

For this project, we were to extend the single cycle MIPS processor from project 2 to support a greater range of instructions. Given that I already implemented most of the processor in project two, I simply had to extend the ALU to perform the additional shifting operations, and improve the control unit to be able to accommodate these changes to the ALU.

In the last project I used separate control units for the general CPU muxes, etc. and the ALU, but for this project I decided to include the logic for the ALU control bus in the CPU control unit module. In this way, I was able to simplify the code and make it much more easily extensible. A truth table for the control unit is below:

Type	Name	regDST	regWrite	ALUSrc	memRead	memWrite	memToReg	branch	ALUControl
R	addu	1	1	0	0	0	0	0	0001
R	subu	1	1	0	0	0	0	0	0011
I	addiu	0	1	1	0	0	0	0	0001
R	add	1	1	0	0	0	0	0	0111
R	sub	1	1	0	0	0	0	0	0010
I	addi	0	1	1	0	0	0	0	0111
R	and	1	1	0	0	0	0	0	0100
I	andi	0	1	1	0	0	0	0	0100
R	or	1	1	0	0	0	0	0	0101
I	ori	0	1	1	0	0	0	0	0101
R	xor	1	1	0	0	0	0	0	0110
I	xori	0	1	1	0	0	0	0	0110
R	sll	1	1	0	0	0	0	0	1110
R	sra	1	1	0	0	0	0	0	1100
R	srl	1	1	0	0	0	0	0	1101
R	slt	1	1	0	0	0	0	0	1010
I	slti	0	1	1	0	0	0	0	1010
R	sltu	1	1	0	0	0	0	0	1011
I	sltiu	0	1	1	0	0	0	0	1011
I	beq	0	0	0	0	0	0	1	0010
I	bne	0	0	0	0	0	0	1	0010
I	lw	0	1	1	1	0	1	0	0111
I	sw	0	0	1	0	1	0	0	0111

In building and testing the processor, I ran into errors that I could not seem to debug, no matter how hard I tried. After building each individual module, I tested them and found each one to work correctly, but I had a lot of issues in getting them to work together, specifically with the register file. I really don't know why the register file would correctly store and return data in single bench tests, but not when included in the processor, and because of this I could never get the processor working. In stepping through my code, I drew everything out and verified that it matched the single cycle processor

given in the textbook, yet because of the issues with the register file, I could not get it working to prove that it worked.

With respect to running the code, I created a makefile to make compiling and running the code easy. Simply typing 'make' in the source directory will compile the code and simulate the program. All the necessary files are included in the command line argument, not included in the actual source code.