CSC 347 LAB REPORT

Lab #2 - 1-bit Adder, Subtractor

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I pledge this work to be my own *Vitaliy Prymak*

Objective:

During this lab, the main goal is to build a circuits to perform 1-bit addition and subtraction with the help of a half adder, half subtractor and a full adder.

Equipment and Chip used:

- *Elenco Digital/Analog Trainer X-150,*
- *Chips: 74HCT08 (AND gate), 74HCT32 (OR gate), 74HCT04 (inverter gate), 74HCT86 Quad 2-input (XOR gate).*

Design procedure:

Design a circuit with AND, OR and XOR gates to perform 1-bit adding, subtraction. Record the results. Create truth table and compare with results. Write Boolean equations.

1. Logic diagram of Half Adder

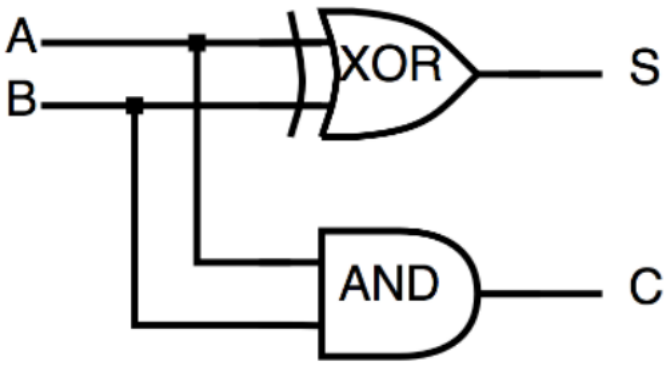


Figure 1 Logic diagram of Half Adder

2. Circuit Construction

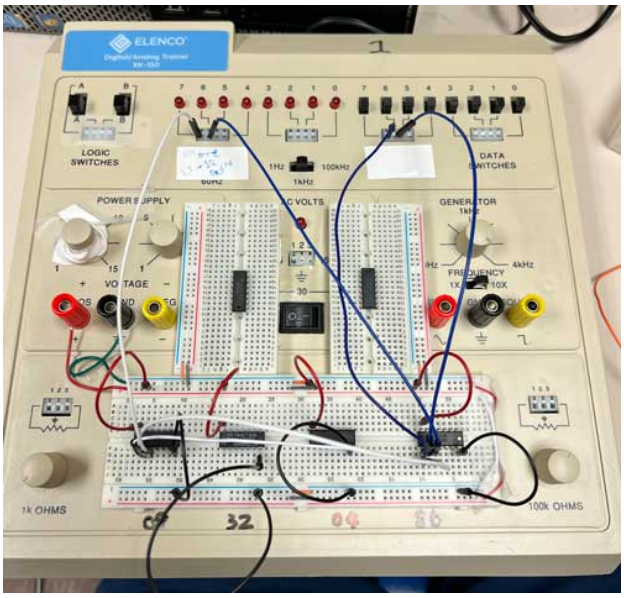


Figure 2. Half Adder circuit

3. Derive the truth table:

A	B	C	S
0	0	0	0
0	1	0	1
1	0	0	1
1	1	1	0

Table 1 Truth table of Half Adder

4. Boolean Equation for S (sum) and C (carry)

$$S = A \oplus B \qquad C = AB$$

2.1 Logic diagram and circuit of Half Subtractor

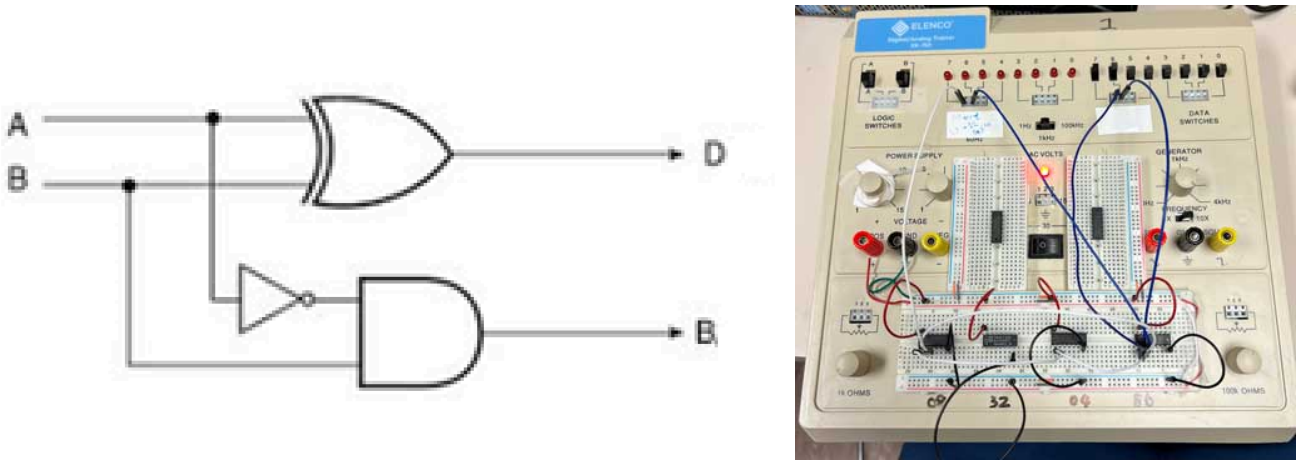


Figure 3 Logic diagram and circuit of Half Subtractor

2.2 Derive the truth table:

A	B	B	D
0	0	0	0
0	1	1	1
1	0	0	1
1	1	0	0

Table 2 Truth table of Half Subtractor

2.3 Boolean Equation for D (difference) and B (borrow)

$$D = A \oplus B \qquad B = A'B$$

3. Logic diagram of Full Adder

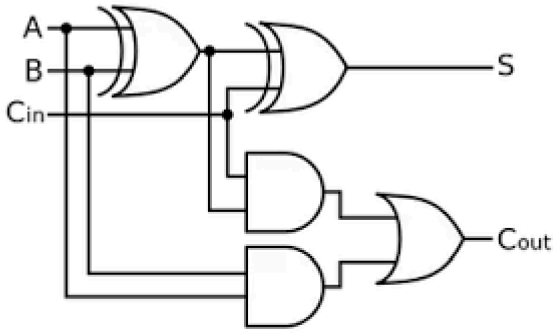


Figure 3 Logic diagram of Full Adder

3.1 Circuit Construction

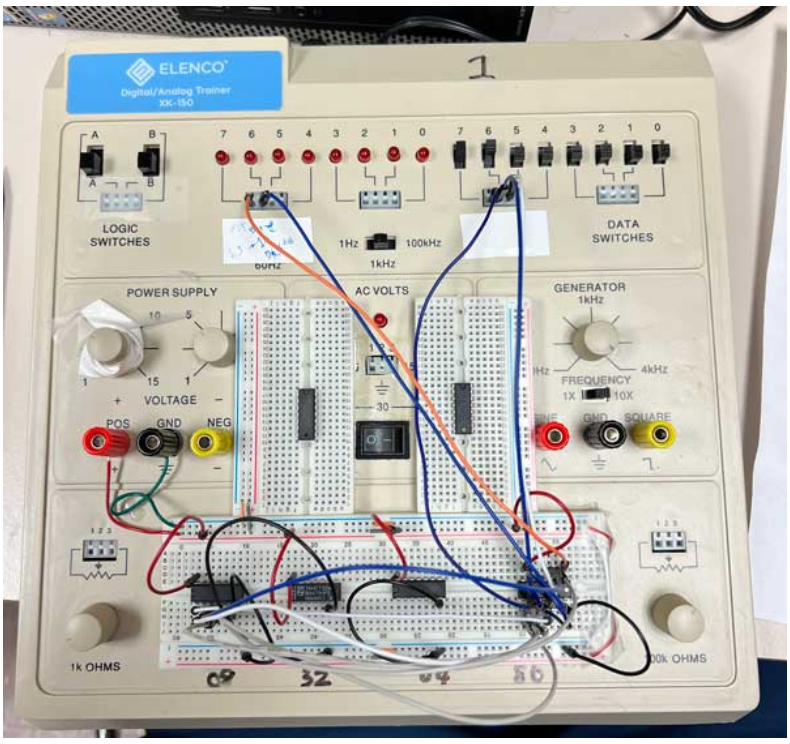


Figure 4 Logic diagram of Full Adder

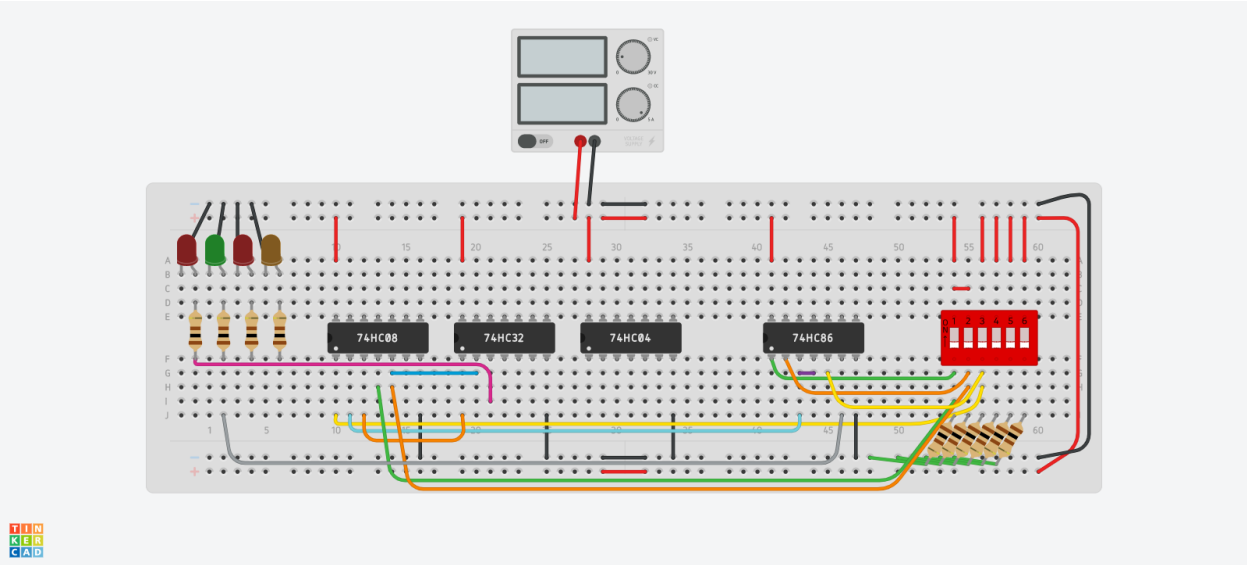


Figure 5 Full Adder circuit in TinkerCad

3.2 Derive the truth table:

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

Table 3 Truth table of Full Adder

3.3 Boolean Equation for S (sum)and Cout (carry)

$$S = (A \oplus B) \oplus Cin \qquad C = (A \oplus B)\,Cin + (AB)$$

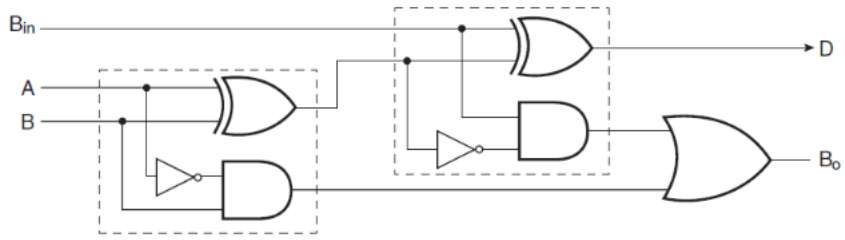
4. Result and Conclusions:

During experiment I've verified that for Half Adder: Sum and Carry bits and for Half Subtractor: Difference and Borrow bits as well as for Full Adder: Sum and Carry bits match experiment's result. After experiment has been concluded I've been able to conclude that Sum and Difference bits is like XOR logical operation and Borrow and Carry bits is like AND logical operation. And by having indicator for Carry allow successfully perform 3 bit addition.

6. Reference: https://www.tinkercad.com/things/1MTxEICTJii-copy-of-csc-347-starter-kit/editel?sharecode=Dqlc6S9-7h2Y8PszqXIKqBKB25K1e0UTLBjkD1hYB50

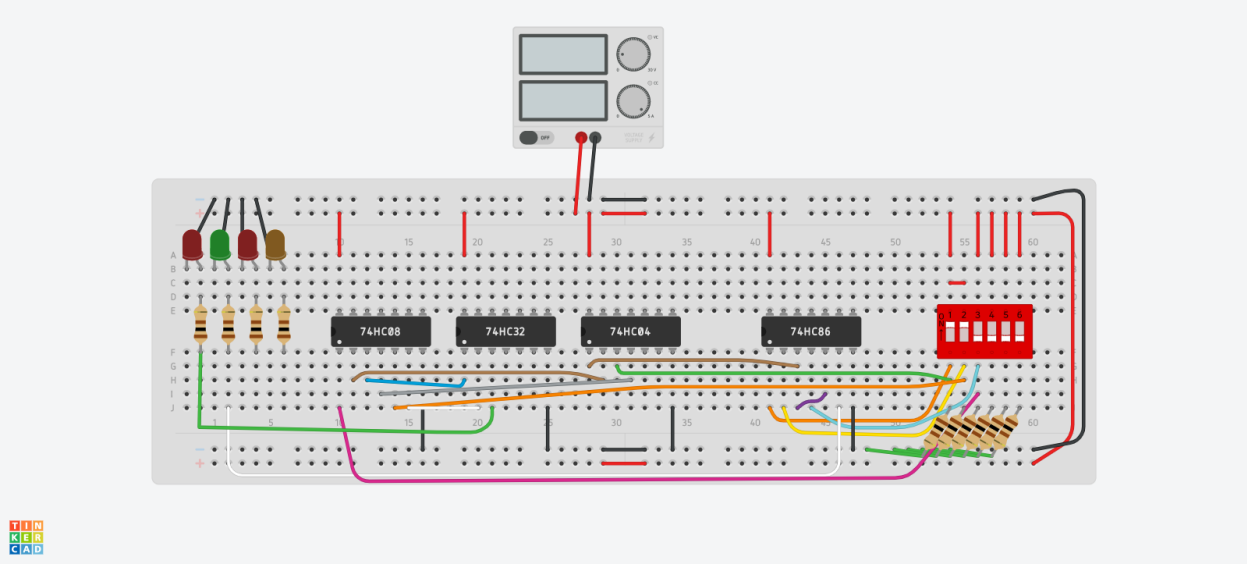
HOMEWORK:

Build a 1-bit subtractor (X - Y - Bin)



A	B	Bin	Bout	D
0	0	0	0	0
0	0	1	1	1
0	1	0	1	1
0	1	1	1	0
1	0	0	0	1
1	0	1	0	0
1	1	0	0	0
1	1	1	1	1

$D = Bin \oplus (A \oplus B)$ $Bout = ((A \oplus B)' * Bin) + (A' * B)$



https://www.tinkercad.com/things/3KOrH2GdOVx-copy-of-csc-347-starter-kit/editel?sharecode=WNJVIB1gDDDfFF4NOS8eHziohhMoWAXVUy2OVs18o1U