[CS M51A FALL 18] Solution to QUIZ 4

Duration: 30 minutes

12/07/2018

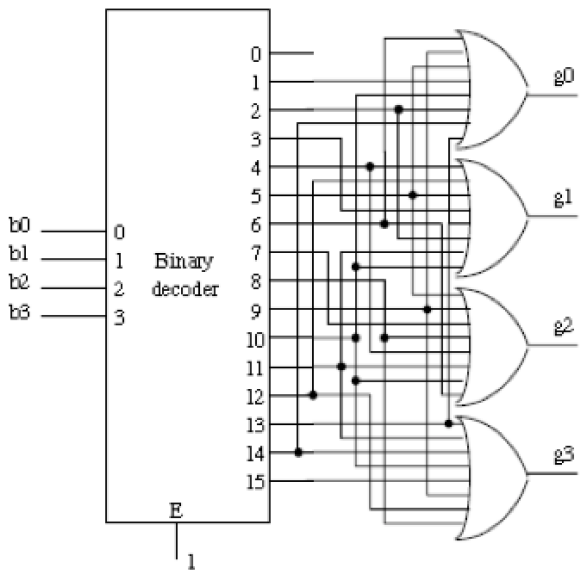
Problem 1 (15 points)

Design a 4-bit binary to 4-bit gray code converter using a decoder. The outputs of the decoder are $y_{15}, ..., y_0$. Show first the switching expressions for the gray code g_3, g_2, g_1, g_0 before drawing the network.

Solution

$g_3 = sum\ m(8, 9, 10, 11, 12, 13, 14, 15)$
$g_2 = sum\ m(4, 5, 6, 7, 8, 9, 10, 11)$
$g_1 = sum\ m(2, 3, 4, 5, 10, 11, 12, 13)$
$g_0 = sum\ m(1, 2, 5, 6, 9, 10, 13, 14)$

binary $b_3b_2b_1b_0$	Gray $g_3g_2g_1g_0$
0000	0000
0001	0001
0010	0011
0011	0010
0100	0110
0101	0111
0110	0101
0111	0100
1000	1100
1001	1101
1010	1111
1011	1110
1100	1010
1101	1011
1110	1001
1111	1000



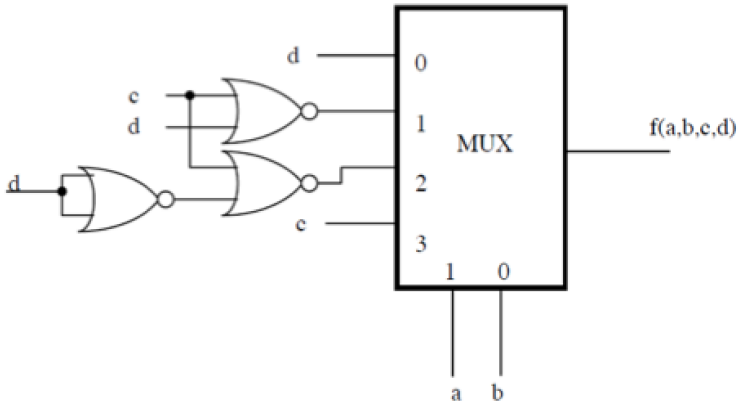
Problem 2 (15 points)

Implement f(a,b,c,d) = one-set(1,3,4,9,14,15) using a 4-input MUX and NOR gates (a and b should be select inputs to the MUX).

Solution

$$f(a,b,c,d) = m_0(a,b)(c'd + cd) + m_1(a,b)c'd' + m_2(a,b)c'd + m_3(a,b)(cd + cd')$$

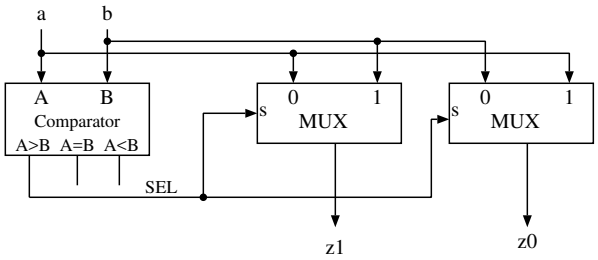
$$f(a,b,c,d) = m_0(a,b)d + m_1(a,b)(c+d)' + m_2(a,b)(c+d')' + m_3(a,b)c$$



Problem 3 (15 points)

Design a network that sorts two nonnegative integers a and b of four bits each with only 4×2-input multiplexers and four-bit comparator and indicate all inputs on the modules used.

Solution The network that sorts two non-negative numbers a and b is shown in Figure



The sorting order is such that $z_1 \leq z_0$. The output of the circuit for different conditions of a and b is shown in the next table.

Input condition	SEL	OUTPUT (z_1, z_0)
$a < b$	0	(a, b)
$a = b$	0	(a, b)
$a > b$	1	(b, a)