

## Four Steps

**Issue** If a functional unit is free and no other active instruction has the same destination register, the scoreboard issues the instruction to the functional unit. This eliminates WAR hazards. If a structural or WAW hazard exists, then the instruction issue stalls, and no further instruction will issue.

**Read Operands** Scoreboard monitors the availability of the source operands. A source operand is available if no earlier issued active instruction is going to write it. When the source operands are available, the scoreboard tells the functional unit to proceed to read the operands from the registers and begin execution. Resolves RAW hazards.

**Execution** Functional unit begins execution upon receiving operands.

When the result is ready, it notifies the scoreboard that it has completed execution.

**Write Result** Once the scoreboard is aware that the functional unit has completed execution, the scoreboard checks for WAR hazards and stalls the completing instruction, if necessary.

## **Main parts to scoreboard**

- Instruction Status Indicates which of the four steps the instruction is in.
- Functional unit status Indicates the state of the functional unit.  
There are nine fields for each functional unit.
- Register result status Indicates which functional unit will write each register, if an active instruction has the register as its destination.  
This field is set to blank whenever there are no pending instructions that will write that register.

## Limitations

- The amount of parallelism among the instructions.
- The number of scoreboard entries.
- The number and type of functional units.
- The presence of antidependence and output dependence

## CDC 6600

- 16 functional units
- 7 for integer operations, 5 for memory references, 4 for floating-point units.
- Group the 16 functional units into 4 groups and have a set of buses called data trunks for each group.
- only one unit per group can read operands or write result per clock.