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Boolean Algebra

Exercise 1: Draw the truth table of the following expressions:

- $F_1(A,B) = A + \overline{AB}$
- $F_2(A,B) = \overline{AB}\,(\mathrm{A}+\mathrm{B})$
- $F_3(A,B,C) = ABC + AB\overline{C} + A\overline{B}C + A\overline{B}\,\overline{C}$

Exercise 2: Prove the following theorems by the truth table

Idempotence : $a + a + a + ... = a$

Identity $a + 0 = a \quad a.1 = a$

Absorption $a.0 = 0 \; a + 1 = 1$

Complementary $a + \overline{a} = 1 \; a.\overline{a} = 0$

$\overline{a.b} = \overline{a} + \overline{b}$

$\overline{a + b} = \overline{a}.\overline{b}$

Exercise 3: Prove the following equations using the properties of Boolean algebra:

$a + a.b = a$

$a.(a + b) = a$

$a + \overline{a}.b = a + b$

$(a + b)(a + \overline{b}) = a$

Exercise 4: Simplify the following equations using the properties of Boolean algebra:

$(a + b)(a + c)$

$(a + b)(\overline{a} + c)$

$\overline{\overline{a}.b + \overline{\overline{a} + b}}$

Exercise 5: Express the following functions in the first and second canonical form:

$f1(x, y, z) = xy + x\overline{z} + \overline{y}z$

f(a, b, c) = 1 if the count of variables at 1 is even

f(a, b, c, d) = 1 if at least two variables are equal to 1

Exercise 6: Simplify the functions of the previous exercice (exercice 5) using the Karnaugh map.

Exercise 7: Plot the logigrams of the functions of the previous exercice (exercice 5).

Exercise 8: Study the function: $F(x, y, z) = x \oplus (y + z)$

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