

# Implicant Simplification and Don't Cares

Tom Kelliher, CS 220

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## 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.