

4.12 第八周

2.	L1	L2	L3	L4	L5	L6
L1	/					
L2	无	/				
L3	WAW	RAW	/			
L4	无	WAW	WAR	/		
L5	RAW	RAW	无	RAW	/	
L6	无	无	无	无	WAW	/

4. (1) $S = \frac{T_A}{T_B} = \frac{(5+5-1+1) \times 0.1ns \times \frac{1}{8}}{(8+(2-1+3)) \times 0.6ns \times \frac{1}{8}} = 1.21$

(2) $CPL_A = \lim_{N \rightarrow \infty} \frac{(2+N-1 + \frac{3}{8}N + 0.2 \times 0.05 \times 2 \times N)}{N} = 1.395$

$CPL_B = \lim_{N \rightarrow \infty} \frac{5+N-1 + \frac{N}{5} + 0.2 \times 0.05 \times 5 \times N}{N} = 1.25$

6. (1) 数据相关:

ld对a1写, addi对a1读和写	RAW, WAW
addi对a1写, sd对a1写	WAW
sd对a2读, addi对a2读和写	WAR
addi对a2写, sub对a2读	RAW
sub对a4写, bnez对a4读	RAW



(2)	1	2	3	4	5	6	7	8	9	10	11	12	13	14
ld a1, 0(a2)	IF	ID	EX	MEM	WB									
addi a1, a1, 1		IF	ID	S	S	EX	MEM	WB						
sd a1, 0(a2)			IF	ID	S	S	S	S	EX	MEM	WB			
addi a2, a2, 4				IF	ID	EX	MEM	WB						
sub a4, a3, a2					IF	ID	S	S	EX	MEM	WB			
bnez a4, Loop						IF	ID	S	S	S	S	EX	MEM	WB
共需 14 个时钟周期 共需 $\frac{100}{5} \times 14 = 280$ 个周期														

7. (1)	1	2	3	4	5	6	7	8	9	10
ld a1, 0(a2)	IF	ID	EX	MEM	WB					
addi a1, a1, 1		IF	ID	S	EX	MEM	WB			
sd a1, 0(a2)			IF	ID	EX	MEM	WB			
addi a2, a2, 4				IF	ID	EX	MEM	WB		
sub a4, a3, a2					IF	ID	EX	MEM	WB	
bnez a4, Loop						IF	ID	EX	MEM	WB

共需 $\frac{100}{5} \times 10 = 200$ 个周期

(2) 共需 $\frac{100}{5} \times 6 + \frac{1}{4} = 120.25$ 个周期



Instruction	1	2	3	4	5	6	7	8	9	10
addi rd, a1, 0(a2)	IF1	IF2	ID1	ID2	EX1	EX2	M1	M2	WB1	WB2
addi a1, a1, 1		IF1	IF2	ID1	ID2	S	S	S	EX1	EX2
sd a1, 0(a2)			IF1	IF2	ID1	ID2	EX1	EX2	M1	M2
addi a2, a2, 4				IF1	IF2	ID1	ID2	EX1	EX2	M1
sub a4, a3, a2					IF1	IF2	ID1	ID2	EX1	EX2
bnez a4, Loop						IF1	IF2	ID1	ID2	EX1

11 12 13 14 15

- ①
- ② M1 M2 WB1 WB2
- ③ WB1 WB2
- ④ M2 WB1 WB2
- ⑤ M1 M2 WB1 WB2
- ⑥ EX2 M1 M2 WB1 WB2

$$9 \times 20 + 6 = 186 \text{ 个周期}$$

$$(2) \text{CPI}_6 = \frac{14}{6} = \frac{2.33}{2.67} \quad \text{CPI}_{7n} = \frac{10}{6} = 1.67 \quad \text{CPI}_{7n2} = \frac{9}{6} = 1.5$$

$$\text{CPI}_{8n} = \frac{14}{6} = 2.33$$



19. (1) add addi ld sd bne jal jalr

是否 是否 是否 是否 是否 是否 是否

(2)

	1	2	3	4	5	6	7	8	9
lw a4, 0(a3)	IF	ID	EX	MEM	WB				
addw a1, a4, a1		IF	ID1	ID2	EX	MEM	WB		
addiw a2, a2, -1			IF	ID	EX	MEM	WB		
addiw a3, a3, 4				IF	ID	EX	MEM	WB	
bnez a2, Loop					IF	ID	EX	MEM	WB

9个周期

(3)

	1	2	3	4	5	6	7	8	9
lw a4, 0(a3)	IF	ID	EX	MEM	WB				
addw a1, a4, a1		IF	ID	EX	MEM	WB			
addiw a2, a2, -1			IF	ID	EX	MEM	WB		
addiw a3, a3, 4				IF	ID	EX	MEM	WB	
bnez a2, Loop					IF	ID	EX	MEM	WB

9个周期

