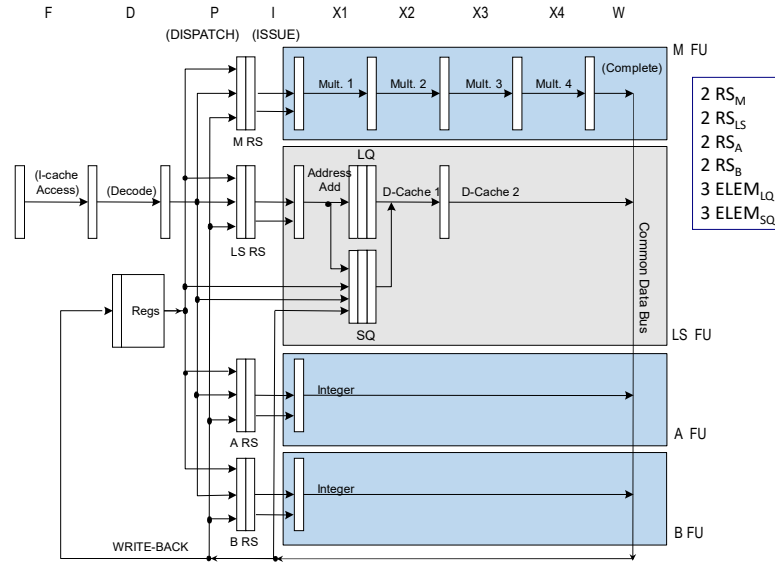


1) (POINTS 27/30) Consider a **dual-dispatch (2 instructions per cycle)** using Tomasulo's algorithm to perform the dynamic scheduling of instructions on the pipeline shown in the following figure.



This pipeline is executing the following program, which performs a search within a vector (initially, R1 = 0).

```

etic:  LW    R2, 0(R1)    ; read Xi
        MULI  R2, R2, 3    ; multiplies Xi by 3
        SW    R2, 0(R1)    ; write Xi
        ADDI  R1, R1, 4    ; update R1
        BNE  R2, R0, etic ; continue to loop if false
    
```

Working hypothesis:

- the issue stage (I) calculates the effective address of the loads and stores.
- dispatch stage (D) and commit stage (C) require one clock cycle.
- only one instruction is issued per cycle.
- loads require five clock cycles, stores require one clock cycle.
- instructions are executed speculatively, and branches are predicted “always taken.”
- dispatch will break the instruction flow when a branch instruction is encountered.
- **there two CDBs.**
- integer units are separated, as illustrated in this table:

Type of Functional Unit	No. of Functional Units	Cycles for stage I	No. of reservation stations
LS: Integer (effective addr.)	1	1	2
A: Integer (op. A-L)	1	1	2
B: Integer (branch cond. calc.)	1	1	2
M: Integer Multiplication	1	4	2

- the functional units TAKE advantage of pipelining techniques internally.
- the load and store queues have three slots each.
- stores have priority over the loads when there is a conflict at the same cycle to access cache.
- ASSUME that the reservation stations could be freed right BEFORE the issue phase.

Complete the following chart until the end of the FOURTH iteration of the above code fragment in the case of dynamic scheduling with speculation. Also add the instruction that occupies a certain reservation station (one of the 8) as indicated:

Instr. No.	Instruction name	ALU RS1	ALU RS2	EAU RS1	EAU RS2	BU RS1	BU RS2	MU RS1	MU RS2	P: Dispatch (start)	I+X: Issue (start-stop)	MEM. ACCESS (start-stop)	W: CDB-write (clock)	C: Commit (clock)	Comments
I01	LW R2, 0(R1)			I01	1-1					1	2-2	3-7	8	9	
...	...														
...	...														

2) (POINTS 3/30) On a Linux system, write the SINGLE command line to perform at the BASH shell prompt the following operation (please note that no intermediate files should be used):

- Change permission for the owner to read and execute all files which have a name starting with “finance” and ending with “sh” and remove permission of reading to the group and other users.