Implicant Simplification and Don't Cares

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Feb. 8, 2006

1 Administrivia

Announcements

Homework due Friday at beginning of class.

Assignment

Read 2.6–7.

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

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