

HW 7

1. a. add \$3, \$4, \$2
- b. sub \$5, \$3, \$1
- c. lw \$6, 200(\$3)
- d. add \$7, \$3, \$6

RAW Deps:

1. b depends on a, \$3 → forward
2. c depends on a, \$3 → forward
3. d depends on a, \$3
4. d depends on c, \$6 → Stall 1, then forward loaded word from mem to EX (ALU)

	1	2	3	4	5	6	7	8	9	10
a	IF	ID	EX	Mem	WB					
b		IF	ID	EX	Mem	WB				
c			IF	ID	EX	Mem	WB			
d				IF	STALL	ID	EX	Mem	WB	

2. a) 1c for lw, 2c stall/bubble, 1c add, 2c stall/bubble

$1 + 2 + 1 + 2 = 6$ cycles, 2 instructions

$$\text{Avg CPI} = 6/2 = \boxed{3}$$

b) 1c lw, 1c stall, 1c add = 3 cycles

$$\text{Avg CPI} = 3/2 = \boxed{1.5}$$

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3. a.) $\text{CPI due to bubbles} = 0.15(1) + 0.1(2) = 0.35 \text{ cycles}$

$$\text{CPI No bubbles} = 1.0$$

$$\text{CPI with bubbles} = 1.35$$

35% increase

b.) $(1000/150)(1/1.35) = 4.938$

1. Yes, forwarding is possible

You will need to modify the data path. Data read from the data memory stage should be fed back. A control signal would also need to be created and possibly a forwarding unit that detects SW after LW and sends the forward signal

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6. a.)

	Right	Wrong
B1	3	0
B2	0	4
B3	3	3
B4	4	1
B5	5	2
Total	15	10

$$\text{Accuracy} = 1 \cdot 15/25 = .6 = 60\%$$

b.)

	Right	Wrong
B1	0	3
B2	4	0
B3	3	3
B4	1	4
B5	2	5
Total	10	15

$$\text{Acc} = 1 \cdot 10/25 = .4 = 40\%$$

c.

	R	W
B1	3	0
B2	3	1
B3	1	5
B4	3	2
B5	3	4
Total	13	12

$$\text{Acc} = 1 \cdot 13/25 = .52 = 52\%$$

d.

	R	W
B1	3	0
B2	3	1
B3	3	3
B4	4	1
B5	5	2
Total	18	7

$$\text{Acc} = 1 \cdot 18/25 = .72 = 72\%$$