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The Truth is Out There!

by Dale Wick for AdamCon 13, July 13, 2001

It is often said that the world from a computer's perspective can be broken down into two camps. Those are variously called 0 and 1 or true and false or on and off. In electronics these are also 0 volts and +5 volts.

Now if you use the Adam, you probably have never spent time giving it instructions as a string of 0's and 1's. This is because the actual details are "abstracted" from you to make it easy to accomplish ever larger tasks.

abstraction is the process of hiding all of the details of the solution to a problem.

Today we will actually work with the following functions:

- NOT - inversion is false if A is true
- AND - requires that both A and B are true.
- OR - called an inclusive or, which is true if any of A or B are true.
- XOR - exclusive or, which is true of one but not both A and B are true.
- NAND - inverted version of AND
- NOR - inverted version of OR

Understanding symbols

To work with these there is an abbreviated notation:

- AND is represented by 'x' or no symbol (like multiplication)
- OR is represented by '+'
- NOT is represented by '!' or a bar overtop

Truth Tables

A truth table is a table that shows all of the inputs, and the output with each combination of inputs:

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

Algebraic simplification

Whenever you have a formula, you can translate it using the following substitutions.

$A + 0 = A$	$A \times 0 = 0$
$A + 1 = 1$	$A \times 1 = A$
$A + A = A$	$A \times A = A$
$A + !A = 1$	$A \times !A = 0$
$A + AB = A$	$A(A + B) = A$
$A!B + B = A + B$	$(A + !B)B = AB$
$AB + A!B = A$	$(A + B)(A + !B) = A$
$AB + BC + (!A)C = AB + (!A)C$	$(A + B)(A + C) = A + BC$

Experimenting in SmartBASIC

```

10 print "A","B","result"
100 a=0: b=0: GOSUB 200
110 a=0: b=1: GOSUB 200
120 a=1: b=0: GOSUB 200
130 a=1: b=1: GOSUB 200
199 END
200 REM The formula
210 c=a OR b
220 ? a,b,c
230 RETURN

```

Change the formula in line 210 to each of the following:

```

210 c=NOT a
210 c=NOT (a AND b)
210 c=NOT (a OR b)
210 c=a AND b
210 c=a OR b
210 c=(a OR b) AND a<>b

```

Now we can prove some of the substitutions using truth tables.

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