Universität Bremen

Fachbereich 03 - Informatik

Logic Synthesis

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WORK SHEET 4

Problem 1. Prove or show a counterexample for each of the following statements.

(a) If the MSOP for the function f is unique, then all prime implicants for f are essential prime implicants.

(b) If the MSOP for the function f is unique, then the minimum POS of f is unique.

(c) Let p be an arbitrary prime implicant of f. There is an MSOP that has p.

(d) The MSOP for a completely specified function f is unique.

(e) The number of product terms in an MSOP for a completely specified function f is equal to the number of sums in an MPOS for f.

Problem 2. Using Karnaugh maps find all prime implicants, all essential prime implicants, and a MSOP for the following functions:

(a) $f = \sum m(0, 2, 4, 5, 8, 9, 10, 13, 14, 15)$

(b) $g = \sum m(0, 1, 4, 5, 11, 15) + d(6, 7)$

(c) $h = \sum m(0, 4, 8, 10, 11, 15) + d(5, 7, 13)$

Problem 3. Show that an MSOP for $f = (x_1 \vee x_2 \vee \cdots \vee x_n)(\overline{x_1} \vee \overline{x_2} \vee \cdots \vee \overline{x_n})$ has at least n products.

Problem 4. Using Quine-McCluskey's method find a MSOP for $f = \sum m(0, 4, 8, 10, 11, 15, 21, 23, 29, 31) + d(5, 7, 13)$.

Problem 5. Which of the following are self-dual functions:

(a) $f = xy$

(b) $g = \overline{x}$

(c) $h = xyz \vee \overline{x}y \vee \overline{xy}z$

Problem 6. Let f be a monotone increasing function of n variables. Prove the following:

(a) All prime implicants of f are essential prime implicants.

(b) There is a unique MSOP for f

Problem 7. Prove that the number of the monotone increasing functions of n variables is at least 2^N, where $N = \binom{n}{\lfloor n/2 \rfloor}$, and $\lfloor k \rfloor$ denotes the maximum integer not greater than k.

Problem 8. Let $f(x_1, x_2, \ldots, x_n) = f(x_2, x_1, x_3 \ldots, x_n) = f(x_2, x_3, \ldots, x_n, x_1)$. Prove that f is a totally symmetric function.