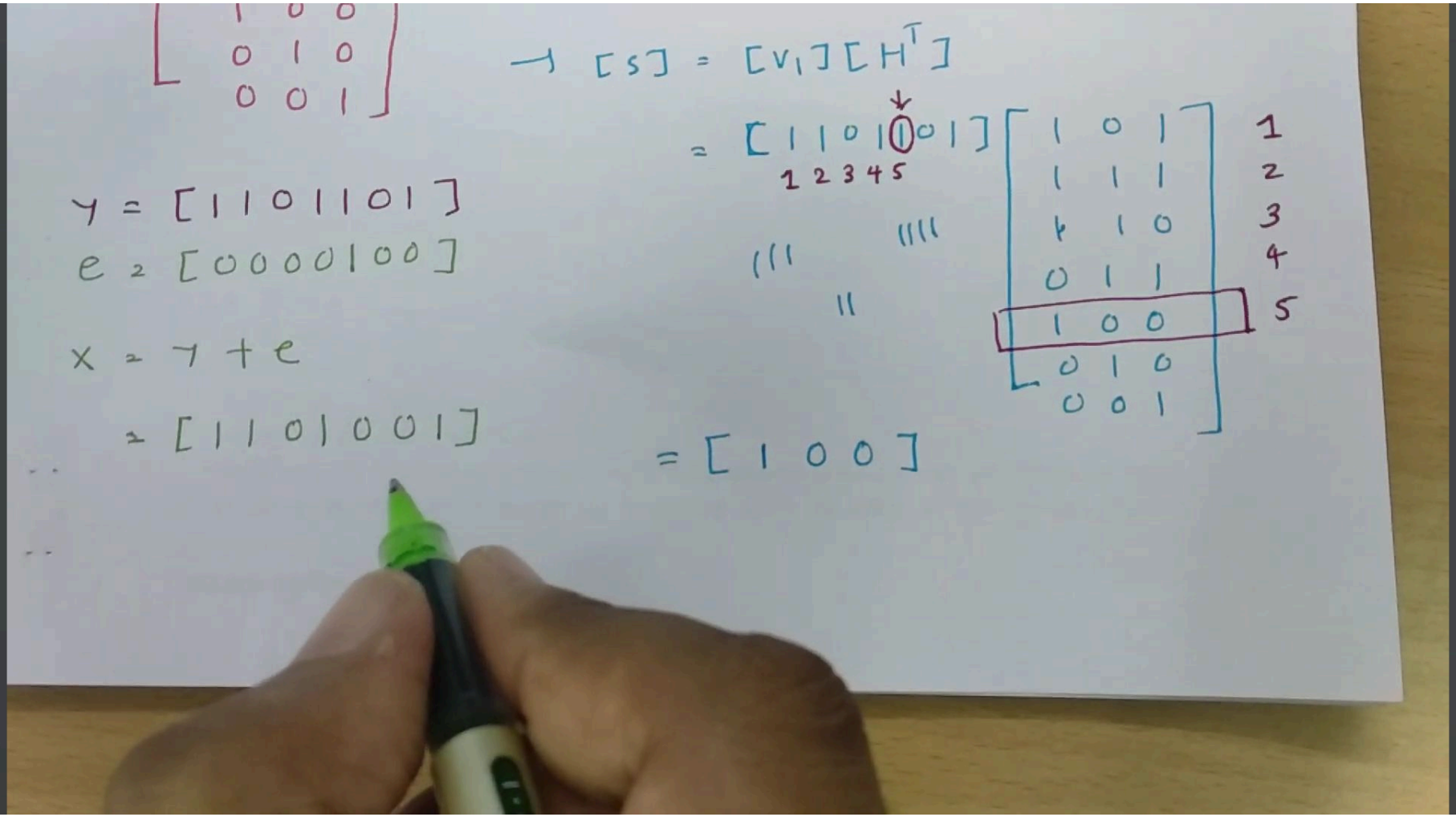
$$= [1\,1\,0\,1\,1\,0\,1] \begin{bmatrix} 1 & 0 & 1 \\ 1 & 1 & 1 \\ 1 & 1 & 0 \\ 0 & 1 & 1 \\ 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

$$= [1\,0\,0]$$

Input A	Input B	Output
0	0	0
0	1	1
1	0	1
1	1	0


$\begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$
$\rightarrow [S] = [V_1][H^T]$
$= [1\,1\,0\,1\,1\,0\,1] \begin{bmatrix} 1 & 0 & 1 \\ 1 & 1 & 1 \\ 1 & 1 & 0 \\ 0 & 1 & 1 \\ 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$
$= [1\,0\,0]$


$\begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$
$\rightarrow [S] = [V_1][H^T]$
$= [1\,1\,0\,1\,1\,0\,1]$
$\begin{bmatrix} 1 & 0 & 1 \\ 1 & 1 & 1 \\ 1 & 1 & 0 \\ 0 & 1 & 1 \\ 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$
$= [1\,0\,0]$


$\begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$
$\rightarrow [S] = [V_1][H^T]$
$= [1\ 1\ 0\ 1\ 0\ 0\ 1]$
1 2 3 4 5
$y = [1\ 1\ 0\ 1\ 1\ 0\ 1]$
$e = [0\ 0\ 0\ 0\ 1\ 0\ 0]$
$x = y + e$
$= [1\ 1\ 0\ 1\ 0\ 0\ 1]$
$= [1\ 0\ 0]$
1 0 1
1 1 1
1 1 0
0 1 1
1 0 0
0 1 0
0 0 1
1
2
3
4
5