Lab Report No 8

Digital Logic Design

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Submitted to:

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Dated:

Week 11

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Solution:

Question:

Implement and verify the 2-bit Adder using 1 half adder and 1 full adder on trainer board.

Brief description (3-5 lines)

Components needed:
- 1 Half Adder (consisting of XOR and AND gates)
- 1 Full Adder (consisting of XOR, AND, and OR gates)

Step 1: Connect the inputs
- Label the input bits as A1, A0, B1, and B0. These represent the two 2-bit numbers you want to add.
- Connect A1 to the first input (A) of the Full Adder.
- Connect B1 to the second input (B) of the Full Adder.
- Connect A0 to the first input (A) of the Half Adder.
- Connect B0 to the second input (B) of the Half Adder.

Step 2: Implement the half adder
- Connect the Sum output of the Half Adder to an LED or output pin to observe the result.
- Connect the Carry output of the Half Adder to the Carry input (Cin) of the Full Adder.

Step 3: Implement the full adder
- Connect the Carry output of the Full Adder to another LED or output pin to observe the final Carry output.
- Connect the Sum output of the Full Adder to an LED or output pin to observe the final sum.

Step 4: Power up the circuit and input values
- Ensure that the power supply for the trainer board is connected and turned on.
- Set the input values A1, A0, B1, and B0 to the desired values (0 or 1). You can use switches or push buttons to input the values.

Step 5: Observe the output
- Once the inputs are set, observe the LED or output pins connected to the Sum and Carry outputs of the full adder.
- The LED connected to the Sum output will display the 2-bit sum result (S1, S0).
- The LED connected to the Carry output will display the carry-out (Cout) of the addition.

Verification:
- To verify the correctness of the 2-bit adder, compare the observed sum (S1, S0) with the expected sum of the input bits (A1, A0, B1, B0).
- Also, compare the observed carry-out (Cout) with the expected carry-out of the addition.

The code
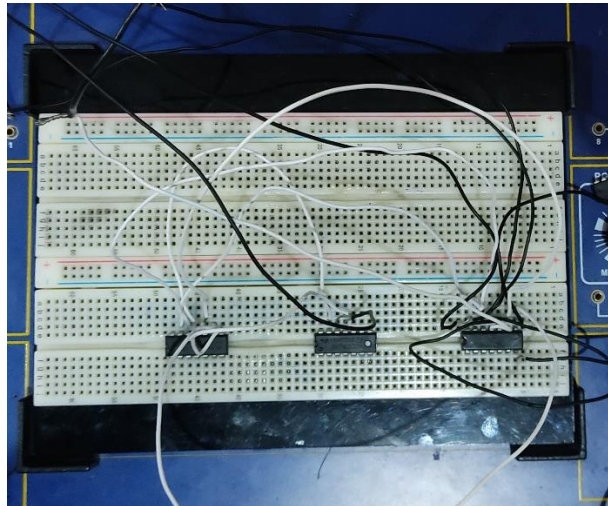
The results (Screenshot)
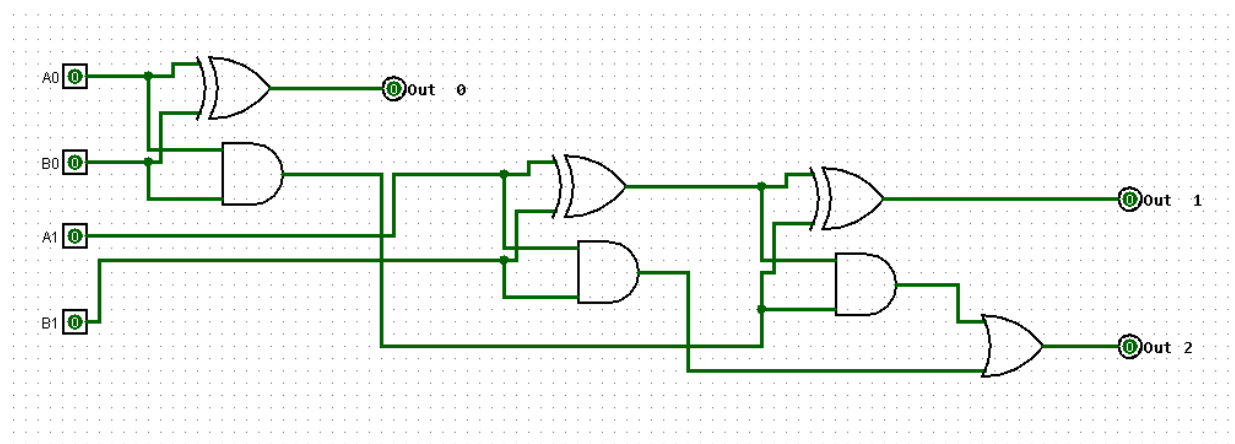
A0	B0	A1	B1	Out0	Out1	Out2
0	0	0	0	0	0	0
0	0	0	1	0	1	0
0	0	1	0	0	1	0
0	0	1	1	0	0	1
0	1	0	0	1	0	0
0	1	0	1	1	1	0
0	1	1	0	1	1	0
0	1	1	1	1	0	1
1	0	0	0	1	0	0
1	0	0	1	1	1	0
1	0	1	0	1	1	0
1	0	1	1	1	0	1
1	1	0	0	0	1	0
1	1	0	1	0	0	1
1	1	1	0	0	0	1
1	1	1	1	0	1	1

Solution:

Question:
Implement and verify the 4-bit Adder using 1 half adder and three full adders with Logisim.

Brief description (3-5 lines)

Step 1:

Launch Logisim Open Logisim on your computer. If you don't have it installed, you can download it from the Logisim website.

Step 2:

Create a new circuit Create a new blank circuit by selecting "File" and then "New" or using the shortcut Ctrl+N.

Step 3:

Add components Add the required components to the circuit by selecting them from the toolbar on the left-hand side and placing them on the circuit canvas.

Components needed:
- 1 Half Adder (consisting of XOR and AND gates)
- 3 Full Adders (consisting of XOR, AND, and OR gates)

Step 4:

Connect the components Connect the inputs and outputs of the components to create the 4-bit adder circuit.

- Label the input bits as A3, A2, A1, A0, B3, B2, B1, and B0. These represent the two 4-bit numbers you want to add.
- Connect A0 to the first input (A) of the Half Adder.
- Connect B0 to the second input (B) of the Half Adder.
- Connect A1 to the second input (A) of the first Full Adder.
- Connect B1 to the third input (B) of the first Full Adder.
- Connect the Sum output of the Half Adder to the first input (Cin) of the first Full Adder.
- Connect A2 to the second input (A) of the second Full Adder.
- Connect B2 to the third input (B) of the second Full Adder.
- Connect the Carry output of the first Full Adder to the first input (Cin) of the second Full Adder.
- Connect A3 to the second input (A) of the third Full Adder.
- Connect B3 to the third input (B) of the third Full Adder.
- Connect the Carry output of the second Full Adder to the first input (Cin) of the third Full Adder.
- Connect the Sum output of the first Full Adder to the Sum output of the circuit.
- Connect the Carry output of the third Full Adder to the Carry output of the circuit.

Step 5:

Connect outputs Connect LEDs or output pins to the Sum output and Carry output of the circuit to observe the result.

**Step 6:**

Simulate and verify

- Click on the "Simulate" button in the toolbar to enter the simulation mode.
- Set the input values A3, A2, A1, A0, B3, B2, B1, and B0 to the desired values (0 or 1). You can use switches or buttons available in Logisim to input the values.
- Observe the LEDs or output pins connected to the Sum output and Carry output of the circuit.
- The LED connected to the Sum output will display the 4-bit sum result (S3, S2, S1, S0).
- The LED connected to the Carry output will display the final carry-out (Cout) of the addition.

Verify the correctness of the 4-bit adder by comparing the observed sum (S3, S2, S1, S0) with the expected sum of the input bits (A3, A2, A1, A0, B3, B2, B1, B0). Also, compare the observed carry-out (Cout) with the expected carry-out of the addition.

The code
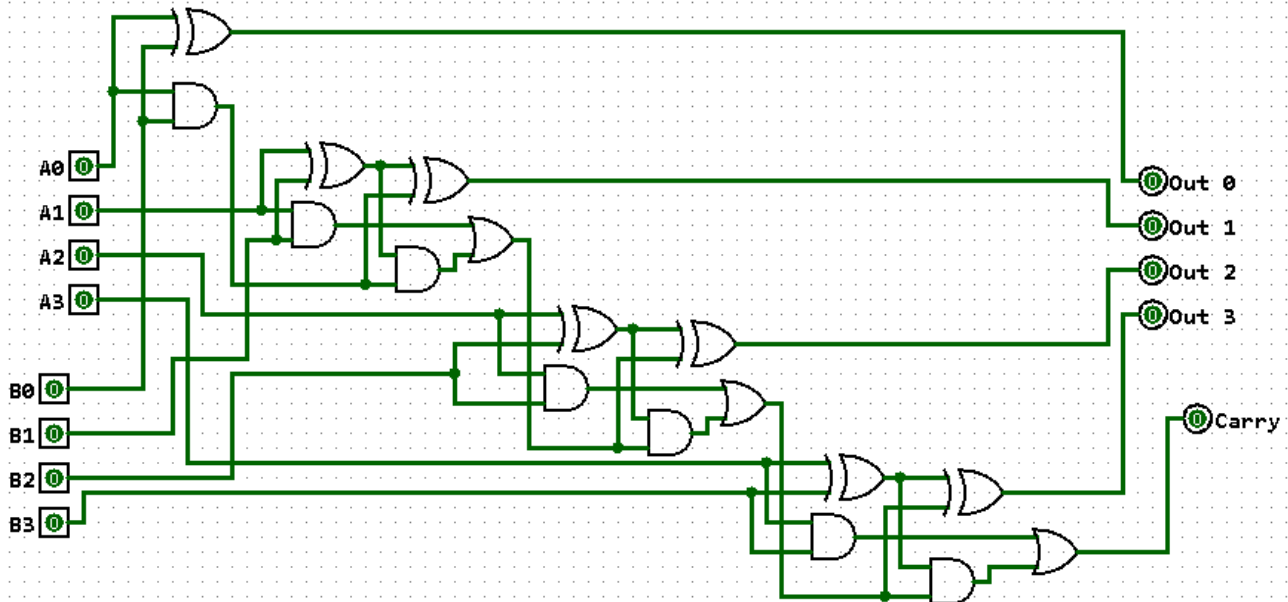
B3	A3	B2	A2	B1	A1	B0	A0	Carry	Out3	Out2	Out1	Out0
0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	1	0	0	0	0	1
0	0	0	0	0	0	1	0	0	0	0	0	1
0	0	0	0	0	0	1	1	0	0	0	1	0
0	0	0	0	0	1	0	0	0	0	0	1	0
0	0	0	0	0	1	0	1	0	0	0	1	1
0	0	0	0	0	1	1	0	0	0	0	1	1
0	0	0	0	0	1	1	1	0	0	1	0	0
0	0	0	0	1	0	0	0	0	0	0	1	0
0	0	0	0	1	0	0	1	0	0	0	1	1
0	0	0	0	1	0	1	0	0	0	0	1	1
0	0	0	0	1	0	1	1	0	0	1	0	0
0	0	0	0	1	1	0	0	0	0	1	0	0
0	0	0	0	1	1	0	1	0	0	1	0	1
0	0	0	0	1	1	1	0	0	0	1	0	1
0	0	0	0	1	1	1	1	0	0	1	1	0
0	0	0	1	0	0	0	0	0	0	1	0	0
0	0	0	1	0	0	0	1	0	0	1	0	1
0	0	0	1	0	0	1	0	0	0	1	0	1
0	0	0	1	0	0	1	1	0	0	1	1	0
0	0	0	1	0	1	0	0	0	0	1	1	0
0	0	0	1	0	1	0	1	0	0	1	1	1
0	0	0	1	0	1	1	0	0	0	1	1	1
0	0	0	1	0	1	1	1	0	1	0	0	0
0	0	0	1	1	0	0	0	0	0	1	1	0
0	0	0	1	1	0	0	1	0	0	1	1	1
0	0	0	1	1	0	1	0	0	0	1	1	1
0	0	0	1	1	0	1	1	0	1	0	0	0
0	0	0	1	1	1	0	0	0	1	0	0	0
0	0	0	1	1	1	0	1	0	1	0	0	1
0	0	0	1	1	1	1	0	0	1	0	0	1
0	0	0	1	1	1	1	1	0	1	0	1	0
0	0	1	0	0	0	0	0	0	0	1	0	0
0	0	1	0	0	0	0	1	0	0	1	0	1
0	0	1	0	0	0	1	0	0	0	1	0	1
0	0	1	0	0	0	1	1	0	0	1	1	0
0	0	1	0	0	1	0	0	0	0	1	1	0
0	0	1	0	0	1	0	1	0	0	1	1	1
0	0	1	0	0	1	1	0	0	0	1	1	1
0	0	1	0	0	1	1	1	0	1	0	0	0
0	0	1	0	1	0	0	0	0	0	1	1	0
0	0	1	0	1	0	0	1	0	0	1	1	1
0	0	1	0	1	0	1	0	0	0	1	1	1
0	0	1	0	1	0	1	1	0	1	0	0	0
0	0	1	0	1	1	0	0	0	1	0	0	0
0	0	1	0	1	1	0	1	0	1	0	0	1
0	0	1	0	1	1	1	0	0	1	0	0	1

0	0	1	0	1	1	1	1	0	1	0	1	0
0	0	1	1	0	0	0	0	0	1	0	0	0
0	0	1	1	0	0	0	1	0	1	0	0	1
0	0	1	1	0	0	1	0	0	1	0	0	1
0	0	1	1	0	0	1	1	0	1	0	1	0
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0	0	1	1	0	1	1	0	0	1	0	1	1
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1	1	0	1	1	1	0	0	1	1	0	0	0
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1	1	1	0	1	1	1	0	1	1	0	0	1

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