

Computer Organization and Structure

Homework #2
Due: 2004/11/2

1. What binary number does this hexadecimal number represent: $7fff\ fffa_{\text{hex}}$? What hexadecimal number does this binary number represent: $1100\ 1010\ 1111\ 1110\ 1111\ 1010\ 1100\ 1110_{\text{two}}$? What decimal number do they represent, respectively?
2. Implement the following C code in MIPS, assuming that `set_array` is the first function called:

```
int i;
void set_array(int num) {
    int array[10];
    for (i=0; i<10; i++) {
        array[i] = compare(num, i);
    }
}
int compare(int a, int b) {
    if (sub(a, b) >= 0)
        return 1;
    else
        return 0;
}
int sub (int a, int b) {
    return a-b;
}
```

Be sure to handle the stack and frame pointers appropriately. The variable code font is allocated on the stack, and `i` corresponds to `$s0`. Draw the status of the stack before calling `set_array` and during each function call. Indicate the names of registers and variables stored on the stack and mark the location of `$sp` and `$fp`.

3. Add comments to the following MIPS code and describe in one sentence what it computes. Assume that `$a0` and `$a1` are used for the input and both initially contain the integers a and b , respectively. Assume that `$v0` is used for the output.

```
                add    $t0, $zero, $zero
loop:          beq    $a1, $zero, finish
                add    $t0, $t0, $a0
                addi   $a1, $a1, -1
                j      loop
finish:       addi   $t0, $t0, 100
                add    $v0, $t0, $zero
```

4. The following code fragment processes two arrays and produces an important value in

register \$v0. Assume that each array consists of 2500 words indexed 0 through 2499, that the base addresses of the arrays are stored in \$a0 and \$a1 respectively, and their sizes (2500) are stored in \$a2 and \$a3, respectively. Add comments to the code and describe in one sentence what this code does. Specifically, what will be returned in \$v0?

```

        sll    $a2, $a2, 2
        sll    $a3, $a3, 2
        add   $v0, $zero, $zero
        add   $t0, $zero, $zero
outer:  add   $t4, $a0, $t0
        lw    $t4, 0($t4)
        add   $t1, $zero, $zero
inner:  add   $t3, $a1, $t1
        lw    $t3, 0($t3)
        bne  $t3, $t4, skip
        addi $v0, $v0, 1
skip:   addi $t1, $t1, 4
        bne  $t1, $a3, inner
        addi $t0, $t0, 4
        bne  $t0, $a2, outer

```

5. Show the single MIPS instruction or minimal sequence of instructions for this C statement:

```
x [10] = x [11] + c;
```

Assume that c corresponds to register \$t0 and the array x has a base address of $4,000,000_{10}$.

6. ~~Write a procedure, `itoa`, in MIPS assembly language that will convert an integer argument into an ASCII decimal string. The procedure should take two arguments: the first is an integer in register \$a0; the second is the address at which to write a result string in register \$a1. Then `itoa` should convert its first argument to a null-terminated decimal ASCII string and store that string at the given result location. The return value from `itoa`, in register \$v0, should be a count of the number of non-null characters stored at the destination.~~