

ENEZ 353 Section 02 Lecture

Wed Sept 25 2019

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Set 3, Slide 22 (continued)

Sum function of 1-bit full adder

A	B	C <sub>in</sub>	true minterm	S
0	0	0		0
0	0	1	$\bar{A}\bar{B}C_{in}$	1
0	1	0	$\bar{A}B\bar{C}_{in}$	1
0	1	1		0
1	0	0	$A\bar{B}\bar{C}_{in}$	1
1	0	1		0
1	1	0		0
1	1	1	$ABC_{in}$	1

SOP canonical form

$$S = \bar{A}\bar{B}C_{in} + \bar{A}B\bar{C}_{in} + A\bar{B}\bar{C}_{in} + ABC_{in}$$

Minterm numbering (Slide 23)

2 variables

A	B	true minterm	minterm number
0	0	$\bar{A}\bar{B}$	0
0	1	$\bar{A}B$	1
1	0	$A\bar{B}$	2
1	1	$AB$	3

3 variables

A	B	C	true minterm	minterm number
0	0	0	$\bar{A}\bar{B}\bar{C}$	0
0	0	1	$\bar{A}\bar{B}C$	1
0	1	0	$\bar{A}B\bar{C}$	2
0	1	1	$\bar{A}BC$	3
1	0	0	$A\bar{B}\bar{C}$	4
1	0	1	$A\bar{B}C$	5
1	1	0	$AB\bar{C}$	6
1	1	1	$ABC$	7

Example:  $m_2 = A\bar{B}$

Example:  $m_5 = A\bar{B}C$



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$$F(A, B) = \overline{A \oplus B} = \overline{\overline{A}B + A\overline{B}} = \sum(m_0, m_3) = \sum(0, 3)$$

$$S(A, B, C_{IN}) = \overline{A}\overline{B}C_{IN} + \overline{A}B\overline{C}_{IN} + A\overline{B}\overline{C}_{IN} + ABC_{IN}$$

0	0	1	0	1	0	0	1	1	1
$m_1$			$m_2$		$m_4$		$m_7$		

$$= \sum(m_1, m_2, m_4, m_7) = \sum(1, 2, 4, 7)$$

$$F = \sum(m_0, m_1, m_3, m_4, m_6)$$

A	B	C	F
0	0	0	1
0	0	1	1
0	1	0	0
0	1	1	1
1	0	0	1
1	0	1	0
1	1	0	1
1	1	1	0

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$A + \overline{B}$  is a single sum

$(A + \overline{B})(A + C)$  is a product of two sums

$A(B + \overline{C})$  is also a product of two sums —  
 $A$  is a kind of sum

$\overline{A}\overline{B}C$  is a product of three sums



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$$F = \overline{A \oplus B}$$

A	B	false maxterm	F
0	0	$A+B$	1
0	1	$A+\bar{B}$	0
1	0	$\bar{A}+B$	0
1	1	$\bar{A}+\bar{B}$	1

$$F = (A+\bar{B})(\bar{A}+B)$$

S output of full adder

A	B	$C_{IN}$	false maxterm	S
0	0	0	$A+B+C_{IN}$	0
0	0	1		1
0	1	0		1
0	1	1	$A+\bar{B}+\bar{C}_{IN}$	0
1	0	0		1
1	0	1	$\bar{A}+B+\bar{C}_{IN}$	0
1	1	0	$\bar{A}+\bar{B}+C_{IN}$	0
1	1	1		1

$$So S = (A+B+C_{IN})(A+\bar{B}+\bar{C}_{IN})(\bar{A}+B+\bar{C}_{IN})(\bar{A}+\bar{B}+C_{IN})$$

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Maxterm

numbers for

3 input variables

A	B	C	false maxterm	maxterm number
0	0	0	$A+B+C$	0
0	0	1	$A+B+\bar{C}$	1
0	1	0	$A+\bar{B}+C$	2
0	1	1	$A+\bar{B}+\bar{C}$	3
1	0	0	$\bar{A}+B+C$	4
1	0	1	$\bar{A}+B+\bar{C}$	5
1	1	0	$\bar{A}+\bar{B}+C$	6
1	1	1	$\bar{A}+\bar{B}+\bar{C}$	7

Substituting  $C_{IN}$  for C

$$\begin{aligned}
 S(A, B, C_{IN}) &= M_0 M_3 M_5 M_6 \\
 &= \prod(M_0, M_3, M_5, M_6) \\
 &= \prod(0, 3, 5, 6)
 \end{aligned}$$

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## Axioms (Slide 33)

There is no new information here.

(A1) and (A1') just say that the set of possible values for a variable is  $\{0, 1\}$ .

All the other axioms just define the NOT, AND, and OR operators.

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