

第三章 2.4.6.7.8.19

2.	I1	I2	I3	I4	I5	I6
I1	-					
I2	\	-				
I3	WAW	RAW	-			
I4	\	WAW	WAR	-		
I5	\	-	RAW	RAW	-	
I6	\	\	\	\	XRAW	-

4. 1) $S = \frac{t_A}{t_B} = \frac{CPI_A \times T \times N}{CPI_B \times T \times N} = \frac{CPI_A \times T \times N}{CPI_B \times T \times N} \times \frac{1}{0.6} \times \frac{N+5.2-1}{N+7.425-1}$

$$= \frac{5}{3} \times \frac{N+4.2}{N+6.425}$$

2) $CPI_A = 0.8 \times 5.2 + 0.2 \times (5.2 + 5\% \times 2)$
 $= 5.2 + 0.2 \cdot 0.05 \times 2 = 5.202$

 $CPI_B = 7.425 + 0.2 \times 0.05 \times 5 = 7.43$

6. 1) Loop:
 ld a1, 0(a2),
 addi a1, a1, 1 } RAW, WAW
 sd a1, 0(a2) } RAW
 addi a2, a2, 4 } WAR
 sub a4, a3, a2 } RAW
 bneq a4, Loop } RAW



2)

ld a1, 0(a2)	IF	1 ID	2 EX	3 MEM	4 WB	5	6	7	8	9	10	11
addi a1, a1, 1	IF	2 ID	3 S	4 S	5 EX	6 MEM	7 WB	8	9	10	11	12
sd a1, 0(a2)	IF	3 ID	4 EX	5 S	6 S	7 S	8 S	9 MEM	WB	10	11	12
addi a2, a2, 4	IF	4 ID	5 S	6 EX	7 MEM	8 WB	9	10	11	12	13	14
sub a4, a3, a2	IF	5 ID	6 S	7 S	8 S	9 S	10 EX	11	12	13	14	15
bneq a4, Loop	IF	6 ID	7 S	8 S	9 S	10 S	11	12	13	14	15	16

一次循环 145 Cycles

25次循环

1 - a2=4 2 - a2=8 ... 25 a2=120

$145 \times 25 = 375$ cycles

7. 1)

ld a1, 0(a2)	IF	1 ID	2 EX	3 MEM	4 WB	5	6	7	8	9	10	11
addi a1, a1, 1	IF	2 ID	3 S	4 EX	5 MEM	6 WB	7	8	9	10	11	12
sd a1, 0(a2)	IF	3 ID	4 S	5 EX	6 MEM	7 WB	8	9	10	11	12	13
addi a2, a2, 4	IF	4 ID	5 S	6 EX	7 MEM	8 WB	9	10	11	12	13	14
sub a4, a3, a2	IF	5 ID	6 S	7 EX	8 MEM	9 WB	10	11	12	13	14	15
bneq a4, Loop	IF	6 ID	7 S	8 EX	9 MEM	10 WB	11	12	13	14	15	16

11

$11 \times 25 = 275$ cycles



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IF 级 工级 WB 级

2) 比较 前6 次 6 最后 11，最后一次跳错在 11 正

$$7 + 23 \times 6 + 11 = 7 + 138 + 11 = 156$$

8.1)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
ld a1, 0(a2)	IF1	IF2	ID1	ID2	EX1	FX2	M1	M2	WB1	WB2				
addi a1, a1, 1	IF1	IF2	ID1	ID2	S	S	S	EX1	EX2	M1	M2	WB1	WB2	
sd a1, 0(a2)	IF1	IF2	ID1	ID2	EX1	EX2	S	S	M1	M2	WB1	WB2		
addi a2, a2, 4	IF1	IF2	ID1	ID2	EX1	EX2	M1	M2	WB1	WB2				
sub a4, a3, a2	IF1	IF2	ID1	ID2	S	EX1	EX2	M1	M2	WB1				
bneq a4, Lop	IF1	IF2	ID1	ID2	S	S	EX1	EX2	M1	M2	WB1			

15
WB2
15
M2
16
WB1
17
WB2

$$9 \cancel{15} + 23 \times 7 + 17 = 187$$

$$6-2 \quad \frac{375}{6 \times 25} = \frac{375}{150} = 2.5$$

$$7-1 \quad \frac{275}{6 \times 25} \approx 1.83$$

$$7-2 \quad \frac{156}{6 \times 25} \approx 1.04$$

$$8-1 \quad \frac{187}{6 \times 25} \approx 1.296$$

1)	add	addi	ld	sd	bne	jal	jalr	
需要 2T?	✓	X	X	✓	✓	✓	✓	
2)	lw a4, 0(a3)	IF	ID	EX	MEM	WB	6	7
	addr a1, a4, a1	IF	ID	S	ID	EX	MEM	WB
	addiw a2, a2, 1	IF	ID	EX	MEM	WB		
	addiw a3, a3, 4	IF	ID	EX	MEM	WB		
	bneq a2, Lop	IF	S	S	ID	EX		
		MEM	WB					



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11

	1	2	3	4	5	6	7	8	9	10
3) lw a4, 0(a3)	IF	ID	EX	MEM	WB					
addr a1, a4, a1		IF	ID	S	EX	MEM	WB			
addiw a2, a2, f			IF	ID	S	EX	MEM	WB		
addiw a3, a3, 4				IF	ID	S	EX	MEM	WB	
bne2 a2, L20					IF	S	ID	EX	MEM	WB
	10									



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