Exercises on the topics of class 14

Exercises with solutions

Ex. 1. A 4 variables BF $f(x_4,x_3,x_2,x_1)$ holds 1 if $x_4 + x_2x_1 = 0$, whereas it is not specified (don't care terms) if $x_4x_1 = 1$. Design a circuit that implements f through a PLA and a MUX.

SOLUTION:

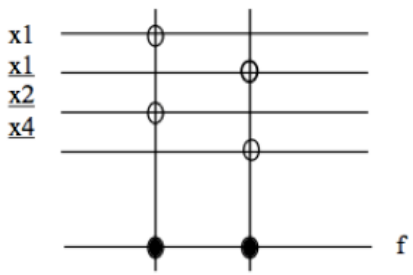
The TT of the function is:

x4	x3	x2	x1	f
0	0	0	0	1
0	0	0	1	1
0	0	1	0	1
0	0	1	1	0
0	1	0	0	1
0	1	0	1	1
0	1	1	0	1
0	1	1	1	0
1	0	0	0	0
1	0	0	1	-
1	0	1	0	0
1	0	1	1	-
1	1	0	0	0
1	1	0	1	-
1	1	1	0	0
1	1	1	1	-

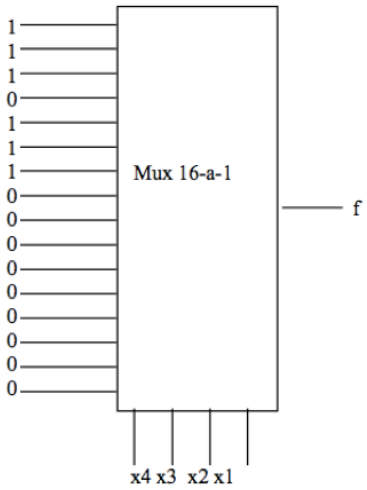
The KM is:

\ x2 x1 / x4 x3 \	00	01	11	10
00	1	1	0	1
01	1	1	0	1
11	0	x	x	0
10	0	x	x	0

and so, the resulting minimal SOP for f is $\underline{x_2}\, x_1 + \underline{x_4}\, \underline{x_1}$
From this, we can obtain the PLA:



For the realization with a MUX, we can choose a 16-to-1. For the don't care symbols, we can indifferently choose to put a 0 or a 1 in that entrance (in this solution, we choose 0 for all don't cares):



Ex. 2. Design a combinatorial circuit that computes function y = x + 3, where x is a 4-bits 2 complement integer in [-8, 7] and y is codified in the same format. Put "don't care" symbols whenever y cannot be represented in the given format.

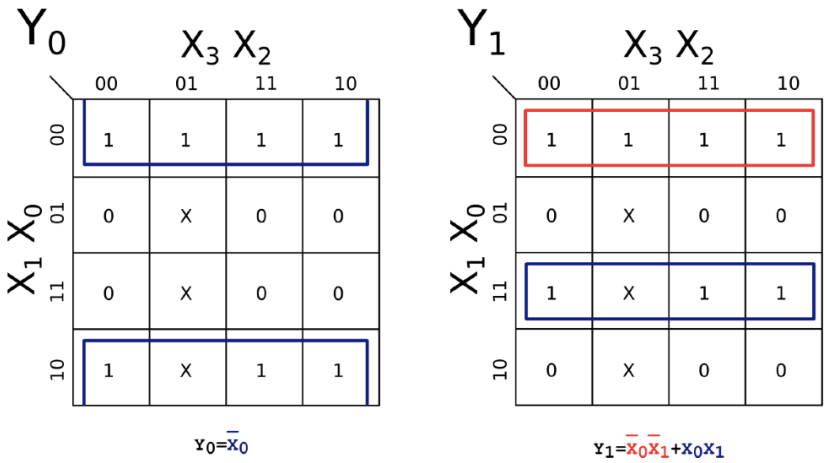
Use a PLA for the two less signifying bits of y, a ROM for all the function and a MUX 8-to-1 for the second most signifying bit.

SOLUTION:

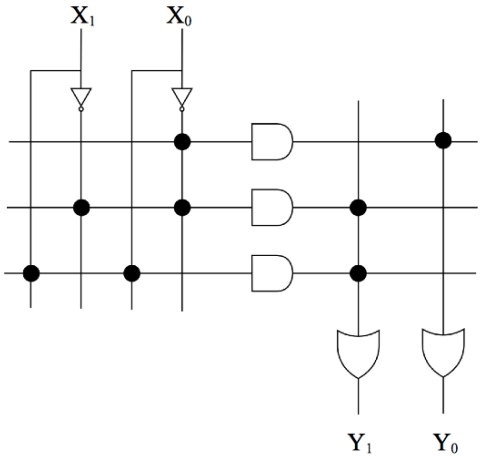
The required function is:

X_3	X_2	X_1	X_0	Y_3	Y_2	Y_1	Y_0
0	0	0	0	0	0	1	1
0	0	0	1	0	1	0	0
0	0	1	0	0	1	0	1
0	0	1	1	0	1	1	0
0	1	0	0	0	1	1	1
0	1	0	1	-	-	-	-
0	1	1	0	-	-	-	-
0	1	1	1	-	-	-	-
1	0	0	0	1	0	1	1
1	0	0	1	1	1	0	0
1	0	1	0	1	1	0	1
1	0	1	1	1	1	1	0
1	1	0	0	1	1	1	1
1	1	0	1	0	0	0	0
1	1	1	0	0	0	0	1
1	1	1	1	0	0	1	0

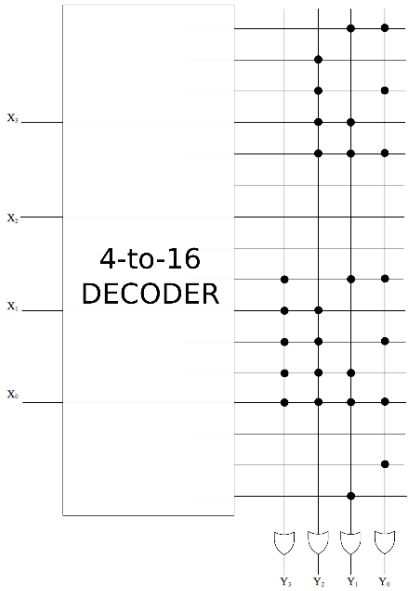
We can now compute the minimal SOP for the two less signifying bits:



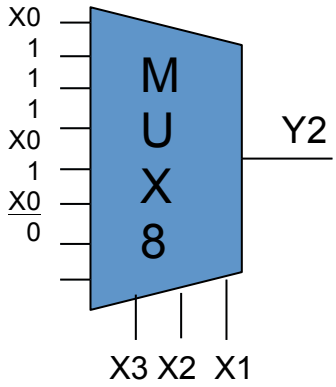
and so the PLA is:



The ROM is codified by looking at the TT of the function:



For the MUX, we use as control lines X_3 , X_2 and X_1. Don't care symbols can be freely put to 0 or 1, but in our case it turns out that all 1s is a good option. So, the resulting circuit is:



Exercises without solutions

Ex. 1. Design a PLA for the 4-variables function f(x3, x2, x1, x0) = m2 + m3 + m4 + m9 that is not defined (don't care) in m0, m1, m6 and m11.

Ex. 2. Design two 4-to-1 MUXs for the two 3-variables BFs f(a2, a1, a0) = m0+m3+m6+m7 and g(a2, a1, a0) = m2+m4+m5+m6.

Ex. 3. Consider the following BF:

x	*y*	*z*	*t1*	*t2*	*t3*	*t4*
0	0	0	0	0	0	0
0	0	1	0	1	1	0
0	1	0	1	0	0	1
0	1	1	1	1	1	0
1	0	0	1	0	0	1
1	0	1	1	1	0	0
1	1	0	1	1	0	1
1	1	1	0	0	0	1

a) Design a ROM for this BF.
b) Compute *t1* and *t4* through a PLA.
c) Compute *t2* and *t3* through a 4-to-1 MUX and a 2-to-1 MUX, respectively.