Lecture 8: Pipeline Hazards

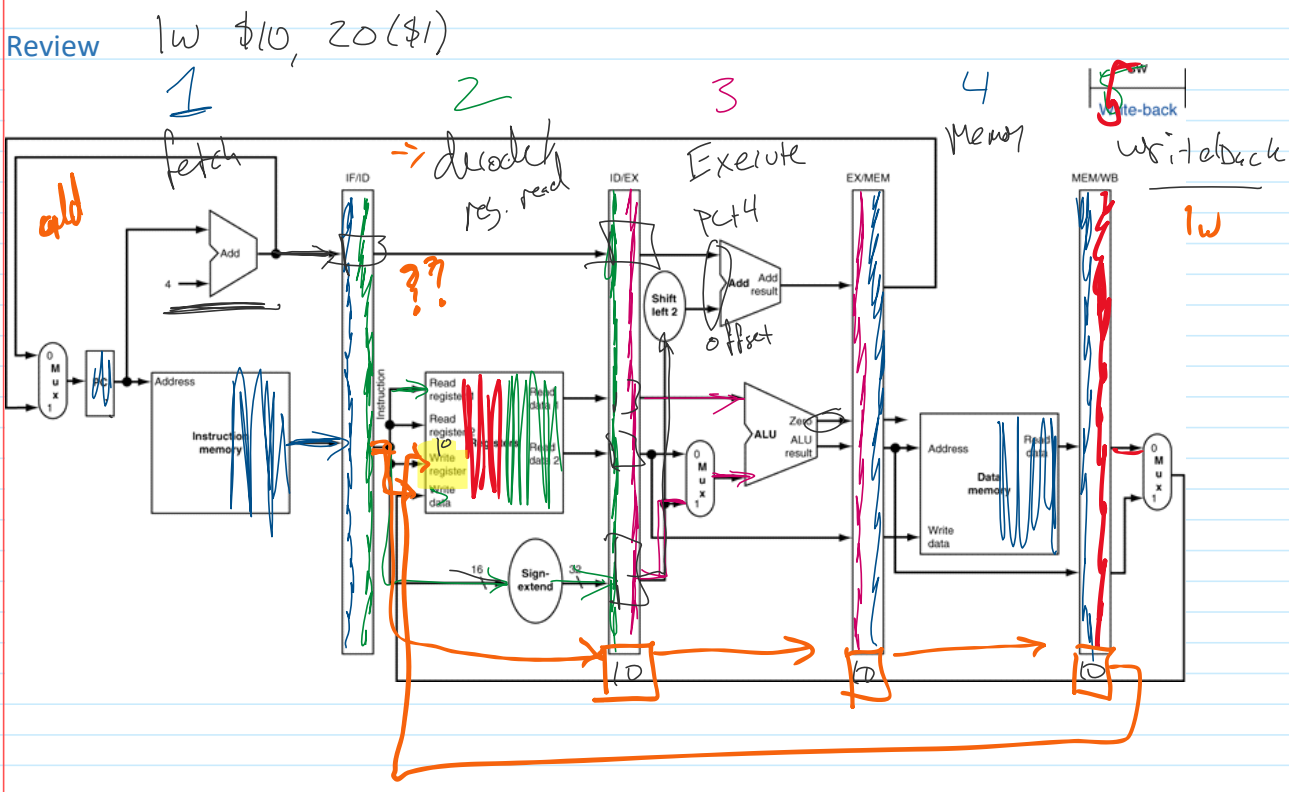
Wednesday, January 31, 2018 9:31 AM

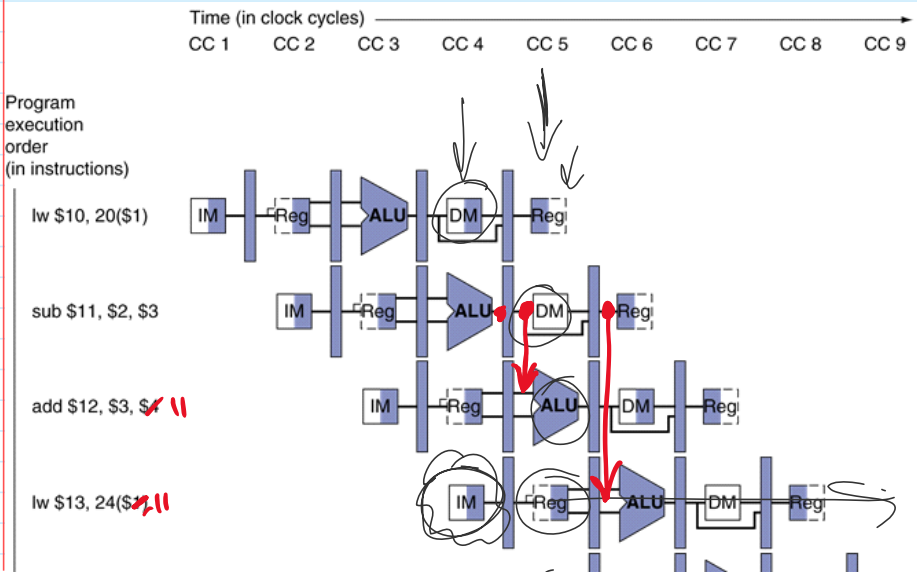
Outline

- Pipeline control details
- 3 types of hazards
- Solving hazards
- Hazard detection

Pipe control

Review

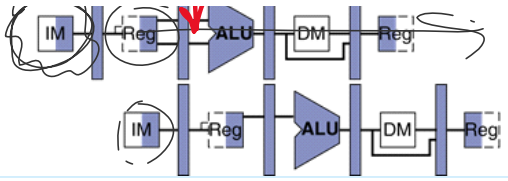


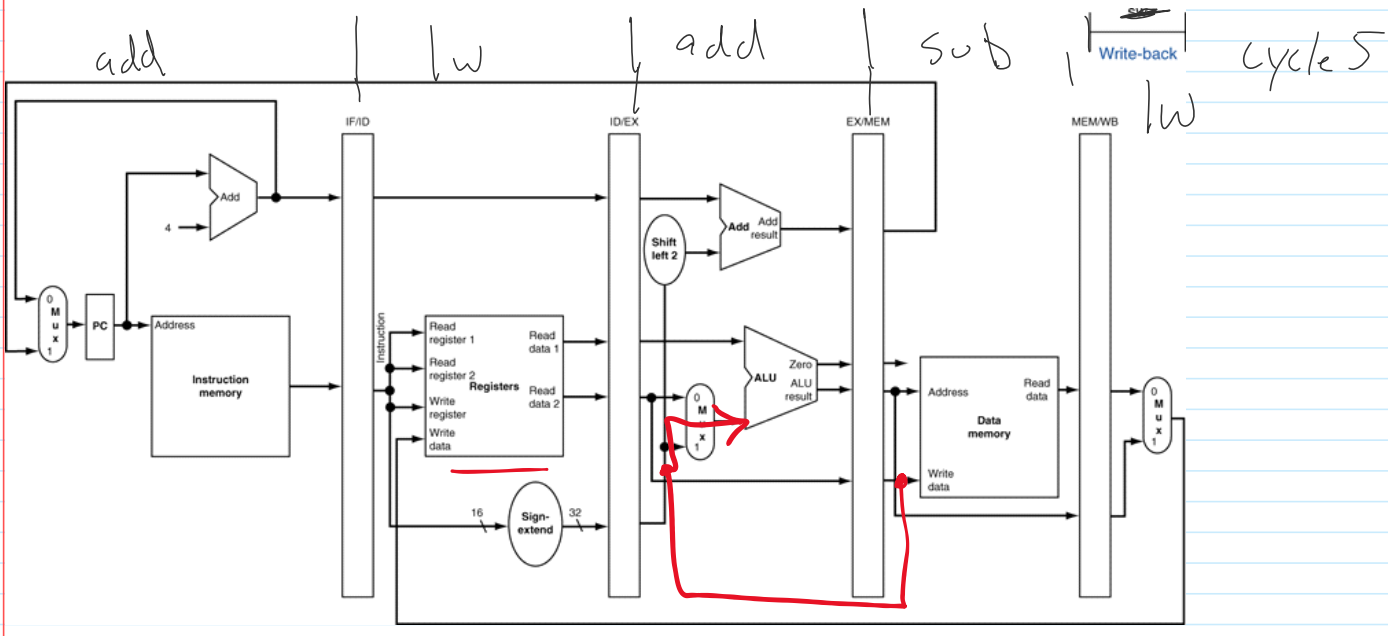


IF ID Ex M WB

lw $13, 24($11)

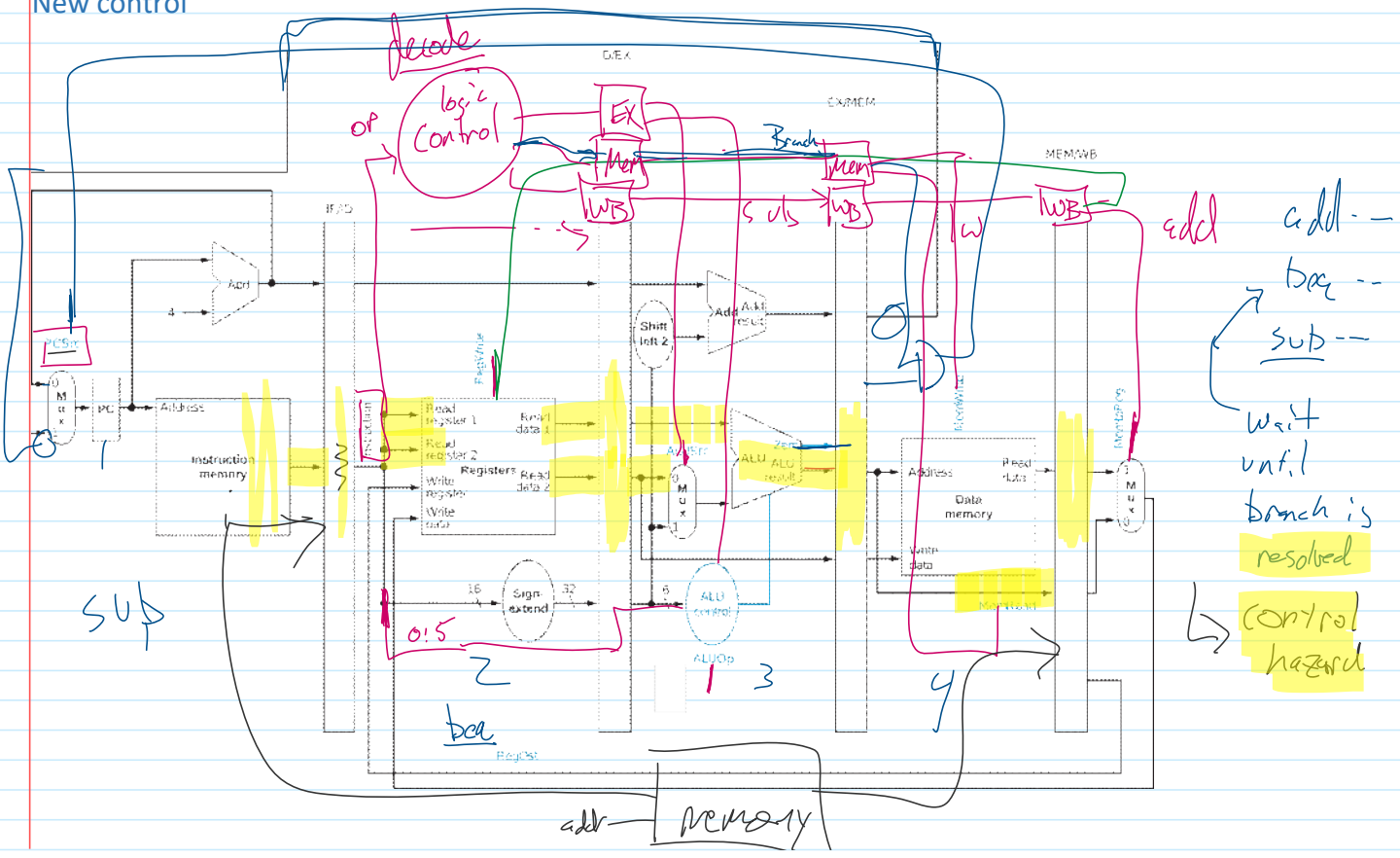
add $14, $5, $6

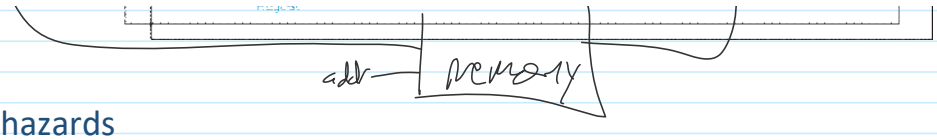




pipeline prf → instruction executed in parallel

New control





Three types of hazards

Control hazards → control instruction (jump or branch) that we must wait to find the next PC

Data hazards → younger instruction depends on the register value written by an older instruction still in pipeline

Structural hazard → Two instructions need to use same hardware

is → add $1, $2, $3 / sub $4, $1, $7

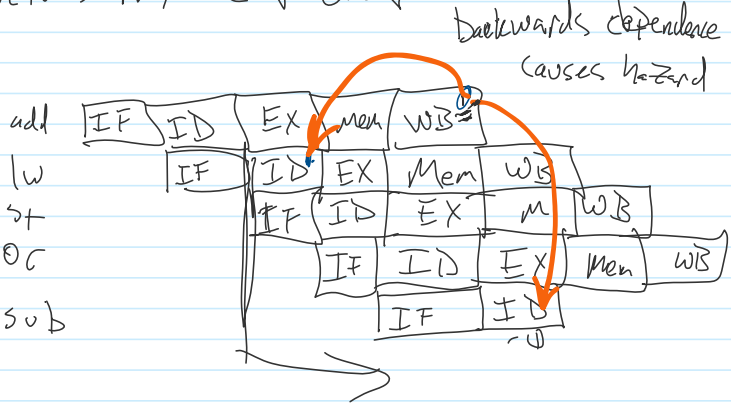
hazard → anything that causes a stall in the pipeline

Hazard depends on two things
- → Instructions + registers/structures they use + order
- → Datapath / pipeline design

```
add $1, $2, $3
lw  $10, 0($1)
st
OR
sub $7, $1, $8
```

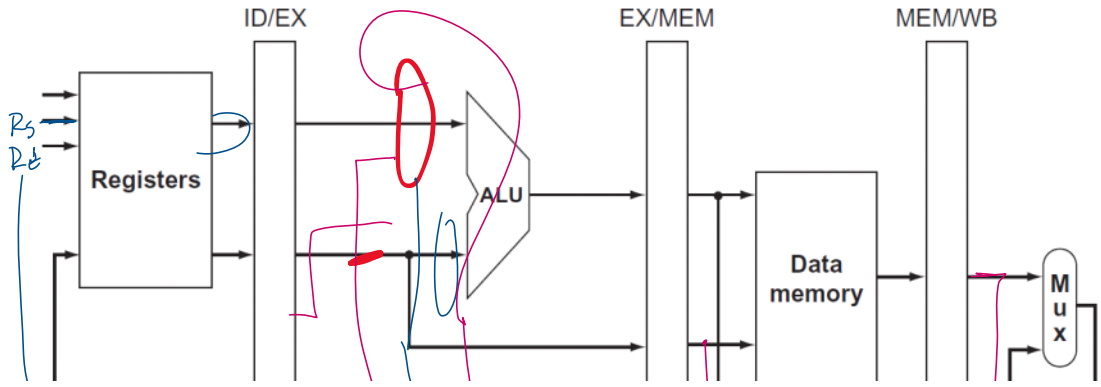
data dependence

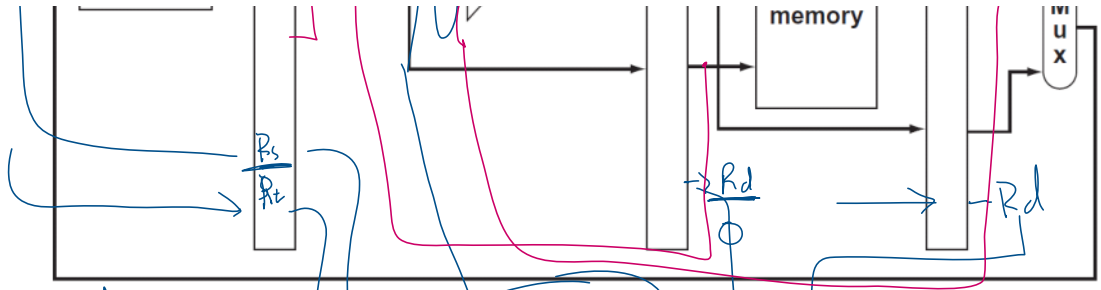
backwards dependence causes hazard



how to reduce hazards?
- Structural → add more hardware. Increases cost
- Control → prediction to "assume" taken or not
- Data hazards → forwarding / bypassing

Hazard detection





add $1, $2, $3
sub $7, $1, $6
rd (rs) rt

ID/Ex. Rs == Ex/Mem. Rd
Rt == Rd