

Lab 09 (All Sections) Prelab: Single Cycle Processor and Control Unit

Name:

Sign the following statement:

On my honor, as an Aggie, I have neither given nor received unauthorized aid on this academic work

1 Objective

In this lab, you will implement the main *control unit* of the MIPS processor. You should know the details of the MIPS single cycle processor and control unit from the textbook.

2 Introduction

If the data path is the “brawn” of a processor, then the control unit is the “brain” of a processor. It generates signals that control the components in the data path, such as multiplexers, ALU, register file, memory units, etc.

3 Questions

1. Add the control unit for the given MIPS data path that supports R-type, load/store and branch instructions only to Figure 1 (not for submission).
2. **Signal stuck-at-0-fault:** A *stuck-at-0-fault* is a hardware fault where the signal is always 0, regardless of what it should be. Describe the effect of the following

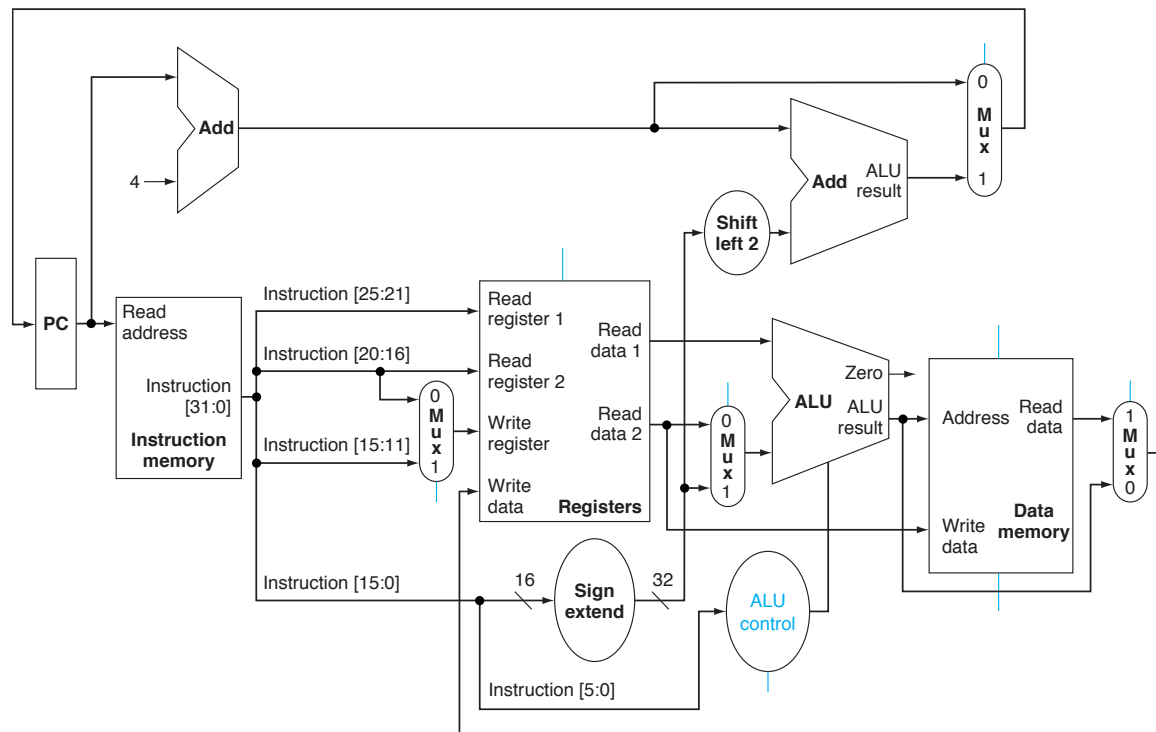


Fig. 1: Single Cycle Datapath that supports R-type, load/store word and branch instructions only.

signal *stuck-at-0-fault* in the single cycle data path that supports R-type, lw/sw and branch instructions only. (Figure 1). Which instructions, if any, will not work correctly? Explain why.

- (a) RegWrite = 0

- (b) Branch = 0

(c) $\text{MemRead} = 0$

(d) $\text{MemWrite} = 0$

(e) $\text{ALUop}[3:0] = 0000$

3. **Signal stuck-at-1-fault:** A *stuck-at-1-fault* is a hardware fault where the signal is always 1, regardless of what it should be. Describe the effect of the following signal *stuck-at-1-fault* in the single cycle data path that supports R-type, lw/sw and branch instructions only (Figure 1). Which instructions, if any, will not work correctly? Explain why.

(a) $\text{RegWrite} = 1$

(b) $\text{Branch} = 1$

(c) $\text{MemRead} = 1$

(d) $\text{MemWrite} = 1$

(e) $\text{ALUop}[3:0] = 1111$

4. As you know the Control unit takes the 6-bit opcode as input and generates the control signals as in Figure 2.

Fill in the following truth table:

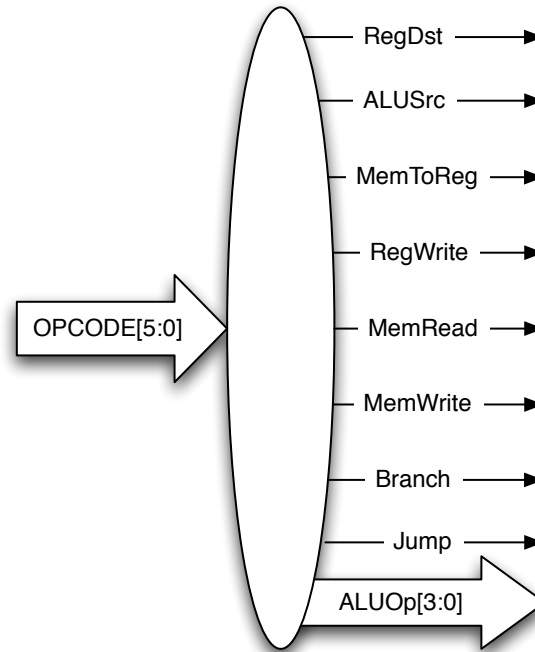


Fig. 2: Opcode Control

[illegible]