Computer Organization

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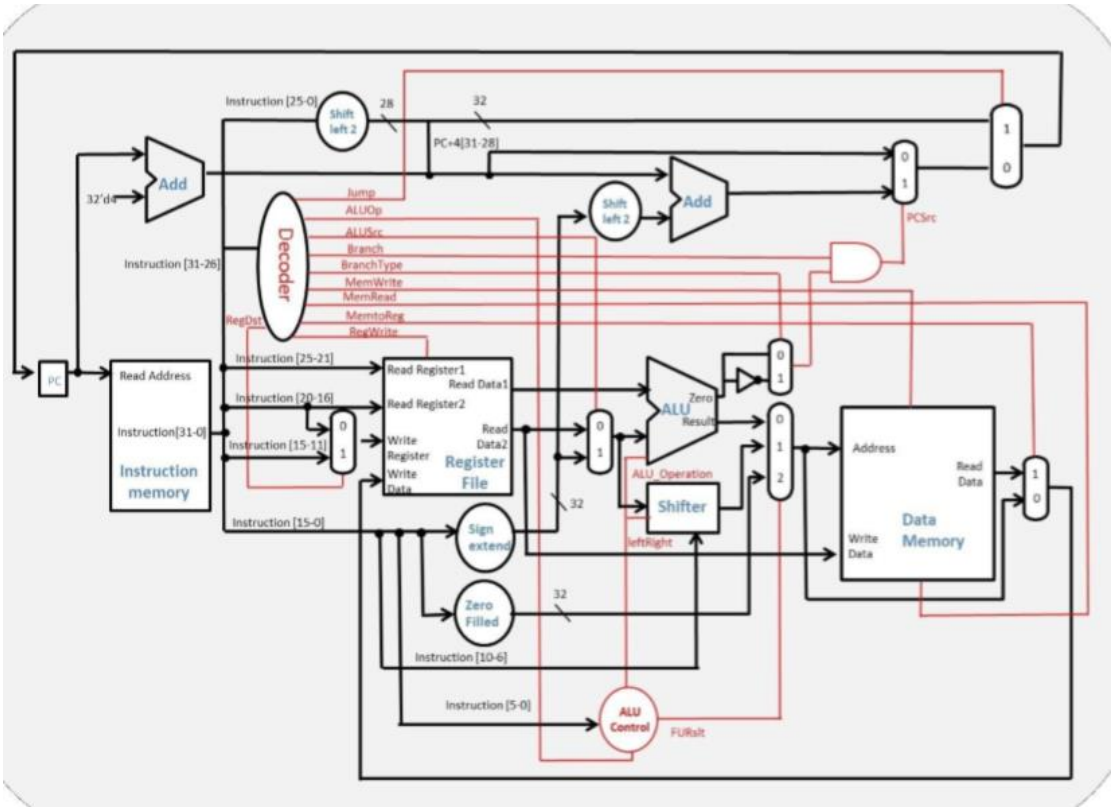
Architecture diagrams:



Hardware module analysis:

We improve on the design of Lab 2 for the additional instructions by adding data memory and mainly making changes to Simple_Single_CPU, Decoder and ALU_Ctrl module.

- Decoder: We add new control signals and make assignments according to the instruction set.
- ALU_Ctrl: We need to add some lines to include new instructions such as bne, beq, lw, and sw.
- Simple_single_CPU: This part is actually the hardest in this Lab. Firstly, we make changes to our previous works by adding Data_Memory module for lw and sw, components for branch and also components for jump. Also, we extends two 2to1_Mux to

3to1_Mux for the advanced set instruction. We think this is the hardest because it is not easy to see where we need to change, you need to inspect carefully to make sure that you don't leave out important part.

Finished part:

Basic cases and advanced set 1.
Basic cases:

1. lw sw – add control signal and mux to control memory read write
2. beq bne – add adder for pc+immediate calculation and also Muxs to select whether to branch or not by referring to zero from ALU.
3. Jump – add jump control signal and mux.

Advanced Set 1

1. Jal – connect pc+4 to write port of register file by extending 2to1-mux after the data memory to 3to1-mux. Also extend the mux to select the write register source to include a new selection (Reg[31]).
2. Jr – extend the jump mux to include input from readdata2 from register file.

Problems you met and solutions:

As we have said, it is not easy to find out where we need to make changes to include the new instructions as simple_single_cpu have many modules and signals so it is easy to make mistakes. Also, Jal and Jr implementation is not given in the diagram, we need to make use of our brain and the internet to find out a way to implement Jal and Jr.

Summary:

This lab is an extension of Lab2, so after we study the pdf guide, we check our Lab2's code carefully and find the main parts we should improve with the help of our textbook. Overall, this Lab is not difficult but need to be very careful to not miss any details.