ECEN 248 - Lab Report

Lab Number: 1

Lab Title: Simple Arithmetic Logic Unit

Section Number: 508

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Date: 10/7/2022

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Note: all sections listed below are mandatory in your post lab reports.

Objectives:

The purpose of this lab is to teach us how to implement a simple arithmetic logic unit which will perform simple addition and subtraction with binary numbers, using breadboarding techniques and an understanding of logic gates.

Design:

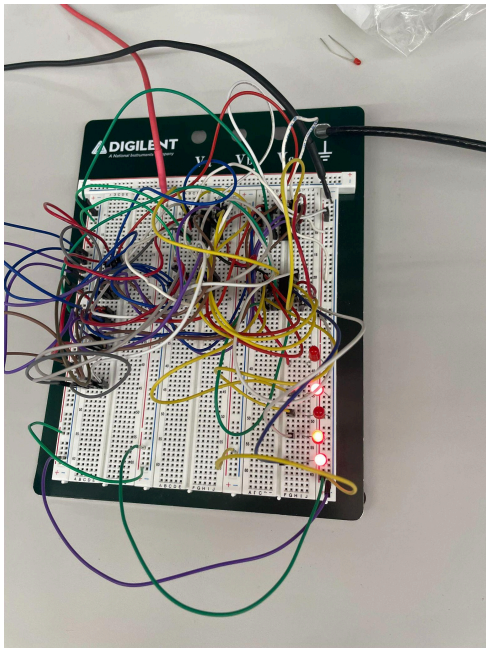
Describe all the steps (be as specific as possible) you use to complete the lab.

First, I added all of the required chips onto the breadboard. These consisted of a Full adder chip, a MUX chip, an XOR chip, and an AND chip. I then set them to ground and added power to the specified slots. After this, I added my input wires, A0, A1, A2, A3, B0, B1, B2, B3, C0, and C1. I then implemented the 4 bit addition/subtraction unit using C1 XOR B0-3, and A0-3 as the inputs, which then outputted S0, S1, S2, S3, and Cout. After this, I connected the 4-bit add/sub unit to the AND gate using S0, S1, S2, and S3 as my inputs, which would output AND0-3. I then implemented the 4-bit 2:1 MUX circuit using C0, S0-3, AND0-3 as my inputs, which would then output R0-3. I then tested the complete ALU circuit.

Results:

Show your results and discuss the observations you made during the lab.

The results showed the sums and differences for each of the test cases. For the first case of 7+8, the inputs for A and B were 0111 and 1000 which outputs 1111 which is 15. For the second case of 7-8, the inputs were 0111 and 0111 which outputted 1111 which is also 15. Finally for 7&8 the result was 0. I noticed that the second test case was incorrect in terms of simple subtraction. 7-8 is equal to -1, however since we are talking about binary numbers, the result was 15, due to the two's complement of -8.



Conclusion:

Summarize what you have done and what you have learned from this lab.

In conclusion, I was able to create and implement an arithmetic logic unit circuit. This lab taught me how to understand the pathing of an ALU circuit and also provide an example of each case through the LED lights.

Post-lab Deliverables:

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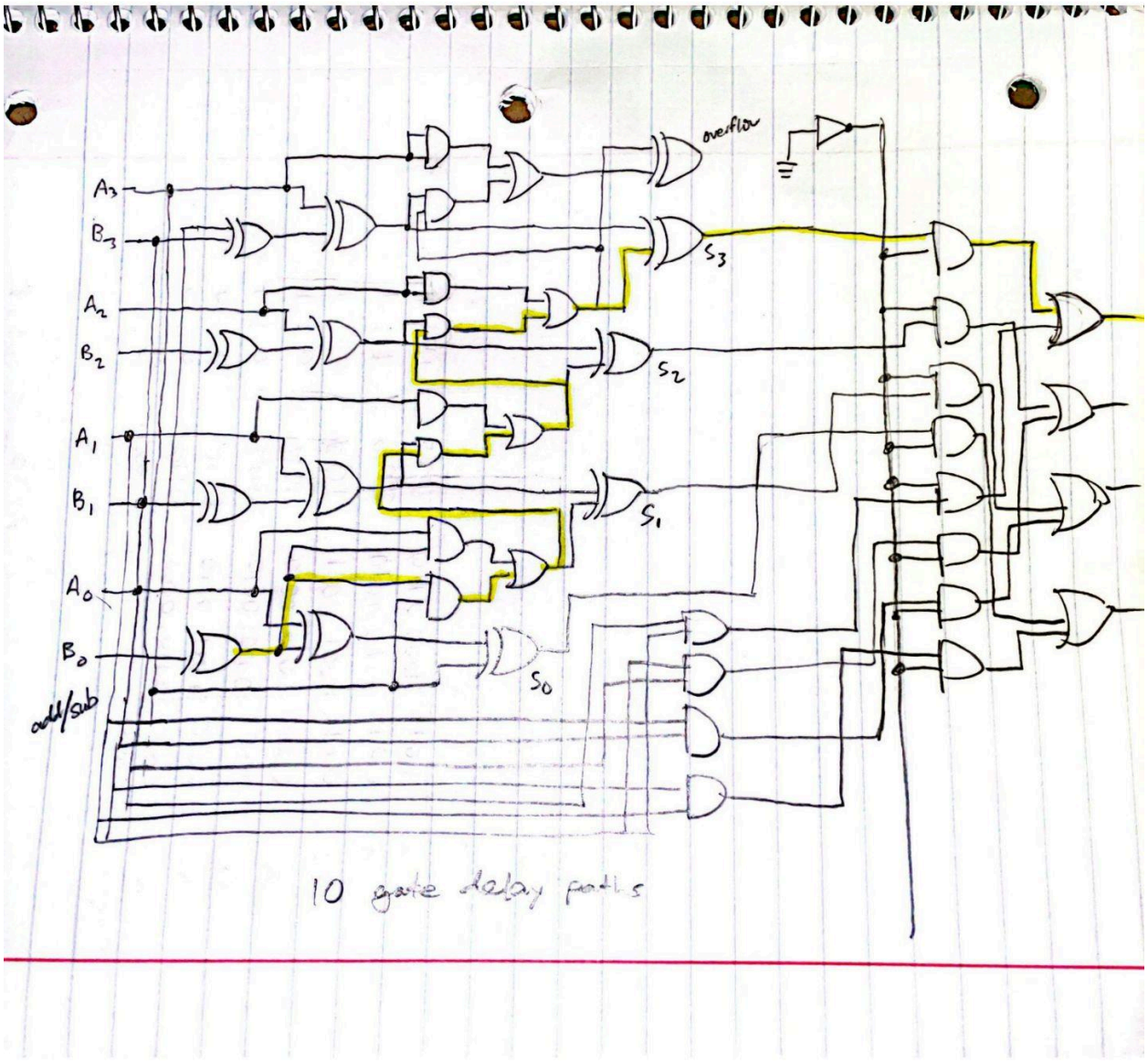
  0100        1 0100       1101       0110
+ 0110      -   1101       1001     - 1001
------      --------       ----     ------
  1010          0001       0110       1101
```

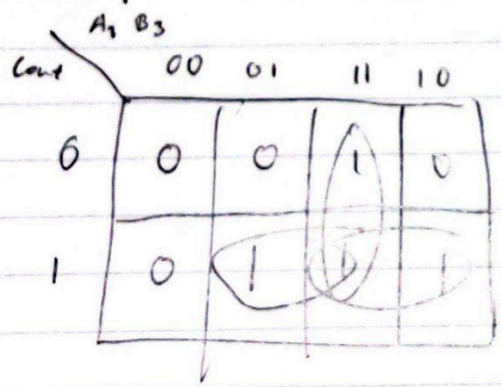
C_0	C_1	Operation	A	B	Result	Overflow
0	0	AND	0100	0110	0100	✗
0	1	AND	0110	1101	0100	✗
1	0	ADD	0100	0110	1010	✓
1	0	ADD	0100	1101	0001	✗
1	0	ADD	1101	1001	0110	✓
1	1	SUB	0100	0111	1101	✓
1	1	SUB	0110	1001	1101	✗



Truth Table

A_3	B_3	C_{out}	Overflow
0	0	0	0
0	0	1	0
0	1	0	0
0	1	1	1
1	0	0	0
1	0	1	1
1	1	0	1
1	1	1	1

Kmap for overflow



$Overflow = A_3B_3 + A_3C_{out} + B_3C_{out}$

$= A_3B_3 + C_{out}(A_3 + B_3)$

Gate Schematic