Minterms, Maps, and Simplification

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1 Administrivia

Announcements

How to order the rows of a truth table: 0 at the top; 2^n-1 at the bottom. Example: two-input AND.

Assignment

Read 2.5.

Written assignment: Some of the Boolean manipulation problems are tricky — start early.

From Last Time

Logic gates and Boolean algebra.

Outline

- 1. Minterms and products
- 2. Simplification using Karnaugh maps.

Coming Up

Karnaugh map manipulation; don't cares.

2 Minterms and Products

- 1. What is a product? A sum?
- 2. Definition of a minterm: A product term containing all literals, complemented or not complemented.

Examples in three variables (X, Y, Z). Identify which are minterms and which are not: $XYZ, X\overline{Y}Z, Z, XZ$.

3. Sum of minterms. Can be derived directly from a truth table.

Example: sum output of a full binary adder. Derive truth table and sum of minterms equation. Observe $F(a, b, c_i) = \sum m(1, 2, 4, 7)$ and relationship to even parity (exclusive or).

4. Product of sums form and difference from sum of minterms (products).

3 Karnaugh Maps

- 1. A graphical tool for minimizing sum of minterm expressions.
- 2. Two-variable maps:
 - (a) Structure; literal and value labels.
 - (b) Theory: Show simplification of $F(A, B) = \sum m(0, 1)$ given

$$\begin{array}{c|cc}
B & & & \\
0 & 1 \\
A & 0 & \overline{A} \overline{B} & \overline{A}B \\
1 & A\overline{B} & AB
\end{array}$$

Actual Karnaugh map:

- 3. Three-Variable maps:
 - (a) Structure and connectivity.
 - (b) Examples: Sum and carry-out of full binary adder.
- 4. Four-Variable maps:
 - (a) Structure and connectivity.
 - (b) Example: Product bit 1 of two-bit multiplier. (Start with "product" table and then produce truth table for bit 1.)
- 5. Five-Variable maps? Higher?