

1.

以 4-bit input 為例

Magnitude Comparator:

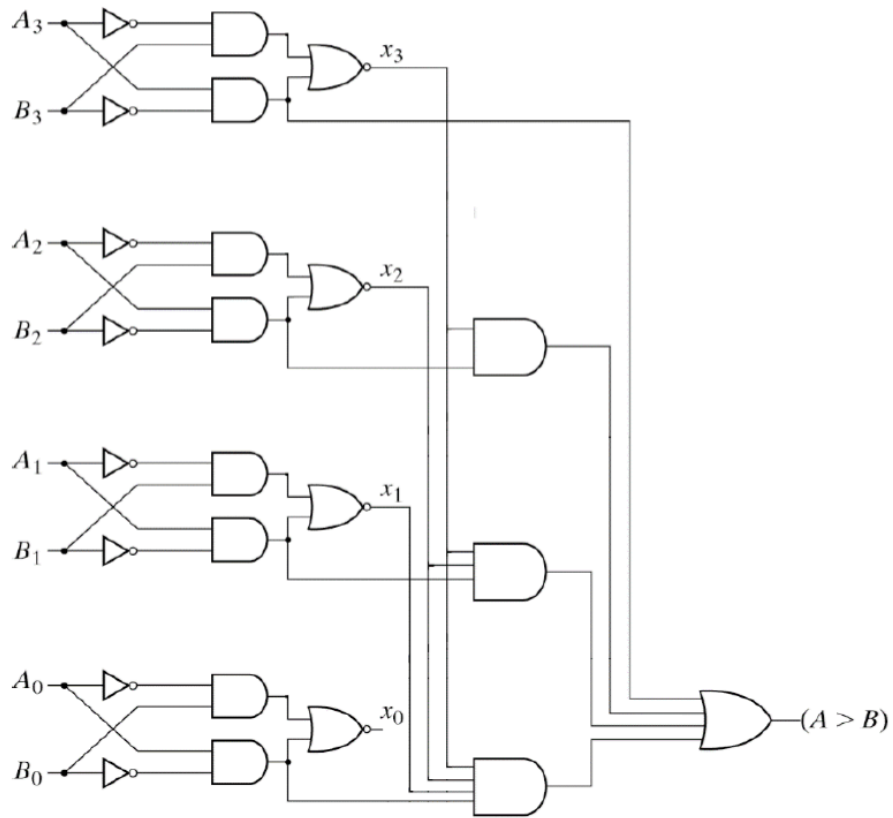
Input:  $A=\{A_3,A_2,A_1,A_0\},B=\{B_3,B_2,B_1,B_0\}$

$$(A>B) = A_3 B'_3 + x_3 A_2 B'_2 + x_3 x_2 A_1 B'_1 + x_3 x_2 x_1 A_0 B'_0$$

$$x_i = A_i B_i + A'_i B'_i$$

If  $A>B$ , output = 1

Else output = 0



Comparator1:

If  $a > b$ , output=1

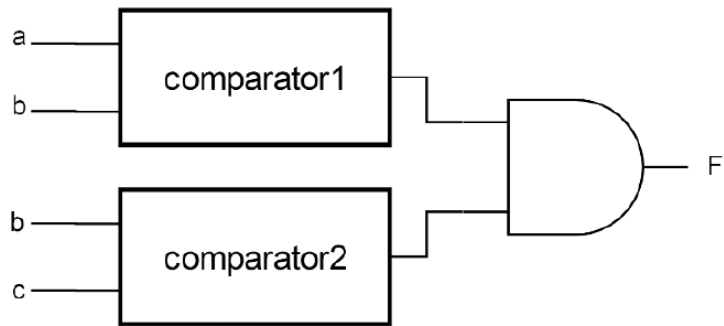
Else output=0

Comparator2:

If  $b > c$ , output=1

Else output=0

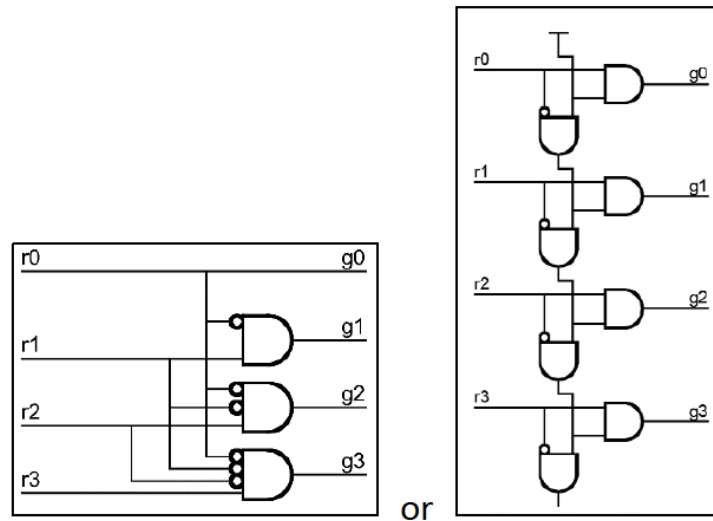
$F = 1$ , only if  $a > b > c$



2.

4-bit arbiter:

Priority:  $r_0 > r_1 > r_2 > r_3$



Input: {  $r_3, r_2, r_1, r_0$  }

Arbiter0:

Priority:  $r_0 > r_3 > r_2 > r_1$  (rightward rotation)

Arbiter1:

Priority:  $r_1 > r_0 > r_3 > r_2$  (rightward rotation)

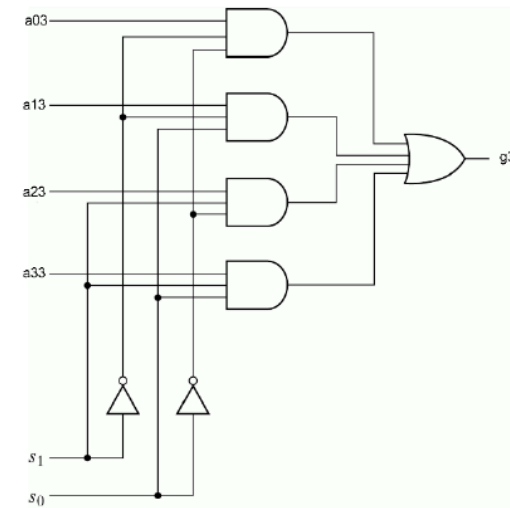
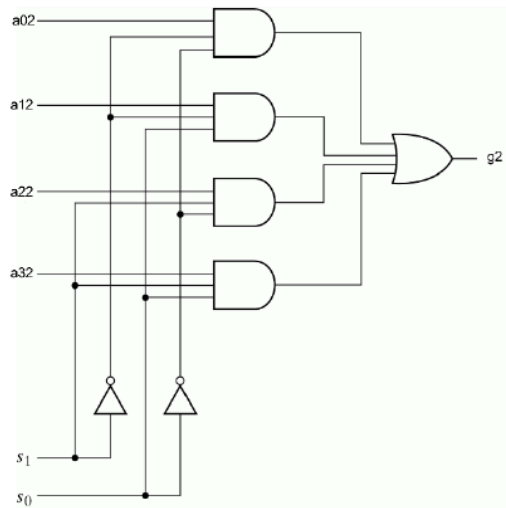
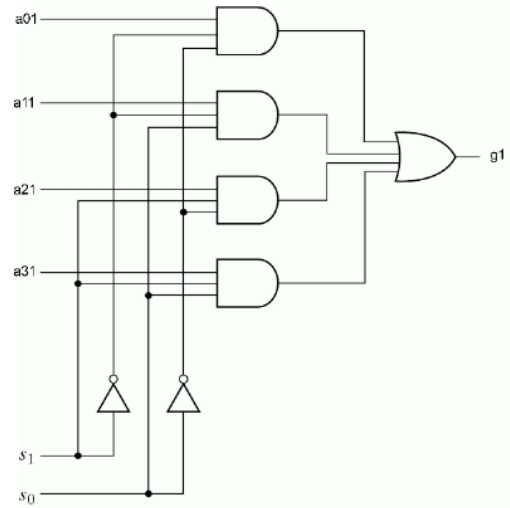
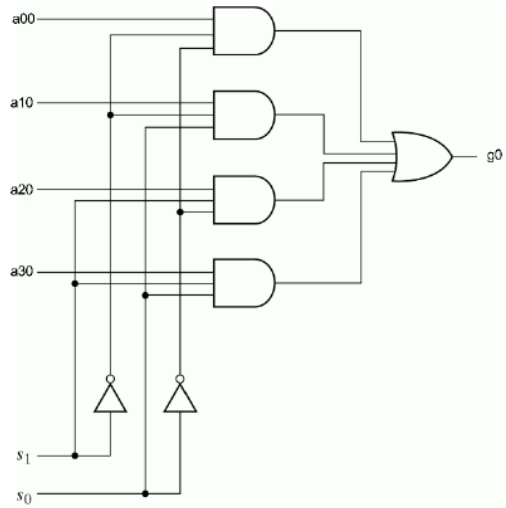
Arbiter2:

Priority:  $r_2 > r_1 > r_0 > r_3$  (rightward rotation)

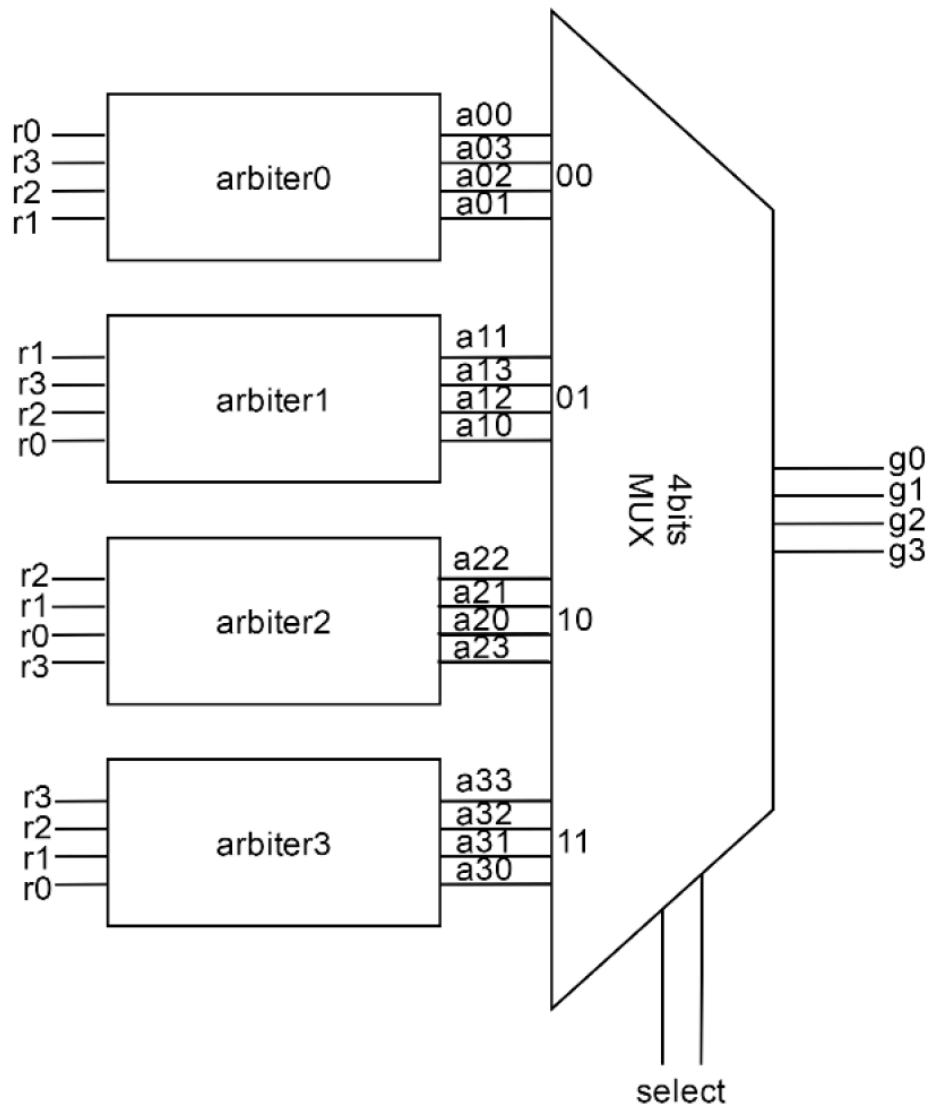
Arbiter3:

Priority:  $r_3 > r_2 > r_1 > r_0$  (rightward rotation)

### 4-bit 4to1 MUX



- Select{ $s_1, s_0$ } = 00: output = arbiter0's output
- Select{ $s_1, s_0$ } = 01: output = arbiter1's output
- Select{ $s_1, s_0$ } = 10: output = arbiter2's output
- Select{ $s_1, s_0$ } = 11: output = arbiter3's output





4.

By DeMorgan's law

$$D0 = x'y'z' = (x+y+z)'$$

$$D1 = x'y'z = (x+y+z')$$

$$D2 = x'yz' = (x+y'+z)'$$

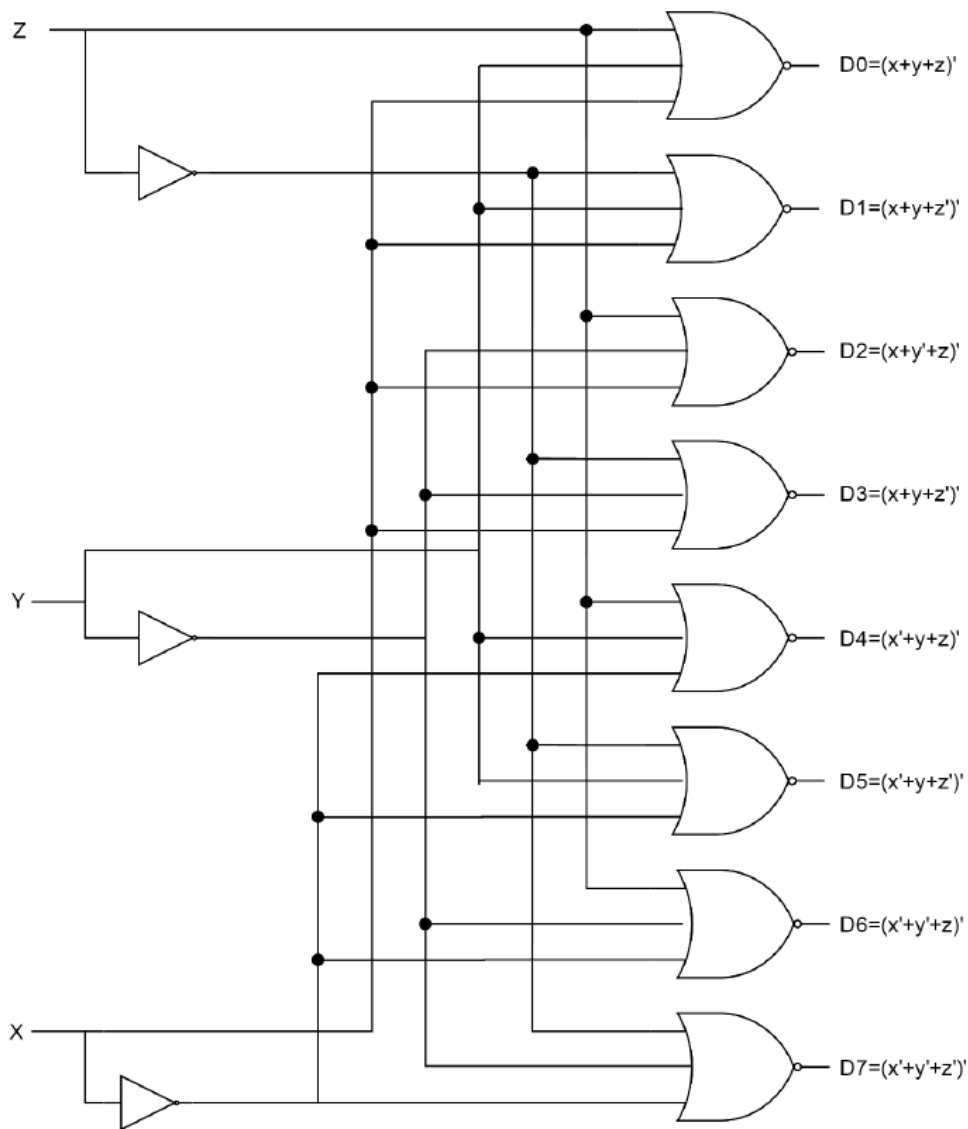
$$D3 = x'yz = (x+y'+z)'$$

$$D4 = xy'z' = (x'+y+z)'$$

$$D5 = xy'z = (x'+y+z)'$$

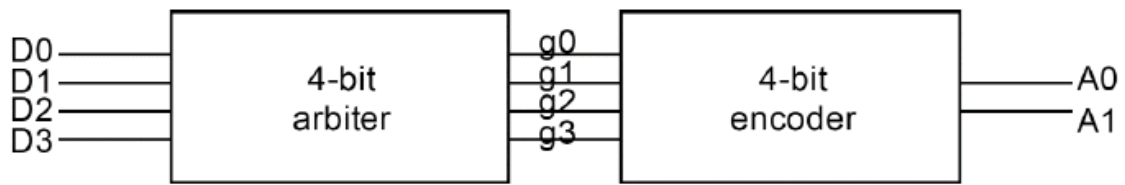
$$D6 = xyz' = (x'+y'+z)'$$

$$D7 = xyz = (x'+y'+z)'$$



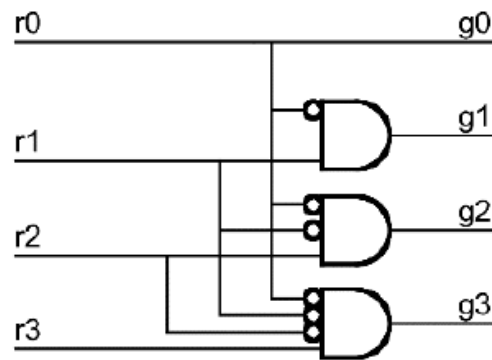
5.





4-bit arbiter:

Priority:  $r_0 > r_1 > r_2 > r_3$  ( $D_0 > D_1 > D_2 > D_3$ )



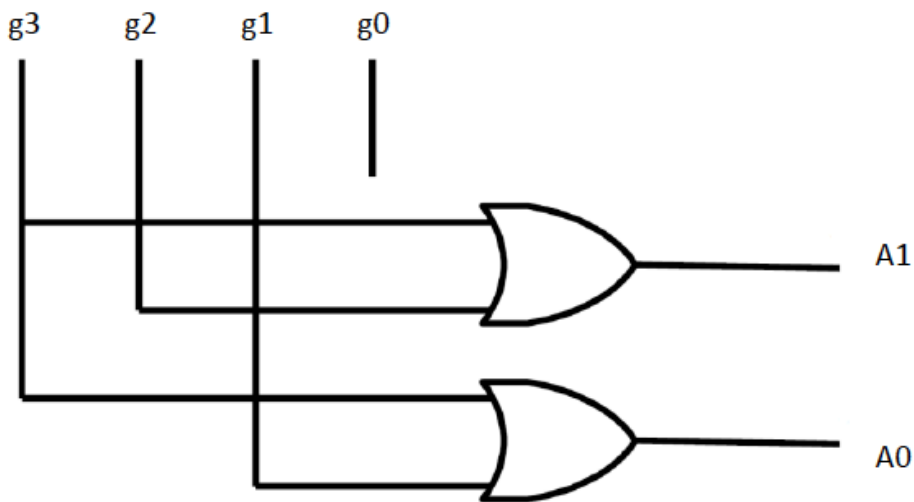
4-bit encoder :

Input:  $\{g_3, g_2, g_1, g_0\}$

Output:  $\{A_1, A_0\}$

$A_1 = g_3 + g_2$

$A_0 = g_3 + g_1$



D3	D2	D1	D0	g3	g2	g1	g0	A1	A0
0	0	0	0	0	0	0	0	0	0
0	0	0	1	0	0	0	1	0	0
0	0	1	0	0	0	1	0	0	1
0	0	1	1	0	0	0	1	0	0
0	1	0	0	0	1	0	0	1	0
0	1	0	1	0	0	0	1	0	0
0	1	1	0	0	0	1	0	0	1
0	1	1	1	0	0	0	1	0	0
1	0	0	0	1	0	0	0	1	1
1	0	0	1	0	0	0	1	0	0
1	0	1	0	0	0	1	0	0	1
1	0	1	1	0	0	0	1	0	0
1	1	0	0	0	1	0	0	1	0
1	1	0	1	0	0	0	1	0	0
1	1	1	0	0	0	1	0	0	1
1	1	1	1	0	0	0	1	0	0