

CSE 140 Homework Three

February 14, 2007

*Only **Problem Set Two** will be graded. Turn in only solutions to **Problem Set Two** which will be due on Feb. 20 2007 at 1:00pm*

1 Problem Set One

- textbook 3.1(e)
- textbook 3.3
- Derive the complements of the functions in Problem 3.4, using De Morgan's law.
- textbook 3.6(b)
- textbook 3.7(a)
- textbook 3.10(d)
- textbook 3.12(b)(c)
- textbook 3.14(a)(b)

2 Problem Set Two

1 We discussed all 16 logical functions of two boolean variables in class. Identify the complete list of *all* logical functions H of two boolean variables, x, y , such that:

$$H'(x', y') = H(x, y)$$

(**Hint:** It is *not* all 16 possible functions.)

2 Consider the following boolean function $F(A, B, C, D) = \sum(m_0, m_1, m_2, m_6, m_8, m_{10}, m_{11}, m_{14}, m_{15})$

(**PART A**) Derive a representation for the function as a minimum product of *maxterms*.

(**PART B**) Implement the function using one OAI gate *only*. You can make the OAI gate as wide and with as many inputs as you would like. You can use extra inverters, if necessary.

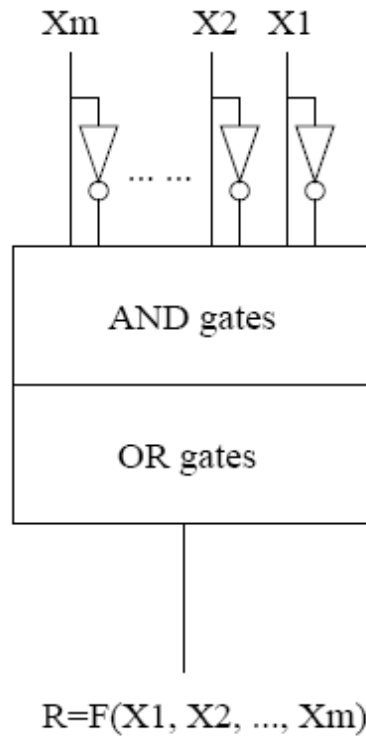


Figure 1: A correct implementation

3 (Boolean Transformations) This question concerns the fate of a CSE140 student who is prone to making mistakes during his engineering internship at a local company. This particular student is given a function as a behavioral specification. His job is to use a 2-level AND-OR gate circuit to correctly implement this function as shown in Figure 1.

After finding the sum of products for the function, the student incorrectly implements it with one of the following mistakes. Either he

Mist1 flips all the inputs,

Mist2 exchanges the AND gates with the OR gates but keeps all the interconnects identical,

Mist3 flips all the inputs and exchanges the AND gates with the OR gates but keeps all the interconnects identical.

Figure 2 provides you with a visual representation of what these mistakes look like. We would like you to identify, for each of the mistakes this student makes, whether:

- A** he will turn out to be lucky and the function he implements will be correct for every possible input combination despite the mistake (thus allowing him to keep his job), or
- B** the particular mistake will cause his implementation to be incorrect for every possible input combination (thus ensuring that he will be fired, and forced to spend more time on his summer courses), or
- C** this mistake will cause his implementation to be correct for some, but not all input combinations (thus forcing him to demonstrate only the correct cases to his manager if he wants to keep his job).

Clearly show your answer by writing one of A, B, or C in each box of the following tables. (Note that in each case F is the function the student must implement correctly in the 2-level form above.)

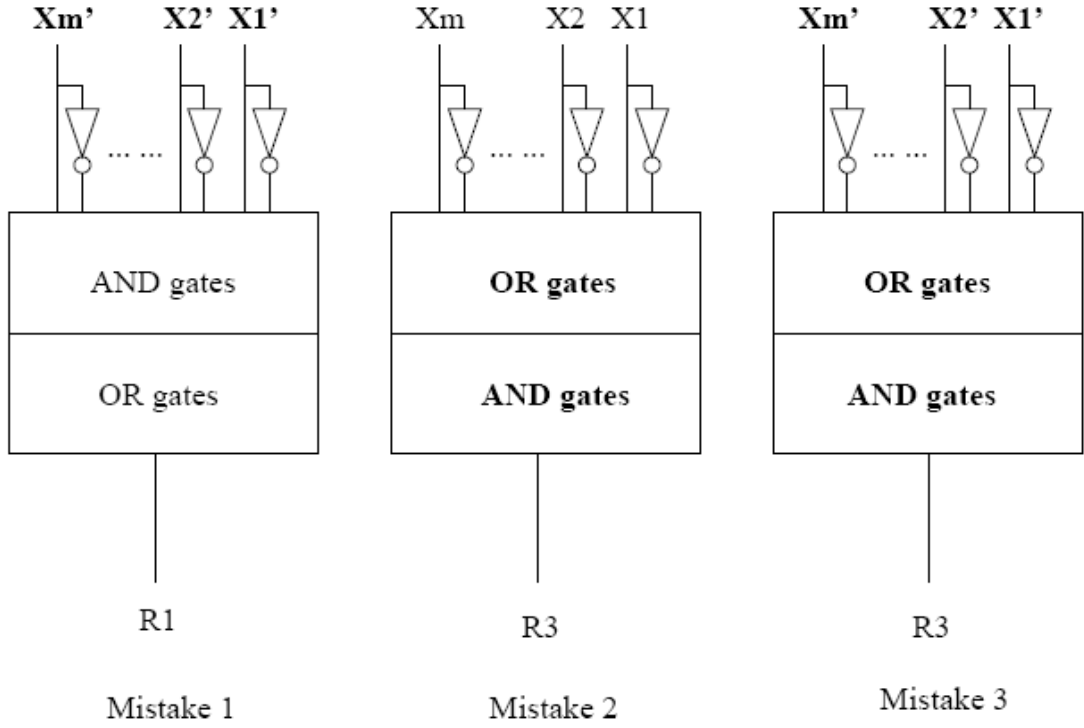


Figure 2: The student's mistakes

(Part A) As noted above, “ $\oplus$ ” is a behavioral description. All the functions shown are still to be implemented using the 2-level AND-OR gate implementation, as shown in Figure 1.

Function	Mist1	Mist2	Mist3
$F = x \oplus y$			
$F = x \oplus y \oplus z$			
$F = u \oplus x \oplus y \oplus z$			

(Part B) For the first 3 cases of this part, F is a function of 3 variables, while in the last case F is a function of 4 variables.

Function	Mist1	Mist2	Mist3
F is composed of minterm m_0, m_2, m_4, m_6			
F is composed of maxterm M_0, M_2, M_5, M_7			
F is composed of minterm $m_1, m_2, m_3, m_4, m_5, m_6$			
F is composed of minterm $m_0, m_3, m_6, m_9, m_{12}, m_{15}$			
F is composed of maxterm $M_0, M_2, M_4, M_{10}, M_{12}, M_{14}$			

(Part C) For this part, F is a function of 3 variables.

Function	Mist1	Mist2	Mist3
m_{7-i} is in F iff m_i is in F'			
m_{7-i} is in F iff m_i is in F			