Module 1 Assignment: Boolean/Digital Logic

EN.605.204 Computer Organization

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

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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.

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

Step1: Apply the Idempotent Law: X+X=X
X'YZ+XYZ+XY'Z'+XYZ'+X'Y'Z'+WX'Y'Z'+W'X'Y'Z'

Step2: Apply the Absorption Law: X+XY=X
X'YZ+XYZ+XY'Z'+XYZ'+X'Y'Z'+W'X'Y'Z'

Step3: Apply the Absorption Law: X+XY=X
X'YZ+XYZ+XY'Z'+XYZ'+X'Y'Z'

Step4: Apply the Distributive Law: XY+XZ=XY+Z
YZ(X'+X)+XY'Z'+XYZ'+X'Y'Z'

Step5: Apply the Complement Law: X+X'=1
YZ1+XY'Z'+XYZ'+X'Y'Z'

Step6: Apply the Identity Law: X*1=X
YZ+XY'Z'+XYZ'+X'Y'Z'

Step7: Apply the Distributive Law: XY+XZ=XY+Z
YZ+XZ'(Y+Y')+X'Y'Z'

Step8: Apply the Complement Law: X+X'=1
YZ+XZ'1+X'Y'Z'

Step9: Apply the Identity Law: X*1=X
YZ+XZ'+X'Y'Z'

Step10: Apply the Distributive Law: XY+XZ=XY+Z
YZ+Z'(X'Y'+X)

Step11: Apply the Absorption Law: X'Y+X=Y+X
YZ+Z'(Y'+X)

Step12: Expand
YZ+Y'Z'+XZ'YZ+Y'Z'+XZ'

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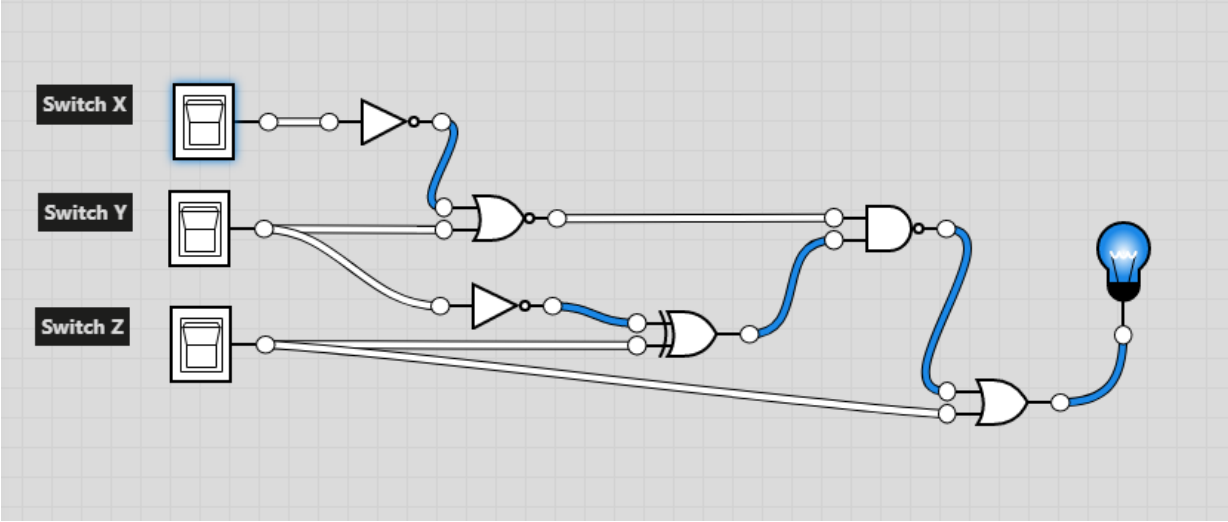
Question #3: Simplifying Boolean Expressions

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



Simplified Boolean expression for the circuit above: X AND Y' AND Z'

Switch X	Switch Y	Switch Z	Output
TRUE	TRUE	TRUE	FALSE
FALSE	TRUE	TRUE	FALSE
TRUE	FALSE	TRUE	FALSE
FALSE	FALSE	TRUE	FALSE
TRUE	TRUE	FALSE	FALSE
FALSE	TRUE	FALSE	FALSE
TRUE	FALSE	FALSE	TRUE
FALSE	FALSE	FALSE	FALSE

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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	O1
FALSE	FALSE	FALSE	FALSE	TRUE
FALSE	FALSE	FALSE	TRUE	TRUE
FALSE	FALSE	TRUE	FALSE	TRUE
FALSE	FALSE	TRUE	TRUE	FALSE
FALSE	TRUE	FALSE	FALSE	TRUE
FALSE	TRUE	FALSE	TRUE	FALSE
FALSE	TRUE	TRUE	FALSE	TRUE
FALSE	TRUE	TRUE	TRUE	TRUE
TRUE	FALSE	FALSE	FALSE	TRUE
TRUE	FALSE	FALSE	TRUE	FALSE
TRUE	FALSE	TRUE	FALSE	TRUE
TRUE	FALSE	TRUE	TRUE	TRUE
TRUE	TRUE	FALSE	FALSE	TRUE
TRUE	TRUE	FALSE	TRUE	FALSE
TRUE	TRUE	TRUE	FALSE	TRUE
TRUE	TRUE	TRUE	TRUE	TRUE

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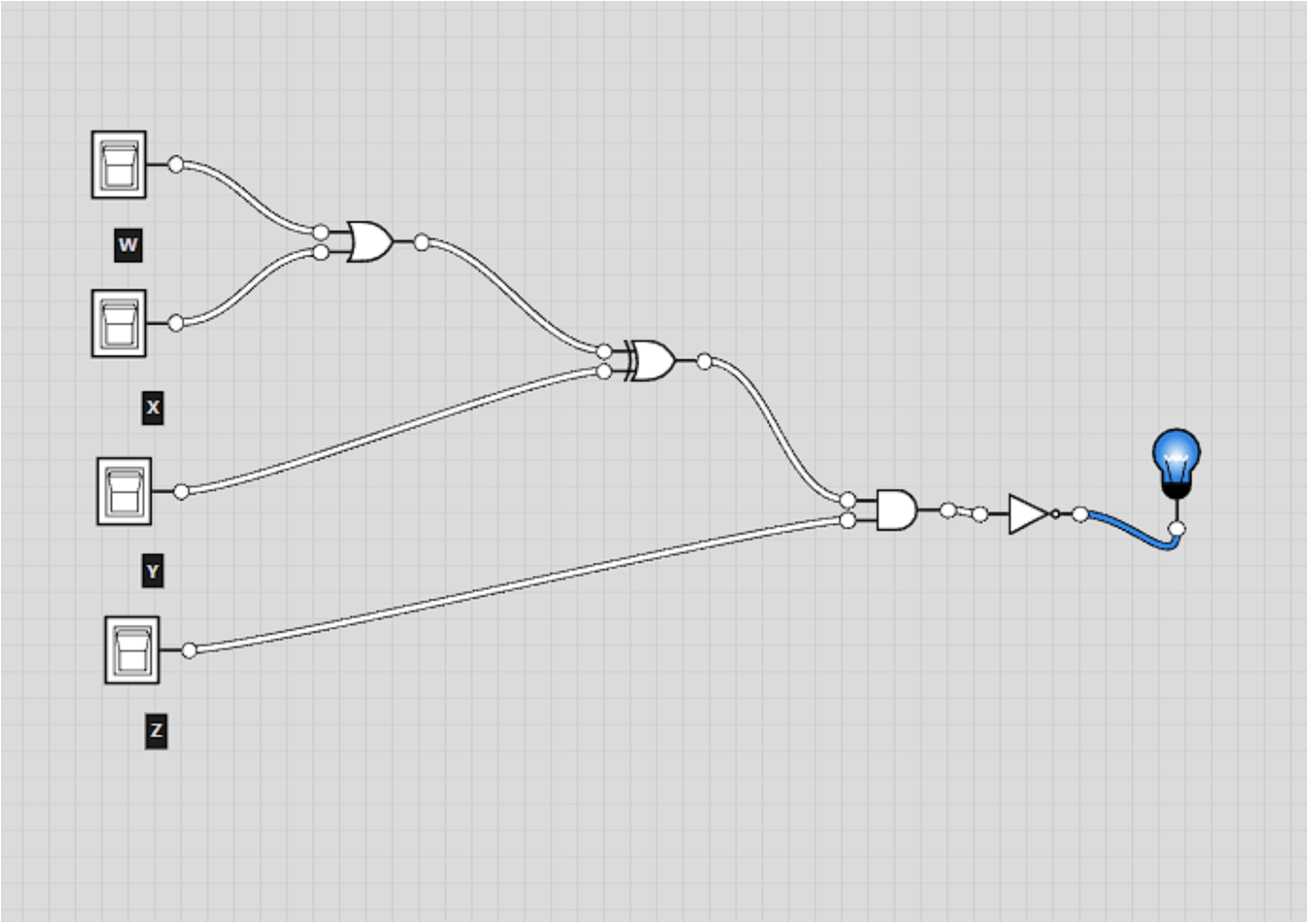

Deliverables

Please submit your assignment showing all work in a PDF named <Your JHEDID>_module1.pdf using the Assignment link on Canvas.

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