Lab 4: Combinational Circuits
EECE 2106.05

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Abstract

Experiment 4 consisted of two separate breadboards, one for each question in the lab assignment. The first part of the assignment was to build a breadboard circuit for a given truth-table while the second part consisted of creating a 3-input majority gate such that any two of the three inputs determined the output of that circuit. First, we were instructed to find the POS and SOP forms of the two circuits. Then, comparing the circuit diagrams of both equations, we were to build the less expensive circuit.

Components:

The components utilized to complete the experiment include:

- Gate 7404 (NOT gate)
- Gate 7408 (AND gate)
- Gate 7432 (OR gate)
- Two resistors
- Two LED lights
- Two Breadboards
    - Cable wires
- Power supply (w/ 5v battery)
    - Multimeter

Experiment:

Part one of the lab consisted of finding the SOP and POS form of the given truth-table below and drawing both circuits to implement on the breadboard the circuit with the lowest possible cost.

A	B	C	Output
0	0	0	1
0	0	1	0
0	1	0	1
0	1	1	1
1	0	0	1
1	0	1	0
1	1	0	0
1	1	1	1

In order to get the SOP and POS form, we utilized the truth-table to get the values needed to form a boolean expression and further simplified utilizing boolean algebra to get the following.

Simplified SOP Equation

$$f_{SOP} = \Sigma m(0,2,3,4,7)$$

$$= m_0 + m_2 + m_3 + m_4 + m_7$$

$$= x_1'x_2'x_3' + x_1'x_2x_3' + x_1'x_2x_3 + x_1x_2'x_3' + x_1x_2x_3$$

$$= x_1'x_2'x_3' + x_1'x_2'x_3' + x_1'x_2x_3' + x_1'x_2x_3 + x_1x_2'x_3' + x_1x_2x_3 \quad \therefore x + x = x$$

$$= x_1'x_3'(x_2' + x_2) + x_2x_3(x_1' + x_1) + x_2'x_3'(x_1' + x_1) \quad \therefore x + x' = 1$$

$$= x_1'x_3' + x_2x_3 + x_2'x_3'$$

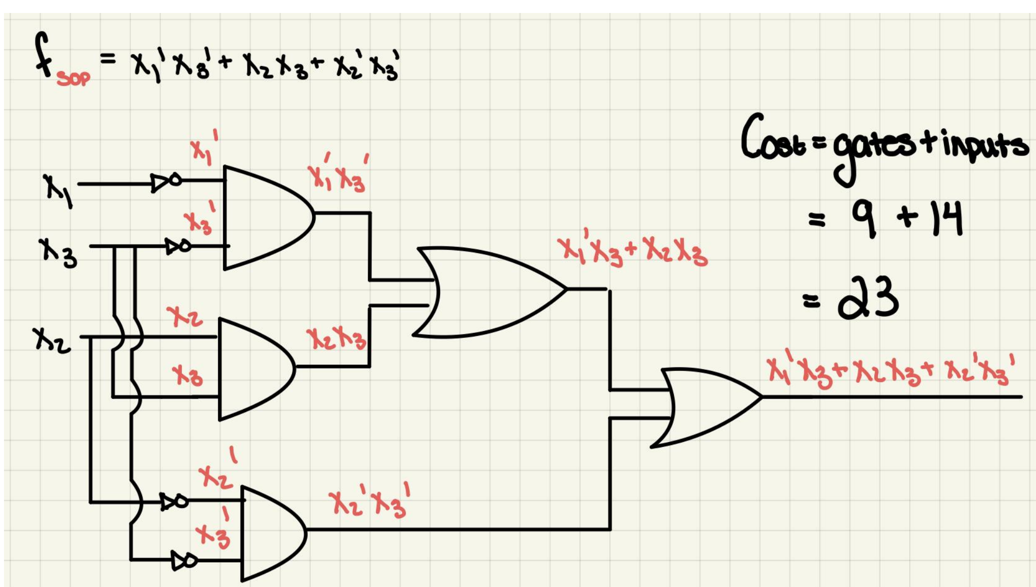
Simplified POS Equation

$$f_{pos} = \Pi M(1,5,6)$$
$$= M_1 \cdot M_5 \cdot M_6$$
$$= (x_1 + x_2 + x_3') \cdot (x_1' + x_2 + x_3') \cdot (x_1' + x_2' + x_3)$$
$$= x_2 + x_3'(x_1 + x_1') \cdot (x_1' + x_2' + x_3) \quad \therefore x + x' = 1$$
$$= (x_2 + x_3') \cdot (x_1' + x_2' + x_3)$$

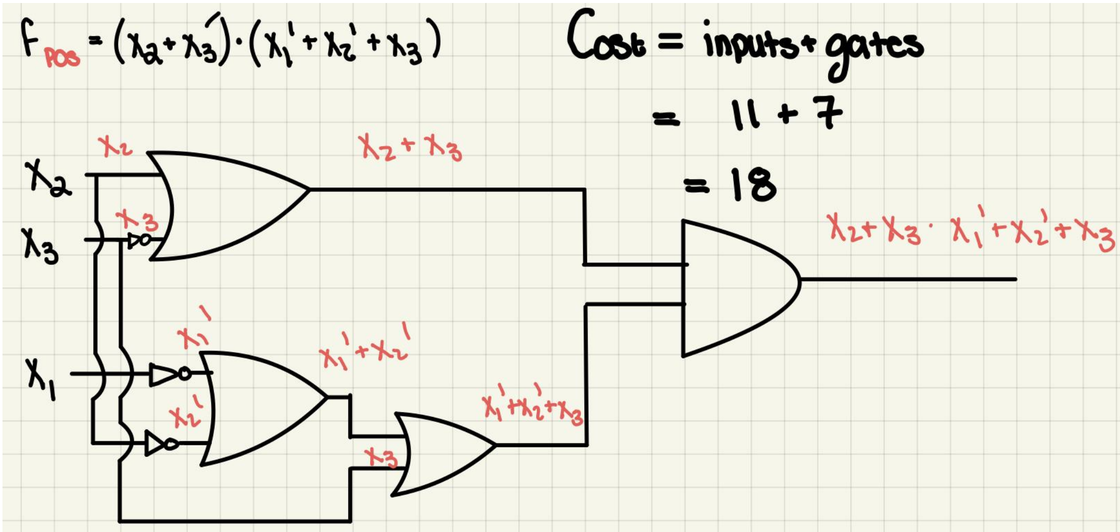
***Note: A = X1, B= X2, C= X3** for part 1 of the assignment.*

After getting the SOP and POS equations, we drew their respective circuits to obtain the lowest cost circuit which is calculated by adding the number of inputs with the number of gates in a circuit.

Simplified SOP Circuit

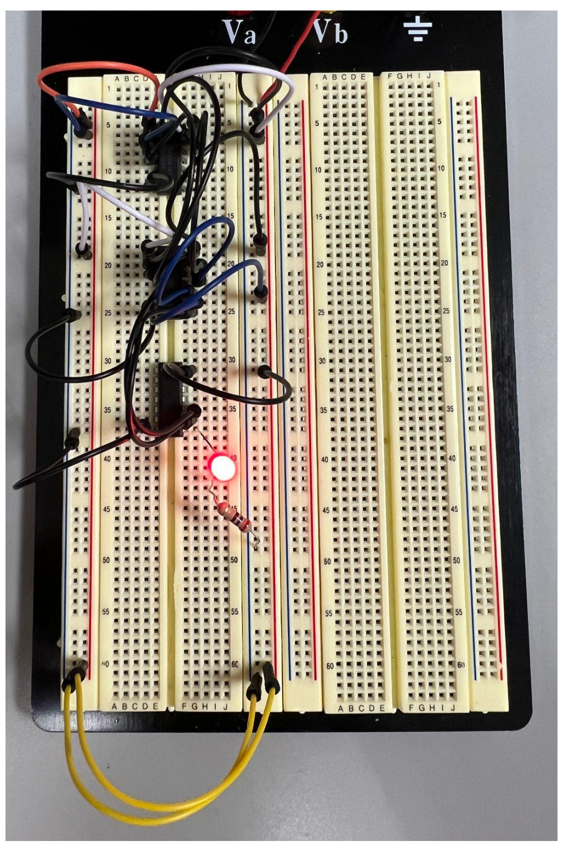


Simplified POS Circuit



As seen in both the SOP and POS circuits, the former has a cost of 23 while the latter has a cost of 18 so we implemented the POS form of the equation on the breadboard which was as follows.

POS Circuit Breadboard



The second part of the experiment included the creation of a 3-input majority truth table, one that came from the previous truth-table. Samuel Lee was responsible for the 3-input majority truth table equation with the SOP equation being:

Y = (AB) + (BC) + (AC)

Truth table for this equation is as follows:

A	B	C	(AB)+(BC)+(AC)
True	True	True	True
True	True	False	True
True	False	True	True
True	False	False	False
False	True	True	True
False	True	False	False
False	False	True	False
False	False	False	False

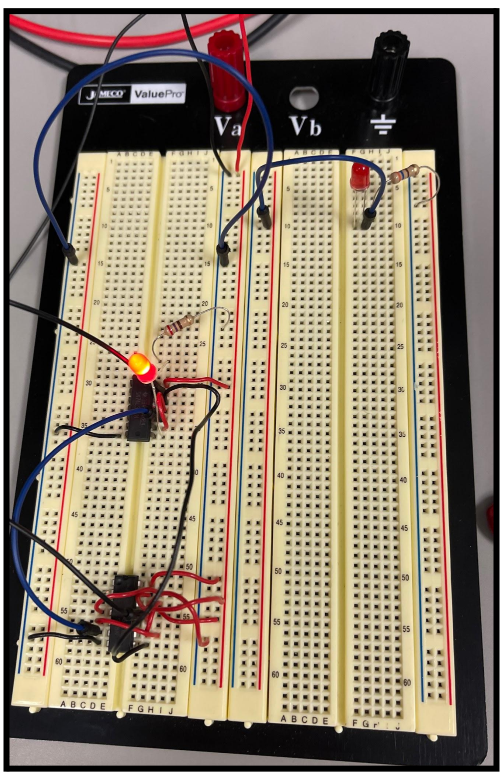
The way to determine this is simple. Basically, we compare every combination of two inputs, hence why we 'AND' the AB, BC, AC, and then 'OR' these three results. In this way, whatever the majority is determines whatever the result is. The POS equation is as follows:

POS equation: Y = (A+B)*(A+C)*(B+C)

And we reached this equation by utilizing Demorgan's Theorem: **Y = ((AB)+(BC)+(AC))'**

The truth table for this equation is as follows:

A	B	C	(A+B)*(A+C)*(B+C)
True	True	True	True
True	True	False	True
True	False	True	True
True	False	False	False
False	True	True	True
False	True	False	False
False	False	True	False
False	False	False	False



SOP circuit of 3 input majority

Conclusion:

Work was split right down the middle, with Carlos Alvizo responsible for the first breadboard circuit matching the first question on the lab assignment, and his portion of the lab report. Samuel Lee was responsible for the second breadboard circuit matching the second question on the lab assignment, and his portion of the lab report. We learned how to create the SOP and POS equation of a given truth table/three-input majority table, determine the cost of both equations and implement it onto a breadboard.