CS M151B HW2 Junhong Wang (504941113)

2.24

$$0x2000\ 0000 \rightarrow 00|10\ \underbrace{\overbrace{0000\ 0000\ 0000\ 0000\ 0000\ 0000\ 00}^{26\text{ bits}}}\ 00$$

(16 bits)

01 1111 1111 1111 11

0010 ... 00 100 00 ← PC+4

It's not possible to reach 0x4000 0000 from 0x2000 0000 with jump instruction because the furthest it can go is 0x2FFF FFFC. ($PC = PC_{31\ldots28} : (26 \text{ bits address}) \times 4$)

It's not possible to reach 0x4000 0000 from 0x2000 0000 with beq instruction because the closest it can go is 0x2002 0000. ($PC = PC + (16 \text{ bits signed address} \times 4)$)

2.26.1

```
LOOP :  slt   $t2, $0, $t1
        beq   $t2, $0, DONE
        subi  $t1, $t1, 1
        addi  $s2, $s2, 2
        j     LOOP

DONE :
```

```
while ( $t1 ≥ 0 ) :
    $t1 -= 1
    $s2 += 2
```

$t1 = 10
$s2 = 0

→

$t1 = -1
$\boxed{\$s2 = 20}$

2.26.3

Assume $N \in \mathbb{N}$.

$N = 1 \rightarrow 7$

$N = 2 \rightarrow 12$

$\vdots$

$N \rightarrow \boxed{5N + 2 \quad \text{(MIPS instructions)}}$

2.46.1

$500 \xrightarrow{-25\%} 375$

$$ET = IC \cdot CPI \cdot CT$$

$$CPI_{OLD} = \frac{5}{9} \cdot 1 + \frac{3}{9} \cdot 10 + \frac{1}{9} \cdot 3 = \frac{38}{9}$$

$$CPI_{NEW} = \frac{375}{775} \cdot 1 + \frac{300}{775} \cdot 10 + \frac{100}{775} \cdot 3 = \frac{3675}{775}$$

$$CT_{NEW} = CT_{OLD} \cdot 1.1$$

$$ET_{OLD} = 900 \cdot 10^6 \cdot \frac{38}{9} \cdot CT_{OLD}$$

$$ET_{NEW} = 775 \cdot 10^6 \cdot \frac{3675}{775} \cdot CT_{OLD} \cdot 1.1$$

$$\frac{ET_{OLD}}{ET_{NEW}} = \frac{\overset{100}{\cancel{900}} \cdot 38 \cdot \cancel{775}}{\cancel{775} \cdot 3675 \cdot \cancel{9} \cdot 1.1}$$

$$= \frac{100 \cdot 38}{3675 \cdot 1.1}$$

$$= 0.94001 \ldots < 1$$

Thus it's not a good design choice because the execution time is larger than before.