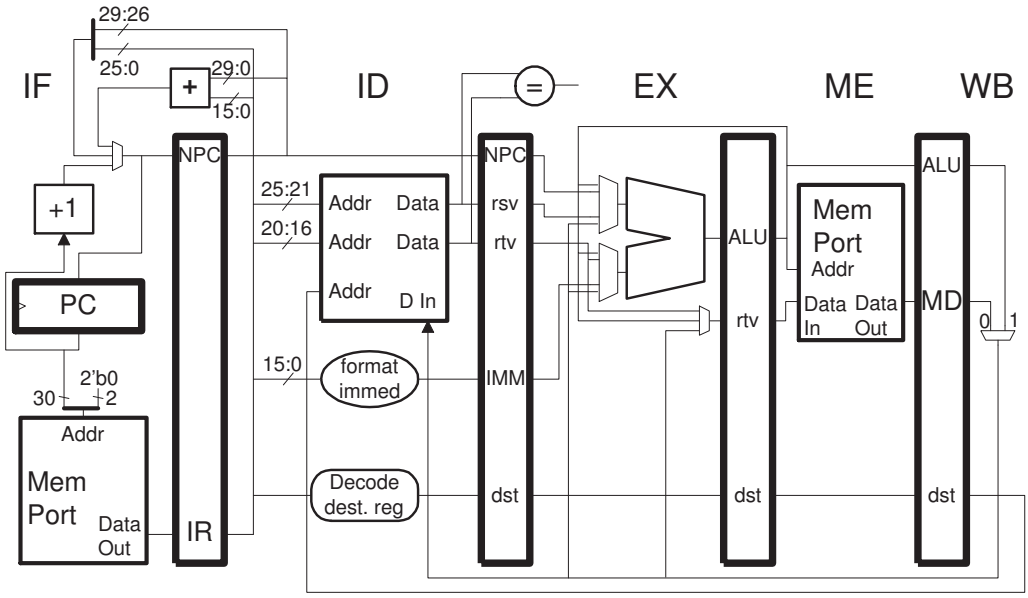
LSU EE 4720 **Homework 1** **Due: 2 March 2011**

Problem 1: The MIPS code below executes on the illustrated implementation. The loop iterates for many cycles.




```
 lw r2, 0(r5)
LOOP:
 lw r1,  0(r2)
 lw r3,  0(r1)
 sw r3, 4(r2)
 bne r3, r0  LOOP
 addi r2, r3, 0
```

(*a*) Show a pipeline execution diagram for enough iterations to determine the CPI. Compute the CPI for a large number of iterations.

(*b*) Show when each bypass path is used. Do so by drawing an arrow to a multiplexor input and labeling it with the cycles in which it was used and the register. For example, something like C10/r9 ⟶ to show that the input is used in cycle 10 carrying a value for `r9`.

Problem 2: Continue to consider the pipeline and code from the previous problem. The store instruction and the branch could both benefit from a new bypass connection.

(*a*) Show a new bypass connection for the store.

(*b*) Indicate the impact of the new store bypass connection on critical path length.

(*c*) Show a new bypass connection needed by the branch.

(*d*) Indicate the impact of the new branch bypass connection on critical path length.

(*e*) Suppose that the cost of the two bypass connections were equal and that both had no critical path impact. If only one could be added to an implementation which would you add? Base your answer not on the example code above, but on what you consider to be typical programs.