

Name:

Id#

ICS 233, Term 142

Computer Architecture & Assembly Language

Quiz# 5

Date: Thursday, April 29, 2015

Q1. Consider the following fragment of MIPS code. Assume that **a** and **b** are arrays of words and the base address of **a** is in **\$a0** and the base address of **b** is in **\$a1**. How many instructions are executed during the running of this code? If ALU instructions (**addu** and **addiu**) take 1 cycle to execute, load/store (**lw** and **sw**) take 5 cycles to execute, and the branch (**bne**) instruction takes 3 cycles to execute, how many cycles are needed to execute the following code (all iterations). What is the average CPI?

```

                                addu $t0, $zero, $zero    # i = 0
                                addu $t1, $a0, $zero    # $t1 = address of a[i]
                                addu $t2, $a1, $zero    # $t2 = address of b[i]
                                addiu $t3, $zero, 101   # $t3 = 101 (max i)
loop:  lw $t4, 0($t2)           # $t4 = b[i]
                                addu $t5, $t4, $s0    # $t5 = b[i] + c
                                sw $t5, 0($t1)        # a[i] = b[i] + c
                                addiu $t0, $t0, 1     # i++
                                addiu $t1, $t1, 4     # address of next a[i]
                                addiu $t2, $t2, 4     # address of next b[i]
                                bne $t0, $t3, loop    # loop if (i != 101)
```

Q2. Suppose that a program runs in 150 seconds on a machine, with ALU operations responsible for 40 seconds of this time, multiply operations responsible for 50 seconds of this time and divide operations responsible for 40 seconds of this time. The remaining time is taken by the remaining operations. Suppose that a new implementation of the machine has improved the execution time of the ALU by a factor of 2, the multiplier by a factor of 1.5 and the divider by a factor of 1.6. Determine the new execution time and the speedup of the program based on the new implementation.