

## Ex1

```
ex1:    LI      x5,0
        SD      x5,7000(x0) ;store i
loop:   LD      x5,7000(x0) ;get value of i
        SLLI    x6,x5,3     ;x6=i*8
        LD      x7,3000(x6) ;load B[i]
        LD      x8,5000(x0) ;load C
        ADD     x9,x7,x8     ;B[i]+C
        SD      x9,1000(x6) ;store A[i]
        ADDI    x5,x5,1      ;i=i+1
        SD      x5,7000(x0) ;load i
        LI      x10,100
        BLE     x5,x10,loop
```

指令执行的次数:

$$2 + (10 * 101) = 1012$$

指令大小:

$$4 * 12 = 48 \text{ bytes}$$

## Ex2

1.		<b>[11:10]</b>	<b>[9:5]</b>	<b>[4:0]</b>
	3个两地址指令	'00', '01', '10'	'00000' to '11111'	'00000' to '11111'
	30个单地址指令	'11'	'00000' to '11101'	'00000' to '11111'
	45个零地址指令	'11'	'11110'	'00000' to '11111'
		'11'	'11111'	'00000' to '01100'

存在符合要求的指令编码

2.		<b>[11:10]</b>	<b>[9:5]</b>	<b>[4:0]</b>
	3个两地址指令	'00', '01', '10'	'00000' to '11111'	'00000' to '11111'
	31个单地址指令	'11'	'00000' to '11110'	'00000' to '11111'
	32个零地址指令	'11'	'11111'	'00000' to '11111'

最多存在32个零地址指令，所以不存在符合要求的指令编码

3.		[11:10]	[9:5]	[4:0]
	3个两地址指令	'00', '01', '10'	'00000' to '11111'	'00000' to '11111'
	24个零地址指令	'11'	'00000'	'00000' to '10111'
	31个单地址指令	'11'	'00001' to '11111'	'00000' to '11111'

最多可以为这一处理器编码31个单地址指令

### Ex3

1.	43	4F	4D	50	55	54	45	52
	C	O	M	P	U	T	E	R
2.	52	45	54	55	50	4D	4F	43
	R	E	T	U	P	M	O	C

3. 4F4D, 5055, 5445

4. 45545550, 5455504D, 55504D4F

### Ex4

1.  $2ns + 0.1ns = 2.1ns$

2.  $5 \text{ cycles} / 4 \text{ instructions} = 1.25$

3. 执行时间 = 指令数 \* CPI \* 时钟周期

加速比 =  $(\text{指令数} * 1 * 7) / (\text{指令数} * 1.25 * 2.1) = 2.67$

### Ex5

1. 仅考虑数据冒险时: 5级流水线CPI = 6 / 5; 12级流水线CPI = 11 / 8

$$\text{加速比} = \frac{(6/5) * 1 * \text{指令数}}{(11/8) * 0.6 * \text{指令数}} = 1.45$$

2. 考虑分支错误的停顿时:

$$\text{CPI} = \text{分支预测指令 CPI} + \text{非分支预测指令 CPI}$$

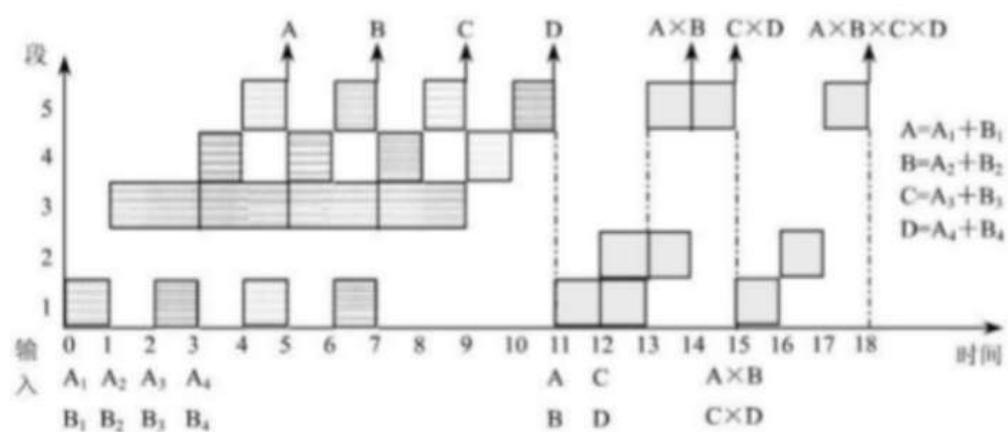
$$= 0.2 * \text{CPI} * 0.95 + 0.2 * (\text{CPI} + \text{CPI}_{\text{额外}}) * 0.05 + 0.8 * \text{CPI}$$

$$= \text{CPI} + 0.2 * \text{CPI}_{\text{额外}} * 0.05$$

第一台机器:  $\text{CPI} = 6 / 5 + 0.2 * 0.05 * 2 = 1.22$

第二台机器:  $\text{CPI} = 11 / 8 + 0.2 * 0.05 * 5 = 1.425$

# Ex6



$$\text{吞吐率: } TP = \frac{7}{18\Delta t}$$

$$\text{加速比: } S = \frac{29\Delta t}{18\Delta t} = 1.61$$

$$\text{效率: } E = \frac{4 \times 5 + 3 \times 3}{5 \times 18} = 0.322$$