Digital Logic & Design

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Lecture 08

Recap

- Commutative, Associative and Distributive Laws
- Rules
- Demorgan’s Theorems

Recap

- Boolean Analysis of Logic Circuits
- Simplification of Boolean Expressions
- Standard form of Boolean expressions

Standard SOP and POS form

- Standard SOP and POS form has all the variables in all the terms
- A non-standard SOP is converted into standard SOP by using the rule $A + \overline{A} = 1$
- A non-standard POS is converted into standard POS by using the rule $A\overline{A} = 0$

Standard SOP form

$$A\overline{C} + B\overline{C}$$

$$= A\overline{C}(B + \overline{B}) + (A + \overline{A})B\overline{C}$$

$$= AB\overline{C} + A\overline{B}\,\overline{C} + AB\overline{C} + \overline{A}B\overline{C}$$

$$= AB\overline{C} + A\overline{B}\overline{C} + \overline{A}B\overline{C}$$

Standard POS form

$$(A + \overline{B} + C)(A + B + \overline{D})(A + \overline{B} + \overline{C} + D)$$

$$= (A + \overline{B} + C + \overline{D})(A + \overline{B} + C + D)$$

$$(A + B + \overline{C} + \overline{D})(A + B + C + \overline{D})(A + \overline{B} + \overline{C} + D)$$

Minterms and Maxterms

- Minterms: Product terms in Standard SOP form (A=1, and A’=0)
- Maxterms: Sum terms in Standard POS form (A= 0 , A’=1)
- Binary representation of Standard SOP product terms
- Binary representation of Standard POS sum terms

Minterms and Maxterms & Binary representations

A	B	C	Min-terms	Max-terms
0	0	0	$\bar{A}.\bar{B}.\bar{C}$	$A+B+C$
0	0	1	$\bar{A}.\bar{B}.C$	$A+B+\bar{C}$
0	1	0	$\bar{A}.B.\bar{C}$	$A+\bar{B}+C$
0	1	1	$\bar{A}.B.C$	$A+\bar{B}+\bar{C}$
1	0	0	$A.\bar{B}.\bar{C}$	$\bar{A}+B+C$
1	0	1	$A.\bar{B}.C$	$\bar{A}+B+\bar{C}$
1	1	0	$A.B.\bar{C}$	$\bar{A}+\bar{B}+C$
1	1	1	$A.B.C$	$\bar{A}+\bar{B}+\bar{C}$

SOP-POS Conversion

- Minterm values present in SOP expression not present in corresponding POS expression
- Maxterm values present in POS expression not present in corresponding SOP expression

SOP-POS Conversion

$\Sigma_{A,B,C}(0,2,3,5,7)$ $\overline{A}\overline{B}\overline{C} + \overline{A}B\overline{C} + \overline{A}BC + A\overline{B}C + ABC$

- $\Pi_{A,B,C}(1,4,6)$ $(A + B + \overline{C})(\overline{A} + B + C)(\overline{A} + \overline{B} + C)$

$\Sigma_{A,B,C}(0,2,3,5,7)$ $\Pi_{A,B,C}(1,4,6)$

Boolean Expressions and Truth Tables

- Standard SOP & POS expressions converted to truth table form
- Standard SOP & POS expressions determined from truth table

SOP-Truth Table Conversion

$$\sum_{A,B,C}(3,4,5,7) = \overline{A}BC + A\overline{B}\,\overline{C} + A\overline{B}C + ABC$$

Input			Output
A	B	C	F
0	0	0	0
0	0	1	0
0	1	0	0
0	1	1	1
1	0	0	1
1	0	1	1
1	1	0	0
1	1	1	1

POS-Truth Table Conversion

$$\Pi_{A,B,C}(1,2,3,5)$$

$$= (A + B + \overline{C})(A + \overline{B} + C)(A + \overline{B} + \overline{C})(\overline{A} + B + \overline{C})$$

Input			Output
A	B	C	F
0	0	0	1
0	0	1	0
0	1	0	0
0	1	1	0
1	0	0	1
1	0	1	0
1	1	0	1
1	1	1	1