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CSE 241 Digital Systems

Apr 6, 2011

Hourly Exam #2

Instructions: Write your name on the top of each sheet. Show all work in the space provided. No calculators or other electronic devices allowed. 50 min closed book.

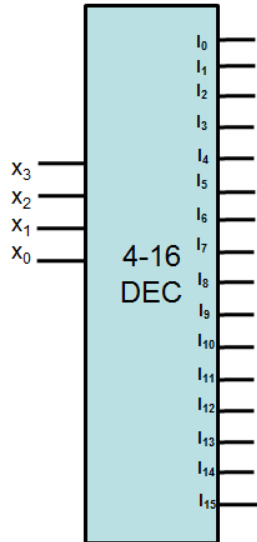
1. $f(w, x, y, z) = x' + z' + w'xyz$

(a) Sketch the Karnaugh Map for f , showing the prime implicant subcubes, and write the product term for each prime implicant of f .

(b) Find the minimal sum.

2. We require a circuit with 4 inputs x_0, \dots, x_3 and two outputs f_0 and f_1 . f_0 should equal 1 if and only if the binary number " $x_3x_2x_1x_0$ " has three touching bits which are the same. So for instance the inputs " $x_3x_2x_1x_0$ "="1000" should yield $f_0=1$, but " $x_3x_2x_1x_0$ "="0100" should give $f_0=0$. Also, f_1 should equal 1 if and only if one of the four inputs is 1 and the rest are 0.

(a) Realize this circuit using the 4-16 DEC shown. Complete the circuit diagram by wiring in OR gates as needed and labelling the outputs f_0 and f_1 .



(b) Is the circuit constructed as in (a) above minimal for any reasonable cost? Justify your answer.

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3.

	0001	0101	0110	0111	1011	1100	1101	1111
A	x	x						
B			x	x				
C					x			x
D						x	x	
E		x		x			x	x

The Prime Implicant Table for a Boolean function $f(w,x,y,z)$ is shown above. The rows are the prime implicants, the columns are the minterms.

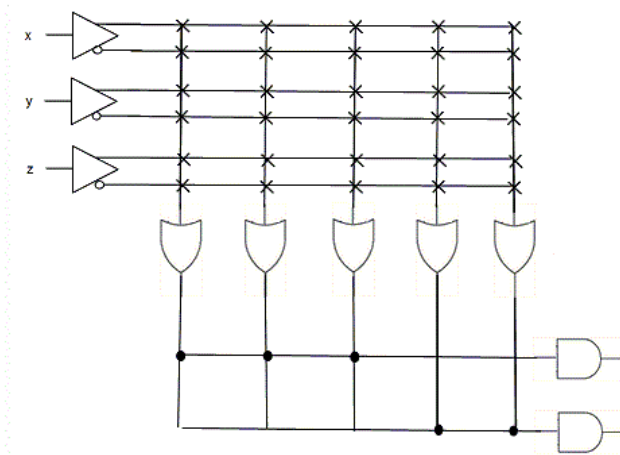
(a) Use the Petrick method to find all irredundant sums. Express your answer in terms of A, B, C, D, E.

(b) Write the minimal sum in terms of f 's literals (w,x,y,z and their complements).

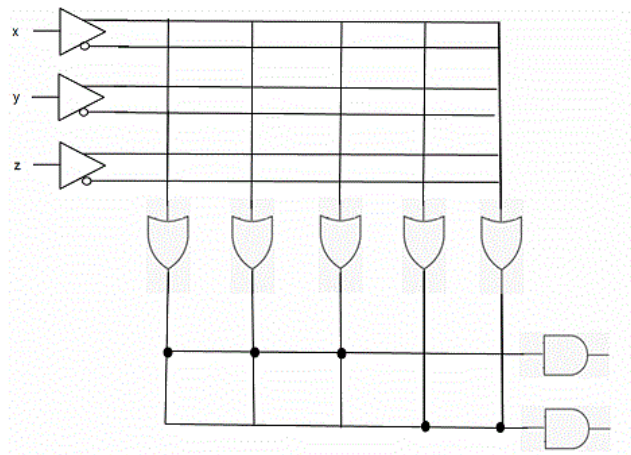
4. $f_0(x, y, z) = xy' + yz' + zx'$
 $f_1(x, y, z) = x' + xyz$

(a) Realize f_0 and f_1 using a programmable read-only memory (PROM) with 3 inputs x, y, z and two outputs f_0 and f_1 . Draw the final PROM logic diagram.

(b) Realize the same f_0 and f_1 using the PLD shown on the left below. This is a PLD similar to a programmable logic array (PLA), but with the AND and OR gate arrays switched. Using your knowledge of how PLD's work in general, complete the diagram on the right by labelling the outputs, and showing with X's which switches you would not blow. Show your work and explain your logic.



PLD device



Your answer