

CS311 - Computer Architecture - Spring 2017

Homework 3 – 70 points

Due: Feb. 22

1. (10 points) Exercise 2.15.1, 2.15.2. Perform these exercises on the following two instructions instead of the instructions in the book:

```
a) not $t1, $t2      # bit-wise invert
b) orn $t1, $t2, $t3 # bit-wise OR of $t2 and !$t3
```

Make sure you use only MIPS instructions, not pseudoinstructions.

2. (5 points) Translate the following HLL code into MIPS

```
if (x > 1009904)    // 1009904 = estimated population of Rhode Island, 2016
    x = 1009904
```

3. (5 points) Suppose MIPS did not have the `sub` instruction. Find a minimal set of instructions to implement `sub $t0, $t1, $t2`. Do NOT use any pseudo instructions.
4. (10 points) Consider the following pseudoinstruction

```
rotl $t1, $t2, shamt
```

This command will rotate the bits of `$t2` by `shamt` bits to the left, replacing the low order bits with the high order bits that are shifted off, and storing the results in `$t1`. For example if `$t2=0xFEDCBA98` and `shamt=8`, then the value of `$t1` will become `0xDCBA98FE`.

- (a) Determine the value of `$t1` (in hex) using the value of `$t2` above, but with a `shamt` value of 1.
 - (b) Translate the above pseudoinstruction into 1 or more MIPS instructions, using as few instructions as possible.
5. (5 points) Exercise 2.17.4, pg. 196. Use only code **b**.
 6. (10 points) Exercise 2.31.1, pg. 211. Use only code **b**. This is similar to an example on page 143 in the text, and your answer should look like the diagram on page 144. You should treat the first two instructions in procedure A as storing the *address* of variable X into `$a0`, i.e. X is actually an array and what we are storing in `$a0` is the base address of the array.
 7. (10 points) Suppose we needed to jump to the memory address `0xAE87698C`.
 - (a) If the current PC value is `0xAF70018B` show the `j` instruction to perform the jump (display it as both a 32-bit binary number and as an equivalent hex value).
 - (b) If the current PC value is `0x8F70018B` explain why we cannot use a `j` instruction to perform the jump. Explain how to solve this problem by using a different unconditional jump instruction.
 8. (15 points) Exercises 2.39.1 through 2.39.6. Use the data in line **b** in both tables.