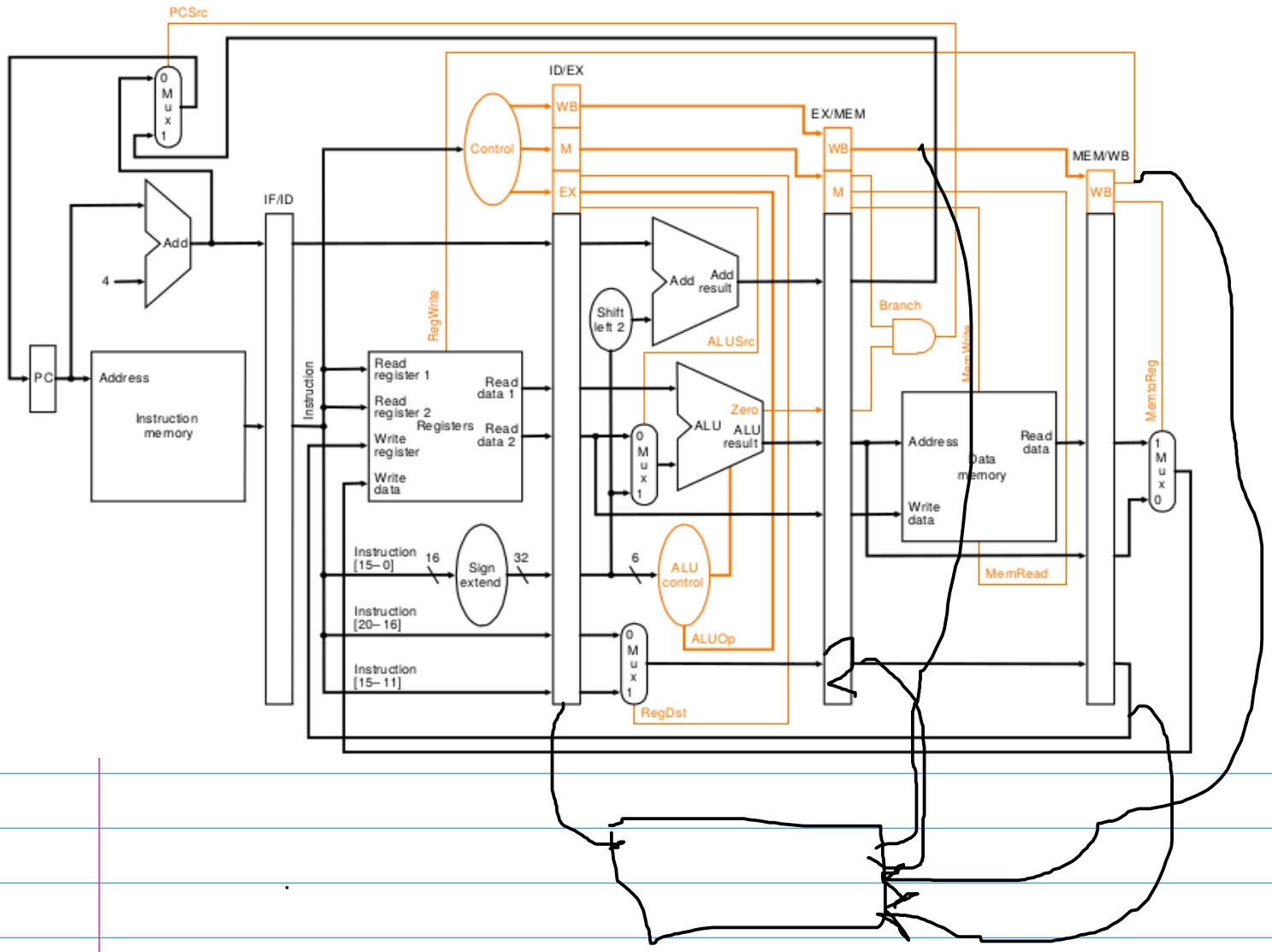
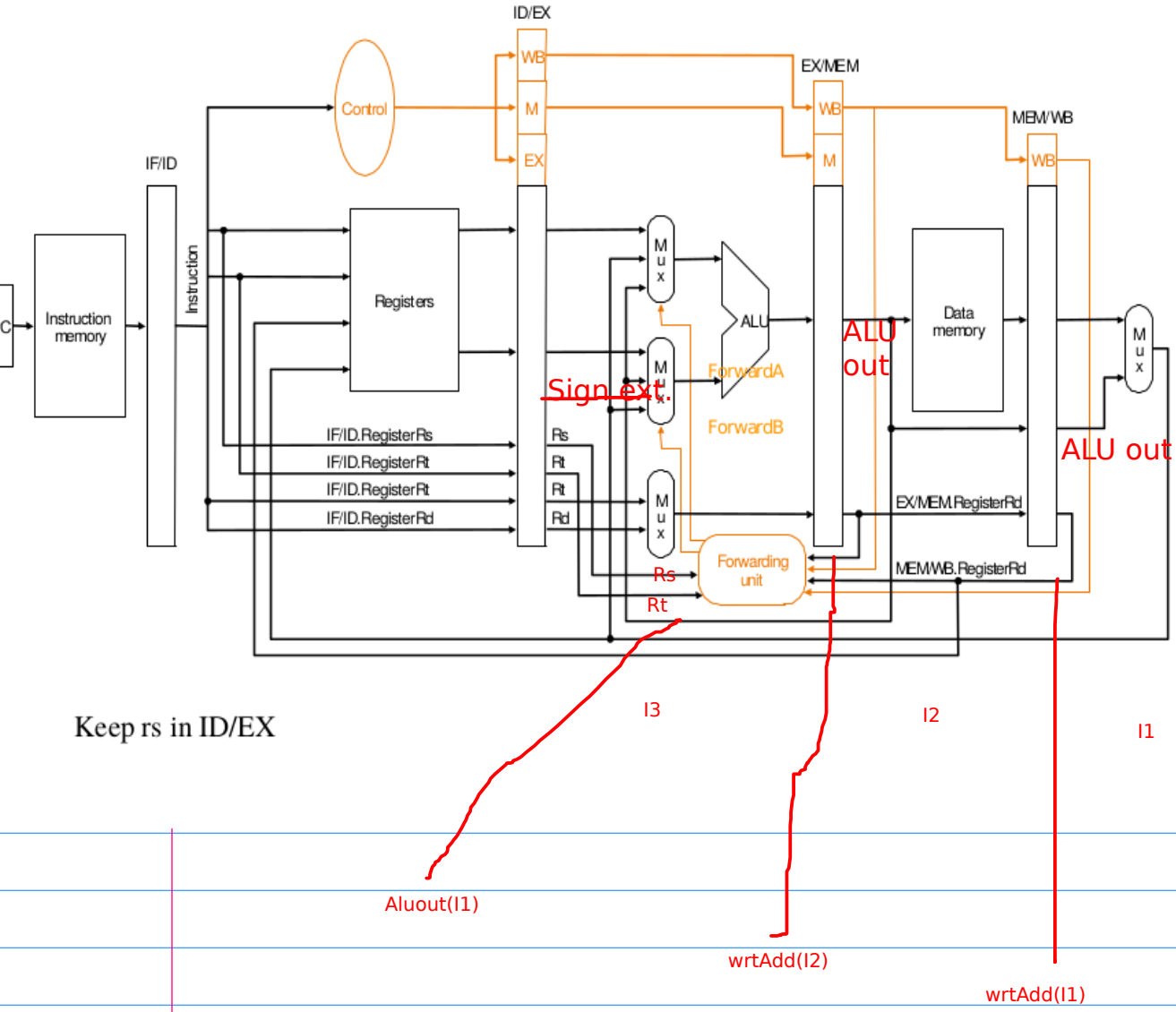
What is going on in cycle 4



ALU Forwarding -- Datapath & Control



Keep rs in ID/EX

I3

I2

I1

Aluout(I1)

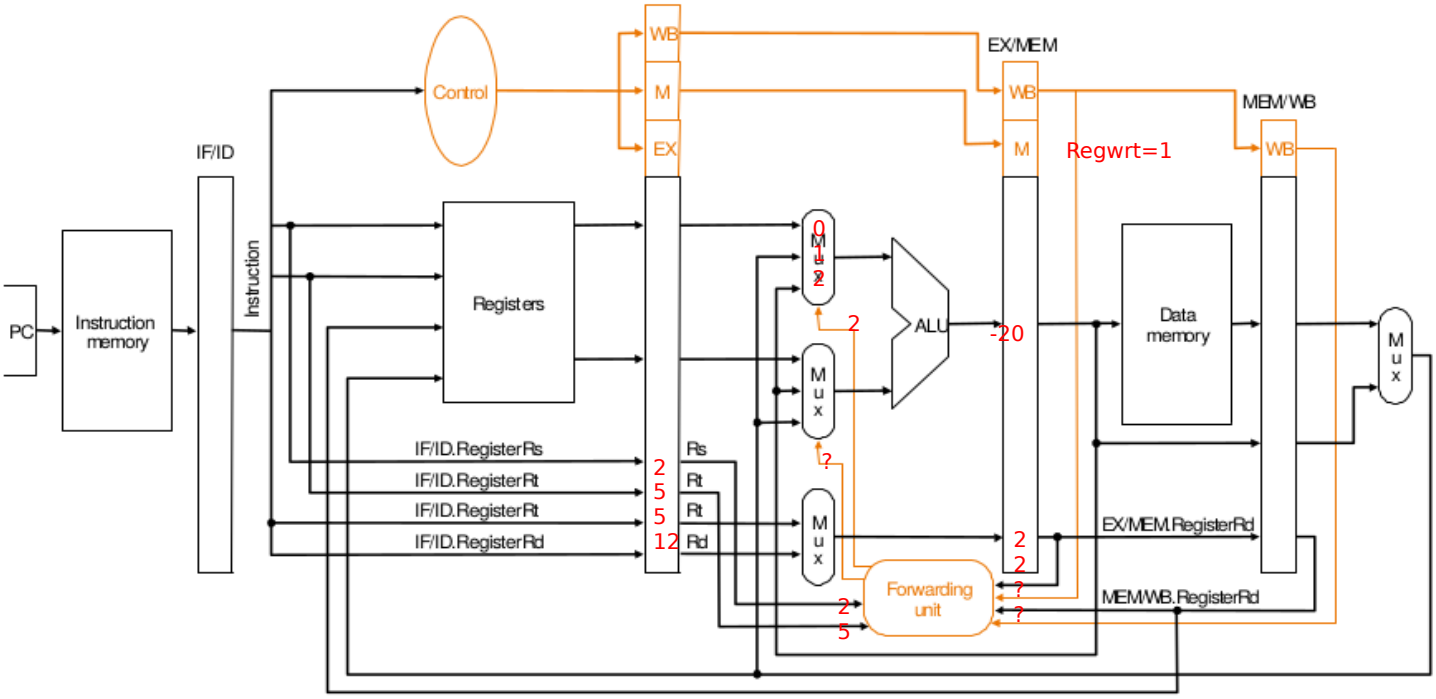
wrtAdd(I2)

wrtAdd(I1)

Or …

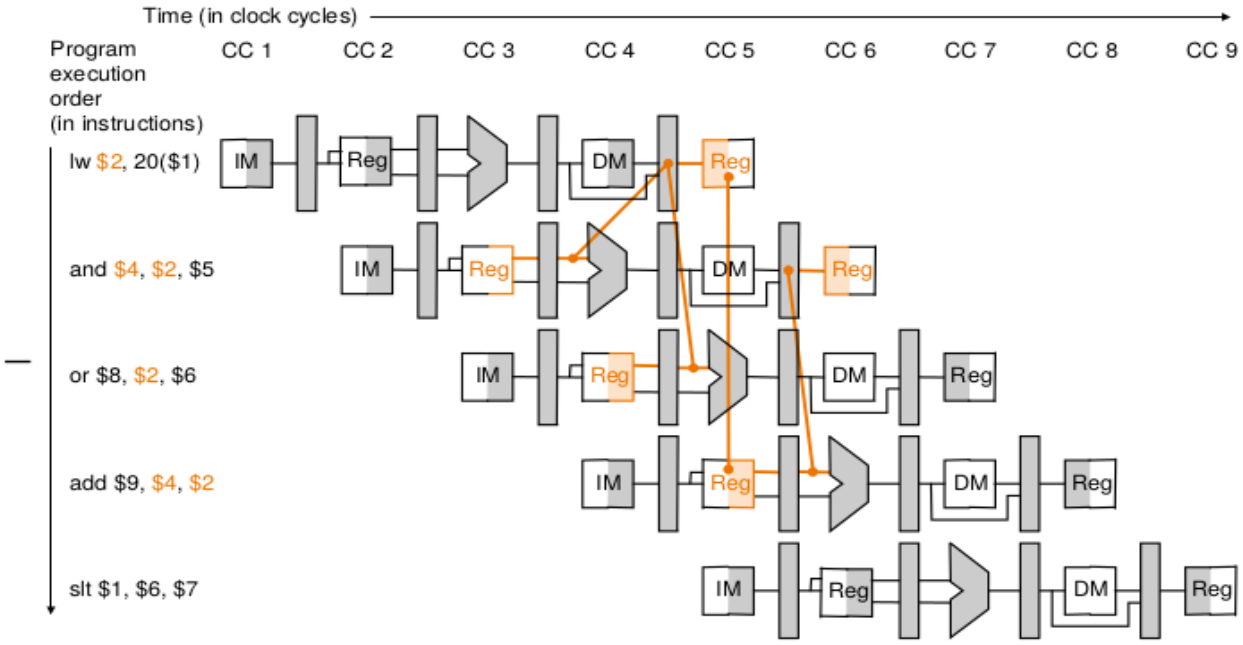
And $12, $2, $5

```
Sub $2, $1, $3
```



Can't always forward

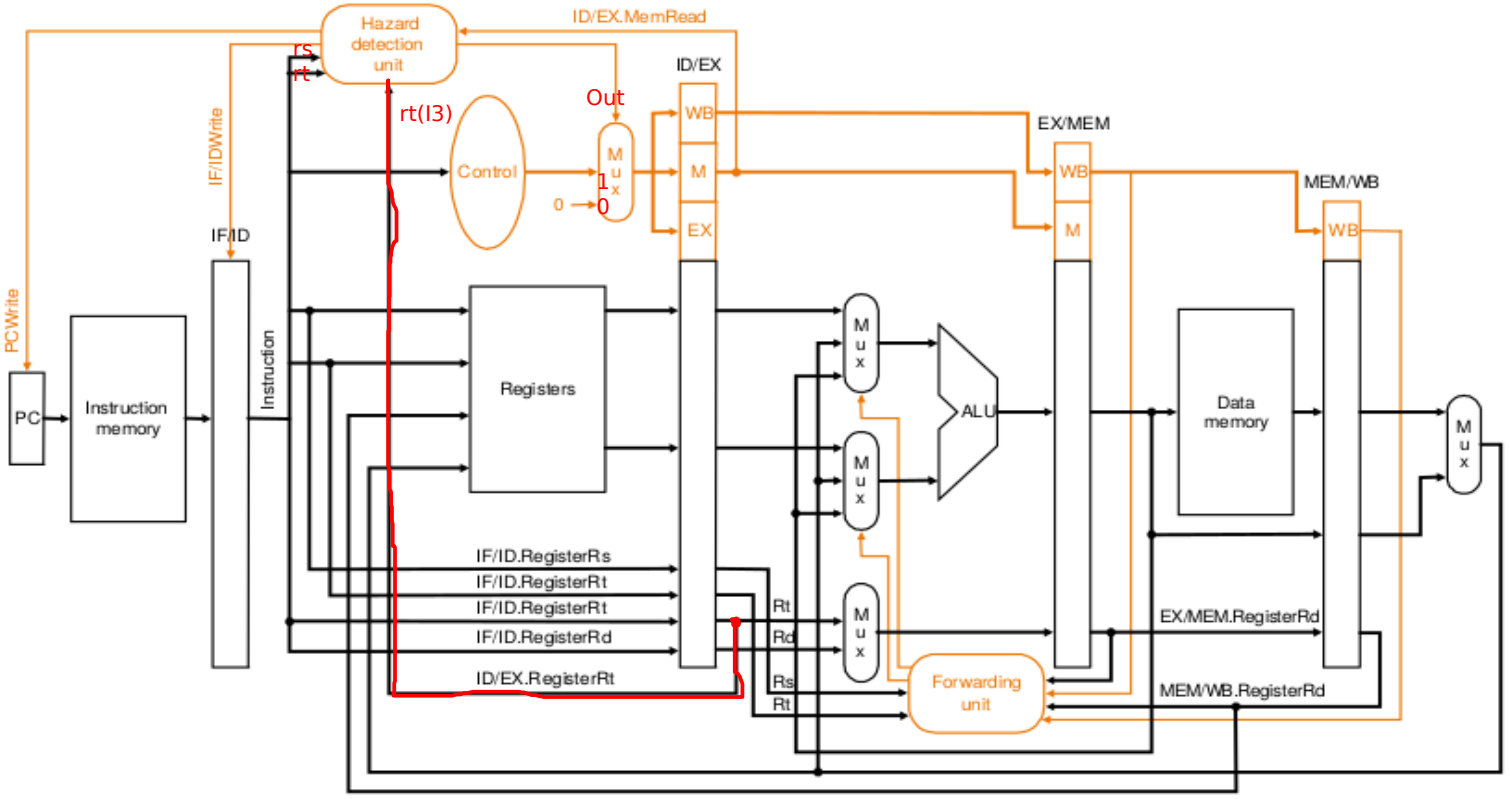
- Load word can still cause a hazard:
  - a read after a *lw* write to the same register.



Thus, we need a hazard detection unit to "stall" the load instruction

Hazard Detection Unit

- Stall by letting an instruction that won't write anything go forward



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I5 I4 I3 I2 I1

lw I3
I4

Detect exists lw - dep between I3 and I4

memRead(I3) = 1 ?
rt(I3) = rs(I4) ?
rt(I3) = rt(I4) ?

If exists hazard (lw)
pcwrt = 0 => I5 fetched twice
IF/ID wrt = 0
I4 stays in instruction decoding for 2 cycles
so I5 will be fetched twice - PC doesn't get updated

Out = 0 => 0.....0 control code