**LSU EE 4720** **Homework 2** **Due: 13 March 2006**

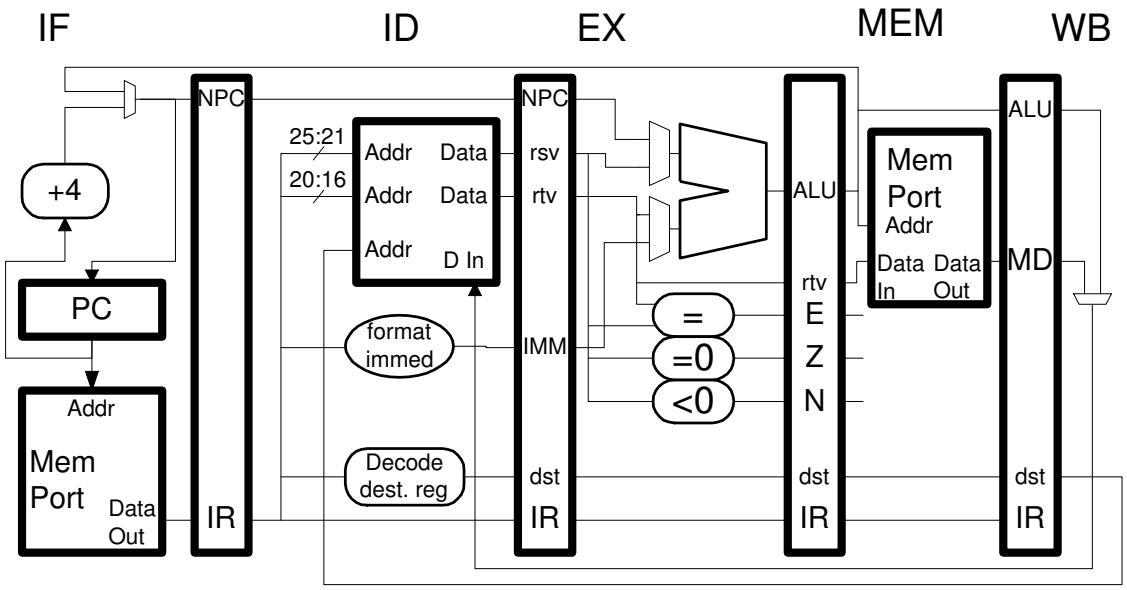
**Problem 1:** The code fragment below runs on the illustrated implementation. Assume the branch is always taken.

(*a*) Show a pipeline execution diagram covering execution to the beginning of the third iteration of the loop.

(*b*) What is the CPI for a large number of iterations?

*Hint: Pay close attention to dependencies and carefully add the stalls to handle them; also pay close attention to the timing of the branch. Work from the illustrated implementation,* **do not** *adapt the solution from a similar past assignment, that would be like preparing for a 10 km run by driving around the jogging trail.*

```
LOOP:
 lw $s0, 0($s1)
 addi $s3, $s0, 4
 bneq $s3, $0 LOOP
 add $s1, $s1, $s2
 xor $t0, $t1, $t2
 or  $t3, $t4, $t5
 and $t6, $t7, $t8
```



**Problem 2:** The code fragment below (the same as the one above) runs on the illustrated implementation (different than the one above—and better!). Assume the branch is always taken.

(*a*) Show a pipeline execution diagram covering execution to the beginning of the third iteration of the loop.

(*b*) What is the CPI for a large number of iterations?

(*c*) An [A] points to a wire on the illustration. On the pipeline execution diagram show the value of that wire in every cycle that the corresponding stage holds a "live" instruction.

(*d*) A [B] points to a wire on the illustration. On the pipeline execution diagram add a row labeled `B`, and on it place an `X` in a cycle if the value on the wire can be changed without changing the way the program executes.

```
LOOP:
 lw $s0, 0($s1)
 addi $s3, $s0, 4
 bneq $s3, $0 LOOP
 add $s1, $s1, $s2
 xor $t0, $t1, $t2
 or  $t3, $t4, $t5
 and $t6, $t7, $t8
```