

CO215, CO Lab 2021, Assignment 1

Roll number: CSB19057

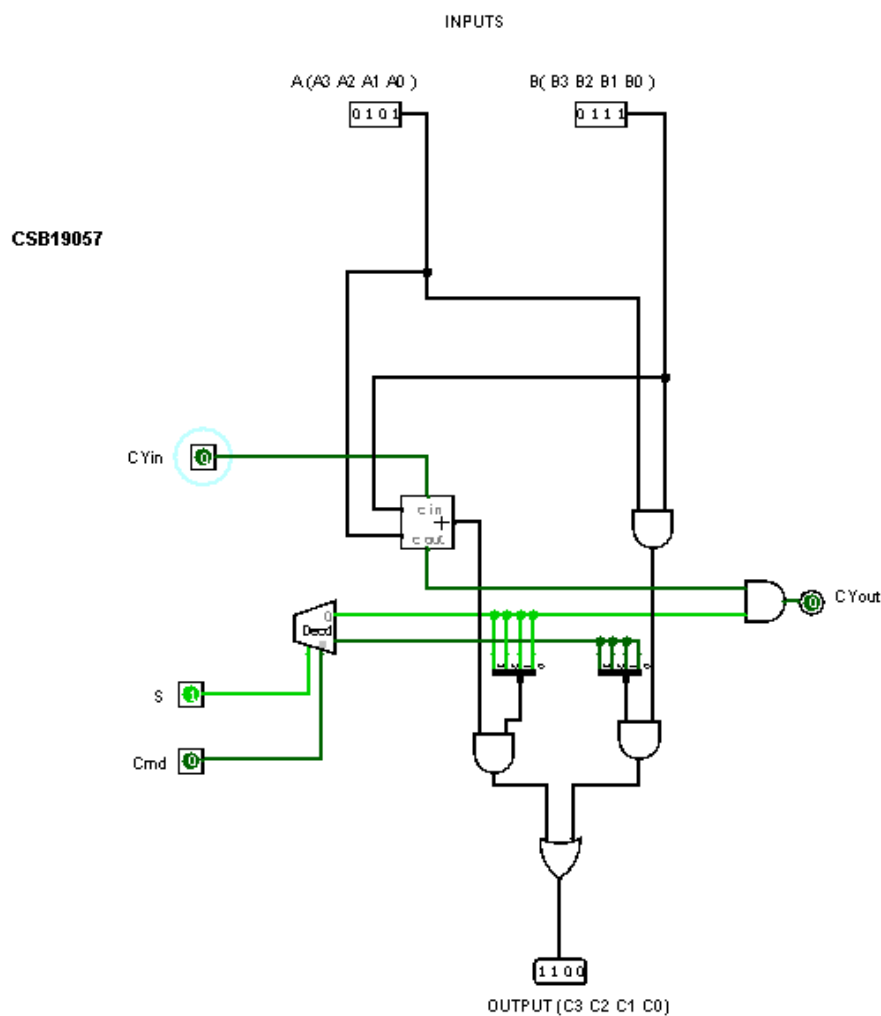
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**Objectives:** To gain an understanding of the functioning of an ALU inside a processor by fabricating it in a logic simulator environment and experimenting with it.

**Exercises:**

- Fabricate a simple 4-bit ALU capable performing the two operations- arithmetic addition and logical AND as shown in the diagram below in a logic simulator environment;
- Apply all combinations of inputs and the commands as indicated in the table below and record the observed corresponding outputs.
- Prepare a report containing the **Objectives**, **Exercise Details**, the **Observation Table** and the **Learnings**

**Details of work:**



**ALU** – the ALU circuit is the main circuit. The switch **S** is used to switch on and off the ALU. It uses decoder to operate as a switch and to direct the Cmd command . The ALU takes two 4 bit inputs A and B , and depending on the switch Cmd it performs either **addition** or **and** operation (0=add,1=And ) and produces output C.

The notations are-

**A, B** – 4-bit input operands

**C** - 4-bit ALU output

**CY<sub>in</sub>**- Carry-in bit to the adder

**CY<sub>out</sub>**- Carry-out bit from the adder

**Cmd**- Command (0 for Add and 1 for AND)

**S** - Select Signal (ALU performs the operation as per command if S=1)

**Observation Table:**

A	B	CYin	Cmd	S		C	CYout	Remarks
5	7	0	0	0		0	0	ALU is switched off and hence not functional
5	7	0	0	1		12	0	Addition is performed and 12 is output
5	7	0	1	0		0	0	ALU is switched off and hence not functional
5	7	0	1	1		5	0	AND operation is performed on A and B
5	7	1	0	0		0	0	ALU is switched off and hence not functional
5	7	1	0	1		13	0	Addition is performed and 13 is output
5	7	1	1	0		0	0	ALU is switched off and hence not functional
5	7	1	1	1		5	0	AND operation is performed on A and B
10	5	0	0	1		15	0	Addition is performed and 15 is output
10	5	1	0	1		0	1	Addition is performed and 0 is output
10	5	0	1	1		0	0	AND operation is performed on A and B
10	5	0	0	1		15	0	Addition is performed and 15 is output
15	0	0	1	0		0	0	ALU is switched off and hence not functional
0	15	0	1	1		0	0	AND operation is performed on A and B
14	7	0	0	1		5	1	Addition is performed and 5 is output
14	7	1	0	1		6	1	Addition is performed and 6 is output
8	2	1	0	1		11	0	Addition is performed and 11 is output
15	15	0	0	1		14	1	Addition is performed and 14 is output
15	15	0	1	1		15	0	AND operation is performed on A and B
15	15	1	0	1		15	1	Addition is performed and 15 is output
15	15	1	1	1		15	0	AND operation is performed on A and B

#### **Learnings:**

This experiment has led to a better understanding of the use of splitters in logisim. And since wires with different bit widths were required to connect at multiple points ,it also led to the introduction of handling of the “incompatible width error”. Use of gates with multi bit inputs led to learning of ways to make logisim experiment cleaner and hassle free .

Coming to the theoretical part, this experiment has led to a better understanding of the AND operations and ADD operations in a 4-bit ALU, and the ways to control the operations and the functionality of an ALU using decoder .