CMSC 411, Computer Architecture
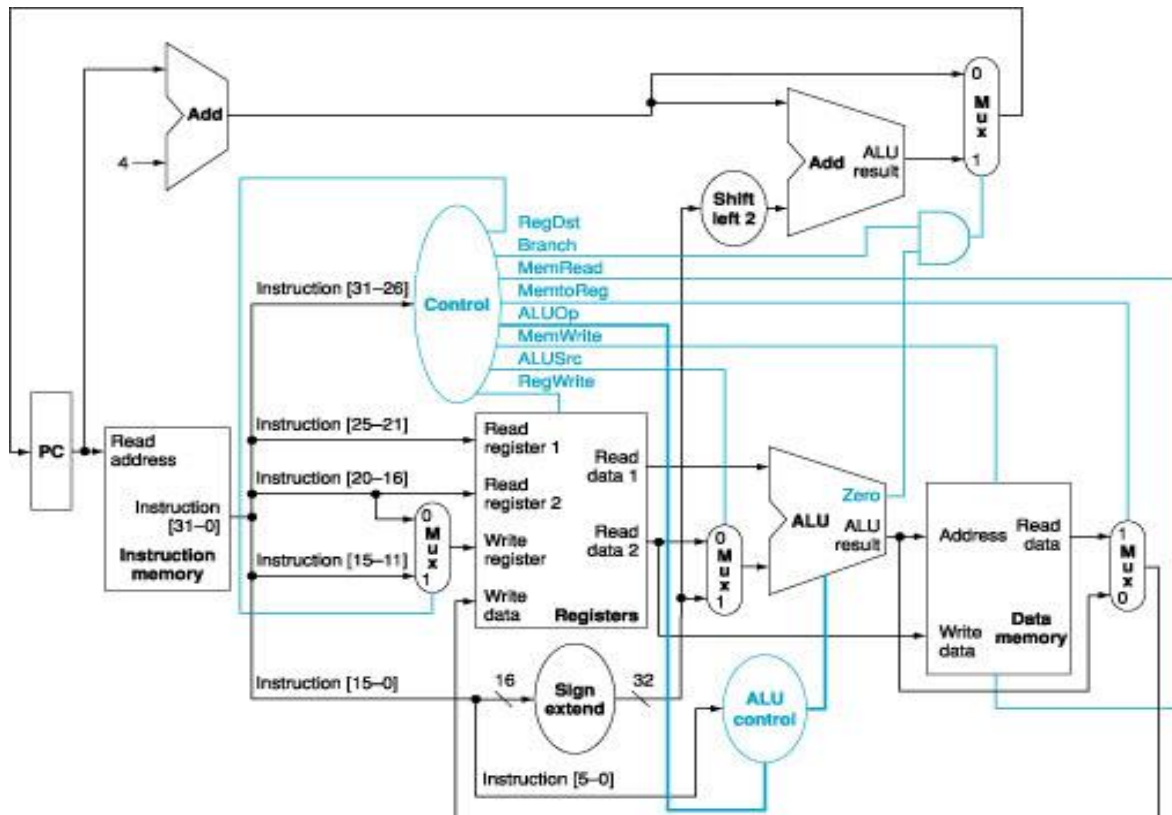
Assignment #3   Due: Tue 10/17/17 in the class

Question 1:   _(30 Points)_

A digital circuit may be hit by stuck-at faults where one or multiple signals stay always 0 or 1 depending on the fault. Describe the effect that a single stuck-at fault would have for the signals shown below, in the single-cycle datapath shown above and discussed in class. Which instructions, if any, will not work correctly? Explain why.

Consider each of the following faults separately:
  A) RegWrite = 0
  B) ALUScr = 0
  C) RegDst = 0
  D) Branch = 0
  E) MemWrite = 1

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Question 2: *(44 Points)*

A) We wish to add the instruction "*addi*" (Add immediate) and "*lui*" (load upper immediate) to the shown single-cycle simple processor. Add any datapath and control signals and show the value of the control signals while executing the new "*addi*" and "*lui*" instruction.

B) This question is similar to part "A" except that we wish to add a variant of the "*lw*" (load word) instruction, which increments the index register after loading word from memory. This instruction ("*l_inc*") corresponds to the following two instructions:

```
lw       $rs, L($rt)
addi     $rt, $rt, 1
```

Again add any datapath and control signals and show the value of the control signals while executing the new instruction.

Question 3: *(26 Points)*

We wish to add the instruction "*jr* (jump register)" to the single-cycle datapath shown in question 1. The instruction loads the program counter with the value stored in the specified register. For example, the effect of "*jr* $r1" can be summarized as PC ← [$r1]. Add any necessary datapaths and control signals and show the value of these control signals when executing all instructions supported by the new datapath. (You can photocopy the figure to make it faster to show the additions.)