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Question #1: Boolean Operators

Given the following values for X, Y, and Z, are the following Boolean expressions true or false?

X = True, Y = True, Z = False

X	True
Y AND Y	True
(X NOR Z) AND Y	False
X XOR Y	False
(X XOR Z) AND (Y XOR Z)	True
(X OR X) XOR Z	True
(X NOR Z) XOR (Y OR Z)	True
(X NAND Z) OR Z	True
((NOT X AND NOT Y) AND Z) NAND X	True
(NOT X OR Y) NAND Z OR NOT Y XOR Z	True

Question #2: Simplifying Boolean Expressions

Simplify the given Boolean expression using the laws of Boolean logic. Show each simplification you make and please include the name of the law you used (e.g. complementation, idempotent, etc.) If you're having trouble getting started, remember this is just like Algebra. Collect like terms and factor them out of the logical expression the exact same way you would an algebraic equation. As a hint, although it isn't clear at first glance, the simplified expression contains just 2 terms!

X'YZ + XYZ + XY'Z'+XYZ' + XY'Z' + X'Y'Z' + WX'Y'Z' + W'X'Y'Z'

Use distributive Law and factor out common terms,

$= YZ(X'+X) + XZ'(Y'+Y) + Y'Z'(X+X') + X'Y'Z'(W+W)$

Use complement Law where $X'+X=1$, $Y'+Y=1$, $W'+W=1$

$= YZ + XZ' + Y'Z' + X'Y'Z'$

Use distributive law again

$= YZ + Z'(X + Y' + X'Y')$

Use distributive law again

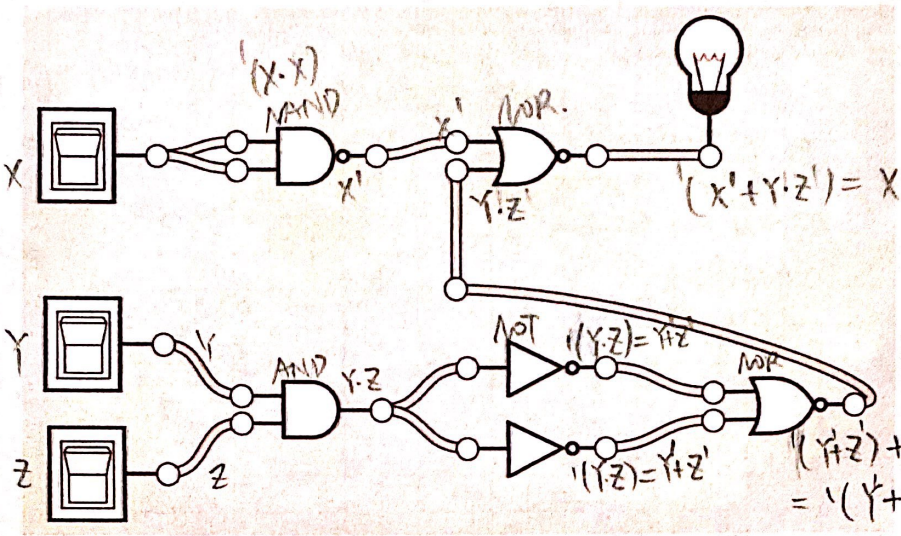
$= YZ + Z'(X + Y'(1+X'))$

Use dominance law, $1+X'=1$

$= YZ + Z'(X+Y')$

Question #3: Digital Circuits & Truth Tables

Give both the simplified combinational Boolean expression and the truth table for the following circuit:



Simplified Boolean expression:

Light Bulb = $X \cdot (Y' + Z')$

Switch 1 (top, X)	Switch 2 (middle, Y)	Switch 3 (bottom, Z)	Light Bulb
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	1
1	1	1	0

Question #4: Creating a Digital Circuit

Draw a circuit that implements the following Boolean logic expression and provide the corresponding truth table.

¬(((W ∧ X) ⊗ Y) ∧ Z)

W	X	Y	Z	Output
0	0	0	0	1
0	0	0	1	1
0	0	1	0	1
0	0	1	1	0
0	1	0	0	1
0	1	0	1	1
0	1	1	0	1
0	1	1	1	0
1	0	0	0	1
1	0	0	1	1
1	0	1	0	1
1	0	1	1	0
1	1	0	0	1
1	1	0	1	0
1	1	1	0	1
1	1	1	1	1