College of Computers and Information

Course: Computer Architecture

Arithmetic Logic and shift unit (2.1)

Prepared by:

Renad AL-Khudaidi   44102721

Huda AL-Ghoraibi   44108363

Bdoor AL-Dagani   44107163

1- Introduction:

In this report, we will discuss the simulation model for an Arithmetic Logic and shift unit (ALU) based on the basic computer design. The ALU is an important component of a computer system, as it performs arithmetic and logical operations on binary data.

2- Project description:

In this project we will implement this circuit using the arithmetic, logic and shift unit via a simulation app called Logisim. An ALU (Arithmetic Logic Unit) circuit is a combinational logic circuit that performs arithmetic and logical operations on binary numbers. The basic operations that an ALU circuit performs include addition, subtraction, logical AND, OR, XOR, and NOT operations, and shift operations. In this report, we will discuss ALU circuit.

3- Design details

The ALU simulation model will consist of the following :

1. Arithmetic Unit: This circuit will perform arithmetic operations such as addition and subtraction.

2. Logic Unit: This circuit will perform logical operations such as AND, OR, NOT and XOR.

3. Shift Unit: This circuit will perform shift operations such as left shift and right shift.
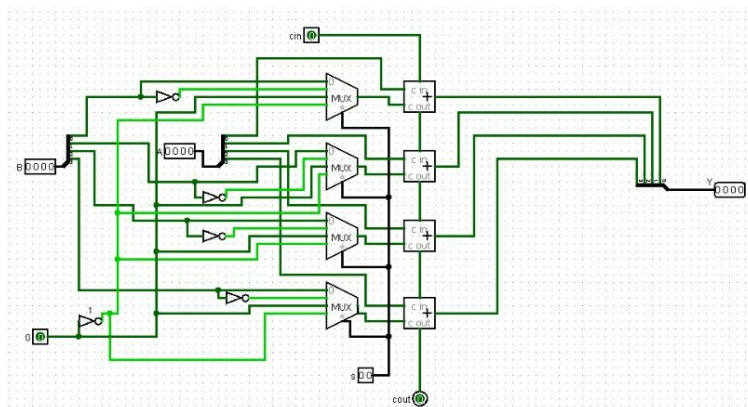
Simulation

The application used in this simulation is: Logisim.

Download Logisim

1- The Arithmetic unit:

S1	S0	Cin	X	Y	Output	Microoperation
0	0	0	A	B	D = A + B	Add
0	0	1	A	B	D = A + B + 1	Add with carry
0	1	0	A	B'	D = A + B'	Subtract with borrow
0	1	1	A	B'	D = A + B'+ 1 = A − B	Subtract
1	0	0	A	0	D = A	Transfer A
1	0	1	A	0	D = A + 1	Increment A
1	1	0	A	1	D = A - 1	Decrement A
1	1	1	A	1	D = A	Transfer A

This is the arithmetic unit, it will perform microoperations such as: Transfer A, Increment A, Addition, Addition with carry, Subtraction with borrow, Subtraction, Decrement A.
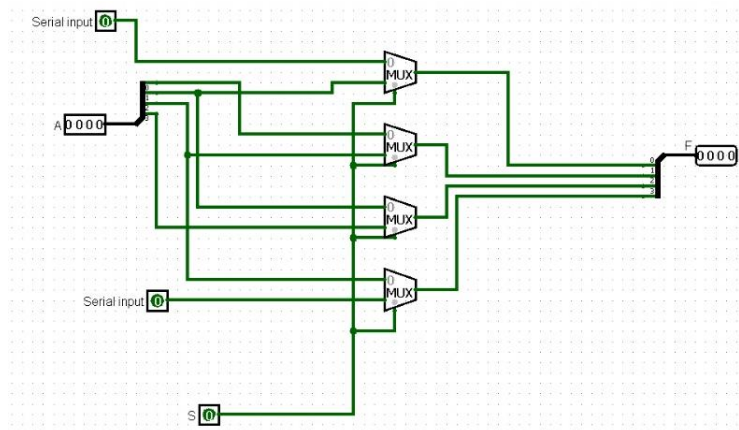
2- The Logic unit:
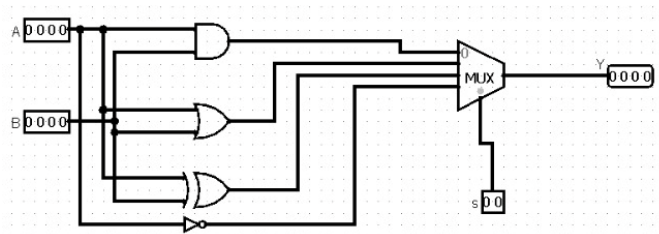
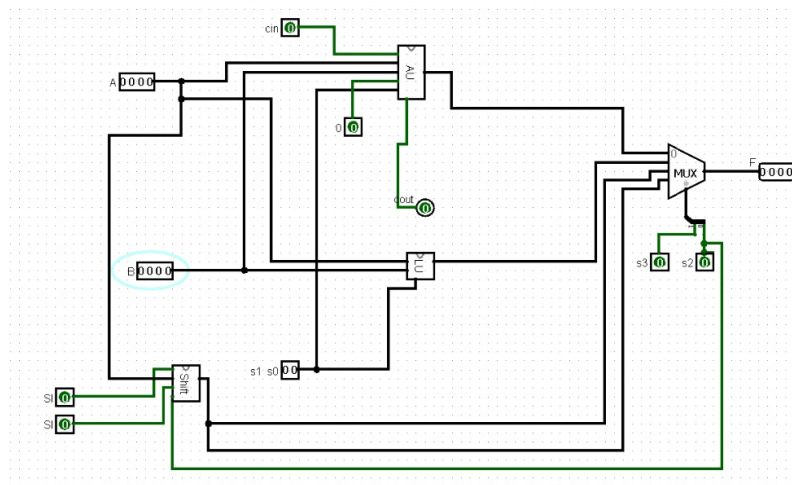| S₁	S₀	Output	Microoperation
0	0	$F = A \wedge B$	AND
0	1	$F = A \vee B$	OR
1	0	$F = A \oplus B$	XOR
1	1	$F = A'$	Complement A

This is the logic unit, it will perform microoperations such as: AND, OR, XOR and Complement A.

3- The shift unit:

This is the shift unit, it will perform microoperations such as: left shift and right shift, also we can choose whether the serial input is 1 or 0.

4- The arithmetic, logic and shift unit :

This is a combinational logic circuit that performs arithmetic, logical and shift operations on binary input.

| S_3	S_2	S_1	S_0	C_{in}	Operation	Function
0	0	1	0	0	F = A	Transfer A
0	0	1	0	1	F = A + 1	Increment A
0	0	0	0	0	F = A + B	Addition
0	0	0	0	1	F = A + B + 1	Add with carry
0	0	0	1	0	F = A + B'	Subtract with borrow
0	0	0	1	1	F = A + B' + 1	Subtraction
0	0	1	1	0	F = A - 1	Decrement A
0	0	1	1	1	F = A	Transfer A
0	1	0	0	X	F = A ∧ B	AND
0	1	0	1	X	F = A ∨ B	OR
0	1	1	0	X	F = A ⊕ B	XOR
0	1	1	1	X	F = A'	Complement A
1	1	X	X	X	F = shr A	Shift right A into F
1	0	X	X	X	F = shl A	Shift left A into F

5- Results and Analysis
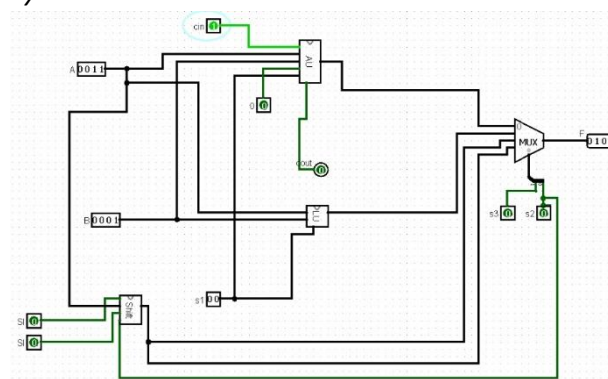
- *Transfer A:*
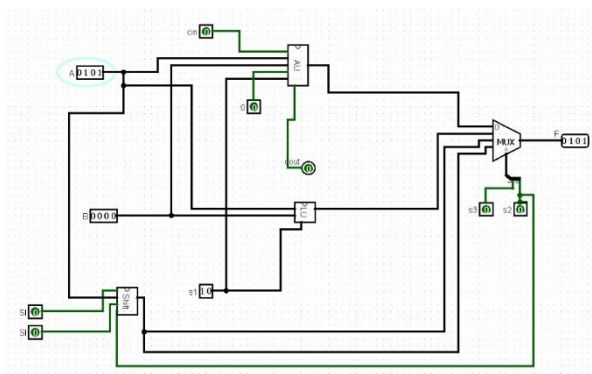
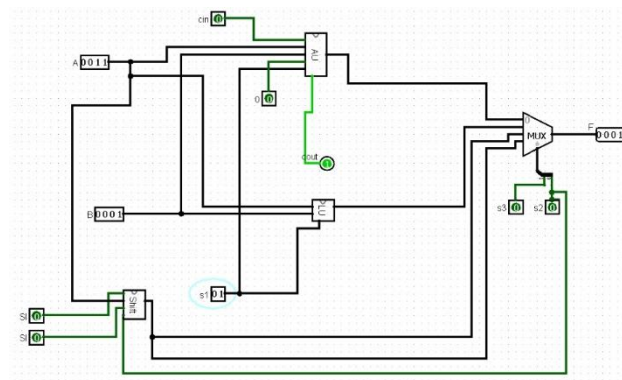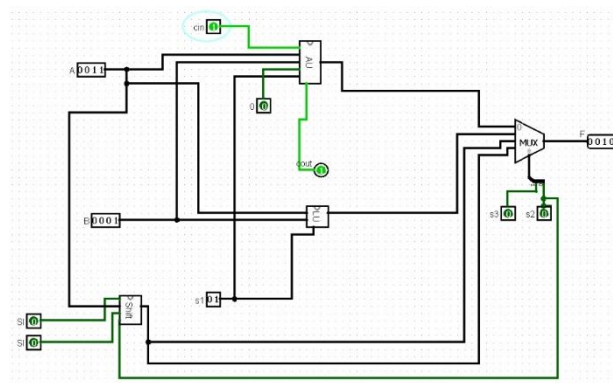*Other way:*
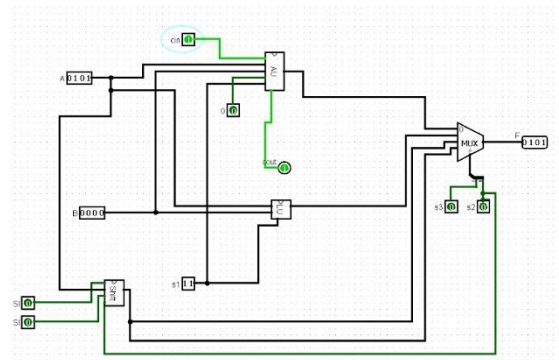
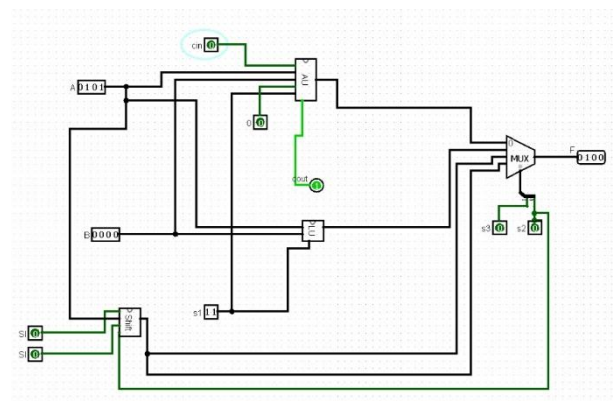- *Increment A:*
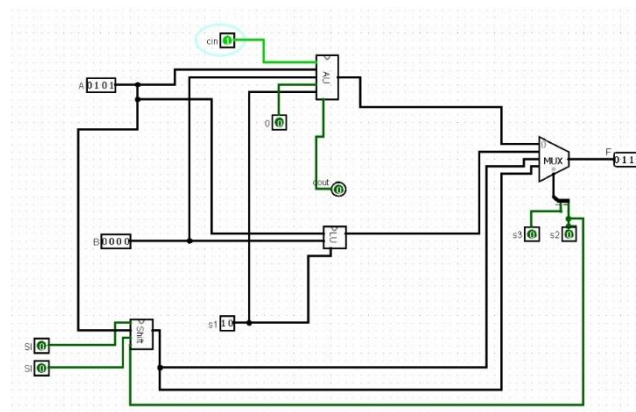
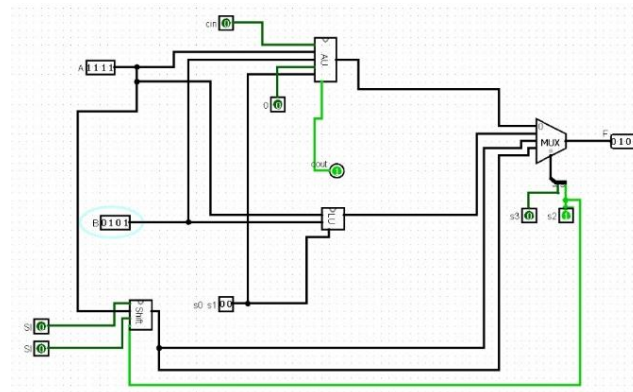- *Addition:*
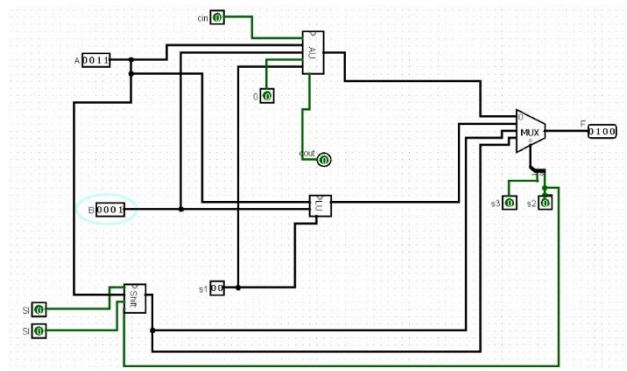
- *Addition with carry:*

- *Subtraction with borrow:*
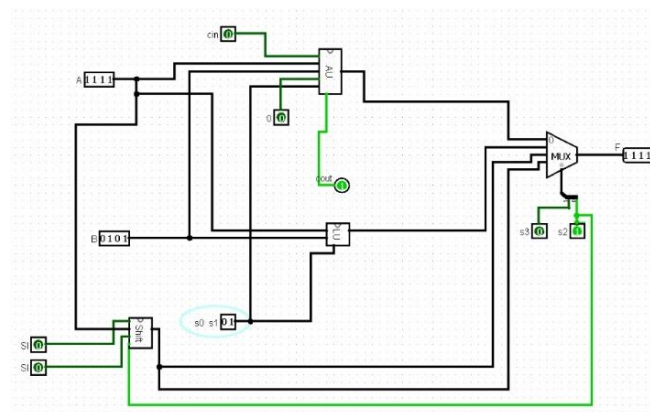

- *Subtraction:*
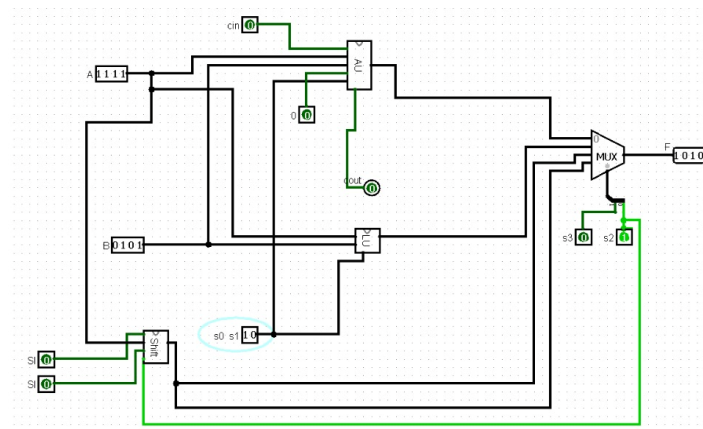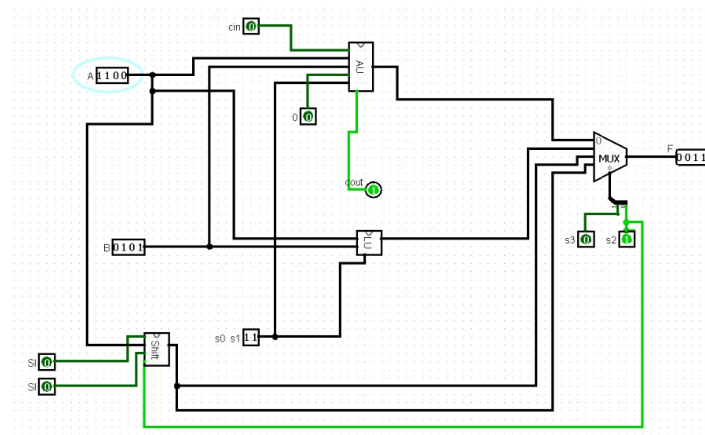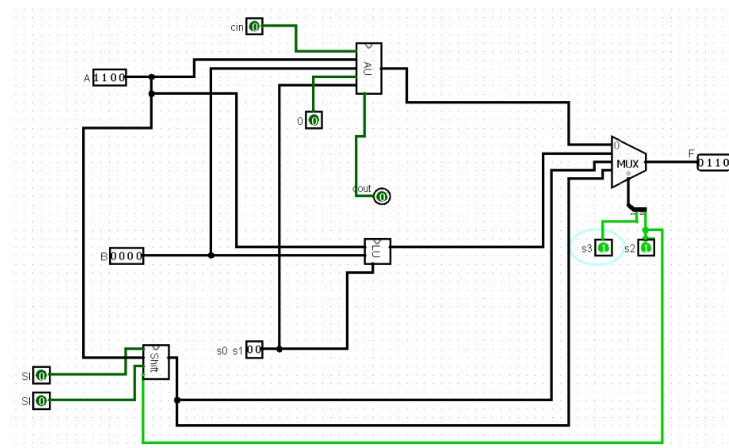

- *Decrement A:*

- *AND:*

- *OR:*

- *XOR:*

- *Complement A:*

- *Shift Right:*

- *Shift Left:*