

ECE 452: Computer Organization and Design Spring 2015

Homework 2: Instruction Set Architectures

Assigned: 3 Feb 2015

Due: 12 Feb 2015

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.
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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

- (10 points)** Provide the type and assembly language instruction for the following binary value: 0000 0010 0001 0000 1000 0000 0010 0000_{two}
- (10 points)** Provide the type and hexadecimal representation of following instruction: sw \$t1, 32(\$t2)
- (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:
```