

Lecture 12: Hazards

Monday, February 4, 2019 8:56 AM

Outline

- Announcements
- Data hazards
 - How to improve performance?
- Structural hazards
- Control hazards

Don't forget feedback on the lab
Extra credit

Data hazard example, again

↳ when we need to stall the pipeline for data dependency between 2 instructions

↳ when a later inst uses register written by an earlier inst

init

x2 → 12
x3 → 13
x4 → 14
x5 → 15
x6 → 16
x7 → 17

add x2, x3, x4
x2 = 13 + 14 = 27

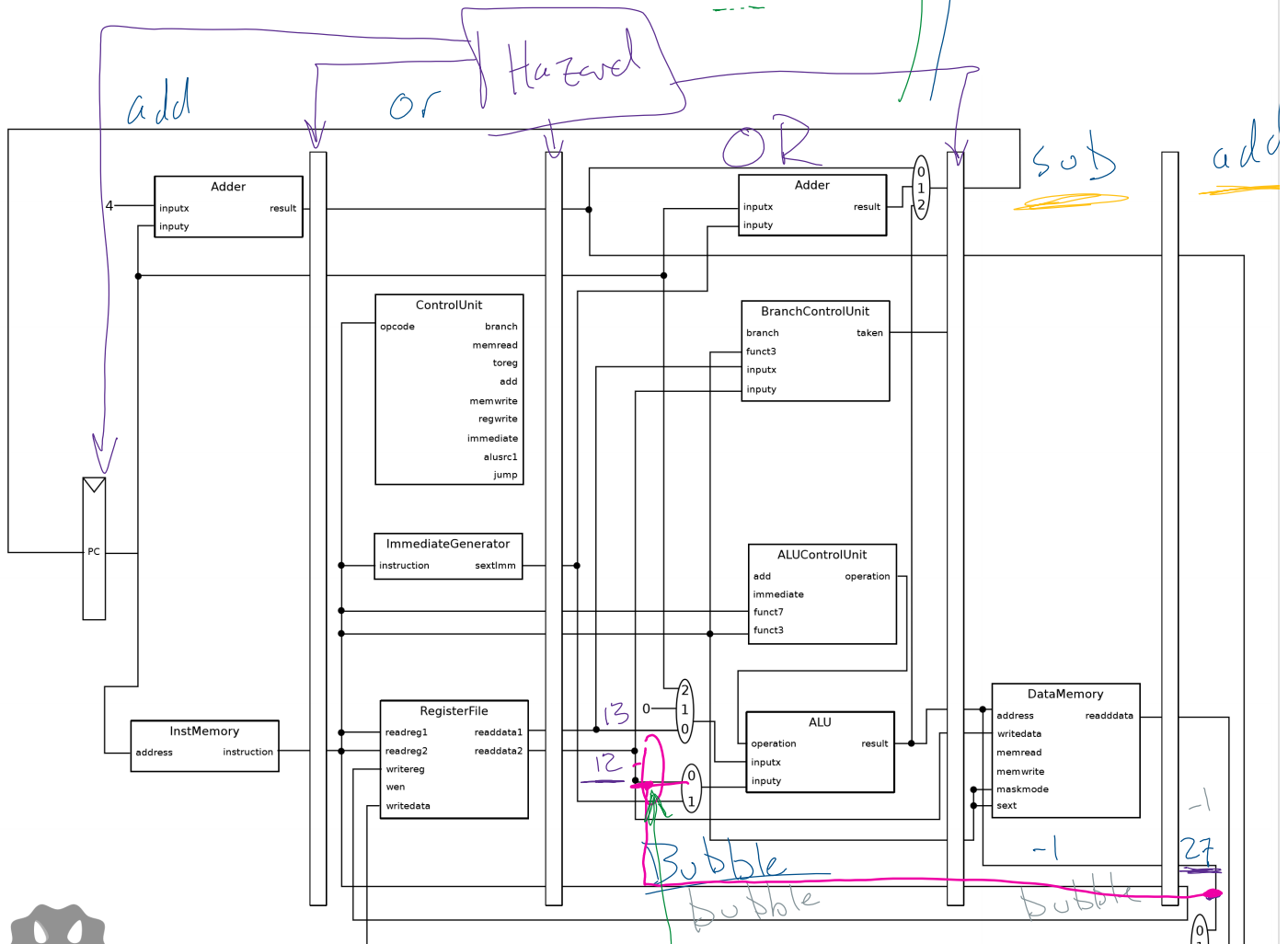
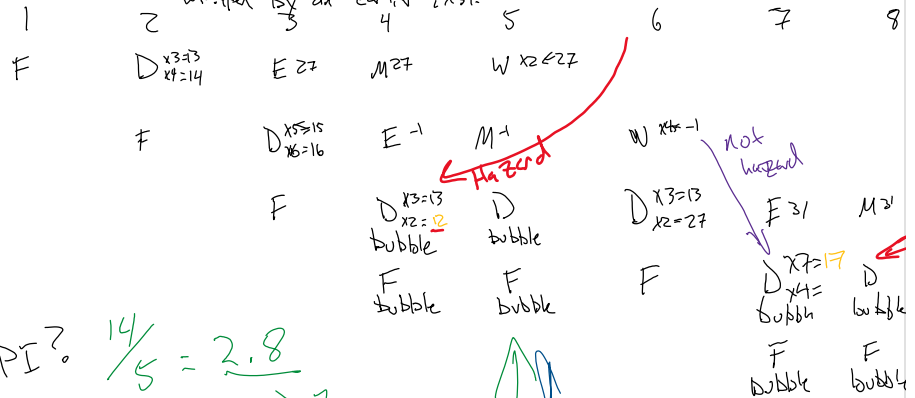
sub x4, x5, x6
x4 = 15 - 16 = -1

or x7, x3, x2
x7 = 13 | 27 = 31

add x8, x7, x4
x8 = 31 + -1 = 30

xor x9, x10, x11

CPI? $\frac{14}{5} = 2.8 > 1$





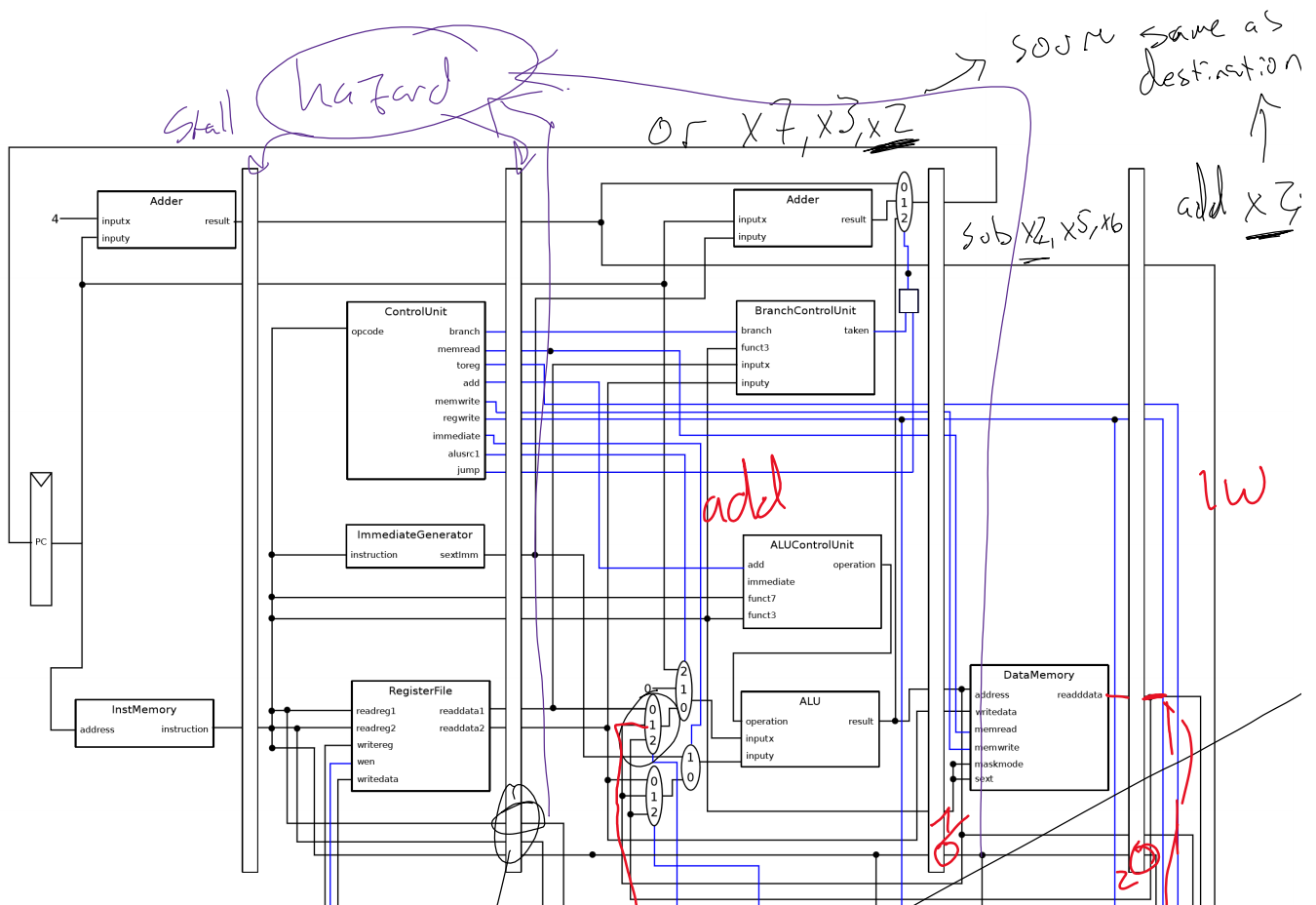
Five cycle DINO CPU

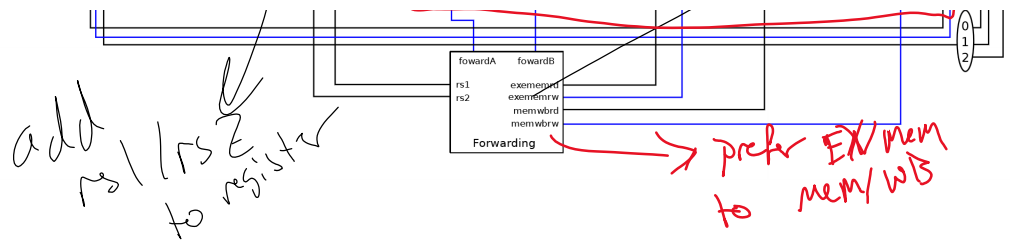
forwarding

add

	1	2	3	4	5	6	7	8	9
add x2, x3, x4 $x2 = 13 + 14 = 27$	F	D	E	M	W				
sub x4, x5, x6 $x4 = 15 - 16 = -1$		F	D	E	M	W			
or x7, x3, x2 $x7 = 13 \vee 27 = 31$			F	D	E	M	W		
add x8, x7, x4 $x8 = 31 + (-1) = 30$				F	D	E	M	W	
xor x9, x10, x11					F	D	E	M	W

CPI w/ forwarding? $\frac{9}{5} = 1.8$





lw x2, 1024(x3)

add x5, x3, x2

load to use hazard

1	2	3	4	5
F	D ^{x3} →	E ^{add}	M- ^{WB} value → x2	
	F	D ^{x2 =} D ^{x3 =}	E ^{bubble}	E

hazard