SWE223: Digital Electronics
Fall 2015

Lecture 3 extention 2
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Textbooks

- M. Moris Mano and Kime, "Digital Logic and computer design", Prentice Hall.

Theorems and Postulates Proof

Proof of Absorption Law

- Absorption Law: $a \cdot (a+b) = a$

Proof: $a(a+b)$

$= (a+0)(a+b)$ (identity)

$= a+0 \cdot b$ (distributive)

$= a + 0$ (identity)

$= a$ (identity)

Proof of $x+x'y'=x+y$

- $x+x'y'=x+y$

Proof: $a + a'*b$

$= (a + a')*(a + b)$ (distributive)

$= (1)*(a + b)$ (complement)

$= (a + b)$ (identity)

Proof of Demorgan's law

- Theorem: $(a+b)' = a'b'$
- Proof: We show that $a+b$ and $a'b'$ are complementary.
- In other words, we show that both of the following are true as per complementary law:
  - $(a+b) + (a'b') = 1$
  - $(a+b)(a'b') = 0$

Complementary Law Says:
$x+x' = 1$, $x.\ x'=0$
Let, $a+b=x$, then $x'=a'b'$ $[(a+b)'=a'b']$

Proof by Complementary Law of OR:
$(a+b)+(a'b')$
$=(a+b+a')(a+b+b')$ (distributive)
$=(1+b)(a+1)$ (complement)
$=1$ (Null law)

SO we can say that $a+b$ and $a'b'$ are complementary.

Proof by Complementary Law of AND:
$(a+b)(a'b')$
$=(a'b')(a+b)$ (commutative)
$=a'b'a+a'b'b$ (distributive)
$=0*b'+a'*0$ (complement)
$=0+0$ (Null law)
$=0$ (identity)

Simplification with Theorems: Example 1

$(a'b'+c)(a+b)(b'+ac)'$

$= (a'b'+c)(a+b)(b(ac)')$ (DeMorgan's)

$= (a'b'+c)(a+b)b(a'+c')$ (DeMorgan's)

$= (a'b'+c)b(a'+c')$ (Absorption)

$= (a'b'b+bc)(a'+c')$ (distributive)

$= (0+bc)(a'+c')$ (complement)

$= bc(a'+c')$ (identity)

$= a'bc+bcc'$ (distributive)

$= a'bc+0$ (complement)

$= a'bc$ (identity)

Simplification with Theorems: Example 2

- $a'b'+ab+a'b$

$= a'b'+(a+a')b$ [distributive]

$= a'b' + b$ [complement]

$= a' + b$ [$x+x'y'=x+y$]

- $a'b'+ab+a'b$

$= a'b'+ab+a'b+a'b$ [idempotent]

$= a'b' + a'b +ab+a'b$ [commutative]

$= a'(b'+b) + (a+a')$ [distributive]

$= a'*1 +1*b$ [complement]

$= a' + b$ [identity]

Same function minimized in two ways.