Alexandria University
Faculty of Engineering
Computer and Systems
Engineering Dept.
First Year

CS131: Digital Computer
Fundamentals
Fall 2024/2025

ALU Assignment

It is required to design a simple 4-bit Arithmetic Logic Unit (ALU).

Inputs:

a) Operands: Two 4-bit inputs A, B.
b) Opcode: One 4-bit input (Used to specify the operation).

Outputs:

a) **8 bits** representing the output of the operation.
b) **Flags** for arithmetic operations:

- The Zero flag
- The Carry/Borrow flag (both are represented using the same bit)
- The Overflow flag.

Operation type	Operation code	Operation
Arithmetic	0000	**Add A + B**: the result, the zero flag, carry and overflow bits should be displayed if any of them happened
	0001	**Subtract A - B**: the result, the zero flag, borrow, and overflow bits should be displayed if any of them happened
	0010	**Subtract B - A**: the result, the zero flag, borrow, and overflow bits should be displayed if any of them happened
	0011	Multiply A * B
Logic	0100	Bit-wise **AND** (A AND B)
	0101	Bit-wise **OR** (A OR B)
	0110	Bit-wise **XOR** (A XOR B)
	0111	Bit-wise **NAND** (A NAND B)
Bit-wise Operations	1000	Display A in **two's complement**
	1001	Display A in **one's complement**
	1010	Shift A **left logical**
	1011	Shift A **right logical**
	1100	Shift A **left Arithmetic**
	1101	Shift A **right Arithmetic**
	1110	Shift A **left circular**
	1111	Shift A **right circular**

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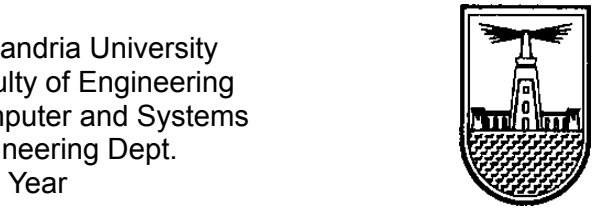

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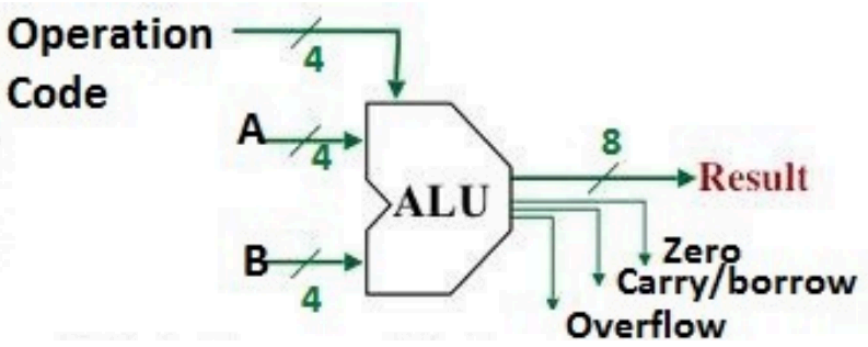

Policy:

- You must work with your lab team on this assignment.
- Try optimizing and minimizing the total number of gates required.
- Search for the terms you don’t understand.
- If 2 or more copies are discovered, all copies will lose submission marks and will be given a penalty of 25% of submission marks. Hence, it is better to deliver nothing than to deliver a copy. No late submission is allowed.

Deliverables:

You should deliver a digital report (You don’t have to print it) containing the following:

1. Truth Tables.
2. Steps of minimization.
3. Circuit Diagrams (Logisim) (You don't have to use tinker cad or wire it physically)