Homework 3 Solutions for Computer Logic and Circuit Design: PHYS306/COSC330

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1 4-1: Boolean Operations and Expressions

1. Exercise 5: (a) 11 (b) 101 (c) 00 (d) 101 (e) 110 (f) 10 (g) 100

2. Exercise 6: (a) The expression reduces to $X = AC + B$ (see Tab. 1). (b) The expression reduces to $X = \bar{A}\bar{B}C$, which is a S-SOP term. Thus, the only true state is 001. (c) The expression may be written $X = A\bar{B}C + ABC + AB\bar{C}$. This is an S-SOP expression with three true states (see Tab. 1). (d) The expression reduces to $X = B$, so X just follows B. (e) The expression reduces to $X = A\bar{B}C + A\bar{B}\bar{C} + AB\bar{C}$, which is an S-SOP expression with three true states (see Tab. 1).

A	B	C	X	A	B	C	X	A	B	C	X
0	0	0	0	0	0	0	0	0	0	0	0
0	0	1	0	0	0	1	0	0	0	1	0
0	1	0	1	0	1	0	0	0	1	0	0
0	1	1	1	0	1	1	0	0	1	1	0
1	0	0	0	1	0	0	0	1	0	0	1
1	0	1	1	1	0	1	1	1	0	1	1
1	1	0	1	1	1	0	1	1	1	0	1
1	1	1	1	1	1	1	1	1	1	1	0

Table 1: Tables for Exercise 6. (left) Part (a) (middle) part (b) (right) part (e).

2 4-2: Laws and Rules of Boolean Algebra

1. Exercise 7: (a) Commutativity of addition (b) commutativity of multiplication (c) distribution.

3 4-3: DeMorgan's Theorems

1. Exercise 11: (a) $X = (\bar{A}+\bar{B}+\bar{C})(\bar{E}+\bar{F}+\bar{G})(\bar{H}+\bar{I}+\bar{J})(\bar{K}+\bar{L}+\bar{M})$ (b) $X = \bar{A}B\bar{C}+BC$ (c) $X = \bar{A}\bar{B}\bar{C}\bar{D}\bar{E}\bar{F}\bar{G}\bar{H}$

4 4-4: Boolean Analysis of Logic Circuits

1. Exercise 13: (a) $X = ABCD$ (b) $X = AB + C$ (c) $X = A + \bar{B}$ (d) $X = AC + BC$

2. Exercise 15: (a) An XOR gate (see Fig. 1). (b) $X = AB + \bar{A}\bar{B} + \bar{A}BC$ (c) $X = \bar{A}BC + \bar{A}B\bar{D}$ (d) $X = A + BC + B\bar{C}D + BD$.
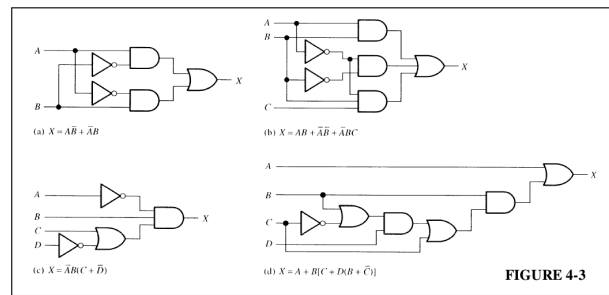

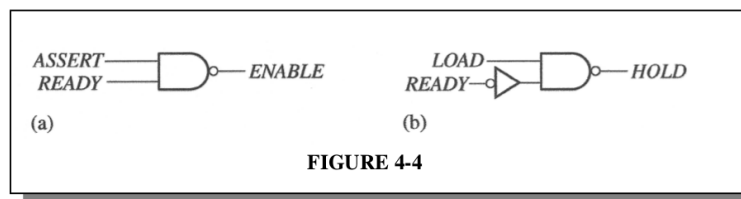Figure 1: Answers to Exercise 15.

3. Exercise 16: See Fig. 2.

FIGURE 4-4

Figure 2: Answers to Exercise 16.

5 4-5: Logic Simplification Using Boolean Algebra

1. Exercise 21: (a) $X = BD + BE + \bar{D}F$ (b) $X = \bar{A}\bar{B}C + \bar{A}\bar{B}D$ (c) $X = B$ (d) $X = AB + CD$ (e) $X = ABC$.

2. Exercise 22: (a) Circuits B and D both reduce to $A\bar{B} + AC\bar{D}$.