

C3

6.

2.

I1	I2	I3	I4	I5	I6	
I1	-					1) Id a1,0(a2) } RAW addi a1,a1,1 } RAW sd a1,0(a2) } RAW
I2	-					addi a2,a2,4 } RAW sub a4,a3,a2 } RAW bneq a4,Loop } RAW
I3	RAW	-				
I4			-			
I5		RAW	-			2) IF 1 2 3 4 5 6 7 8 9
I6			RAW			Id a1,0(a2) IF ID EX MEM addi a1,a1,1 IF ID S EX MEM WB

4.

(1)	A: CPI = $1 + \frac{1}{5} = \frac{6}{5}$	sd a1,0(a2) IF S ID EX S MEM
	B: CPI = $1 + \frac{1}{8} \times 3 = \frac{11}{8}$	addi a2,a2,4 IF ID S EX MEM
	$S = \frac{Ins \times CPI_A}{0.6nS \times CPI_B} = \frac{1 \times \frac{6}{5}}{0.6 \times \frac{11}{8}} = \frac{16}{11}$	sub a4,a3,a2 IF S ID S
	加速比是 $\frac{16}{11}$	bneq a4,Loop IF S ID S

(2)	A: 分支指令 $\rightarrow 2 \times 5\% + 1 \times 95\% = 1.05$	sub a4,a3,a2 S EX MEM WB
	CPI = $\frac{6}{5} \times (80\% \times 1 + 20\% \times 1.05) = \frac{303}{250}$	bneq a4,Loop S ID S EX MEM WB
	B: $5 \times 5\% + 1 \times 95\% = 1.2$	

$$CPI = \frac{11}{8} \times (80\% \times 1 + 20\% \times 1.2) = \frac{143}{100}$$

共需要400个时钟周期 $16 \times \frac{100}{4} = 400$

$$A: CPI = 1.212$$

$$B: CPI = 1.43$$

$$S: CPI = 1.05$$

7.

1 2 3 4 (5) 6 7 8 9
 ld a1,0(a2) IF ID EX MEM WB1, WB2
 addi a1,a1,1 IF ID S EX MEM WB
 sd a1,0(a2) IF S ID EX MEM WB1, WB2
 addi a2,a2,4 IF ID S EX MEM WB
 sub a4,a3,a2 IF ID EX MEM WB1, WB2
 bneq a4,Loop IF ID EX WB1, WB2
 // sub a4,a3,a2 WB1, WB2

共需要275个时钟周期

$$11 \times 25 = 275$$

2) 分支预测准确

- 轮 6个指令

$$6 \times 25 + (11 - 1) = \frac{160}{11} \text{ 个时钟周期}$$

8.
 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 (1)
 ld a1,0(a2) IF1 IF2 ID1 ID2 EX1 EX2 MEM1 MEM2
 addi a1,a1,1 IF1 IF2 ID1 ID2 S S EX1 EX2 MEM1 MEM2 WB1 WB2
 sd a1,0(a2) IF1 IF2 ID1 ID2 S S ID2 EX1 EX2 S S MEM1 MEM2 WB1 WB2
 addi a2,a2,4 IF1 IF2 S S S ID1 ID2 EX1 S EX2 MEM1 MEM2 WB1 WB2
 sub a4,a3,a2 IF1 IF2 S S S ID2 ID1 ID2 S S EX1 EX2 MEM1 MEM2
 bneq a4,Loop IF1 IF2 ID1 S S ID2 S EX1 EX2
 // sub a4,a3,a2 WB1 WB2
 bneq a4,Loop MEM1 MEM2 WB1 WB2

18 19 20 21



扫描全能王 创建

有分支预测器 - 轮 6 个微

$$6 \times 25 + (21 - 1) = 170 \text{ 个时钟周期}$$

2) 对 6. 题 2)

$$CPI = 1 + \frac{1}{6} \times (6+4) = \frac{8}{3}$$

对 7. 题 1)

$$CPI = 1 + \frac{1}{6} \times (1+4) = \frac{11}{6}$$

对 7. 题 2)

$$CPI = 1 + \frac{1}{6 \times 25} \times \frac{1}{6} \times 1 = \frac{7}{6}$$

对 8. 题 1)

$$CPI = 1 + \frac{1}{6} \times \frac{1}{6} \times 6 = 2$$

19.

a) add addi ld sd bne jal jalr

题需 是 否 否 是 否 否
要2周期

2) 1 2 3 4 5 6 7 8 9 10 11

lw a4,0(a3) IF ID EX MEM

addw a1,a4,a1 IF ID1 ID2 EX MEM WB

addiw a2,a2,-1 IF ID EX MEM WB

addiw a3,a3,4 IF S ID EX MEM WB

bnez a2, Loop IF ID S EX MEM WB

循环单次迭代需要 11 个周期

3) 1 2 3 4 5 6 7 8 9 10

lw a4,0(a3) IF ID EX MEM

addw a1,a4,a1 IF S 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

单次迭代需要 10 个周期



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