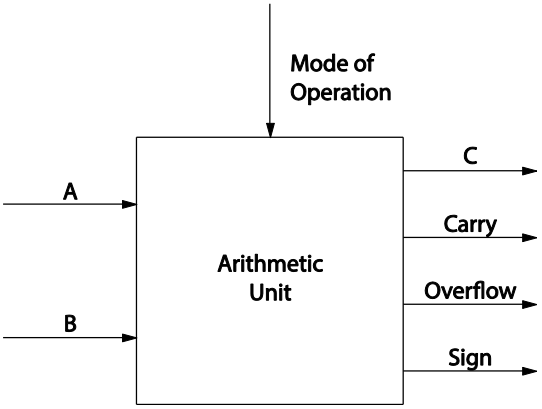
Project Description

Introduction

In this project, students are required to design and implement an arithmetic unit that is capable of adding, subtracting and multiplying two signed magnitude numbers, and displays the result of the operation performed along with some additional flags regarding the operation and the result.



Description

The arithmetic unit takes two 3-bits signed magnitude inputs, A and B, and an additional input called Mode of Operation, which informs the arithmetic unit which function to perform on A and B:

1. Addition $C = A + B$
   During the addition, A, B and C are all 3-bits signed numbers.

2. Subtraction $C = A - B$
   During the subtraction, A, B and C are all 3-bits signed numbers.

3. Multiplication $C = A \times B$
   During the multiplication, A and B are 3-bits signed numbers and C is a 5-bits signed number. The multiplication of 2-bits by 2-bits yields a result of 4-bits, therefore C is composed of 4-bits for the value and 1-bit for the sign.
   The multiplication of $3 \times 3 = 9$, which in binary is $(11)_2 \times (11)_2 = (1001)_2$

Flags:

1. Carry flag:
   The carry flag indicates if an arithmetic carry or borrow has been generated. The flag is set to 1 if a carry or burrow was generated during the operation, and 0 otherwise.

2. Overflow flag:
   The overflow flag indicates if there was an arithmetic overflow, meaning that the result is too large to fit in the result with the given number of bits.
   This occurs when:
   a. The addition of two 2-bits positive numbers is greater than 3. This can also be thought of as the addition of two positive numbers yielded a negative number.
   b. The difference of two 2-bits negative numbers is greater than -4. This can also be thought of as the addition of two negative numbers yielded a positive number.

   The overflow flag is set to 1 if an overflow occurs, and 0 otherwise.

3. Sign flag:
   The sign flag indicates whether the result is negative or not. The sign flag is set to 1 when the result is negative, and 0 otherwise.

Deliverables:

1- A **Printed Document** contains:
   a. For each team member: Name, ID and work done in the project.
   b. Block Diagram.
   c. Your test cases.
   d. Inputs and Outputs.

2- A **CD** contains:
   a. Soft-copy of the document.
   b. All logisim files.

3- **Hardware** of your circuit to be evaluated at discussion time.