

## CS 430 Problem Set #5

**Date assigned:** Friday, October 31, 2008.

**Date due:** Monday, November 10, 2008 @ 11:45am.

**Points:** 55 pts.

1. (9 pts) Consider an arithmetic right shift.
  - a. Show how to use an arithmetic right shift in C.
  - b. Show how to use an arithmetic right shift in x86 assembly.
  - c. In what way are numbers rounded using an arithmetic right shift (e.g. rounded toward  $+\infty$ , toward  $-\infty$ , toward zero, away from 0). Briefly explain your answer.
2. (5 pts) 11.3 on p. 412
3. (5 pts) Work problem 11.5 on p. 413.
4. (8 pts) Work problem 11.16 on p. 414.
5. (8 pts) Design a variable length opcode to allow ALL of the following to be encoded in a 36-bit instruction:
  - a. 7 instructions with two 15-bit addresses and one 3-bit register number
  - b. 500 instructions with one 15-bit address and one 3-bit register number
  - c. 50 instructions with no addresses or registers
6. (20 pts) Consider the following assembly language program for a winMIPS64 processor.

```
.data
n:      .word 5
vals:   .word 0,1

        .text
main:   ld r1,vals(r0)
        ld r2,n(r0)
        ld r4,vals+8(r0)
        ld r5,vals(r0)
ll:     dadd r1,r1,r2
        dsub r2,r2,r4
        slti r3,r2,0
        beqz r3,ll
        halt
```

- a. Give a general English description of what this program does. Do not describe each statement one at a time for your English description.
- b. Run this program through the winMIPS64 simulator and report on: a) the number of cycles this program takes to run and b) the CPI for this program
- c. What is the machine language for the statement `beqz r3,ll`?
- d. There are three different pieces of information for the machine language statement in c. Describe each of these pieces of information.
- e. The MIPS branch instruction behaves differently than the x86 branch instruction. Using the machine language for the statement `beqz r3,ll`, explain how this instruction works. Further, how far forward and backward can this instruction branch? One possible resource is [http://www.cs.ucr.edu/~junyang/teach/F04\\_203A/MIPS64manual.pdf](http://www.cs.ucr.edu/~junyang/teach/F04_203A/MIPS64manual.pdf)

You may submit this assignment in one of two way: (1) a Google document shared with [ShereenKhoja@gmail.com](mailto:ShereenKhoja@gmail.com), (2) a Word document attached to an email sent to [ShereenKhoja@gmail.com](mailto:ShereenKhoja@gmail.com). Do not submit a hard copy. Name your document "05PSPUNet", i.e. mine would be called "05PSkhoj0332".