

I1 I2 I3 I4 I5 I6

2. I1

I2 1 - 1

I3 WAW RAW -

I4 WAW WAR \ J - T1

I5 RAW RAW \

I6 RAW \

4. (1) $T_A = 1\text{ns}, CPI_A = N + 4 + \frac{N}{5}$

$T_B = 0.6\text{ns}, CPI_B = N + 11 + 3 \cdot \frac{N}{8}$

$$S = \frac{T_A \cdot CPI_A}{T_B \cdot CPI_B} = \frac{\frac{6N+20}{33}}{\frac{33N+33}{8}} = \frac{48}{33} \cdot \frac{16}{224} \cdot \frac{1}{(N+8)}$$

(2) $CPI_A = N + 4 + \frac{N}{5} + 2 \cdot N \cdot 20\% \cdot 5\% = 1.22N + 4$

$$CPI_B = N + 11 + \frac{3N}{8} + 5N \cdot 20\% \cdot 5\% = 1.425N + 11$$

6. (1) ① ld a1, 0(a2); addi a1, a1, 1 RAW

② addi a1, a1, 1; sd a1, 0(a2) RAW

③ sd a1, 0(a2); addi a2, a2, 4 RAW

④ addi a2, a2, 4; sub a4, a3, a2 RAW

⑤ sub a4, a3, a2; bnez a4, Loop RAW

⑥ addi a2, a2, 4; ...; ld a1, 0(a2). RAW



扫描全能王 创建

(2) 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15

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 EX MEM WB

addi a2, a2, 4 IF ID S S S S EX S MEM WB

sub a4, a3, a2 IF ID S S S S S S S S EX S

bnez a4, Loop IF ID S S S S S S S S S S S

15 16 17 18 19 20 21 22

sub a4, a3, a2 S MEM WB

bnez a4, loop S S S EX S MEM WB

- 共 21 个 CLK IF

7. W 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16

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 S EX MEM WB

addi a2, a2, 4 IF ID S S EX MEM WB

sub a4, a3, a2 IF ID S S EX MEM WB

bnez a4, loop IF ID S S EX MEM WB

- 共 12 个 CLK IF

v) 下一周期在 bnez a4, loop 完成 EX 行开始

故 CLK 变为 10



扫描全能王 创建

8.

1 2 3 4 5 6 7 8 9 10 11 12

ld a1, 0(a2)	IF1	IF2	ID1	ID2	EX1	EX2	M1	M2	WB1	WB2		
addi a1, a1, 1	IF1	IF2	ID1	ID2	S	S	S	S	EX1	EX2	M1	M2
sd a1, 0(a2)	IF1	IF2	ID1	ID2	S	S	S	S	SEX1	EX2	M1	
addi a2, a2, 4	IF1	IF2	ID1	ID2	S	S	S	S	S	S	S	
sub a4, a3, a2	IF1	IF2	ID1	ID2	S	S	S	S	S	S	S	
bnez a4, Loop	IF1	IF2	ID1	ID2	S	S	S	S				
	13	14	15	16	17	18	19	20	21	22	23	

ld ..

addi .. WB1 WB2

sd .. M2 WB1 WB2

addi .. S EX1 EX2 M1 M2 WB1 WB2

sbt .. S S S EX1 EX2 M1 M2 WB1 WB2

bnez .. S S S S S EX1 EX2 M1 M2 WB1 WB2

ld a1, 0(a2)

IF1 IF2

-步 ²⁰ 个 CLK

$$(2) G(2): CPI = \frac{21}{6} = \frac{7}{2}$$

$$7(1): CPI = \frac{12}{6} = 2$$

$$7(2) H: CPI = \frac{10}{6} = \frac{5}{3}$$

$$8(1): CPI = \frac{19}{6}$$



扫描全能王 创建

(1) w) addl addi ld sd bne jal jalr
是 否 否 否 是 否 否

(2) 1 2 3 4 5 6 7 8 9 10 11 12

lw a4, 0(a3) IF ID EX MEM WB

addw a1, a4, a1 IF ID, ID S EX MEM WB

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

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

bnez a2, Loop IF ID S S S EX MEM WB

- 共 12 个 CLK

(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

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

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

bnez a2, Loop IF ID S EX MEM WB

- 共 10 个 CLK



扫描全能王 创建