Logical Expressions

CS 350, Lecture 5, Wed Jan 25, 2012

ver. Mon, Jan 30, 2012, 12:20 pm

Activity 5.1: Logical Operations; Truth Tables

A. Why?

- Logical operations on bits is the lowest level of computation we do.
- Mathematical calculations on bits can be viewed as logical operations on bits.

B. Outcomes

At the end of today, you should:

- Be able to perform logical operations on individual bits using truth tables and simplifications.

C. Questions

1. What is the minimal parenthesization for ((*NOT X*) *OR* (*NOT Y*)) *AND Z*? (I.e., which parentheses are redundant because of the precedence/associativity rules?)
2. What do we get if we add the redundant parentheses back to *NOT X AND Y OR Z*? (Don't bother adding parentheses around individual variables.)
3. Verify one of DeMorgan's laws by writing a truth table for *NOT*(*X AND Y*) and *NOT X OR NOT Y*. (You should find they are equivalent; i.e., have exactly the same results columns.)
4. Write a truth table comparing ((*X NAND Y*) *NAND Z*) and (*X NAND* (*Y NAND Z*)). Are they equivalent?

D. Solutions

1. (*NOT X OR NOT Y*) *AND Z*
2. ((*NOT X*) *AND Y*) *OR Z*
3.

X	*Y*	*NOT*	*(X*	*AND*	*Y)*		*((NOT X)*	*OR*	*(NOT Y))*
0	0	1	0	0	0		1	1	1
0	1	1	0	0	1		1	1	0
1	0	1	1	0	0		0	1	1
1	1	0	1	1	1		0	0	0

4.

X	*Y*	*Z*	*((X*	*NAND*	*Y)*	*NAND*	*Z)*		*(X*	*NAND*	*(Y*	*NAND*	*Z))*
0	0	0	0	1	0	1	0		0	1	0	1	0
0	0	1	0	1	0	0	1		0	1	0	1	1
0	1	0	0	1	1	1	0		0	1	1	1	0
0	1	1	0	1	1	0	1		0	1	1	0	1
1	0	0	1	1	0	1	0		1	0	0	1	0
1	0	1	1	1	0	0	1		1	0	0	1	1
1	1	0	1	0	1	1	0		1	0	1	1	0
1	1	1	1	0	1	1	1		1	1	1	0	1

