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Objectives of this laboratory are noted below:

i) to know about digital system ~~design~~ design mechanism.

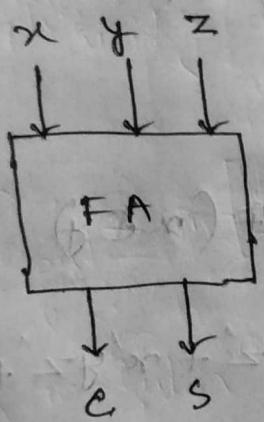
ii) to know about adder (half and full), zero/one circuit and arithmetic circuit.

iii) to know how to implment digital circuits using logisim.

iv) to implment arithmetic circuit using logisim and verify outputs.

v) to implment a circuit using top-down modular fashion.

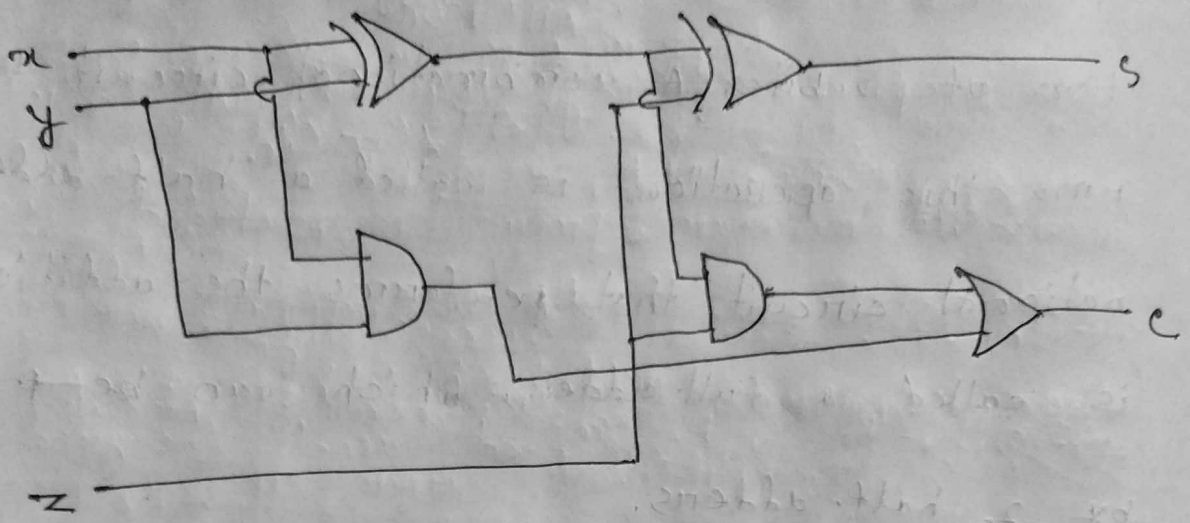
Introduction: The most basic arithmetic operation the addition of 2 bits. A combinational circuit that performs this operation is called a half-adder. A combinational circuit that performs the addition of 3 bits is called a full-adder, which can be implimented by 2 half-adders.



x	y	z	S	C
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

Full Adder

(3)



Implementation of FA

here,

The sum output is, $S = z \oplus (x \oplus y)$

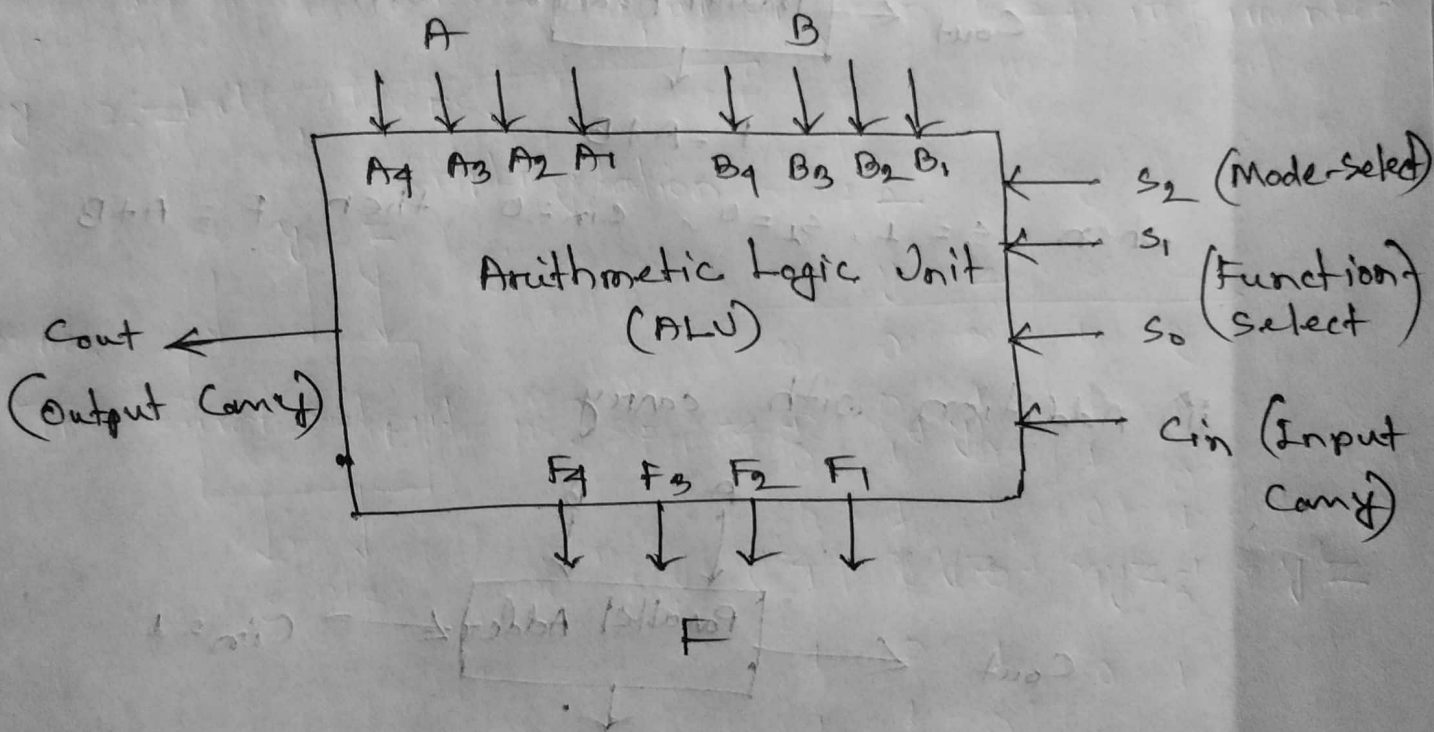
$= xy'z' + x'yz' + xyz + x'y'z$

The carry output is, $c = z(x'y + xy') + xy$

$= xy'z + x'yz + xy$

(4)

Arithmetic Logic Unit (ALU): An arithmetic ~~and~~ logic unit is a digital circuit used to perform arithmetic and logical operations. It represents the fundamental building block of a computer.

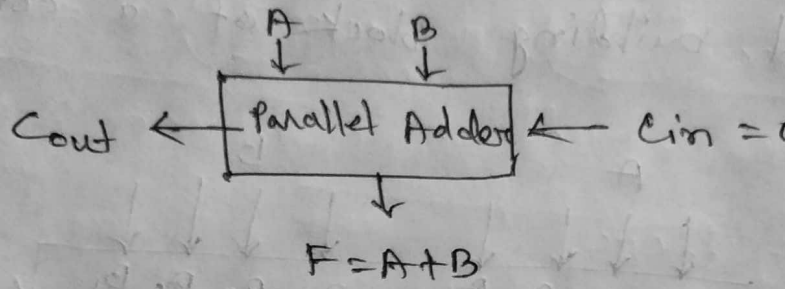


Block Diagram of a 4-bit ALU

(5)

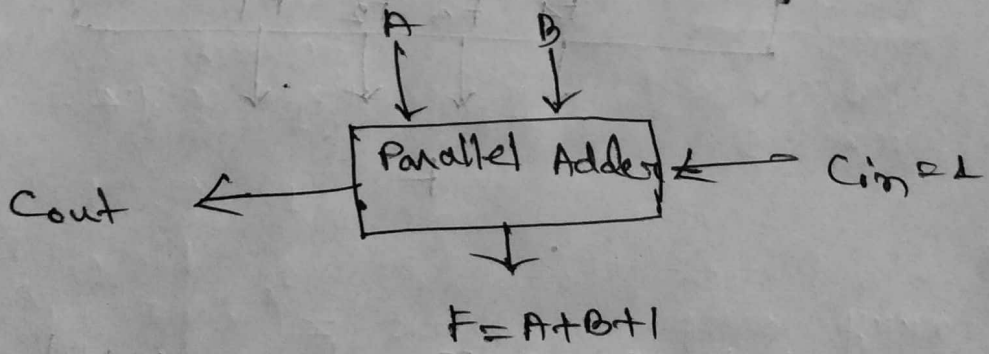
There are 8 operations of ALU. They are given below:

i) Addition



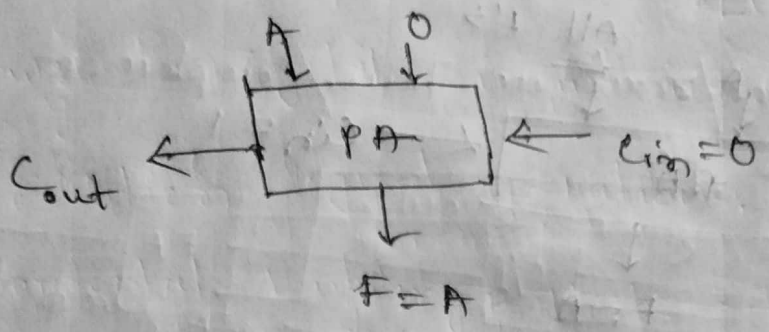
when $S_1 = 1$, $S_0 = 0$, $c_{in} = 0$ then $F = A+B$

ii) Addition with carry



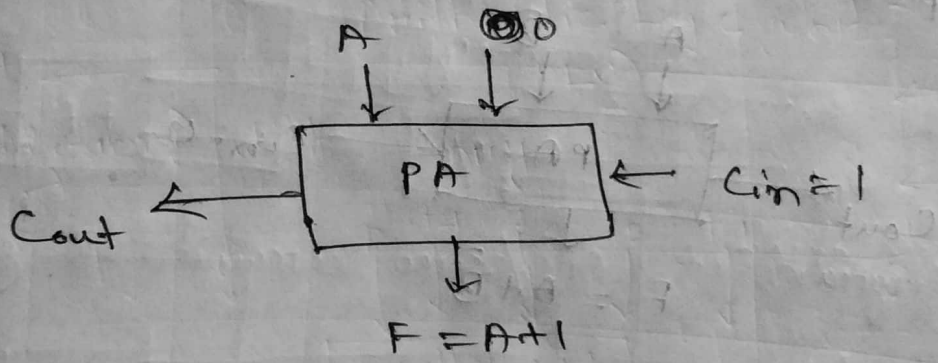
when $S_0 = 1$, $S_1 = 0$, $c_{in} = 0$ 1 then $F = A+B+1$

iii) Transfer A



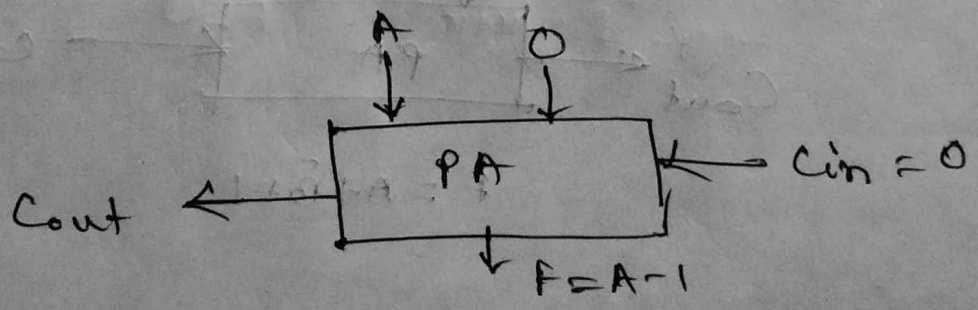
when $S_1=0$, $S_0=0$, $C_{in}=0$ then $F=A$

iv) Increment A



when $S_0=0$, $S_1=0$, $C_{in}=1$ then $F=A+1$

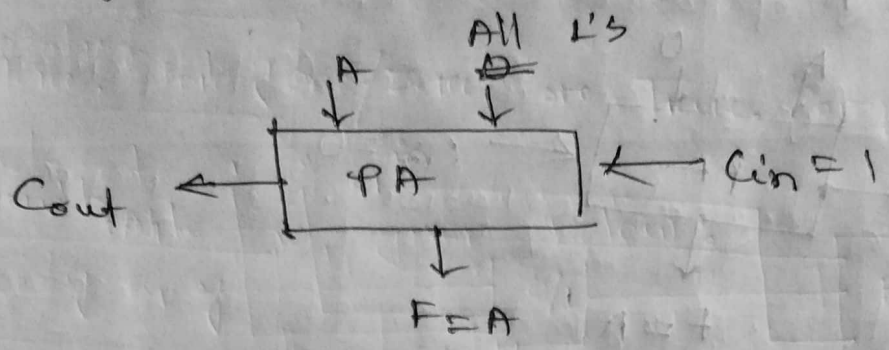
v) Decrement A



when $S_0=1$, $S_1=1$, $C_{in}=0$ then $F=A-1$

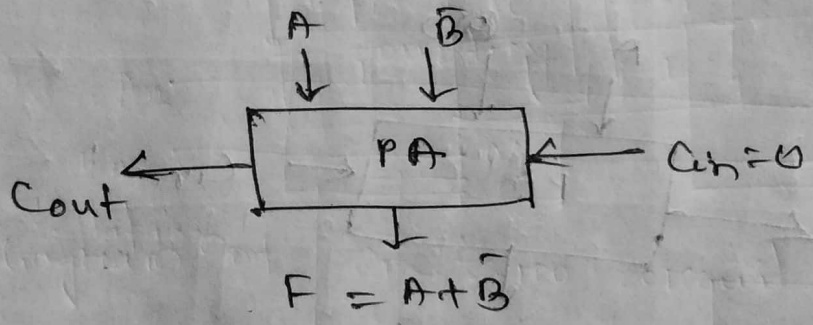
(7)

ii) Transfer A



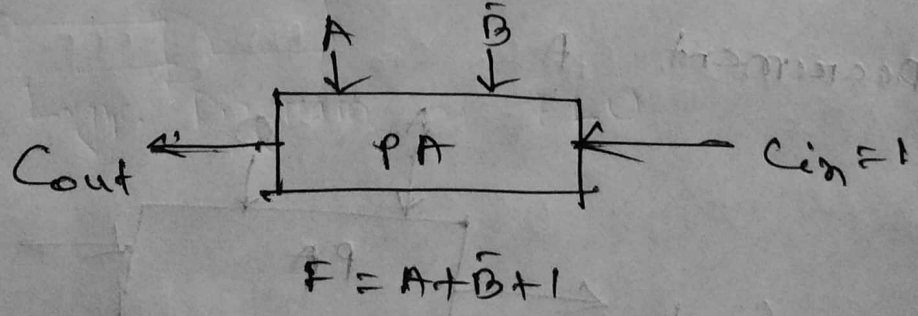
when $S_0=1$, $S_1=1$, $C_{in}=1$ then $F=A$

iii) A plus 1's complement



when $S_0=0$, $S_1=1$, $C_{in}=0$ then $F=A+\bar{B}$

iii) Subtraction



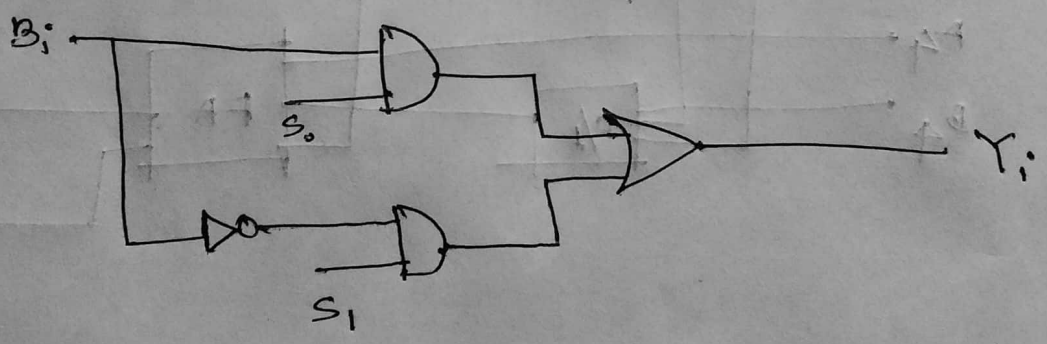
when $S_0=0$, $S_1=1$, $C_{in}=1$ then $F=A+\bar{B}+1$

(8)

Here, for one/zero or True/Complement circuit, the truth table is given below:

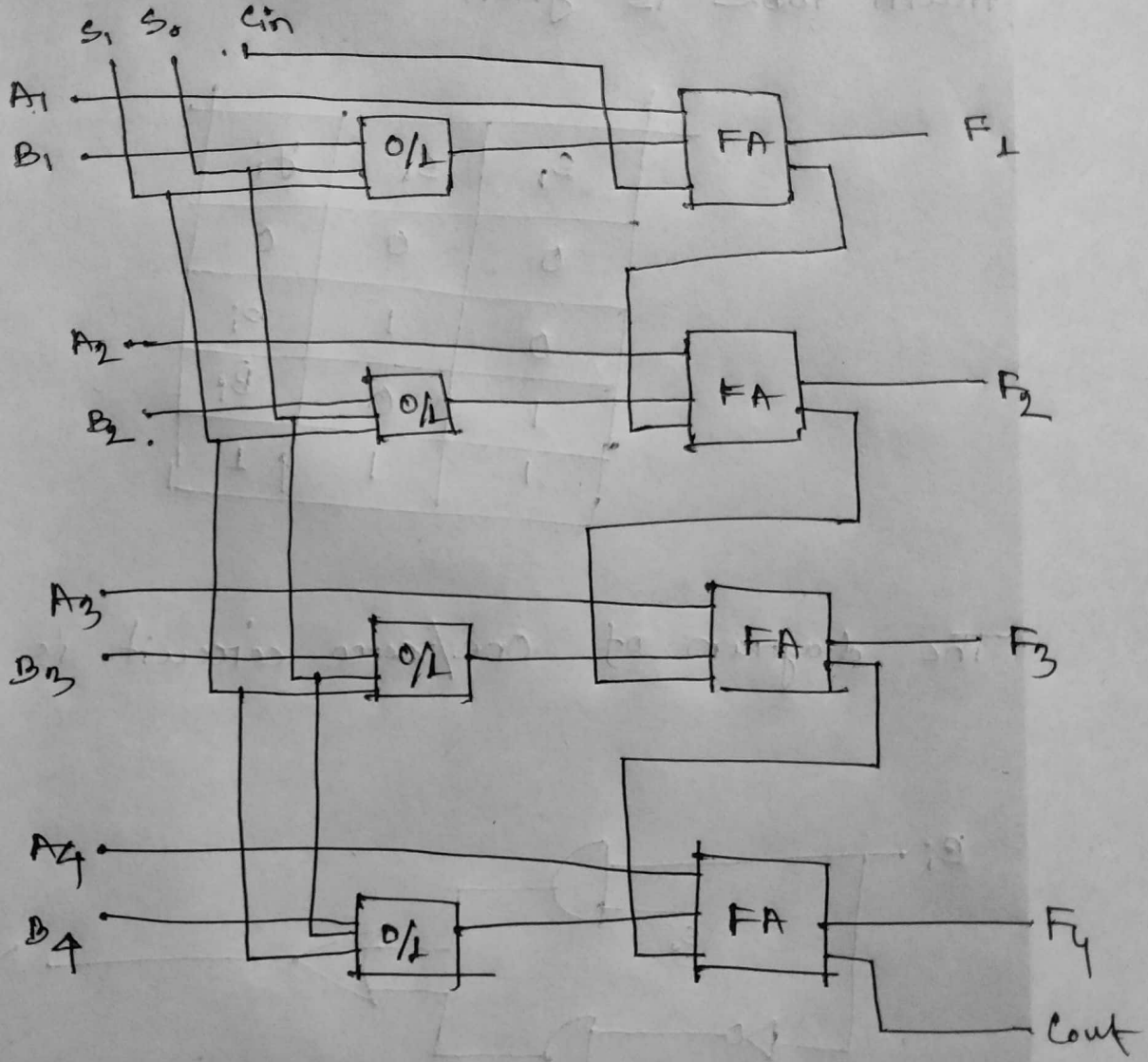
S_1	S_0	y_i
0	0	0
0	1	B_i
1	0	$\bar{B}_i$
1	1	1

The diagram of one/zero circuit is given below:



(9)

The ALU diagram for 4 bits is ~~gen~~ given below:



Logic Diagram of ALU

Conclusion: In this laboratory, arithmetic circuit has been impliment using logisim. Full adder and ~~zero~~ one-zero modular circuit is included into main arithmetic circuit successfully, 8 bits arithmetic circuit is implemented and desigred outputs are checked properly.