EE2000 Logic Circuit Design

Lecture 5 – Combinational Functional Blocks

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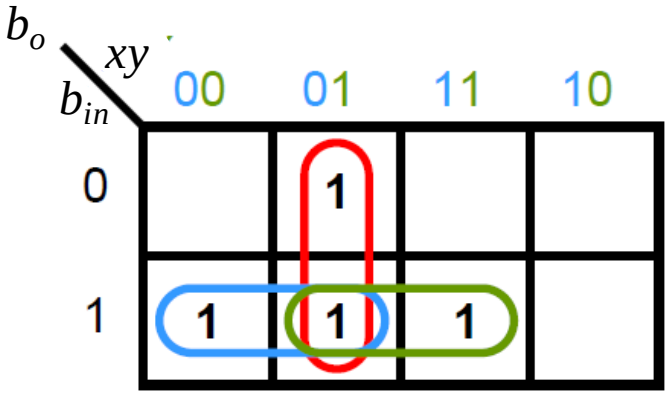
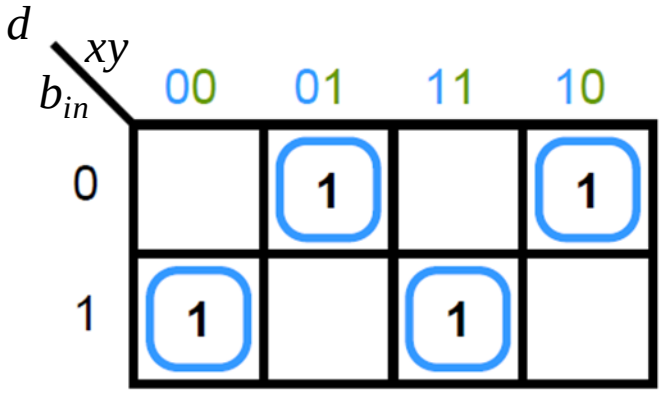
Exercise

c \ ab	00	01	11	10
0	m_0	m_2	m_6	m_4
1	m_1	m_3	m_7	m_5



$$b_o = x'y + x'b_{in} + yb_{in} = x'y + b_{in}(x' + y)$$
$$= x'y + b_{in}(x'y' + x'y + xy)$$
$$= x'y(1 + b_{in}) + b_{in}(x'y' + xy)$$
$$= x'y + b_{in}(x \oplus y)'$$

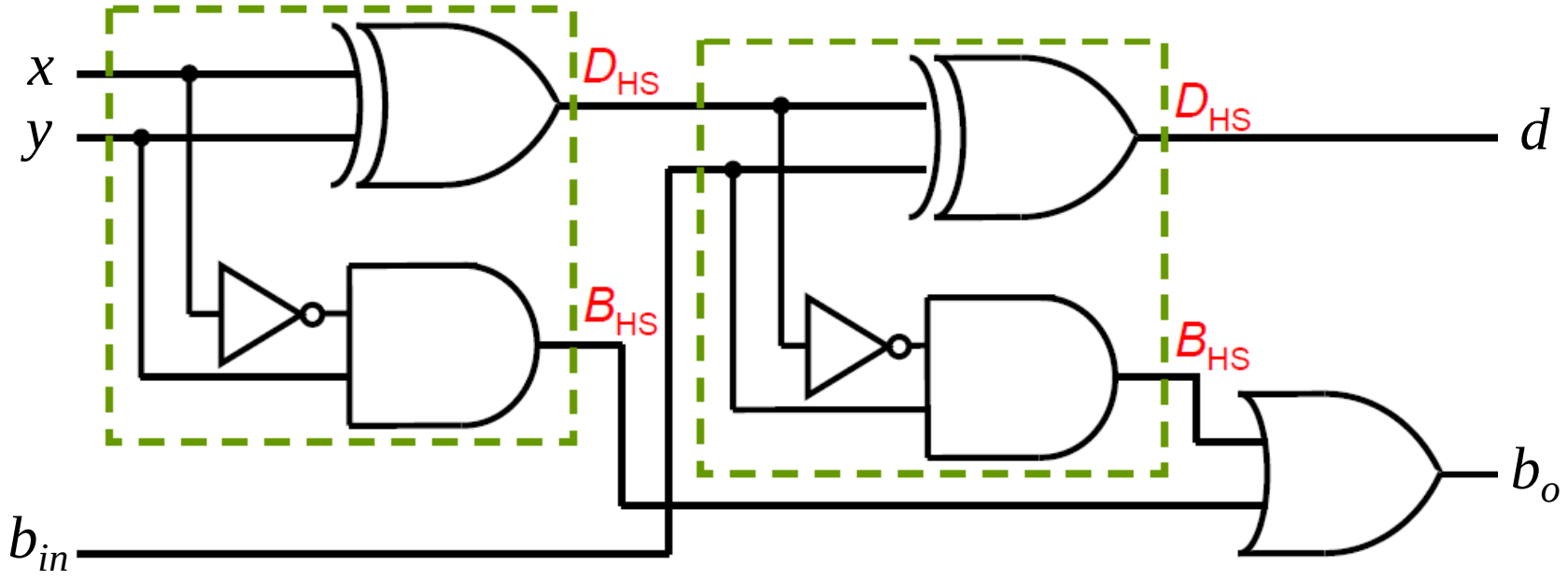


$$d = x'y'b_{in} + xyb_{in} + x'yb'_{in} + xy'b'_{in}$$
$$= b_{in}(x'y' + xy) + b'_{in}(x'y + xy')$$
$$= b_{in}(x \oplus y)' + b'_{in}(x \oplus y)$$
$$= b_{in} \oplus (x \oplus y)$$

Exercise

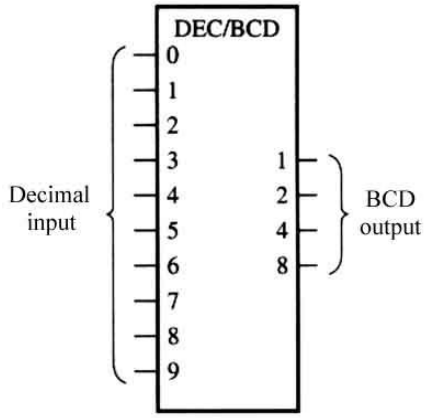
c \ ab	00	01	11	10
0	m_0	m_2	m_6	m_4
1	m_1	m_3	m_7	m_5

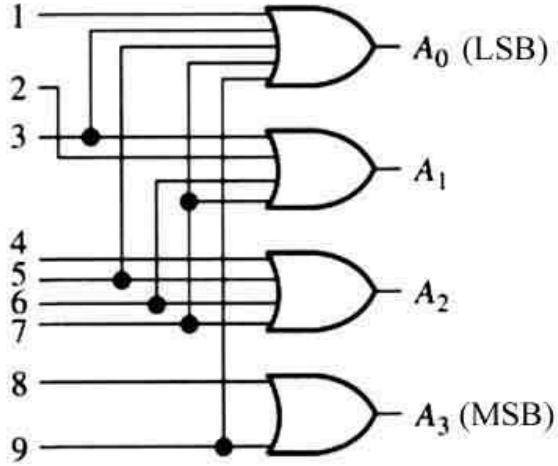
$b_o = x'y + b_{in}(x \oplus y)'$ $\quad d = b_{in} \oplus (x \oplus y)$



Exercise (Decimal-to-Binary Encoder)

Inputs										Outputs			
0	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	A_3	A_2	A_1	A_0
1	0	0	0	0	0	0	0	0	0	0	0	0	0
0	1	0	0	0	0	0	0	0	0	0	0	0	1
0	0	1	0	0	0	0	0	0	0	0	0	1	0
0	0	0	1	0	0	0	0	0	0	0	0	1	1
0	0	0	0	1	0	0	0	0	0	0	1	0	0
0	0	0	0	0	1	0	0	0	0	0	1	0	1
0	0	0	0	0	0	1	0	0	0	0	1	1	0
0	0	0	0	0	0	0	1	0	0	0	1	1	1
0	0	0	0	0	0	0	0	1	0	1	0	0	0
0	0	0	0	0	0	0	0	0	1	1	0	0	1

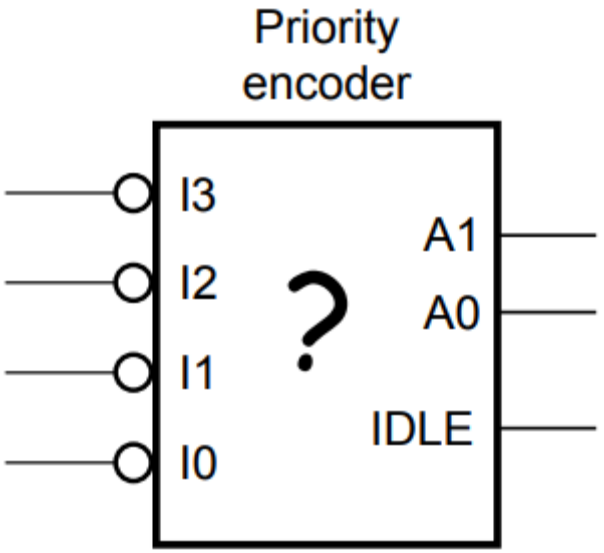




Exercise (Active Low)

- Design an Active Low 4-input priority encoder whereby inputs with higher subscript numbers has higher priority.
- Output IDLE is High when all inputs are high.

Input				Output		
I_3	I_2	I_1	I_0	A_1	A_0	IDLE
1	1	1	1	X	X	1
1	1	1	0	0	0	0
1	1	0	X	0	1	0
1	0	X	X	1	0	0
0	X	X	X	1	1	0



Exercise (Active Low)

Input				Output		
I_3	I_2	I_1	I_0	A_1	A_0	IDLE
1	1	1	1	X	X	1
1	1	1	0	0	0	0
1	1	0	X	0	1	0
1	0	X	X	1	0	0
0	X	X	X	1	1	0

$$\text{IDLE} = I_3 I_2 I_1 I_0$$

$$A_0 = I_3' + I_3 I_2 I_1'$$

$$= I_3' + I_2 I_1'$$

$$A_1 = I_3 I_2' + I_3'$$

$$= I_2' + I_3'$$

Simplification

a'+ ab = a' + b

Exercise (Active Low)

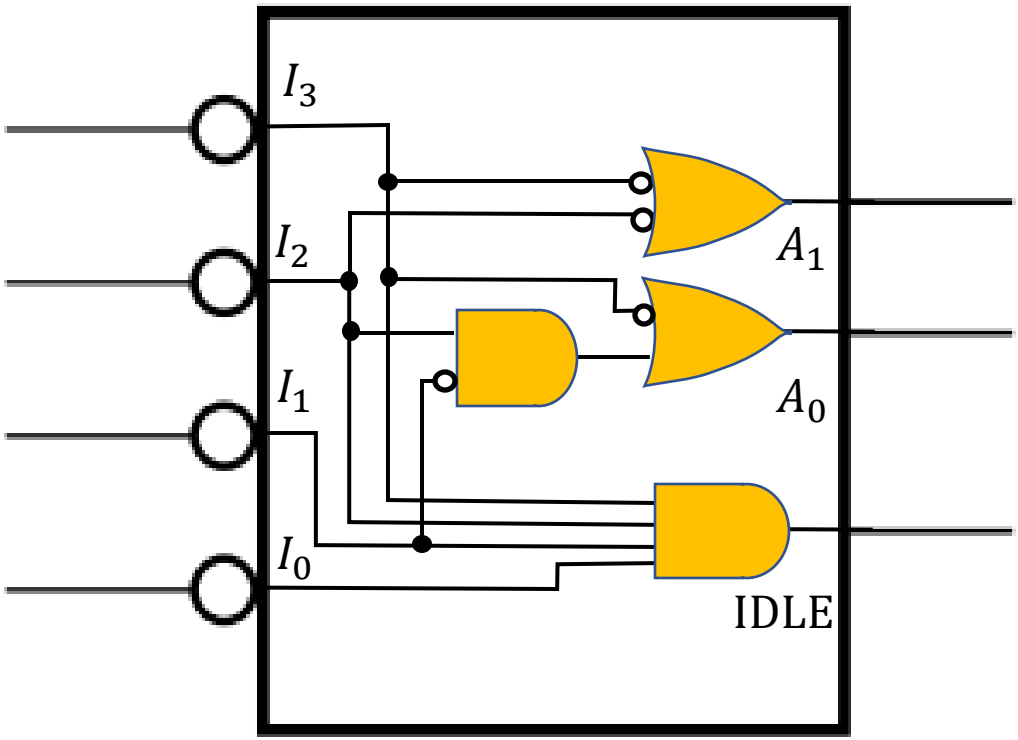
$$\text{IDLE} = I_3 I_2 I_1 I_0$$

$$A_0 = I_3' + I_3 I_2 I_1'$$

$$= I_3' + I_2 I_1'$$

$$A_1 = I_3 I_2' + I_3'$$

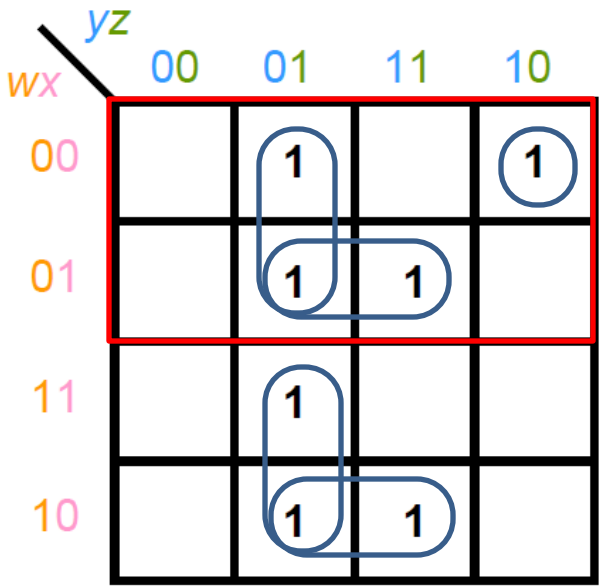
$$= I_2' + I_3'$$



Exercise

Realize the function $f(w, x, y, z) = \sum m(1, 2, 5, 7, 9, 11, 13)$ using a 2-to-1 MUX

$$w = S_0$$



$$f(w = 0) = y'z + xz + x'yz'$$

$$f(w = 1) = y'z + x'z$$

Exercise

Realize the function $f(w, x, y, z) = \sum m(1, 2, 5, 7, 9, 11, 13)$ using an 8-to-1 MUX

wxyz	F	S_2=w , S_1=x, S_0=y
0000	0	I_0=z
0001	1	
0010	1	I_1=z′
0011	0	
0100	0	I_2=z
0101	1	
0110	0	I_3=z
0111	1	

wxyz	F	S_2=w , S_1=x, S_0=y
1000	0	I_4=z
1001	1	
1010	0	I_5=z
1011	1	
1100	0	I_6=z
1101	1	
1110	0	I_7=0
1111	0	