Chapter 2 Exercise

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2.4 [5] <§§2.2, 2.3>

For the MIPS assembly instructions below, what is the corresponding C statement?

Assume:

- Variables f, g, h, i, and j are assigned to registers $s0, $s1, $s2, $s3, and $s4, respectively.
- The base addresses of the arrays A and B are in registers $s6 and $s7, respectively.

```
sll $t0, $s0, 2         # $t0 = f * 4
add $t0, $s6, $t0       # $t0 = &A[f]
sll $t1, $s1, 2         # $t1 = g * 4
add $t1, $s7, $t1       # $t1 = &B[g]
lw  $s0, 0($t0)         # f = A[f]
addi $t2, $s0, 4
lw  $t0, 0($t2)
add $t0, $t0, $s0
sw  $t0, 0($t1)
```

> [!Note] This 2.6 Table is used for the question below

2.6

The table below shows 32-bit values of an array stored in memory.

Address	Data
24	2
38	4
32	3
36	6
40	1

2.9 [5] <§§2.2, 2.3>

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 addresses 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];
```

2.10 [5] <§§2.2, 2.3>

Translate the following MIPS code to C. Assume that the variables `f`, `g`, `h`, `i`, and `j` are assigned to registers `$s0`, `$s1`, `$s2`, `$s3`, and `$s4`, respectively. Assume that the base address of the arrays AandBare in registers$s6and$s7`, respectively.

```
addi $t0, $s6, 4
add  $t1, $s6, $s0
sw   $t1, 0($t0)
lw   $t0, 0($t0)
add  $s0, $t1, $t0
```

2.19.1 [5] <§2.6>

For the register values shown above, what is the value of `$t2` for the following sequence of instructions?

```
sll $t2, $t0, 44
or  $t2, $t2, $t1
```

2.19.2 [5] <§2.6>

For the register values shown above, what is the value of `$t2` for the following sequence of instructions?

```
sll  $t2, $t0, 4
andi $t2, $t2, -1
```

2.19.3 [5] <§2.6>

For the register values shown above, what is the value of `$t2` for the following sequence of instructions?

```
srl  $t2, $t0, 3
andi $t2, $t2, 0xFFEF
```

2.23 [5] <§2.7>

Assume `$t0` holds the value `0x00101000`.
What is the value of `$t2` after the following instructions?

```
    slt   $t2, $0, $t0
    bne   $t2, $0, ELSE
    j     DONE

ELSE:
    addi  $t2, $t2, 2
DONE:
```

2.26 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:
```

2.26.1 [5] <§2.7>

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

2.26.2 [5] <§2.7>

For the loop above, write the equivalent C code routine. Assume that the registers `$s1`, `$s2`, `$t1`, and `$t2` are C-level integers `A`, `B`, `i`, and `temp`, respectively.

2.26.3 [5] <§2.7>

For the loops written in MIPS assembly above, assume that the register `$t1` is initialized to the `value N`. How many MIPS instructions are executed?

2.27 [5] <§2.7>

Translate the following C code to MIPS assembly code. Use a minimum number of instructions. Assume that the values of `a`, `b`, `i`, and `j` are in registers `$s0`, `$s1`, `$t0`, and `$t1`, respectively. Also, assume that register `$s2` holds the base address of the `array D`.

```
for (i = 0; i < a; i++)
    for (j = 0; j < b; j++)
        D[4 * j] = i + j;
```

2.29 [5] <§2.7>

Translate the following loop into C. Assume that the C-level integer i is held in register `$t1`, `$s2` holds the C-level integer called result, and `$s0` holds the base address of the integer MemArray.

```
add $t1, $0, $0
LOOP:
    lw   $s1, 0($s0)
    add  $s2, $s2, $s1
    addi $s0, $s0, 4
    addi $t1, $t1, 1
    slti $t2, $t1, 100
    bne  $t2, $0, LOOP
```

2.31 [5] <§2.8>

Implement the following C code in MIPS assembly. What is the total number of MIPS instructions needed to execute the function?

```
int fib(int n) {
    if (n == 0)
        return 0;
    else if (n == 1)
        return 1;
    else
        return fib(n - 1) + fib(n - 2);
}
```