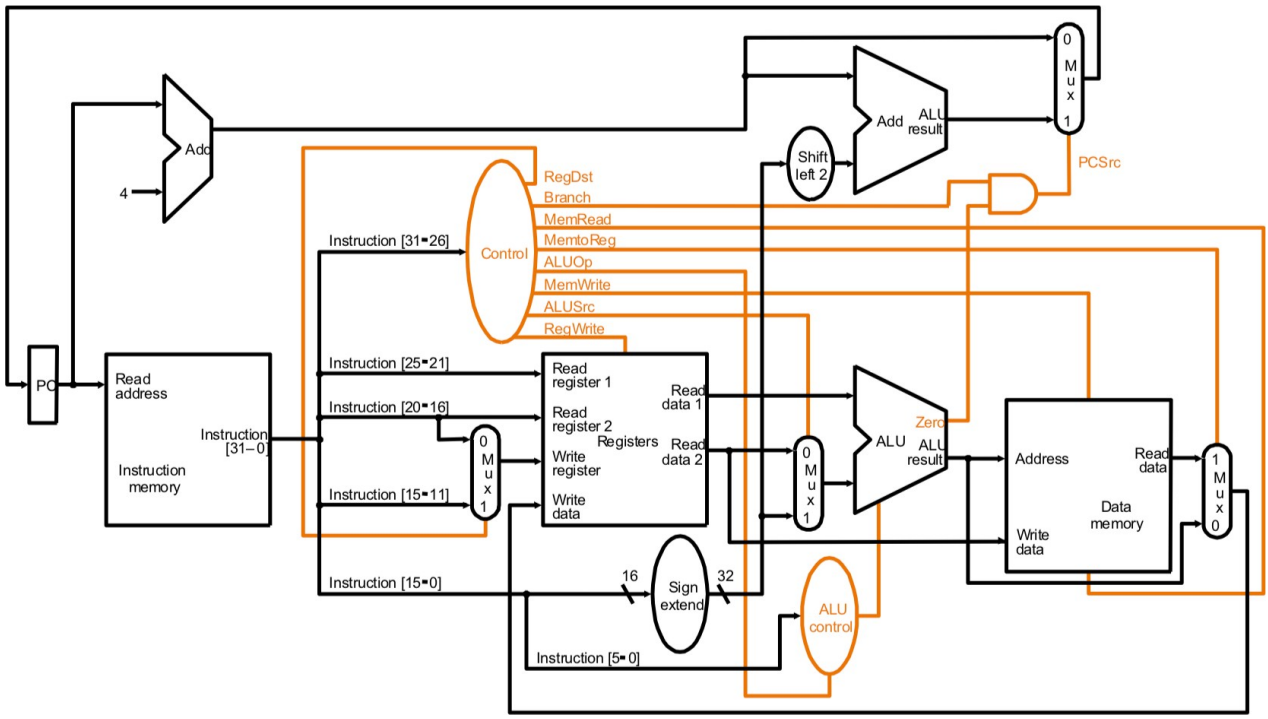
EC413 Computer Organization
Lab 7 – Single-Cycle CPU

Overview:
The purpose of Lab 7 is to learn in-depth how a CPU works. Given the basic single-cycle MIPS CPU, you will add, debug, and test several new features.



Recommended Order of Tasks:

1. PreLab: Simulate the project and generate outputs for the given instruction sequences. Add testbench for AND, NOR and XOR.
2. Add capability for SLT instruction. This is similar to how we implemented XOR in the Pre-Lab. Edit ALU.v and ALU_control.v accordingly.
3. Add instruction J. You may start with the general implementation using the text provided in discussion slides. If you implement your own block, explain with comments.
    a. J target ➔ This jumps to the address "target"
4. Add I type instructions: ADDI, ANDI, LUI
    a. For ADDI and ANDI:
    - Notice the op_code and add corresponding capability into the control
    b. For LUI:
    - The immediate value is shifted left 16 bits and stored in the register. The lower 16 bits are zeroes.
    - lui $t, imm ➔ $t = (imm << 16); advance_pc (4);
5. Add instruction BNE.
6. Modify your testbench so it tests for all the following instructions
    a. **ALU:** ADD, ADDI, SUB, OR, XOR, AND, ANDI, NOR, SLT
    b. **Memory:** SW, LW, LUI
    c. **Branch:** BEQ, BNE
    d. **Jump:** J

DELIVERABLES:

Submission on blackboard:

1. All your .v files
2. A brief report with a:
    - Description of how you added each of the instruction capability
    - Waveforms for the following test cases: SLT, LUI, BNE, J

A DEMO to one of the TAs:

Be sure to submit all your code and report on blackboard before the demo
Both group members must be present during the demo
ALL GRADING WILL BE DONE DURING THE DEMO

GRADING GUIDELINES:

1. Ensure all code and brief report have been submitted to blackboard [**20 points**]

2. Quickly demonstrate the concepts learnt during the Prelab and Verilog files have been submitted to blackboard[**10 points**]

3. Demonstrate SLT instruction[**10 points**]

4. Demonstrate J instruction[**10 points**]

5. Demonstrate I-type instructions ADDI, ANDI, LUI [10 points each – **30points**]

6. Demonstrate BNE instruction[**10 points**]

5. Demonstrate overall understanding through short questions asked [**10 points**]