Class:	CPE 100L - 1002	Semester:	SPRING 2020

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Instructor's comments:

1. Introduction / Theory of Operation

Lab 4 is about the combinational circuit design of a full adder. Through this lab, we developed the ability to write a Boolean expression for given logic circuits, applied rules of Boolean algebra, reduced expressions to its simplest form, construct the circuits, prove that the two circuits are similar in a truth table, and finally gained understanding of delay and power consumption.

2. Prelab Report

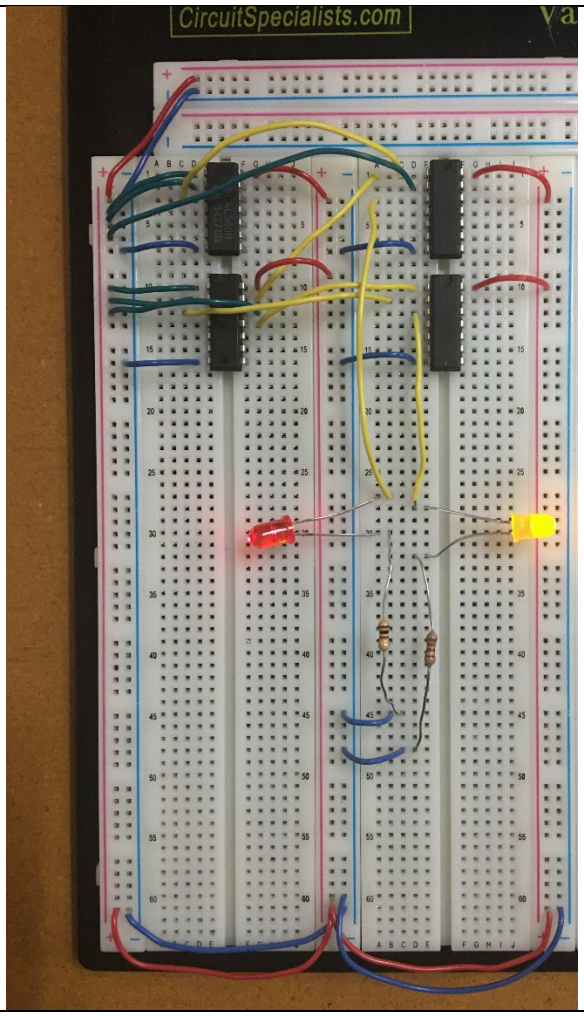
The prelab report will be attached in the submission.

3. Results of the experiments

Experiment	Experiment Results
1	a. Truth table for Full Adder

A	B	Cin	S	Cout
0	0	0	0	0
0	0	1	1	0
0	1	0	1	0
0	1	1	0	1
1	0	0	1	0
1	0	1	0	1
1	1	0	0	1
1	1	1	1	1

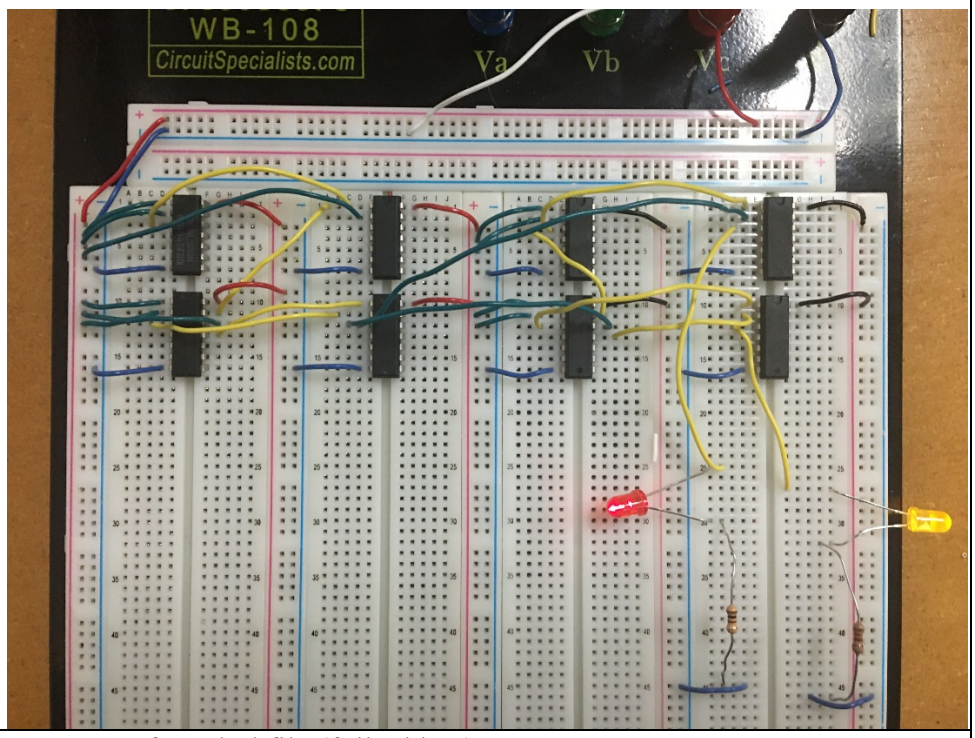
b.



2

a. Truth table for Full Adder

A1	A0	B1	B0	Cout	S1	S0
0	0	0	0	0	0	0
0	0	0	1	0	0	1
0	0	1	0	0	0	1
0	0	1	1	0	1	1
0	1	0	0	0	0	1
0	1	0	1	0	1	0
0	1	1	0	0	1	1
0	1	1	1	1	0	0
1	0	0	0	0	0	1
1	0	0	1	0	1	1
1	0	1	0	1	0	0
1	0	1	1	1	0	1
1	1	0	0	0	1	1
1	1	0	1	1	0	0
1	1	1	0	1	0	1
1	1	1	1	1	1	0

	b. 
3	a. Contents of symbol file (full adder?) (header "symbol" (version "1.2")) (symbol (rect 16 16 112 112) (text "fulladder" (rect 5 0 54 14)(font "Arial" (font_size 8))) (text "inst" (rect 8 80 25 92)(font "Arial")) (port (pt 0 32) (input) (text "A" (rect 0 0 9 14)(font "Arial" (font_size 8))) (text "A" (rect 21 27 30 41)(font "Arial" (font_size 8))) (line (pt 0 32)(pt 16 32))) (port (pt 0 48) (input) (text "B" (rect 0 0 8 14)(font "Arial" (font_size 8))) (text "B" (rect 21 43 29 57)(font "Arial" (font_size 8))) (line (pt 0 48)(pt 16 48))) (port (pt 0 64) (input) (text "Cin" (rect 0 0 17 14)(font "Arial" (font_size 8))) (text "Cin" (rect 21 59 38 73)(font "Arial" (font_size 8))) (line (pt 0 64)(pt 16 64))

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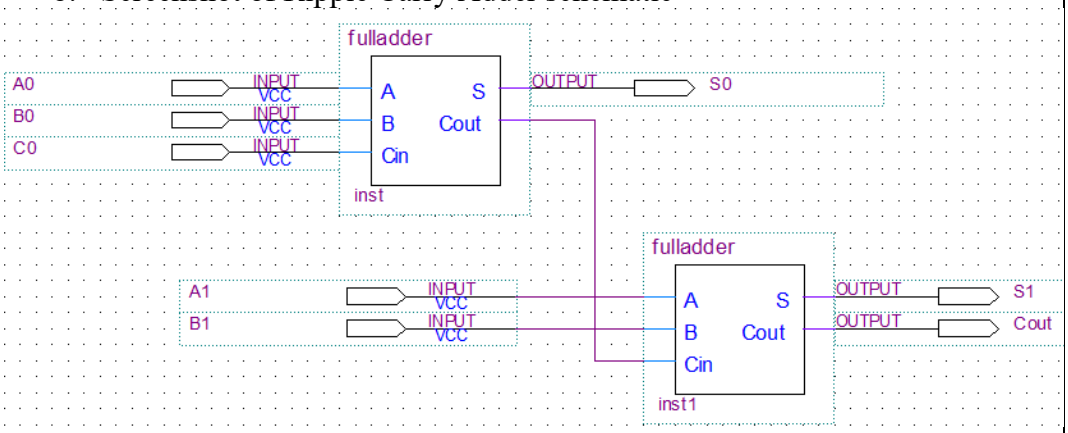
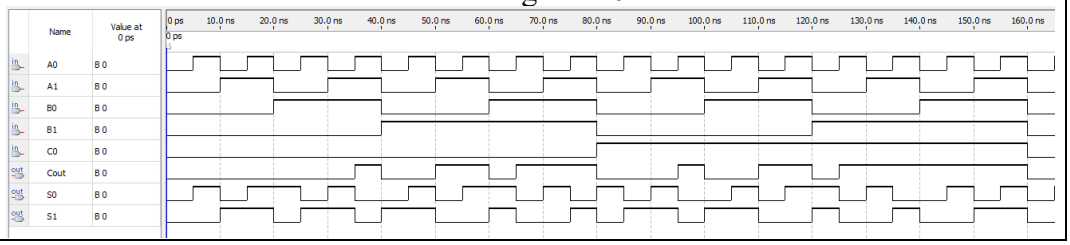
        )
        (port
                (pt 96 32)
                (output)
                (text "S" (rect 0 0 8 14)(font "Arial" (font_size 8)))
                (text "S" (rect 67 27 75 41)(font "Arial" (font_size 8)))
                (line (pt 96 32)(pt 80 32))
        )
        (port
                (pt 96 48)
                (output)
                (text "Cout" (rect 0 0 25 14)(font "Arial" (font_size 8)))
                (text "Cout" (rect 50 43 75 57)(font "Arial" (font_size 8)))
                (line (pt 96 48)(pt 80 48))
        )
        (drawing
                (rectangle (rect 16 16 80 80))
        )
)
```

b. Screenshot of Ripple Carry Adder schematic



c. Screenshot of simulation showing 11+10 addition.



4. Answer the questions

1) A full adder is a logical circuit that performs an addition on three one-bit numberse. The full adder produces a sum of the three inputs and carry value. The difference between a half-adder and a full-adder is that the full-adder has three inputs and two inputs, while the half-adder only has two inputs and two outputs. The half-adder cannot sum up the carry digit from the previous class.

2) In mathematics and mathematical logic, Boolean algebra is the branch of algebra which values of the variables in the truth table are true and false, denoted as 1 and 0 respectively. Boolean algebra is used to analyze and simplify logic circuits.
3) The binary addition algorithm is where the concepts of "carry in" and "carry out" are used. After arranging the bits into a columns set up for binary addition, the bit at the top of the column is called the "carry into column". The right bit of the result is placed under the column of bits. The left bit is called the "carry out of the column".

5. Conclusions

This lab was easier than lab 3 because lab 3 was the introduction to using the breadboard, and now that we know how to use the breadboard, it was much easier to build the circuits. The conclusion of our lab resulted in both the sum and carry out represented by the LED lights successfully turning on, which means that the sum and carry out were both "1" or logical high. The problem that we encountered during the lab was that we did not know how to make two LED lights light up at the same time. In order to fix this problem, we decided to put the LED and resistors on different lines, resulting in multiple lights turning on.