

Implicant Simplification and Don't Cares

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1 Administrivia

Announcements

Assignment

Read 2.6–2.8.

Written assignment due Friday.

From Last Time

Minterms and maps.

Outline

1. Implicants and friends.
2. Don't cares.

Coming Up

NAND gates, implementation, XOR, parity.

2 Implicants and Friends

Consider $F(A, B, C, D) = \sum m(0, 2, 3, 8, 9, 10, 12, 13)$. Diagram on K-map.

1. A few implicants: $\overline{A} \overline{B} \overline{C} \overline{D}$, $\overline{B} \overline{C} \overline{D}$, $\overline{B} \overline{D}$.

Not implicants: $\overline{B} C$, ABD .

2. Prime Implicants: $\overline{B} \overline{D}$, $\overline{A} \overline{B} C$, $A \overline{C}$.

(Neither of the first two implicants are prime.)

3. Essential prime implicants. All three of the prime implicants are essential.

Example with non-essential prime implicant: $F(A, B, C) = \sum m(0, 1, 5, 7)$. Prime implicants: $\overline{A} \overline{B}$, $\overline{B} C$, AC . Essential prime implicants: $\overline{A} \overline{B}$, AC .

2.1 Simplifying an Expression

1. Find prime implicants.
2. Include all essential prime implicants.
3. Include minimal number of remaining prime implicants to cover all minterms.

2.2 Example

Find all prime implicants, essential prime implicants, and simplify:

$$F(A, B, C, D) = \sum m(0, 2, 5, 7, 8, 10, 12, 13, 14, 15). \quad (2-19(a))$$

3 Don't Cares

Simply: for invalid input values, we don't care what the output value is.

Also: we simply don't care what the output value is for a particular input value.

3.1 Examples

1. Find all prime implicants, essential prime implicants, and simplify: $F(A, B, C) = \sum m(3, 5, 6)$, $d(A, B, C) = \sum m(0, 7)$. (2-25(a))
2. Real-world example. Consider a BCD to 7-segment display decoder. Develop a simplified Boolean expression for the middle segment.