JOINT INSTITUTE
交大密西根学院

Ve270 Introduction to Logic Design

Homework 2

Assigned: May 25, 2017

Due: June 1, 2017, at the beginning of the class.

The homework should be submitted in hard copies.

1. Prove theorem 3 on slide 16 of Topic 3. (5 points)

2. Problem 2.26. (10 points)

2.26 Let variables S represent a package being small, H being heavy, and E being expensive. Let's consider a package that is not small as big, not heavy as light, and not expensive as inexpensive. Write a Boolean equation to represent each of the following:

(a) Your company specializes in delivering packages that are both small and inexpensive (a package must be small AND inexpensive for us to deliver it); you'll also deliver packages that are big but only if they are expensive.

(b) A particular truck can be loaded with packages only if the packages are small and light, small and heavy, or big and light. Simplify the equation.

(c) Your above-mentioned company buys the above-mentioned truck. Write an equation that describes the packages your company can deliver. Hint: Appropriately combine the equations from the above two parts.

3. Problem 2.28. (5 points)

2.28 Use algebraic manipulation to convert the following equation to sum-of-products form:
$F = a'b(c + d') + a(b' + c) + a(b + d)c$

4. Problem 2.29. (5 points)

2.29 Use DeMorgan's Law to find the inverse of the following equation: $F = abc + a'b$. Reduce to sum-of-products form. Hint: Start with $F' = (abc + a'b)'$

5. Problem 2.40 (5 points)

2.39 Convert the function F shown in the truth table in Table 2.10 to an equation. Don't minimize the equation.

2.40 Use algebraic manipulation to minimize the equation obtained in Exercise 2.39.

TABLE 2.10 Truth table.

a	b	c	F
0	0	0	1
0	0	1	0
0	1	0	1
0	1	1	0
1	0	0	1
1	0	1	1
1	1	0	1
1	1	1	0

6. Problem 2.48 (c) (5 points)

2.48 Convert the following Boolean equations to canonical sum-of-minterms form:

(a) F(a,b,c) = a'bc + ab

(b) F(a,b,c) = a'b

(c) F(a,b,c) = abc + ab + a + b + c

(d) F(a,b,c) = c'

7. Problem 2.55. (15 points)

2.54 A museum has three rooms, each with a motion sensor (m0, m1, and m2) that outputs 1 when motion is detected. At night, the only person in the museum is one security guard who walks from room to room. Create a circuit that sounds an alarm (by setting an output A to 1) if motion is ever detected in more than one room at a time (i.e., in two or three rooms), meaning there must be one or more intruders in the museum. Start with a truth table.

2.55 Create a circuit for the museum of Exercise 2.54 that detects whether the guard is properly patrolling the museum, detected by *exactly* one motion sensor being 1. (If no motion sensor is 1, the guard may be sitting, sleeping, or absent.)

8. Problem 6.3 (10 points)

6.3 Perform two-level logic size optimization for F(a,b,c) = ab'c + abc + a'bc + abc' using (a) algebraic methods, (b) a K-map. Express the answers in sum-of-products form.

9. Problem 6.5, using both algebraic methods and K-map. (10 points)

6.5 Perform two-level logic size optimization for F(a,b,c,d) = a'bc' + abc'd' + abd using a K-map.

10. Problem 6.8. (10 points)

6.8 Perform two-level logic size optimization for F(a,b,c,d) = a'bc'd + ab'cd', assuming that a and b can never both be 1 at the same time, and that c and d can never both be 1 at the same time (i.e., there are don't cares).

11. Problem 6.11 (a) (10 points)

6.11 For the equation F(a,b,c,d) = ab'c' + abc'd + abcd + a'bcd + a'bcd', determine all prime implicants and all essential prime implicants: $\boxed{\text{(a)}}$ using a K-map, (b) using the tabular method.

12. Problem 6.14 (10 points)

6.14 Using algebraic methods, reduce the number of gate inputs for the following equation by creating a multilevel circuit: F(a,b,c,d,e,f,g) = abcde + abcd'e'fg + abcd'e'f'g'. Assume only AND, OR, and NOT gates will be used. Draw the circuit for the original equation and for the multilevel circuit, and clearly list the delay and number of gate inputs for each circuit.