

CSE 278 Spring 2015 - Computer Architecture

Project 4: (100 points) Due on Wednesday, May 6 by 11:59 pm

Learning Outcomes

- Understand how to build an ALU with logic gates
- Extend an ALU to perform logical shifts, multiplication and division
- Understand how to use a multiplexer

Instructions

Download LogiSim and the ALU that I demonstrated in class (you will find links in resources below). Update the ALU according to the requirements posted below. Save the file as proj3.circ and upload the file to Niihka.

Description

In class, we learned that an ALU is the heart of the computer because it is the hardware that actually performs the majority of the assembly instructions when we run our programs. The ALU demonstrated in class is only capable of 4 basic instructions: AND, OR, ADD, SUB. The goal of this project is to extend the ALU to perform: SHL, SHR, MUL, and DIV. You need to ensure that each of these operations can perform 8-bit calculations. You also need to create your own 8x1 multiplexer. Your multiplexer must be wired so that the control lines are mapped to the following operations: 000 => AND, 001 => OR, 010 => ADD, 011 => SUB, 100 => SHL, 101 => SHR, 110 => MUL, 111 => DIV. You also need to ensure that the ZERO, NEGATIVE, CARRY, and OVERFLOW bits are set appropriately for each operation. You can use the Intel manual (link below) to understand how those bits are set for SHL, SHR, MUL, and DIV operations. Your MUL and DIV operations only need to support operations that will fit in an 8-bit result. Finally, you can also assume that the numbers are unsigned.

Requirements

Follow the following requirements, you will lose 25 points for each one that is violated:

- You cannot use the builtin SHIFTER, MULTIPLIER or DIVIDER in LogiSim
- You cannot use the builtin MULTIPLEXER, so you need to replace the two multiplexers with your own custom-built 8x1 multiplexer
- You can only use 1-bit circuit elements but input, output and splitters can be 8-bits

Resources

- LogiSim -
<http://www.users.miamioh.edu/stjustpt/cse278/resources/logisim-win-2.7.1.exe> for Win
or <http://www.users.miamioh.edu/stjustpt/cse278/resources/logisim.jar> for Mac
- Link to ALU - <http://www.users.miamioh.edu/stjustpt/cse278/resources/ALUweek2.circ>
- Intel Manual -
<http://www.users.miamioh.edu/stjustpt/cse278/resources/64-ia-32-architectures-software-developer-instruction-set-reference-manual-325383.pdf>