Lecture 5 - CS

Monday, June 22, 2009
10:39 AM

Announcement

HW 1 : Due on Thursday.
before class

Lecture Notes from last time are already on class website.

Scanned version is posted.

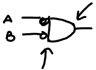
Review

* Logic Circuit ⟷ Boolean Expression

Ex.

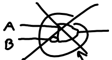
$A \cdot B$

$A + B$

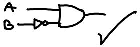


$\bar{A} \cdot \bar{B}$ (Negative-AND)

$A \cdot \bar{B}$



is not a gate



$A \cdot (\bar{B})$ is not the same as $\overline{(A \cdot B)}$

Do the B complement first and then AND with the A

Do the AND first and then complement the rest.

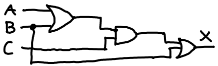
Ex. Find the value of X for all possible values of the variables when

$X = \underbrace{(A+B) \cdot C} + B$

A	B	C	(A+B)	·C	+B
0	0	0	0	0	$\boxed{0}$
0	0	1	0	0	$\boxed{0}$
0	1	0	1	0	$\boxed{1}$
0	1	1	1	1	$\boxed{1}$
1	0	0	1	0	$\boxed{0}$
1	0	1	1	1	$\boxed{1}$
1	1	0	1	0	$\boxed{1}$
1	1	1	1	1	$\boxed{1}$

Ex Draw the logic circuit represented by

$X = (A+B) \cdot C + B$



Ex. Simplify

$(A+B) \cdot C + B = AC + \underbrace{BC + B}$

$= AC + BC + B \cdot 1$

$= AC + B(\underbrace{C+1}_{1})$

$= AC + B \cdot 1$

$= AC + B$

Ex. $A \cdot B + A(B+C) = \underbrace{A \cdot B + AB}_{AB} + AC$

(A.M.)

$= AB + AC$

$= A(B+C)$

Ex. Check

AB +

by tru

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

Advantage :

Disadvantage :

that

A(B+C) ≠ A(B+C)

th table.

AB + A(B+C)				A(B+C)
0	0	0	0	0
0	0	0	1	0
0	0	0	1	0
0	0	0	1	0
0	0	0	0	0
0	1	1	1	1
1	1	1	1	1
1	1	1	1	1

same!

1) A.M. quick (usually)
simple

Need to know laws/rules.

2) Truth table

Advantage : straight-forward

Disadvantage : Tedious

3) K-map ← Alternative way to write a truth table.

Back to "new material"

Ex. $\underbrace{X \text{ NAND } 1}$ = $\overline{X}$

$\overline{X\cdot 1} = \overline{X}$

Ex. X NOR 0 = $\overline{X}$

$\overline{X+0} = \overline{X}$

Ex. X NAND X = $\overline{X}$

$\overline{X\cdot X}$

Ex. X NOR X = $\overline{X}$

$\overline{X+X}$

* $\overline{X}$ = X NAND X
= X NOR X
= X NAND 1
= X NOR 0

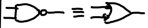
DeMorgan's Theorem ←

1) $\overline{A_1\cdot A_2\cdot A_3\cdots A_n} = \overline{A_1}+\overline{A_2}+\cdots+\overline{A_n}$

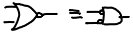
2) $\overline{A_1+A_2+\cdots+A_n} = \overline{A_1}\cdot\overline{A_2}\cdot\cdots\cdot\overline{A_n}$

Two variables

$\overline{X\cdot Y} = \overline{X}+\overline{Y}$



$\overline{X+Y} = \overline{X}\cdot\overline{Y}$



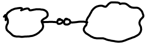
Ex $\overline{\overline{A}BC} = \overline{\overline{A}}+\overline{B}+\overline{C} = A+\overline{B}+\overline{C}$

D.T.

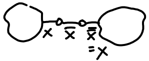
$\overline{\overline{A}+B+C} = A\cdot\overline{B}\cdot\overline{C}$

D.T.

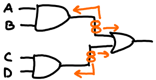
"Play with bubble"



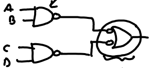
$\overline{\overline{X}} = X$



Suppose you have

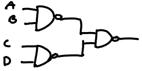


NAND



NAND

also NAND



Conclusion

1) You can crea
bubble (-o
nothing and

2) When you m
through an
an OR gate
(AND ⟷ OR)

3) Sometimes, yo
an isolated
final design,
as " -▷o- "
"o" is not
"-▷o-" is

te a <u>pair</u> of
—o—) out of
move them.

ove a bubble ("o")
AND gate or
, the gate changes

← De Morgan's theorem

may want to leave
bubble in your
/answer. Write it
instead of "—o—".

a gate.
a NOT gate.

No pun intended.

Product term: is a single literal or a product of two or more literals.

$A\bar{B}C$, AC, $A\cdot\bar{B}\cdot C\cdot D$, $\bar{A}\cdot\bar{B}\cdot\bar{C}$, A, $\bar{B}$

Caution

$\overline{ABC}$ is not a product term.

Sum term: is a single literal or a <u>sum</u> of two or more literals.

Ex. $A+\bar{B}+C$
$A+C$

Caution: $\overline{A+B+C}$ is not a sum term.

Ex. $A+\underbrace{A\bar{B}C}_{\text{not literals.}}$ is <u>not</u> a sum term.

$A+A\bar{B}C$ is <u>not</u> a product term.

Q: When does $A\bar{B}C=1$?

$A=1$
$\bar{B}=1$
$C=1$

Therefore, $A\bar{B}C=1$ iff $(A,B,C)=(1,0,1)$

iff: if and only if

Q: When does $\underbrace{A+\bar{B}+C}=0$?

$$\left.\begin{aligned} A&=0\\ \bar{B}&=0\\ C&=0 \end{aligned}\right\} \Rightarrow \text{ iff } (A,B,C)=(0,1,0)$$

Sum-of-Products (SOP)

is a sum of product terms.

Ex $A\bar{B}+ABC$,
$AB+C$,
$ABC+CDE$

Ex. Develop a truth table for
$X=A\bar{B}+ABC$

A	B	C	$A\bar{B}+ABC$
0	0	0	0
0	0	1	0
0	1	0	0
0	1	1	0
1	0	0	1
1	0	1	1
1	1	0	0
1	1	1	1

$A\bar{B}=1$?
$A=1$
$B=0$

← Free to choose the vale of "C".

$ABC=1$?
$A=1$
$B=1$
$C=1$

Remark:

① $A\bar{B}$ corresponds to two "1"'s in the truth table.

② ABC corresponds to a unique "1" (or a unique row) in the truth table.

Next time: Standard $\underline{\underline{\text{SOP}}}$

↑