

ECE 2029 Final Project Notes/ Outline

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Introduction/ Goal of project

- an ALU (Arithmetic Logic Unit) is one of the three main parts of a CPU along with memory and a control unit
- and ALU is the part of the CPU that does all arithmetic and logical operations
- In this project, a 4 bit ALU is designed in Verilog and implemented on an FPGA board
 - Can perform different types of arithmetic and logical operations on any 2 variables
 - * performs operation based on a 4 bit code given by the control unit
 - Can perform the following:
 - * Addition, subtraction, multiplication and division (Arithmetic)
 - * AND, NAND, OR, NOR, NOT, XOR, XNOR (bitwise logic)
 - * Shifting operations (left shift, right shift)
 - * Incrementing Operations

Design/ Block Diagram (Spend most time here)

- ALU has 8 inputs and 5 outputs.
 - 4 of the 5 outputs are the 4 bits showing the result of the operation
- ALU consists of two units (Arithmetic and Logic)
 - Arithmetic executes arithmetic operations, and the Logic executes logical operations and shift operations
 - These two units contain each individual module for every operation
 - * based on the 4 selection lines, one of these modules will be used in order to complete the operation

Individual blocks with inputs and outputs and their function

- Adder - A full-Adder circuit is utilized in this implementation, with A, B, and Carry in as inputs, and Sum, Carry out as outputs.

- A full subtractor is utilized with similar inputs and outputs to the adder. The difference in inputs is the Borrow in and Borrow out bits
- AND Gate - This is implemented as a basic logic gate with A, B as inputs and Y as an output.
- NOT Gate - another basic logic gate with A as an input and Y as an output
- Increment and Decrement Operators - either adds or subtracts one from the operand. Single input, A, and single output Y
- Shift operators - shifts operand by a user given number of bits. Input is both the operand and the number of bits to be shifted. There is a single output, the operand

Design Results

Waveform