Computer Organization and Design

Homework 2 答案与评分细则

Problem 1. (20 points)

Provide the type and assembly language instruction for the following binary value: 0000 0010 0001 0000 1000 0000 0010 0000_{two}

Ans: Opcode: 000000, so the type is R. ….. (5 points)

Opcode: 000000(0), funct: 100000(20_{hex}) → add ….. (3 points)

rs: 10000(16), → $s0

rt: 10000(16), → $s0

rd: 10000(16), → $s0

shamt: 00000(0), → 0 ….. (rs, rt, rd, shamt 的值写出来: 2 points)

Assembly language: add $s0, $s0, $s0 ….. (10 points)

Problem 2. (20 points)

Provide the type and hexadecimal representation of following instruction: sw $t1, 32($t2)

Ans: The type of store word is I type. ….. (5 points)
Opcode: $2b_{hex}$ (101011), rs: $t2 (01010), rt: $t1 (01001), immediate: 32 (0000000000100000)
The binary representation is:
1010 1101 0100 1001 0000 0000 0010 0000_{two} …..(10 points)
The hexadecimal representation is: 0xAD490020 …..(5 points)

Problem 3. (20 points)

Translate the following C code to MIPS. Assume that the variables f, g, h, i, and j are assigned to registers $s0, $s1, $s2, $s3, and $s4, respectively. Assume that the base address of the arrays A and B are in registers $s6 and $s7, respectively. Assume that the elements of the arrays A and B are 4-byte words:

```
B[8] = A[i] + A[j];
```

Ans:

```
sll $t0, $s3, 2            # t0 ← 4*i
```

```
add $t0, $t0, $s6           # t0 ← Addr(A[i])

lw $t0, 0($t0)              # t0 ← A[i]

sll $t1, $s4, 2             # t1 ← 4*j

add $t1, $t1, $s6           # t0 ← Addr(A[j])

lw $t1, 0($t1)              # t0 ← A[j]

add $t0, $t0, $t1           # t0 ← A[i]+A[j]

sw $t0, 32($s7)             # B[8] ← t0
```

评分标准：

答案不唯一，按功能点给分。

1. 数组和寄存器的关系与题目描述一致 … 3 point
2. 正确使用 lw 和 sw 对内存进行存取，按照基址+偏移量访问内存 …6 points
3. 偏移量的计算是否正确（i，j，8 需要乘以 4） … 9 points
4. 使用 add 完成加法运算 … 2 points

Problem 4. (20 points)

Consider the following MIPS loop:

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

1）Assume that the register $t1 is initialized to the value 10. What is the value in register $s2 assuming $s2 is initially zero?

Ans:

$t1=10, $s2=0;

$t1=9, $s2=2;

$t1=8, $s2=4;

$t1=7, $s2=6;

$t1=6, $s2=8;

$t1=5, $s2=10;

$t1=4, $s2=12;

$t1=3, $s2=14;

$t1=2, $s2=16;

$t1=1, $s2=18;

$t1=0, $s2=20; Then the loop is done, the final value in register $s2 is 20.

…… (10 points，结果对即可满分，结果若不对视过程情况给分，$s2 从 0 开始每次循环+2 得 5 分，循环次数正确得 5 分)

2）For each of the loops above, write the equivalent C code routine. Assume that the registers $s1, $s2, $t1, and $t2 are integers A, B, i, and temp, respectively.

Ans:

```
while (i>0){
    i = i - 1;
    B+=2;
}
```

….. (10 points, 答案不唯一，得分判断标准：

1. 先判断后执行得 5 分；(do…while…这种先执行后判断的扣分)
2. 执行部分 i=i-1 和 B+=2 顺序正确得 3 分 （先减后加）
3. 变量与题目描述一致得 2 分)

Problem 5. (20 points)

Write the MIPS assembly code that creates the 32-bit constant 0010 0000 0000 0001 0100 1001 0010 0100$_{\text{two}}$ and stores that value to register $t1.

Ans:

```
lui $t1, 0x2001         # $t1 = 0010 0000 0000 0001 0000 0000 0000 0000two
ori $t1,$t1, 0x4924         # $t1 = 0010 0000 0000 0001 0100 1001 0010 0100two
```

…… (20 points, 十进制也可:

lui $t1, 8193

ori $t1, $t1,18724

，不是这种形式的不得分，最终结果不在$t1 的扣 5 分)

十六进制前没有 0x 的扣 5 分，二进制表示的扣 5 分（MIPS 对这两种形式无法正确识别）