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Engineering - 303

Lab 10

4/4/2017

Introduction/Description

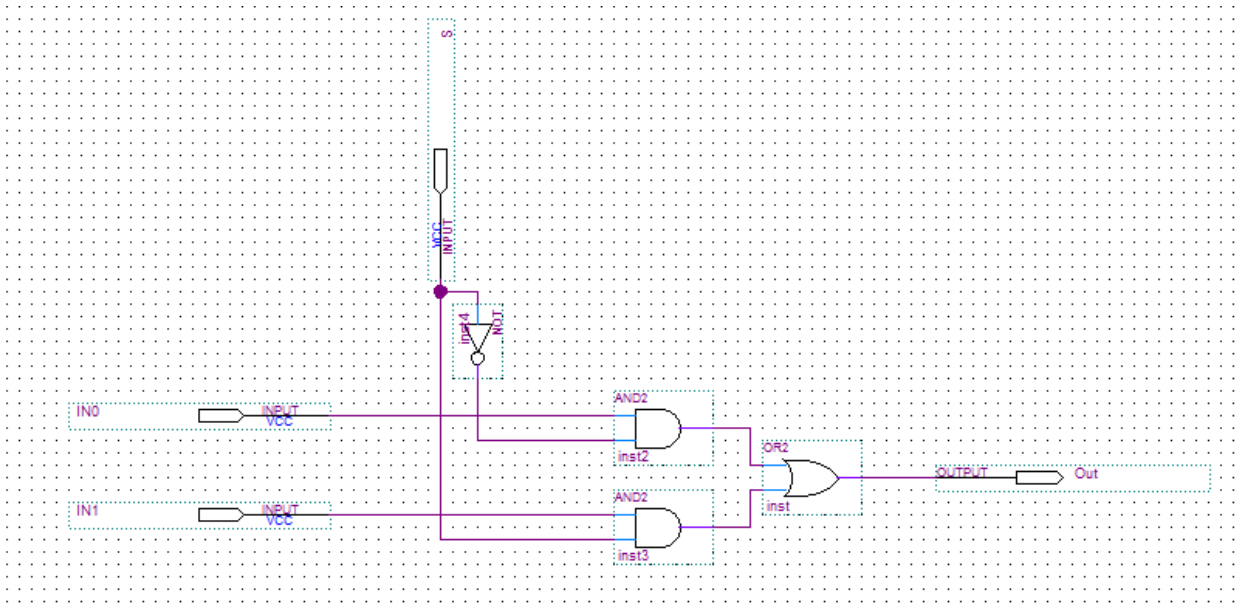
The goal of this lab was to begin to design all the separate components that are required in an early microprocessor. This lab focused on creating the ALU which stands for Arithmetic Logic unit. In this lab, we were instructed to create four different types of circuits. The first was called a 2-1 mux. This circuit essentially took two inputs and decided which one to use based on the binary value of a selection input. The 4-1 mux did the same thing except with four different inputs. The next circuit was called a logic circuit and was capable of performing basic logic operations on many inputs. Lastly, we created a circuit that was capable of performing many common arithmetic operations.

Design

Part 0 - 2 to 1 Mux

In the first part of the lab, I was instructed to implement a circuit design that would be able to determine which input to use based upon the value of a selection input. There were no truth tables created for this circuit as my only goal was to input it into Quartus and verify its correct operation.

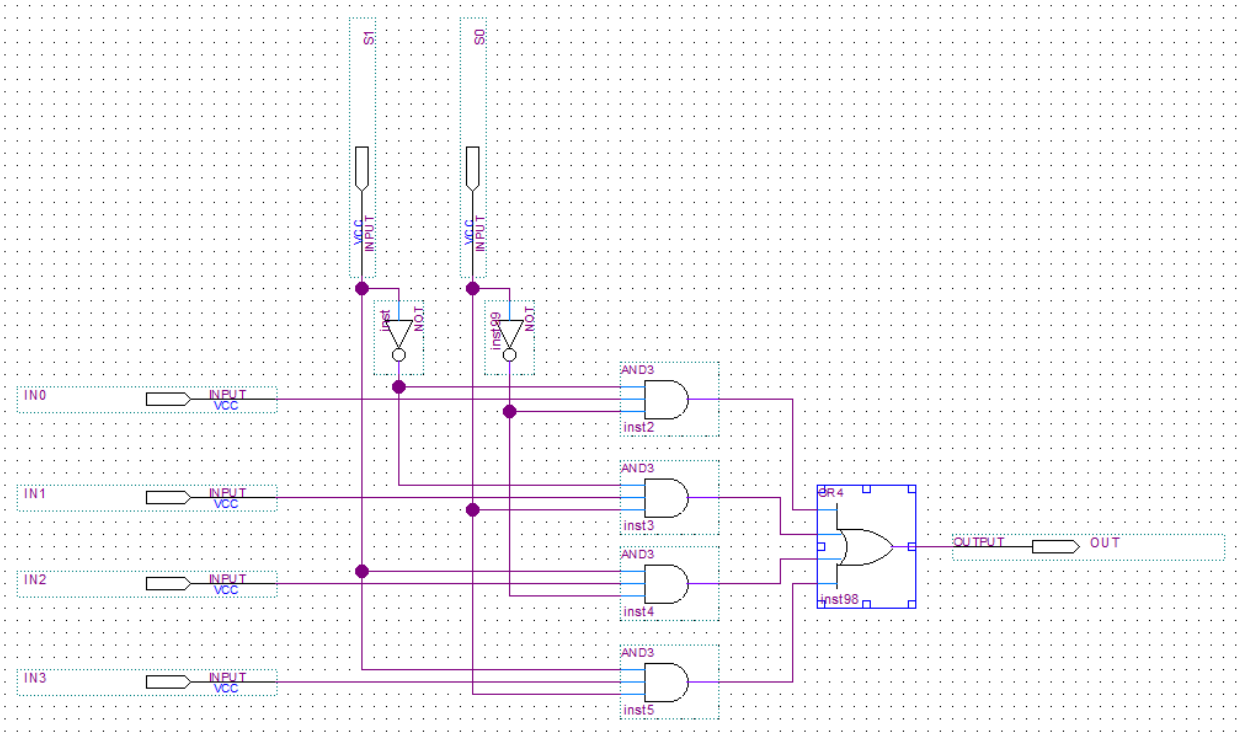
Here is the Block-Diagram design for the circuit.



Part 1 - 4 to 1 Mux

In this section of the lab, I was supposed to implement a circuit very similar to the previous circuit. The only difference between these two circuits was that this circuit selected from a total of four inputs instead of two.

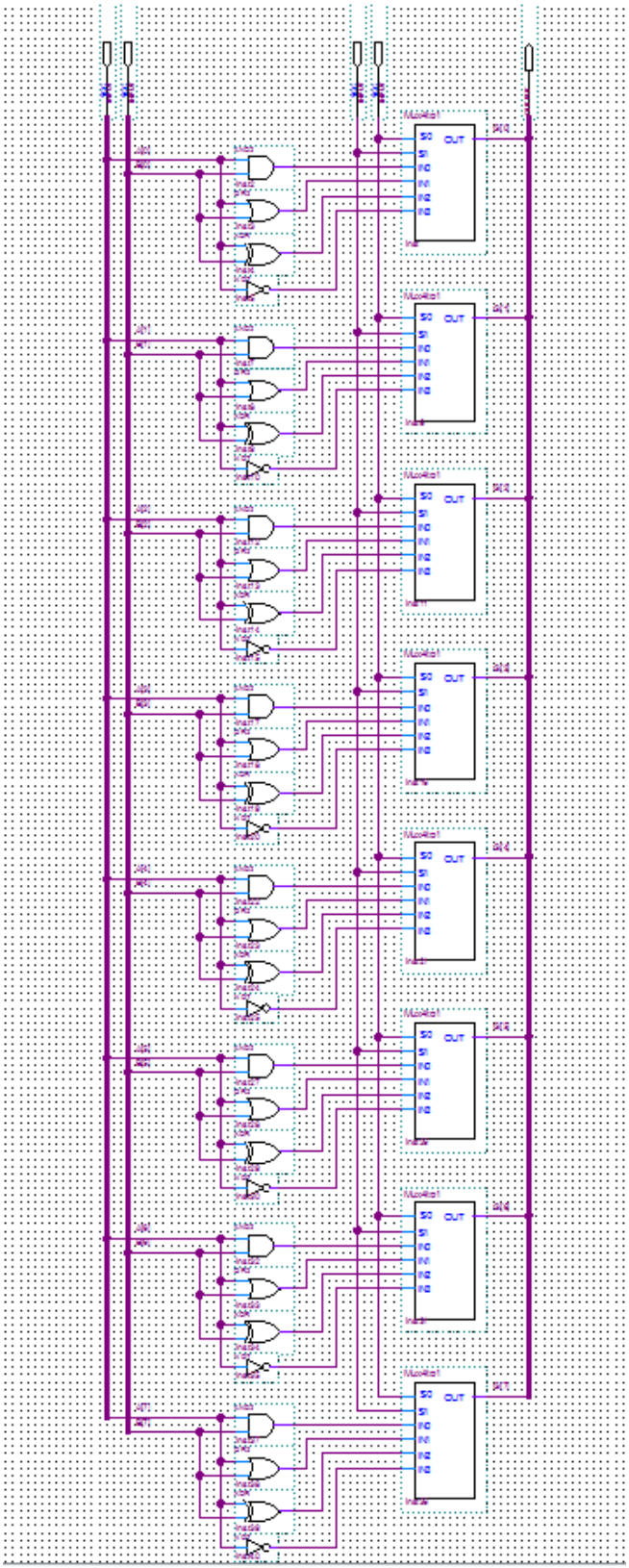
Here is the Block-Diagram design for the circuit.



Part 2 - ALU Logic Stage

In the third part of the lab, I was supposed to implement the logic stage of the ALU. This circuit is capable of performing all of the basic logic operations which include, AND, OR, XOR, and NOT. In addition, this circuit is attached to the 4 to 1 mux enabling it to choose which logic operation it needs to output. Also, this circuit is able to perform this operation on 8-bit binary strings.

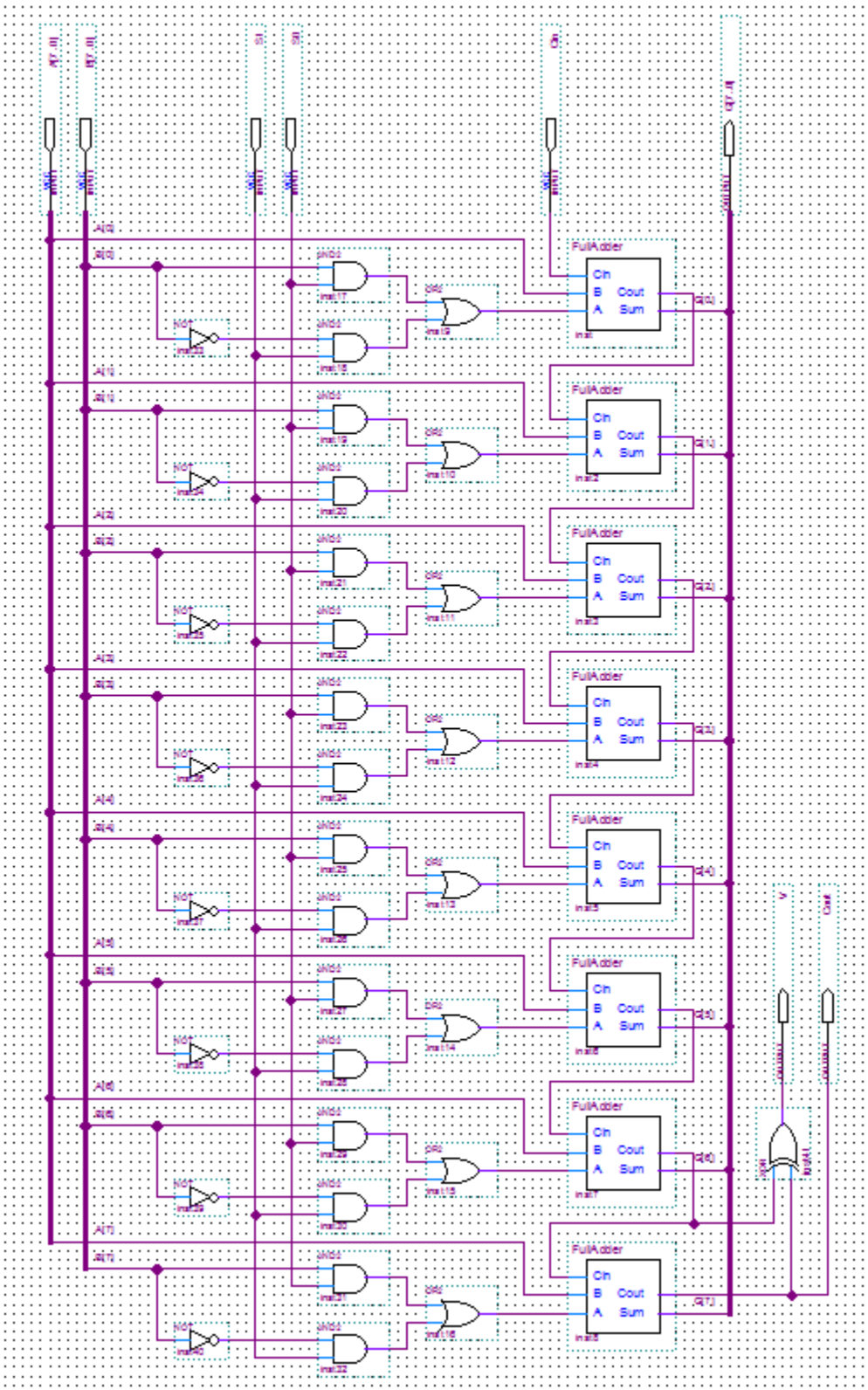
Here is the Block-Diagram design for the circuit.



Part 3 - ALU Arithmetic Stage

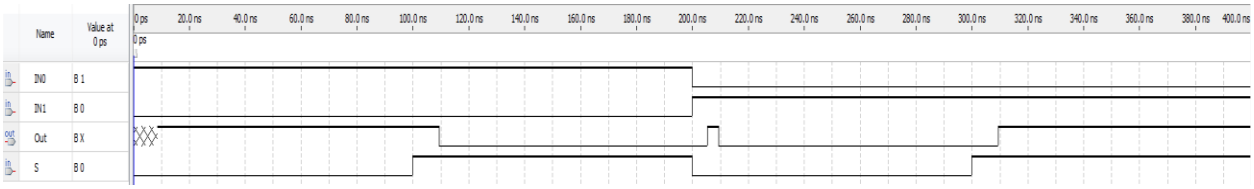
In the last part of the lab, I was told to implement a design for the arithmetic stage of the ALU. This circuit is capable of performing many of the common arithmetic problems in programming. This includes but not limited to, Adding two numbers, increment a number by one, decrement a number by one, and subtract one number from another number. Like the previous circuit, this circuit is capable of performing these operations on 8-bit binary strings.

Here is the Block-Diagram design for the circuit.

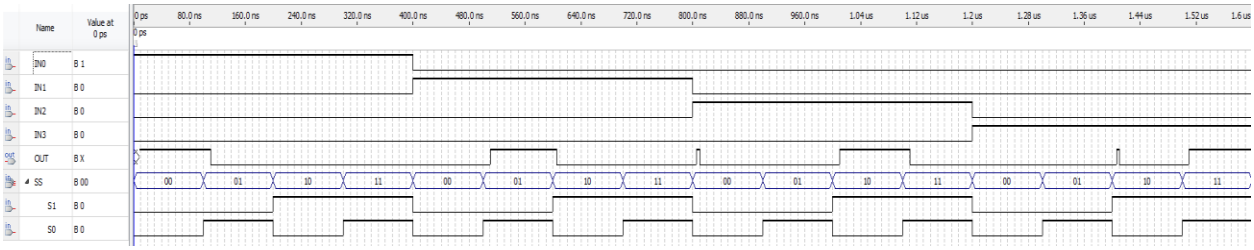


Testing

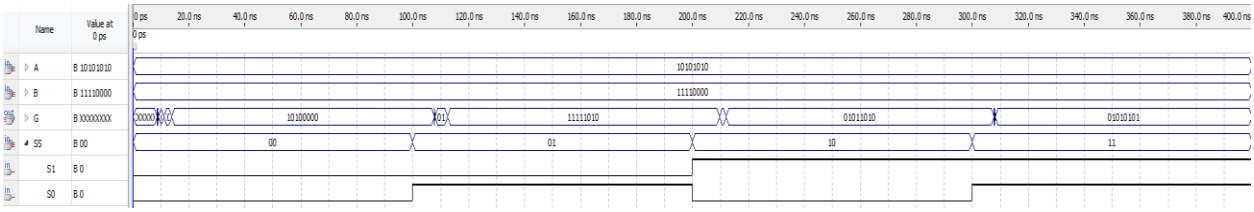
When testing the 2 to 1 Mux I encountered no problems and it performed as expected for every single input combination.



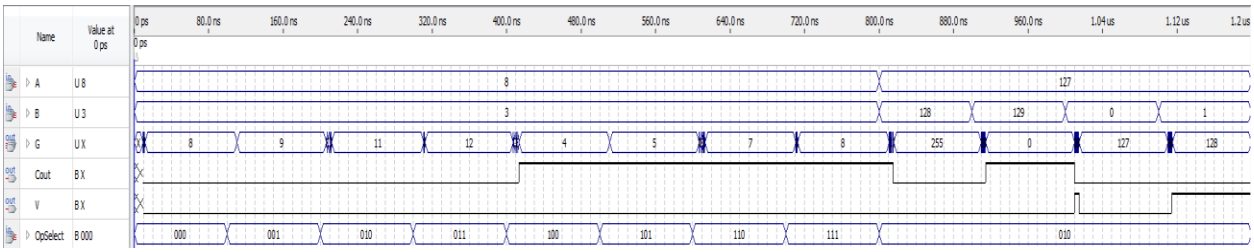
When testing the 4 to 1 Mux I encountered no problems and it performed as expected for every single input combination.



When testing the ALU Logic Stage I encountered no problems and it performed as expected for every single input combination.



When testing the ALU Arithmetic Stage I encountered no problems and it performed as expected for every single input combination.



Conclusion

In this lab, I began to learn about all of the components that are necessary to create an operational microprocessor. This lab dealt with the ALU of the processor. In addition, this lab reinforced the concept of abstraction as without this necessary concept the complexity of this circuit would easily overwhelm me. If I were to perform this lab again I would strive to understand the working of both the Logic and Arithmetic stage of the ALU better as their design is intriguing. This lab proved to be enjoyable and informative. And I am very excited to begin creating my very own microprocessor!