**Lab 3: Logical Expressions**

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**Part 1: Simplification**

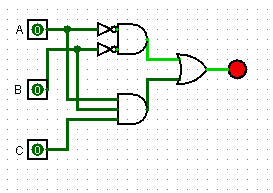
Simplify the following expressions, draw the simplified circuit in Logisim:

1. F = A’B’C’ + A’B’(C + C’) + ABC

= A’B’C’ + A’B’(1) + ABC

= A’B’(C + 1) + ABC

= A’B’ + ABC

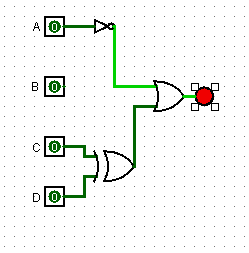


1. F = A’ + A’B’C’D’ + A’B’CD’ + A’B + A’B’C’D’ + C’D + CD’

= A’(1 + B’C’D’ + B’CD’ + B + B’C’D’) + C’D + CD’

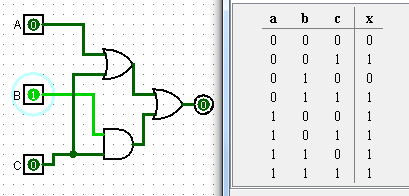
= A’(1) + C’D + CD’

= A’ + (C D)



**Part 2: Reverse Engineering**

For the following circuit, derive its truth table, and write down the sum of minterms and the product of maxterms:



|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| i | A | B | C | A + C | B \* C | (A + C) + (B \* C) | mi | Mi |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | A’B’C’ | A + B + C |
| 1 | 0 | 0 | 1 | 1 | 0 | 1 | A’B’C | A + B + C’ |
| 2 | 0 | 1 | 0 | 0 | 0 | 0 | A’BC’ | A + B’ + C |
| 3 | 0 | 1 | 1 | 1 | 1 | 1 | A’BC | A + B’ + C’ |
| 4 | 1 | 0 | 0 | 1 | 0 | 1 | AB’C’ | A’ + B + C |
| 5 | 1 | 0 | 1 | 1 | 0 | 1 | AB’C | A’ + B + C’ |
| 6 | 1 | 1 | 0 | 1 | 0 | 1 | ABC’ | A’ + B’ + C |
| 7 | 1 | 1 | 1 | 1 | 1 | 1 | ABC | A’ + B’ + C’ |

Sum of Minterms = Σ( 1, 3, 4, 5, 6, 7)

= A’B’C + A’BC + AB’C’ + AB’C + ABC’ + ABC

Product of Maxterms: Π( 0, 2)

= (A’B’C’) \* (A’BC’)

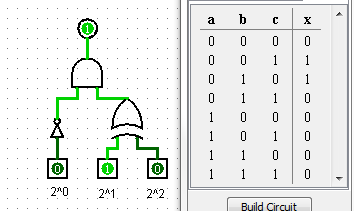
**Part 3: Circuit Implementation**

Using Logisim, design a 3-input circuit that outputs a “1” when the corresponding binary Inputs represent an even number between 1 and 5 (2, 4) following these steps:

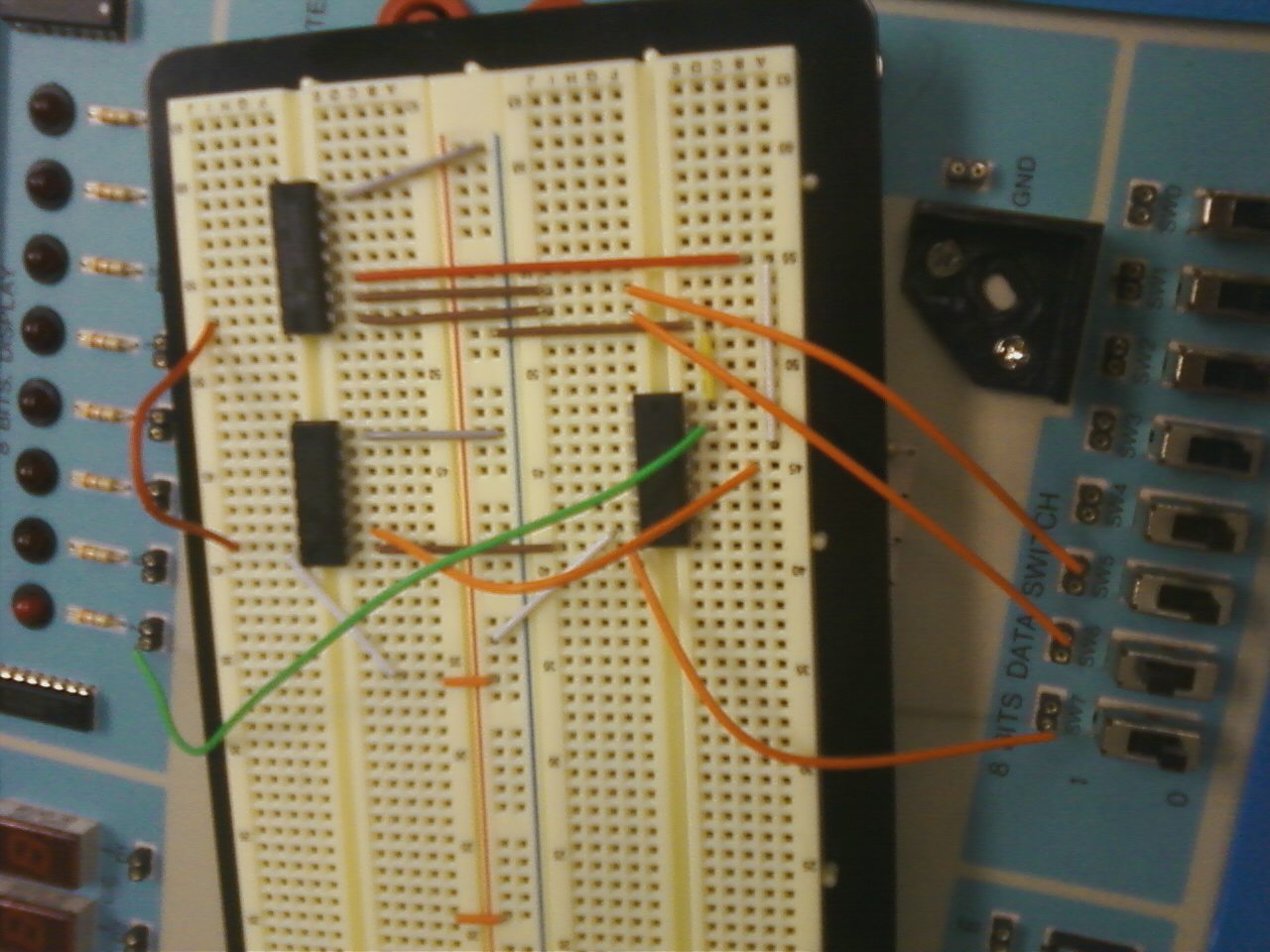
1. Draw the truth table

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| 20 | 21 | 22 | (20)’ | 21 22 | (20)’ \* (21 22) |
| 0 | 0 | 0 | 1 | 0 | 0 |
| 0 | 0 | 1 | 1 | 1 | 1 |
| 0 | 1 | 0 | 1 | 1 | 1 |
| 0 | 1 | 1 | 1 | 0 | 0 |
| 1 | 0 | 0 | 0 | 0 | 0 |
| 1 | 0 | 1 | 0 | 1 | 0 |
| 1 | 1 | 0 | 0 | 1 | 0 |
| 1 | 1 | 1 | 0 | 0 | 0 |

1. Obtain the logical expression in sum-of-minterms and simplify it. Draw circuit in Logisim.



1. Implement circuit on breadboard.

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As can be seen in the picture, the switch that would correspond to the binary 21s place digit is switched on, meaning the decimal number 2 is represented. This is one of the conditions for the aforementioned function to output “1,” and so the LED is lit up to indicate this.