

Lab 2: Sum of Products Expression
EECE 2106.05

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Abstract

Lab 2 consisted of a boolean expression, $Y = A'B + B'C'D' + BCD + AB'CD$ that was to be simplified and then constructed onto a breadboard using only NOT, AND, and OR gates. Testing was performed to ensure that the output of the breadboard circuit correctly matched the expected truth table of the resulting equation. One item of interest was the simplification of the equation, where the final simplification step performed by Samuel and Carlos was disputed by the Teaching Assistant and the professor.

Components:

The components utilized to complete the experiment include:

- Gate 7404 (NOT gate)
- Gate 7408 (AND gate)
- Gate 7432 (OR gate)
- One resistor (output)
- LED light
- Breadboard
 - Cable wires
- Power supply (w/ 5v battery)
 - Multimeter

Experiment:

The purpose of this experiment was to first simplify and then construct the boolean equation **$Y = A'B + B'C'D' + BCD + AB'CD$** .

Simplification goes as follows:

Original equation: $Y = A'B + B'C'D' + BCD + AB'CD$

$$= CD (B + AB') + A'B + B'C'D'$$

$$= CD (A+B)$$

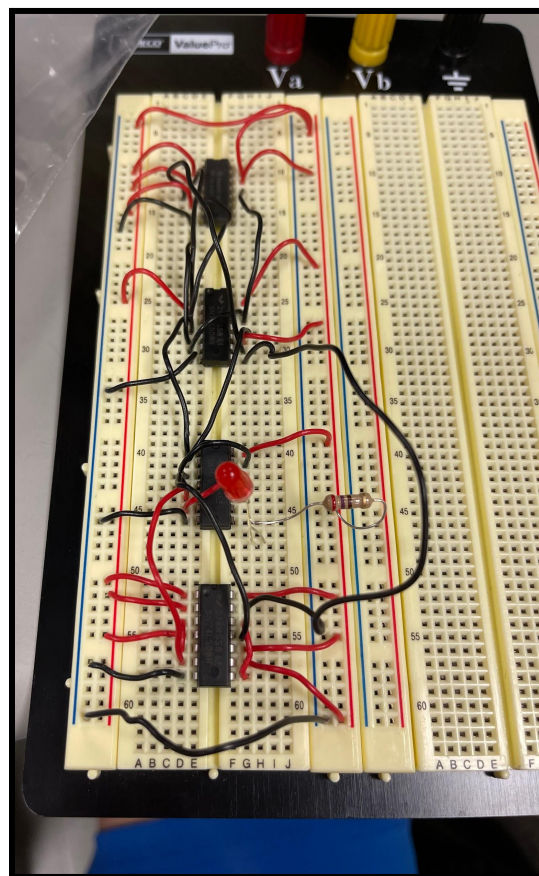
$$= A'B + B'C'D' + ACD + BCD \text{ (Intended simplification)}$$

$$= A'B + B'C'D' + ACD \text{ (Disputed/Incorrect step)}$$

Both Samuel Lee and Carlos Alvizo constructed a breadboard based on the equation $Y = A'B + B'C'D' + ACD$. However, both the teaching assistant (TA) and the professor found an issue with this equation, as the expected equation was $A'B + B'C'D' + ACD + BCD$. According to the teaching assistant, in order to get from $A'B + B'C'D' + ACD + BCD$ to $A'B + B'C'D' + ACD$, we need to use an exclusive OR gate. The logic table for the two equations match, but this discrepancy should be noted to the reader.

Here is Samuel Lee's breadboard (Figure 1), which may have had a faulty wire or gate because the expected output when all inputs were true should also be true, but no light appeared when powered.

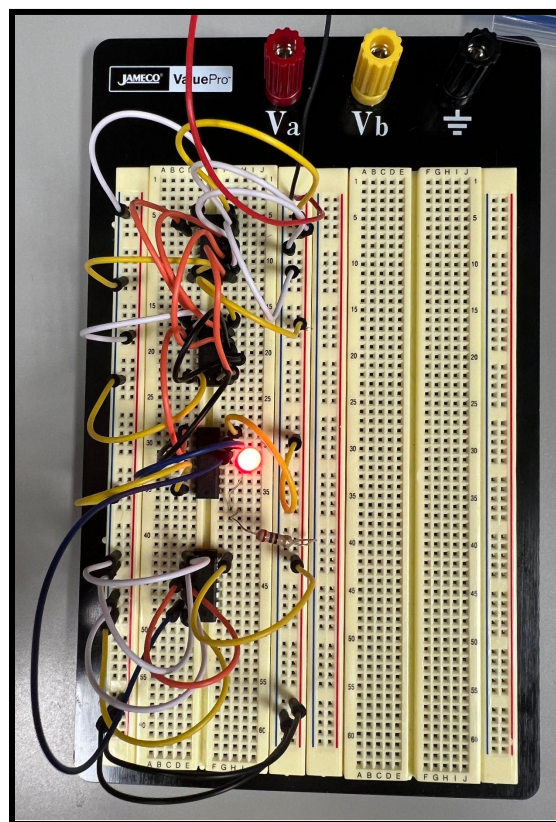
Figure 1: Samuel's Completed (Faulty) Breadboard



The following breadboard (Figure 2) is the one that was presented to the TA and found that it was logically equivalent to the intended simplified form of the equation if the equation we utilized was incorrect. For further understanding the order of the gates from top to bottom are NOT (7404), AND (7408), OR (7432) and AND with $A'B$ and $B'C'D$ being represented on the first AND gate and ACD being represented on the second AND gate. All three equations being connected to the OR gate and outputted to an LED light with a resistor to test out if our logic aligns with that of the equation's truth tables.

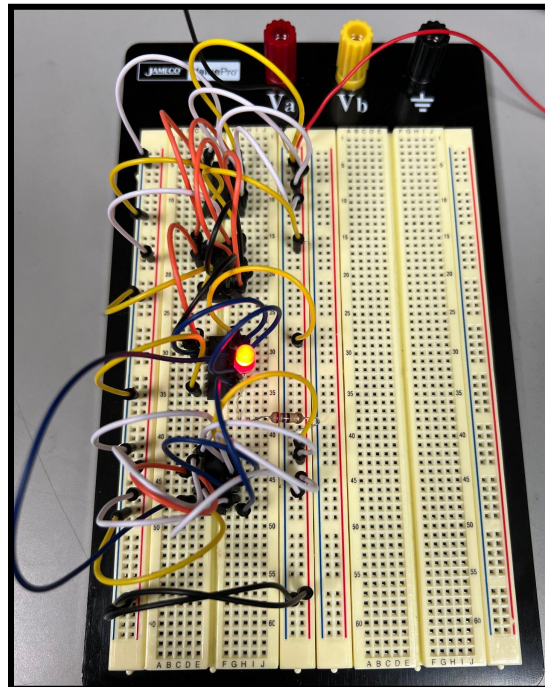
Figure 2: Carlos' Breadboard w/ Logically Equivalent but Incorrect Expression

Simplification



Lastly, after conducting the lab and hearing the comments from the professor and TA, we decided to slightly modify our breadboard (Figure 3) to meet the intended simplification which includes BCD in the output. We did this by adding B, C, and D on the second AND gate where they'd be combined to BCD and then outputting the result to the OR gate where the final solution would then include the inputs we didn't include previously to form $Y = A'B + B'C'D' + ACD + BCD$.

Figure 3: Correct Breadboard w/ Intended Simplification



Truth table for the equation $Y = A'B + B'C'D' + ACD + BCD$ below:

A	B	C	D	A'B	B'C'D	ACD	BCD	Output
T	T	T	T	F	F	T	T	T
T	T	T	F	F	F	F	F	F
T	T	F	T	F	F	F	F	F
T	T	F	F	F	F	F	F	F
T	F	T	T	F	F	T	F	T
T	F	T	F	F	F	F	F	F
T	F	F	T	F	F	F	F	F
T	F	F	F	F	T	F	F	T
F	T	T	T	T	F	F	T	T
T	T	T	F	T	F	F	F	T
F	T	F	T	T	F	F	F	T
F	T	F	F	T	F	F	F	T
F	F	T	T	F	F	F	F	F
F	F	T	F	F	F	F	F	F
F	F	F	T	F	F	F	F	F
F	F	F	F	F	T	F	F	T

Conclusion:

Carlos Alvizo's breadboard was shown to the Teaching Assistant, along with Carlos' pre-lab report. Although both Carlos and Samuel wrote a pre-lab report, Carlos' was the only one shown. Samuel was responsible for the conclusion, cover page, parts of the abstract, components list, and part of the experiment documentation. Carlos was responsible for part of the experiment documentation, part of the abstract, and communicating with the Teaching Assistant over the simplification discrepancy discussed in the experiment documentation.

In conclusion, although the simplification of the boolean expression was disputed, a breadboard following the correct logic truth table was constructed. Both Samuel and Carlos learned about construction of a breadboard following a complicated circuit path.