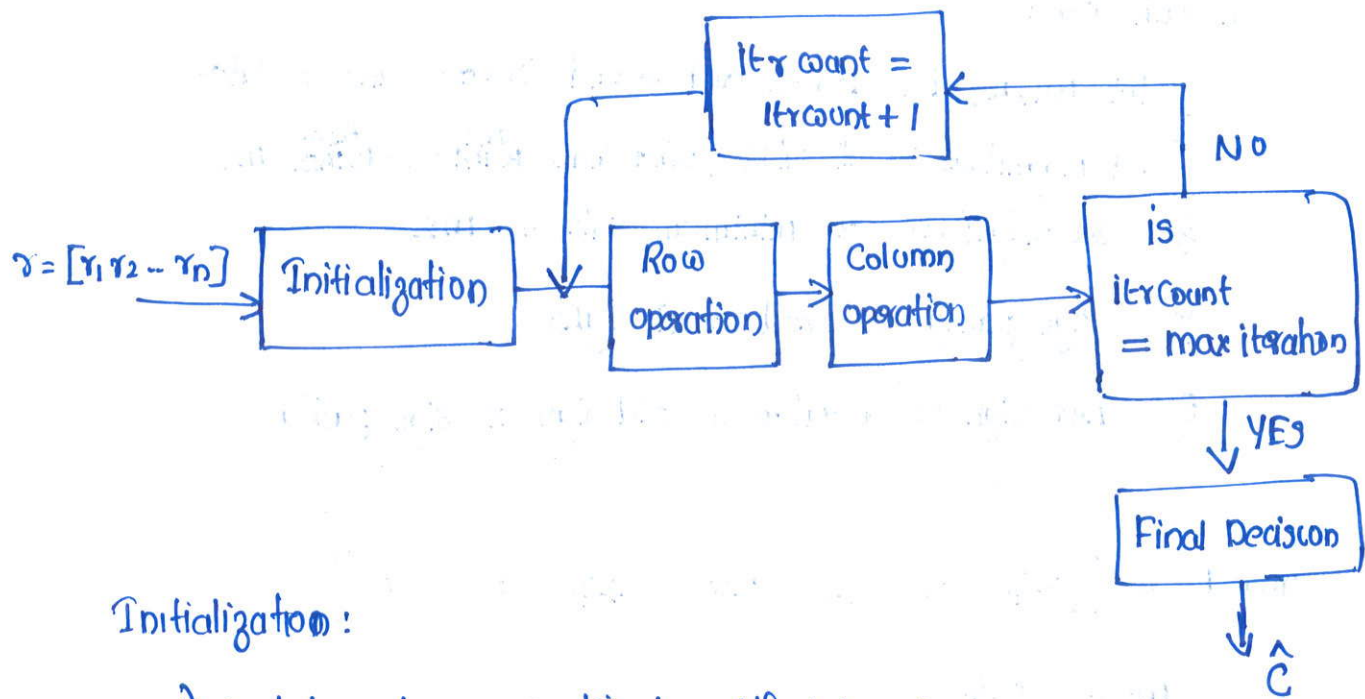


An Example min-sum Decoder :



Initialization :

1) update storage matrix L with elements of \bar{r} at locations of non zero elements in parity check matrix H .

2) itrCount = 1

Example :

Parity check matrix of $(7,4)$ hamming code :

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

$$r = [0.4 \quad -0.9 \quad 1.1 \quad 0.8 \quad -1.4 \quad 0.3 \quad -0.2]$$

$$L = \begin{bmatrix} 0.4 & 0 & 1.1 & 0.8 & -1.4 & 0 & 0 \\ 0.4 & -0.9 & 0 & 0.8 & 0 & 0.3 & 0 \\ 0.4 & -0.9 & 1.1 & 0 & 0 & 0 & -0.2 \end{bmatrix}$$

Initialization of storage matrix L with r at non zero locations in H .

A) iteration = 1, row 1

on each row:

- 1) let m_1, m_2 be lowest and second lowest absolute values
- 2) set magnitude of all values, other than $m_1 = \frac{m_2}{m_1}$
- 3) set magnitude of minimum value = m_2
- 4) sign parity = prod of all signs
- 5) new sign of a value = old sign \times sign parity

$$\text{row 1} = \begin{bmatrix} 0.4 & 0 & 1.1 & 0.8 & -1.4 & 0 & 0 \end{bmatrix}$$

$$m_1 = 0.4$$

$$m_2 = 0.8$$

$$\text{sign parity} = -1$$

row 1 after min sum operation:

$$= \begin{bmatrix} -0.8 & 0 & -0.4 & -0.4 & 0.4 & 0 & 0 \end{bmatrix}$$

storage matrix after iteration 1 and row 1

$$L = \begin{bmatrix} -0.8 & 0 & -0.4 & -0.4 & 0.4 & 0 & 0 \\ 0.4 & -0.9 & 0 & 0.8 & 0 & 0.3 & 0 \\ 0.4 & -0.9 & 1.1 & 0 & 0 & 0 & -0.2 \end{bmatrix}$$

③ Iteration 1 and after all ~~for~~ rows

$$L = \begin{bmatrix} -0.8 & 0 & -0.4 & -0.4 & 0.4 & 0 & 0 \\ -0.3 & 0.3 & 0 & -0.3 & 0 & -0.4 & 0 \\ 0.2 & -0.2 & 0.2 & 0 & 0 & 0 & -0.4 \end{bmatrix}$$

"row operations completed"

④ Iteration 1 ; column 1

In each column :

1) corresponding r value in \bar{r} is updated with sum of all elements in the column and existing r value.

2) values in ~~the~~ column is updated with new r value - old value.

$$r = \begin{bmatrix} 0.4 & -0.9 & 1.1 & 0.8 & -1.4 & 0.3 & -0.2 \end{bmatrix}$$

column 1 of L after all row operations

$$\begin{bmatrix} -0.8 \\ -0.3 \\ 0.2 \end{bmatrix}$$

$$\begin{aligned} \text{New } r \text{ value} &= (0.4 + (-0.8) + (-0.3) + (0.2)) \\ &= 0.5 \end{aligned}$$

$$\text{updated column} = (0.5) - \begin{bmatrix} -0.8 \\ -0.3 \\ 0.2 \end{bmatrix} = \begin{bmatrix} 0.3 \\ 0.2 \\ -0.7 \end{bmatrix}$$

updated \bar{r} after column 1 operation

$$\bar{r} = [-0.5 \quad -0.9 \quad 1.1 \quad 0.8 \quad -1.4 \quad 0.3 \quad -0.2]$$

updated L after column 1 operation.

$$L = \begin{bmatrix} 0.3 & 0 & -0.4 & -0.4 & 0.4 & 0 & 0 \\ 0.2 & 0.3 & 0 & 0.3 & 0 & -0.4 & 0 \\ -0.7 & -0.2 & 0.2 & 0 & 0 & 0 & -0.4 \end{bmatrix}$$

⑤ Iteration = 1, after all column operations.

$$\text{updated } \bar{r} = [-0.5 \quad -0.8 \quad 0.9 \quad 0.1 \quad -1.0 \quad -0.1 \quad -0.6]$$

$$\text{updated } L = \begin{bmatrix} 0.3 & 0 & 1.3 & 0.5 & -1.4 & 0 & 0 \\ 0.2 & -1.1 & 0 & 0.4 & 0 & 0.3 & 0 \\ -0.7 & 0.6 & 0.7 & 0 & 0 & 0 & -0.2 \end{bmatrix}$$

"Iteration 1 completed"

Updated L is used for next iterations.