CDA 3201L #002

TIME: 2:00 PM – 3:50 PM (FRIDAYS)

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PURPOSE AND OBJECTIVES

- Understand the functionality of basic logic gates and combinational circuits.
- Implement Boolean expressions using basic logic gates.
- Utilize Logisim to implement the circuit from the Boolean expressions.

ASSIGNMENT:

Part A: Simplify the following Boolean expression using the Laws of Boolean algebra, and implement the resulting circuit using inverters, 2-input AND gates, and 2-input OR gates.

$$Z = Y (WU + WU) + U\,Y$$

Part B: Verify that the NOR operation is functionally complete using Laws of Boolean algebra.   (Hint: Implement the functions NOT, AND, and OR only using 2-input NOR gates).

COMPONENTS USED

- Logism (simulation software)
- AND gates, OR gates, NOR gates, connection wires (in logism)

DESIGN DESCRIPTION

PART 1:

Simplification of the expression:

$$
\begin{aligned}
Z &= Y (WU + WU) + U\,Y \\
&= Y\,(WU) + UY \\
&= WUY + UY \\
&= UY\,(W + 1) \\
&= UY\,(1) \\
&= UY
\end{aligned}
$$

U	Y	U*Y
0	0	0
0	1	0
1	0	0
1	1	1

The circuit designed used two inputs (U and Y) and an AND gate, with U and Y as inputs, to get the final result.

Part 2:

To prove that NOR gate is functionally complete, we will implement NOT, AND, and OR gates using only NOR gates.

NOT gate:

$\quad$A'
= A'A'
= (A + A)'
= A NOR A

OR gate:

A + B
= ((A +B)')'
= (A'B')'
= (A'B' + A'B')'
= ((A+B)' + (A +B)')'
= (A NOR B) NOR (A NOR B)

AND gate:

AB
= ((AB)')'
= (A' + B')'
= (A'A' + B'B')'
= ((A +A)' + (B + B)')'
= (A NOR A) NOR (B NOR B)

Based on these expressions AND, OR, and NOT gates were constructed using NOR gates.

OBSERVATION AND DATA ANALYSIS

- Simplifying a Boolean expression through Boolean algebra laws simplifies the equation and reducing the cost of the circuit by reducing the number of components used.
- Functionally complete gates like NAND, and NOR can used to build any logical circuit.

DISCUSSION AND CONCLUSION

- There was no observed difference between the actual and the expected results, due to the fact that logism (a simulation software) was used.