

4月13日

~~$CPI_B = \frac{0.8N + K - 1 + 0.2N}{N}$~~

2.

	I ₁	I ₂	I ₃	I ₄	I ₅	I ₆
I ₁	-					
I ₂	-	-				
I ₃	WAW	RAW	-			
I ₄	-	WAR	WAR	-		
I ₅	RAW	RAW	RAW	RAW	-	
I ₆	-	-	-	-	RAW	-

4. 1) $S = \frac{S_B}{S_A} = \frac{1ns \times (N+5-1 + \frac{N}{5} \times 1)}{0.6ns \times (N+12-1 + \frac{N}{8} \times 3)}$

$= \frac{1ns \times (\frac{6}{5}N + 4)}{0.6ns \times (\frac{11}{8}N + 11)}$

$\approx \frac{16}{11}$

2) $CPI_A = \frac{\cancel{N+K-1} + N+5-1 + 0.2N \times 0.05 \times 2 + \frac{N}{5} \times 1}{N} = \frac{1.22N+4}{N}$

$CPI_B = \frac{N+12-1 + 0.2N \times 0.05 \times 5 + \frac{N}{8} \times 3}{N} = \frac{1.425N+11}{N}$

6. 1) RAW 读写序: $ld\ a1, 0(a2)$ 与 $addi\ a1, a1, 1$ 与 $sd\ a1, 0(a2)$
 $addi\ a2, a2, 4$ 与 $sub\ a4, a3, a2$.

$sub\ a4, a3, a2$ 与 $bnez\ a4, Loop$.

WAW 写序: $ld\ a1, 0(a2)$ 与 $addi\ a1, a1, 1$ 与 ~~$sd\ a1, 0(a2)$~~

WAR 写序: $addi\ a1, a1, 1$ 与 $sd\ a1, 0(a2)$
 $sd\ a1, 0(a2)$ 与 $addi\ a2, a2, 4$ 与 $ld\ a1, 0(a2)$

列表如下:

	I1	I2	I3	I4	I5	I6
I1	-					
I2	RAW	-				
I3	RAW	RAW	-			
I4	RAW			-		
I5	WAR	-	WAR	-		
I6	-	-	-	-	RAW	-

2)	1	2	3	4	5	6	7	8	9	10	11	12
$ld\ a1, 0(a2)$	IF	ID	EX	MEM	WB							
$addi\ a1, a1, 1$		IF	ID	S	S	EX	MEM	WB				
$sd\ a1, 0(a2)$			IF	S	S	ID	S	S	EX	MEM	WB	
$addi\ a2, a2, 4$				S	S	IF	S	S	ID	EX	MEM	WB

	9	10	11	12	13	14	15
$sub\ a4, a3, a2$	IF	ID	S	S	EX	MEM	WB
$bnez\ a4, Loop$	IF	S	S	S	EX	MEM	WB

共需18个周期.

7.1)	1	2	3	4	5	6	7	8	9
ld a1,0(a2)	IF	ID	EX	MEM	WB				
addi a1,a1,1		IF	ID	S	EX	MEM	WB		
sd a1,0(a2)			IF	S	ID	EX	MEM	WB	
addi addi a2,a2,4					IF	ID	EX	MEM	WB

	6	7	8	9	10	11	12	13
sub a4,a3,a2	IF	ID	EX	MEM	WB			
bnez a4,Loop		IF	ID	EX	MEM	WB		

共需 11 个周期

2) 此时, 应为 9 个周期.

8.1)	1	2	3	4	5	6	7	8	9	10
ld a1,0(a2)	ZF1	ZF2	ZD1	ZD2	EX1	EX2	M1	M2	WB1	WB2

	1	2	3	4	5	6	7	8	9	10
addi a1,a1,1		IF1	IF2	ID1	ZD2	S	S	S	EX1	EX2

	11	12	13	14	15	16	17	18	19	20
	M1	M2	WB1	WB2						

	1	2	3	4	5	6	7	8	9	10
ld a1,0(a2)			ZF1	ZF2	ID1	S	S	S	ID2	S

	11	12	13	14	15	16	17	18	19	20
	EX1	EX2	M1	M2	WB1	WB2				

	1	2	3	4	5	6	7	8	9	10
addi a2, a2, 4.				IF1	IF2	S	S	S	ID1	S
	11	12	13	14	15	16	17	18	19	20
	ID2	EX1	EX2	MEM1	M2	WB1	WB2			

	1	2	3	4	5	6	7	8	9	10
sub a4, a3, a2					IF1	IF2	S	S	S	IF2
	11	12	13	14	15	16	17	18	19	20
	ID1	ID2	S	EX1	EX2	M1	M2	WB1	WB2	

	1	2	3	4	5	6	7	8	9	10
mez a4, loop						IF			IF	S
	11	12	13	14	15	16	17	18	19	20
	IF	IF	S	ID	EX	EX	EX	EX		
						IF1	IF2			

故需要 17 个周期

$$6: CPL = \frac{18}{6} = 3.$$

$$7: 1) CPL = \frac{11}{6} = \frac{11}{6}$$

$$2) CPL = \frac{9}{6} = \frac{3}{2}$$

$$8: CPL = \frac{17}{6}$$

19. 1) add addi ld sd bne jal jalr

是弱序 ✓ X X ~~✓~~ ✓ ✓ X X

2)	1	2	3	4	5	6	7	8
lw a4, 0(a3)	IF	ID	EX	MEM	WB			
addw a1, a4, a1		IF	ID	ID	EX	EX	MEM	WB
addi w a2, a2, -1			IF	ID	IF	S	ID	EX MEM
				9				
				WB				
	6	7	8	9	10	11	12	
addi w a3, a3, 4	IF	ID	EX	MEM	WB			
bnez a2, Loop		IF	ID	EX	MEM	EX	MEM	WB.
					EXE			

周期数为 12

3)	1	2	3	4	5	6	7	8	9	10
lw a4, 0(a3)	IF	ID	EX	MEM	WB					
addw a1, a4, a1		IF	ID	S	EX	MEM	WB			
addi w a2, a2, -1			IF	S	ID	EX	MEM	WB		
addi w a3, a3, 4				IF	IF	ID	EX	MEM	WB	
bnez a2, Loop						IF	ID	EXE	MEM	WB

周期数为 10.