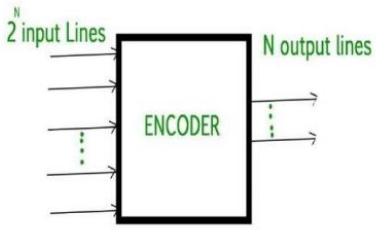
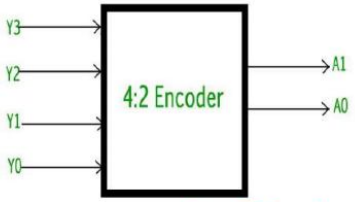
Encoder

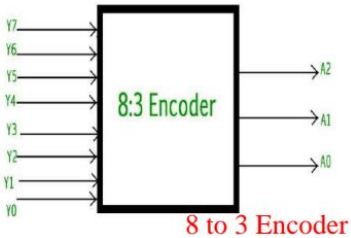
- An Encoder is a combinational circuit that performs the reverse operation of Decoder.
- It has maximum of **2^N input lines** and **'N' output lines**, hence it encodes the information from 2^N inputs into an N-bit code.
- It will produce a binary code equivalent to the input.



- The 4 to 2 Encoder consists of **four inputs Y3, Y2, Y1, Y0 and two outputs A1 and A0**.
- At any time, only one of these 4 inputs can be '1' in order to get the respective binary code at the output.
- The 8 to 3 Encoder or octal to Binary encoder consists of **8 inputs** : Y7 to Y0 and **3 outputs** : A2, A1 & A0.
- Each input line corresponds to each octal digit and three outputs generate corresponding binary code.



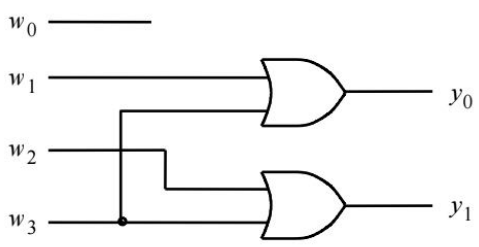
4 to 2 Encoder



8 to 3 Encoder

4-to-2 Binary Encoder

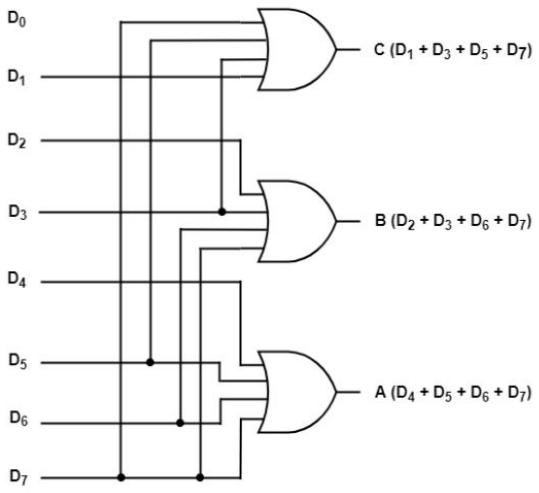
w_3	w_2	w_1	w_0	y_1	y_0
0	0	0	1	0	0
0	0	1	0	0	1
0	1	0	0	1	0
1	0	0	0	1	1



8-to-3 Binary Encoder

At any one time, only
one input line has a value of 1.

Inputs								Outputs		
D_0	D_1	D_2	D_3	D_4	D_5	D_6	D_7	A	B	C
1	0	0	0	0	0	0	0	0	0	0
0	1	0	0	0	0	0	0	0	0	1
0	0	1	0	0	0	0	0	0	1	0
0	0	0	1	0	0	0	0	0	1	1
0	0	0	0	1	0	0	0	1	0	0
0	0	0	0	0	1	0	0	1	0	1
0	0	0	0	0	0	1	0	1	1	0
0	0	0	0	0	0	0	1	1	1	1



Priority Encoder

- One of the main disadvantages of standard digital encoder is that they can generate the wrong output code when there is more than one input present at logic level "1".
- One simple way to overcome this problem is to "Prioritize" the level of each input pin.
- If there is more than one input at logic level "1" at the same time, the actual output code would only correspond to the input with the highest designated priority.
- This type of digital encoder is known as **Priority Encoder** or **P-Encoder** for short.
- The **Priority Encoder** solves the problems by allocating a priority level to each input.
- The *priority encoders* output corresponds to the currently active input which has the highest priority.
- So, when an input with a higher priority is present, all other inputs with a lower priority will be ignored.

4-to-2 Priority Encoder

Truth Table

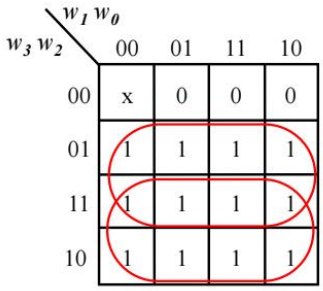
w_3	w_2	w_1	w_0	y_1	y_0
0	0	0	0	x	x
0	0	0	1	0	0
0	0	1	x	0	1
0	1	x	x	1	0
1	x	x	x	1	1

w_3	w_2	w_1	w_0	y_1	y_0
0	0	0	0	x	x
0	0	0	1	0	0
0	0	1	x	0	1
0	1	x	x	1	0
1	x	x	x	1	1

	w_3	w_2	w_1	w_0	y_1	y_0
0 0 0 0	0	0	0	0	x	x
0 0 0 1	0	0	0	1	0	0
0 0 1 x	0	0	1	0	0	1
	0	0	1	1	0	1
0 1 x x	0	1	0	0	1	0
	0	1	0	1	1	0
	0	1	1	0	1	0
	0	1	1	1	1	0
1 x x x	1	0	0	0	1	1
	1	0	0	1	1	1
	1	0	1	0	1	1
	1	0	1	1	1	1
	1	1	0	0	1	1
	1	1	0	1	1	1
	1	1	1	0	1	1
	1	1	1	1	1	1

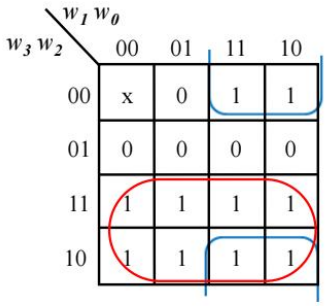
K-Map

w_3	w_2	w_1	w_0	y_1	y_0
0	0	0	0	X	X
0	0	0	1	0	0
0	0	1	0	0	1
0	0	1	1	0	1
0	1	0	0	1	0
0	1	0	1	1	0
0	1	1	0	1	0
0	1	1	1	1	0
1	0	0	0	1	1
1	0	0	1	1	1
1	0	1	0	1	1
1	0	1	1	1	1
1	1	0	0	1	1
1	1	0	1	1	1
1	1	1	0	1	1
1	1	1	1	1	1



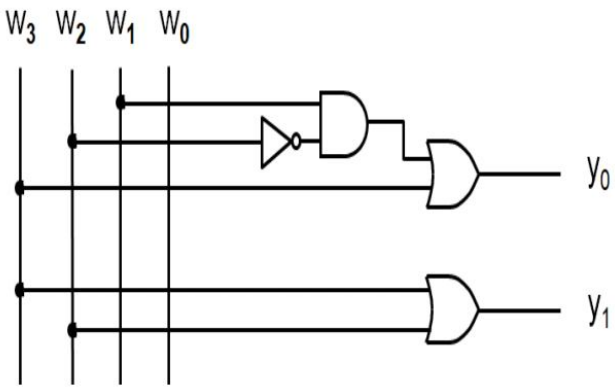
$y_1 = w_3 + w_2$

w_3	w_2	w_1	w_0	y_1	y_0
0	0	0	0	X	X
0	0	0	1	0	0
0	0	1	0	0	1
0	0	1	1	0	1
0	1	0	0	1	0
0	1	0	1	1	0
0	1	1	0	1	0
0	1	1	1	1	0
1	0	0	0	1	1
1	0	0	1	1	1
1	0	1	0	1	1
1	0	1	1	1	1
1	1	0	0	1	1
1	1	0	1	1	1
1	1	1	0	1	1
1	1	1	1	1	1



$y_0 = w_3 + w_1 \overline{w_2}$

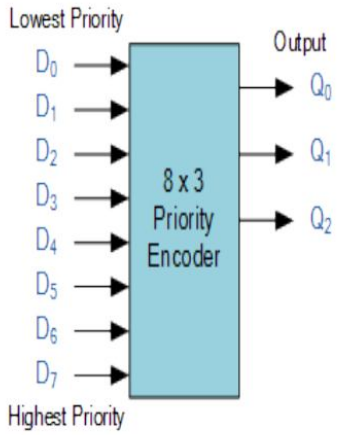
Circuit for the 4-to-2 priority encoder



$y_0 = w_3 + w_1\overline{w_2}$

$y_1 = w_3 + w_2$

8-to-3 Priority Encoder



Inputs								Outputs		
D_7	D_6	D_5	D_4	D_3	D_2	D_1	D_0	Q_2	Q_1	Q_0
0	0	0	0	0	0	0	1	0	0	0
0	0	0	0	0	0	1	x	0	0	1
0	0	0	0	0	1	x	x	0	1	0
0	0	0	0	1	x	x	x	0	1	1
0	0	0	1	x	x	x	x	1	0	0
0	0	1	x	x	x	x	x	1	0	1
0	1	x	x	x	x	x	x	1	1	0
1	x	x	x	x	x	x	x	1	1	1

X = dont care

- From the truth table of the Priority Encoder, the Boolean expression with data inputs D_0 to D_7 and outputs Q_0, Q_1, Q_2 is given as:

$$Q_0 = \sum\left(\bar{D}_6\left(\bar{D}_4\bar{D}_2D_1 + \bar{D}_4D_3 + D_5\right) + D_7\right)$$

$$Q_1 = \sum\left(\bar{D}_5\bar{D}_4(D_2 + D_3) + D_6 + D_7\right)$$

$$Q_2 = \sum(D_4 + D_5 + D_6 + D_7)$$