# Module 1 Hints: Boolean Logic

## Hint #1

Remember ' is the NOT operator, + can be used as the OR operator, and * can be used as the AND operator.

**Simplify the following expression:**

AB + A'B + BC * A'C'

This is boolean algebra, so the same rules in arithmetic and algebra apply. So, we can re-write this as:

AB + A'B + (A'C * BC') - we need both C and C' but this is impossible:

AB + A'B - we factor out the B:

B(A + A') - we use the complement law here, so (A + A') = 1:

B(1) = B •

**Simplify the following expression:**

XY + XY' + X'Z + YZ

We can start by factoring out an X and a Z to get:

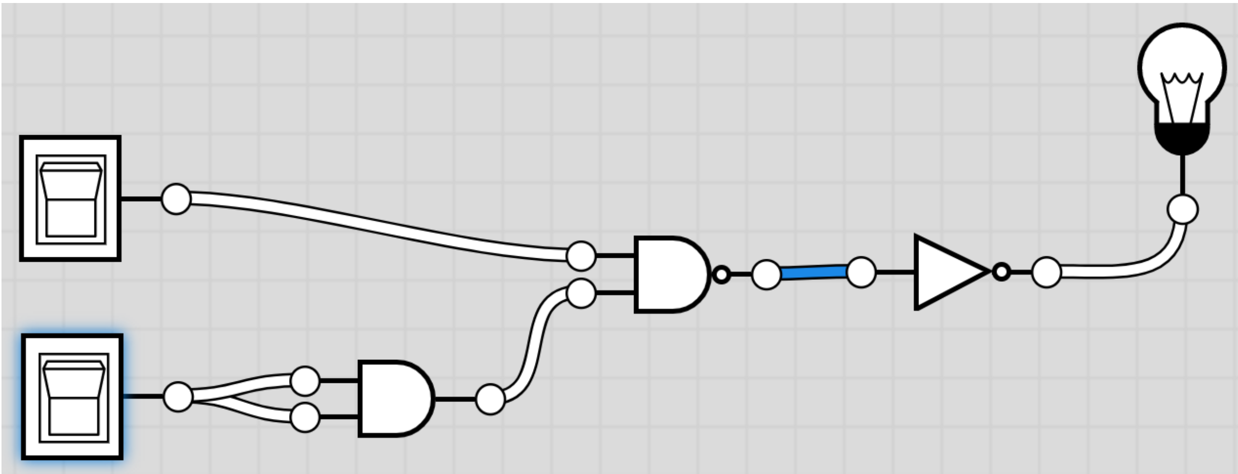
X(Y + Y') + Z(X' + Y)

We use the complement law to reduce (Y + Y'):

X(1) + Z(X' + Y) = X + Z(X' + Y) •

## Hint #2

For the following circuit, provide the simplified Boolean expression along with the corresponding truth table:



First we'll label the top switch (initially off) as X, and the bottom switch (initially off) as Y.

Notice Y comprises both inputs to the first AND gate. So, if Y is off both inputs are 0, and if Y is on, both inputs are a 1.

So, the first term in our expression, working from left to right, is **Y AND Y**

Next, we take the input from X and feed that into the NAND gate along with the output from the AND gate we discussed in the previous step. This gives us:

**X NAND (Y AND Y)**

From the idempotent law, (Y AND Y) = Y:

**X NAND Y**

Finally, we negate the entire output using the NOT gate before sending the output to the lightbulb:

**'(X NAND Y)**

The NOT negates the NAND and we're left with:

**X AND Y •**

So, the lightbulb is on whenever X and Y are on at the same time. You can build and test it here.

For a circuit with 2 inputs we have 2^2 = 4 possible outputs. We know the lightbulb if off when X and Y are both true (1) and on otherwise, so our truth table becomes:

| X | Y | Bulb |
|---|---|---|
| 0 | 0 | 0 |
| 0 | 1 | 0 |

| | | |
|---|---|---|
| 1 | 0 | 0 |
| 1 | 1 | 1 |