Three Parts of the Scoreboard

1. Instruction status—which of 4 steps the instruction is in

2. Functional unit status—Indicates the state of the functional unit (FU). 9 fields for each functional unit
   - Busy—Indicates whether the unit is busy or not
   - Op—Operation to perform in the unit (e.g., + or –)
   - Fi—Destination register
   - Fj, Fk—Source-register numbers
   - Qj, Qk—Functional units producing source registers Fj, Fk
   - Rj, Rk—Flags indicating when Fj, Fk are ready

3. Register result status—Indicates which functional unit will write each register, if one exists. Blank when no pending instructions will write that register

Detailed Scoreboard Pipeline Control

Instruction status	Wait until	Bookkeeping
Issue	Not busy (FU) and not result(D)	Busy(FU)← yes; Op(FU)← op; Fi(FU)← `D'; Fj(FU)← `S1'; Fk(FU)← `S2'; Qj← Result('S1'); Qk← Result(`S2'); Rj← not Qj; Rk← not Qk; Result('D')← FU;
Read operands	Rj and Rk	Rj← No; Rk← No
Execution complete	Functional unit done	
Write result	∀f((Fj(f)≠Fi(FU) or Rj(f)=No) & (Fk(f) ≠Fi(FU) or Rk(f)=No))	∀f(if Qj(f)=FU then Rj(f)← Yes); ∀f(if Qk(f)=FU then Rj(f)← Yes); Result(Fi(FU))← 0; Busy(FU)← No

Scoreboard Example

FP Add latency = 2 clocks, Multiply = 10, Divide = 40

Instruction status

Instruction		j	k	Issue	Read compl	Write Result
LD	F6	34+	R2			
LD	F2	45+	R3			
	F0	F2	F4			
SUBD	F8	F6	F2			
DIVD	F10	F0	F6			
ADDD	F6	F8	F2			

Functional unit status

Name	Busy	Op	dest Fi	S1 Fj	S2 Fk	Qj	FU for k Qk	Fj? Rj	Fk? Rk
Integer	No								
Mult1	No								
Mult2	No								
Add	No								
Divide	No								

Register result status

Clock	F0	F2	F4	F6	F8	F10	F12	...	F30
FU									

Scoreboard Example Cycle 62

Instruction status

		j	k	Read operand	comple	Write Result
LD	F6	34+	R2	1	2	3	4
LD	F2	45+	R3	5	6	7	8
	F0	F2	F4	6	9	19	20
SUBD	F8	F6	F2	7	9	11	12
DIVD	F10	F0	F6	8	21	61	62
ADDD	F6	F8	F2	13	14	16	22

	Name	Busy	Op	dest Fi	S1 Fj	S2 Fk	Qj	FU for k Qk	Fj? Rj	Fk? Rk
	Integer	No								
	Mult1	No								
	Mult2	No								
	Add	No								
0	Divide	No								

Register result status

Clock		F0	F2	F4	F6	F8	F10	F12	...	F30
62	FU									