ECE 452: Computer Organization and Design
Spring 2017

Homework 2: Instruction Set Architectures

Assigned: 7 Feb 2017
Due: 14 Feb 2017

Instructions:

- Please submit your assignment solutions via Canvas in a word or pdf file.
- Some questions might not have a clearly correct or wrong answer. In such cases, grading is based on your arguments and reasoning for arriving at a solution.

Q1 (25 points) Translate the following MIPS code snippets into C code

a. **(10 points)** For the MIPS assembly instructions below, what is the corresponding C statement? 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.

```
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, $t0, 4
lw   $t0, 0($t2)
add  $t0, $t0, $s0
sw   $t0, 0($t1)
```

b. **(15 points)** 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 A and B are in registers $s6 and $s7, respectively.

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

Q2 (15 points) Find the shortest sequence of MIPS instructions that extracts bits 16 down to 11 from register $t0 and uses the value of this field to replace bits 31 down to 26 in register $t1 without changing the other 26 bits of register $t1.

Q3 (20 points) 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;
```

Q4 (30 points) Answer the following

a. **(10 points)** Provide the type and assembly language instruction for the following binary value: 0000 0010 0011 0000 1000 0000 0010 0000_{two}
b. **(10 points)** Provide the type and hexadecimal representation of following instruction: sw $t1, 32($t2)
c. **(10 points)** Provide the type, assembly language instruction, and binary representation of instruction described by the following MIPS fields: op=0, rs=3, rt=2, rd=3, shamt=0, funct=34

Q5 (10 points) Assume $t0 holds the value 0b00101000. 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:
```