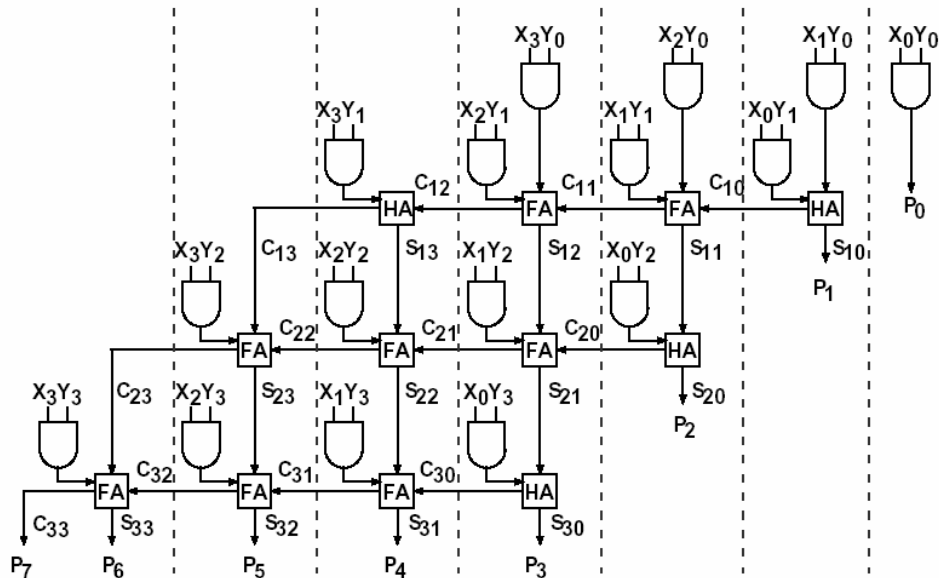


ECE 370: Digital Systems-Logic Design
VHDL Sample Lab Exam 1: Spring 2005

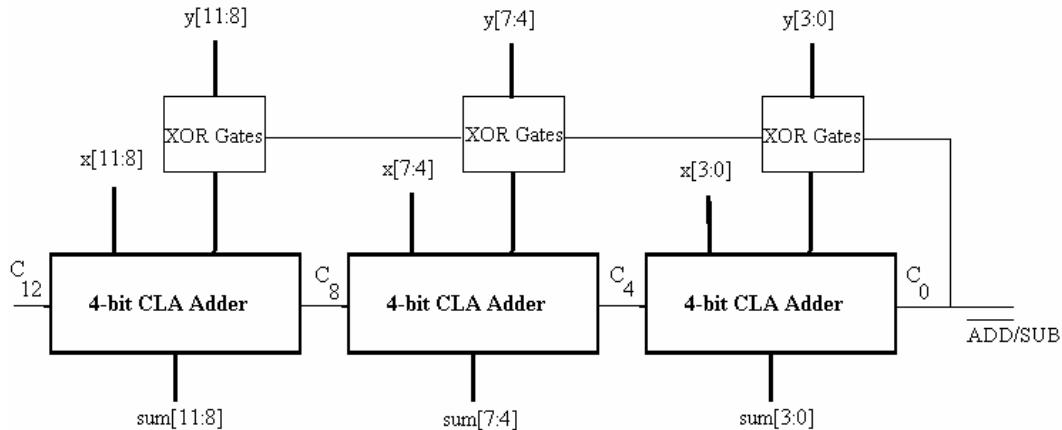
Design Problem 1

The figure below shows the schematic for a 4-bit digital system known as an *array multiplier*. Use VHDL to design the 4-bit *array multiplier*.



Design Problem 2

Design an n-bit carry-look-ahead adder (CLA) using VHDL and create a package. Design a 12-bit carry-look-ahead adder/subtractor **with overflow detection** by instantiating 3, 4-bit instances of the above component by including the package. This creates a 12-bit CLA adder that uses a ripple-carry scheme in 4-bit chunks.

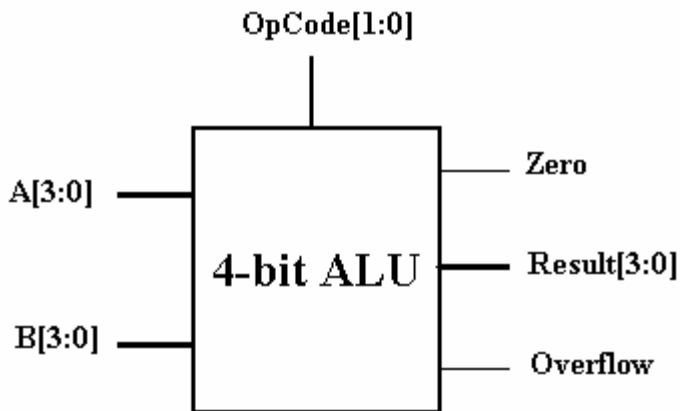


Design Problem 3

An Arithmetic Logic Unit (ALU) is a combinational digital system found in microprocessors. Its purpose is to perform all the arithmetic and logical operations (AND, OR, NOT, NOR, LESS_THAN, ADD, SUBTRACT, MULTIPLY, etc...) for the processor. Here are the input/output specifications for a typical n -bit ALU.

- Contains two n -bit inputs and one m -bit input.
 - *A*: n -bit signed number on which an operation will be performed.
 - *B*: n -bit number on which an operation will be performed.
 - *OpCode*: m -bit input that corresponds to the 2^m different operations that are performed by the ALU. The OpCode “tells” the ALU what operation to perform.
- Contains one n -bit output and two single-bit outputs
 - *Result*: n -bit signed number that holds the result of the specific operation performed on inputs *A* and *B*.
 - *Overflow*: When performing addition or subtraction, the ALU needs to indicate if overflow has occurred.
 - *Zero*: Indicates if the result is zero.

Use behavioral VHDL design to implement a 4-bit simplified ALU shown below. The ALU only performs AND, OR, ADD, and SUBTRACT. Your design should have all of the inputs and outputs described above, with appropriate lengths.



OpCode	Operation to Perform
00	AND
01	OR
10	ADD
11	SUBTRACT