

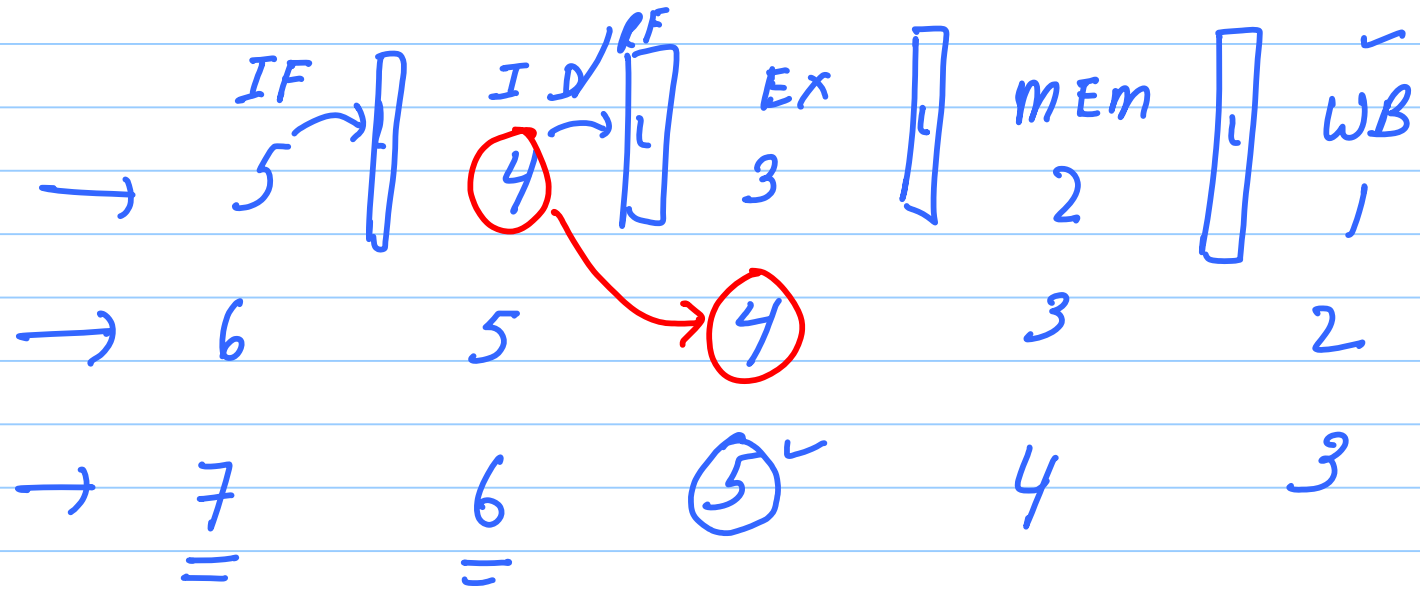
Oct 17th

Note Title

17-10-2011

Instruction Processing:

IF → ID_{RF} → EX → MEM → WB

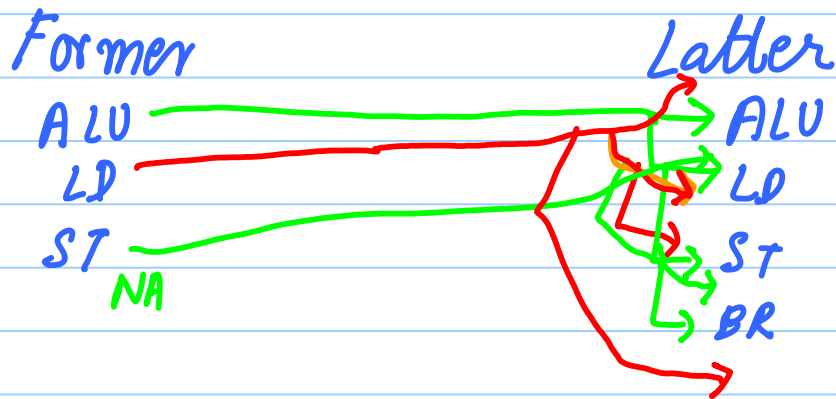
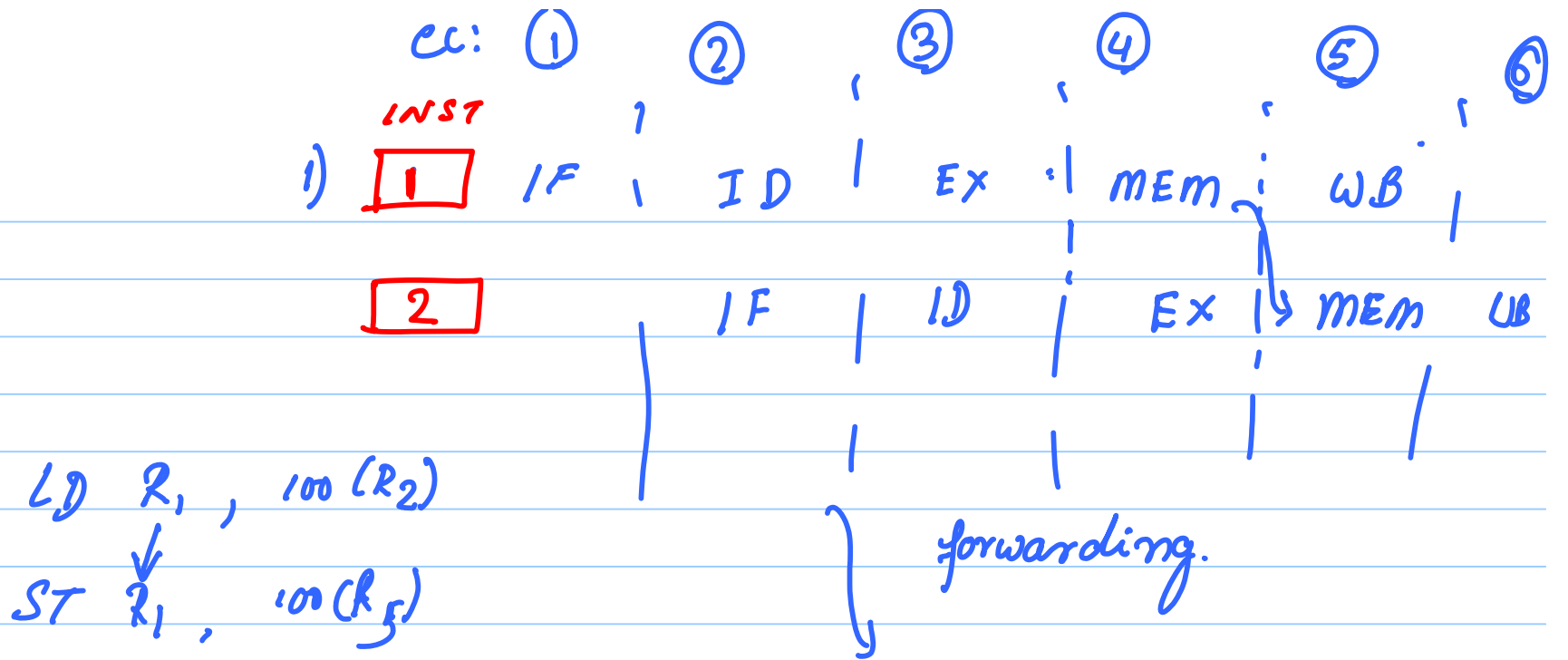


4 ADD (R_1) R_2, R_3
5 ADD $R_5, (R_1), R_6$

- 1) Data dependences (data hazards)
 - 2) Control dependences (control hazards)
 - 3) Structural hazards 4
-

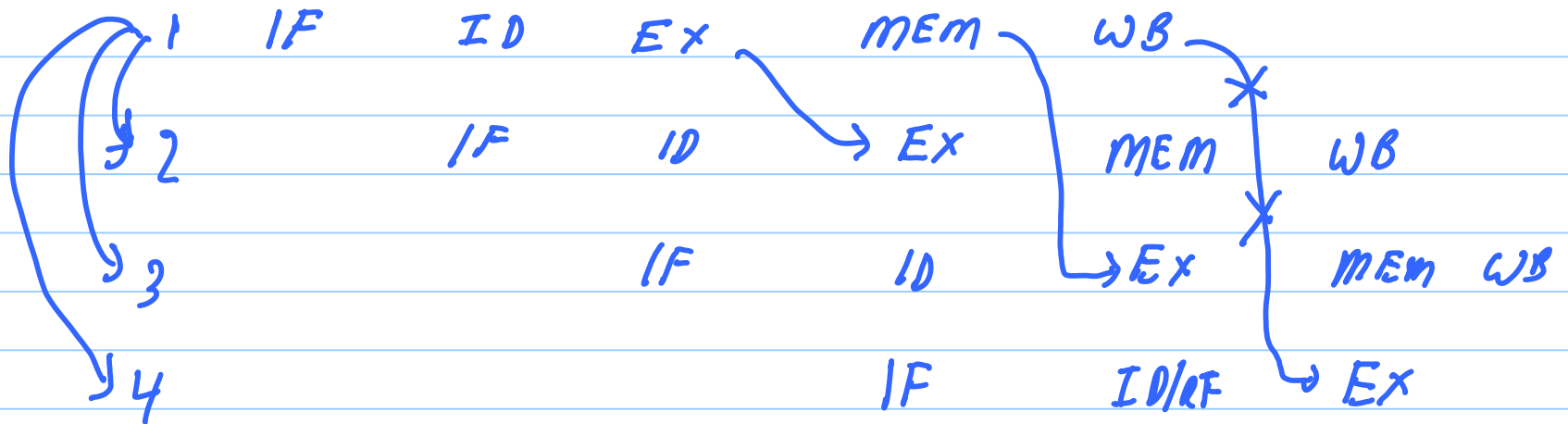
1) Data hazards

1) ADD R_3, R_1, R_2
2) ADD R_4, R_3, R_2

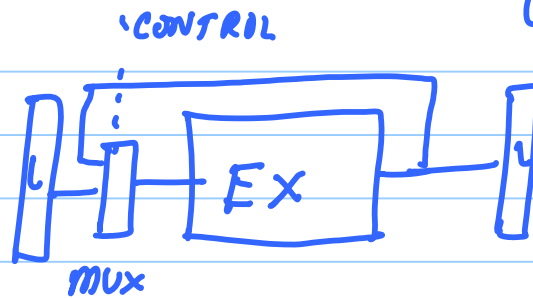


Load-Use hazard

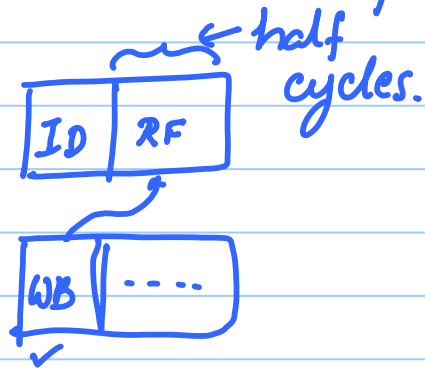
→ Cannot forward after load
in most cases.



How is forwarding achieved.
(EX - EX)



WB \rightarrow ID/RF (forwarding not required)



Three forwarding paths:

EX → EX
 MEM → EX
 MEM → MEM



Forwarding works
 other than
 — Load-Use
 hazard

If you cannot forward →



How to stall a pipeline:

- 1) Insert a NOP instruction
- 2) Freeze the previous stages for k cycles.
 $k \rightarrow$ length of the bubble.

Control Hazard: (BRANCH IN MIPS BEQ R₁, R₂, offset)

IF ID EX MEM WB



BRANCH: 2-cycle bubble

1) strategy: incur this penalty all the time.

2) predict the branch

verify the prediction in the EX stage

correct ✓

incorrect: remove the instructions in the IF & ID stage.

start fetching from the correct address