4:2 Priority encoder

y_0	y_1	y_2	y_3	w_1	w_0	IST
0	0	0	0	d	d	0
1	X	X	X	0	0	1
0	1	X	X	0	1	1
0	0	1	X	1	0	1
0	0	0	1	1	1	1
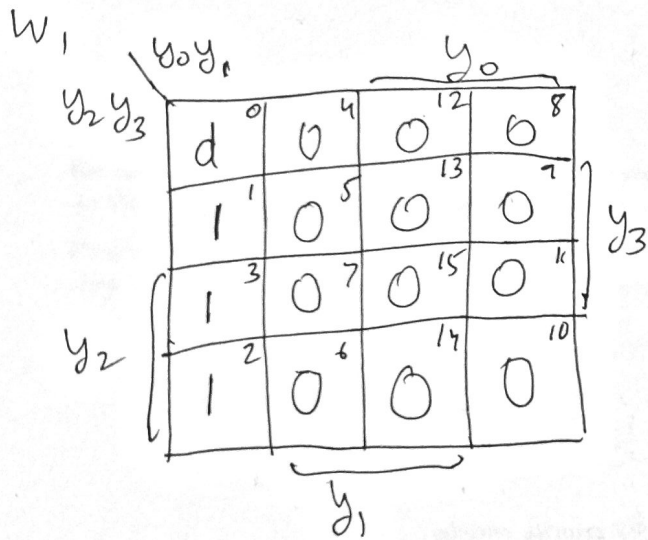
$$W_1 = \overline{y_0}\,\overline{y_1}$$

$$IST = y_0 + y_1 + y_2 + y_3$$
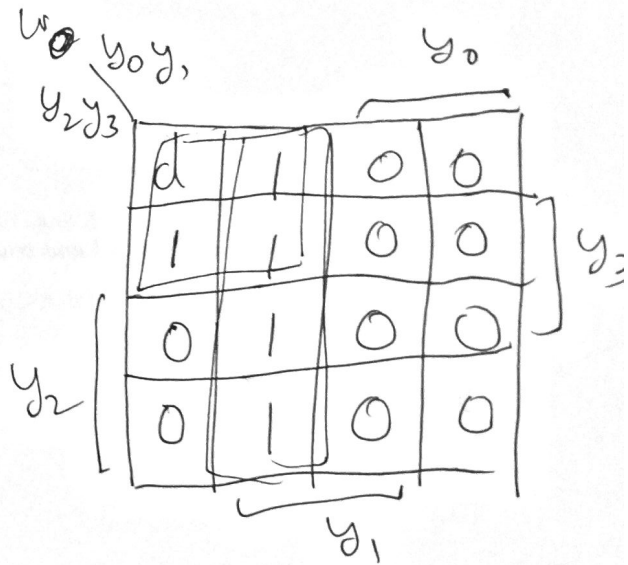
$$W_0 = \overline{y_0}\,\overline{y_2} + \overline{y_0}\,y_1$$

$$= \overline{y_0}\,y_1 + \cancel{}$$

$$+ \overline{y_0}\,\overline{y_1}\,\overline{y_2}\,y_3$$

$$+ \overline{y_0}\,\overline{y_1}\,\overline{y_2}\,\overline{y_3}$$

$$= \overline{y_0}\,y_1 + \overline{y_0}\,\overline{y_1}\,\overline{y_2}$$

$$= \overline{y_0}\,y_1\,y_2 + y_0\,y_1\,\overline{y_2} + y_0\,y_1\,\overline{y_2}$$

$$= \overline{y_0}\,y_1 + y_0\,\overline{y_2}$$

8:3 Priority encoder

y_0	y_1	y_2	y_3	y_4	...	y_7	w_2	w_1	w_0	IST
0	0	0	0	0	----	0	d	d	d	1
1	x	x	x	x			0	0	0	1
0	1	x	x	x			0	0	1	1
0	0	1	x	x			0	1	0	1
0	0	0	1	x			0	1	1	(
0	0	0	0	1	-----		1	0	0	1
					:	1				
0	0	0	0	0	---	1	1	1	1	1

$$w_2 = \bar{y}_0\,\bar{y}_1\,\bar{y}_2\,\bar{y}_3$$

$$w_1 = \bar{y}_0\bar{y}_1\left(y_2 + \bar{y}_2\left(y_3 + \bar{y}_3\bar{y}_4\bar{y}_5\left(y_6 + \bar{y}_6 y_7\right)\right)\right)$$
$$= \bar{y}_0\bar{y}_1\left(y_2 + \bar{y}_2\left(y_3\right.\right.$$

$$w_0 = \bar{y}_0\left(y_1 + \bar{y}_1\left(\bar{y}_2\left(y_3 + \bar{y}_3\bar{y}_4\left(y_5 + \bar{y}_5\bar{y}_6 y_7\right)\right)\right)\right)$$

$$IST = y_0 + y_1 + y_2 + \,...\, + y_7$$

8:3 Priority encoder

Consider

$$\bar{y}_0 \bar{y}_1 (y_2 + \bar{y}_2 y_3)$$

$$= \bar{y}_0 \bar{y}_1 (y_2 + y_3)$$

$$= \bar{y}_0 \bar{y}_1 y_2 + \bar{y}_0 \bar{y}_1 y_3$$

Consider

$$\bar{y}_0 \bar{y}_1 \left[y_3 + \bar{y}_3 \bar{y}_4 \bar{y}_5 y_6 \right]$$

$$= \bar{y}_0 \bar{y}_1 \left(y_3 + \bar{y}_4 \bar{y}_5 y_6 \right)$$

$$\bar{y}_0 \bar{y}_1 \, \bar{y}_4 \bar{y}_5 \left(y_6 + \bar{y}_6 y_7 \right)$$

$$W_1 = \bar{y}_0 \bar{y}_1 \left(y_2 + y_3 + \bar{y}_4 \bar{y}_5 y_6 \right)$$

$$W_0 = \bar{y}_0 \left(y_1 + \bar{y}_2 \left(y_3 + \bar{y}_4 \left(y_5 + \bar{y}_6 \right) \right) \right)$$

$$= \bar{y}_0 \left(y_1 + \bar{y}_2 y_3 + \bar{y}_2 \bar{y}_4 y_5 + \bar{y}_2 \bar{y}_4 \bar{y}_6 \right)$$