Name: Id#

COE 301/ICS 233, Term 161

Computer Architecture & Assembly Language

Quiz# 3 Solution

 Date: Tuesday, Nov. 22, 2016

## **Q1.** A recursive procedure **TH**(N) returns 1+2\***TH**(N-1) for N >1, 1 if N=1, and zero otherwise. This is called Tower of Hanoi. **TH**(N) is defined as follows:

 int TH(int N) {

 if (N <= 0) return 0;

 else if (N=1) return 1;

 else return (1 + 2\*TH(N-1));

 }

Assume TH receives its argument N in register $a0 and return its results in $v0. The above procedure is called from some Main program, which needs not to be implemented here. Write a minimal MIPS program for the above procedure.

TH: slti $t0, $a0, 1 # (n< 1)?

 beq $t0,$0, next # if false branch to next

 li $v0,0 # $v0 = 0

 jr $ra # return to caller

next: slti $t0, $a0, 2 # (n < 2)?

 bne $t0,$0,iterate # if false branch to iterate

 li $v0,1 # $v0 = 1

 jr $ra # return to caller

iterate: addiu $sp,$sp,-4 # allocate 1 word on stack

 sw $ra,0($sp) # save return address

 addiu $a0,$a0,-1 # argument = n-1

 jal TH # call TH(n-1)

 sll $v0, $v0, 1 # $v0 = 2\*TH(n-1)

 addi $v0, $v0, 1 # return 1 +2\*TH(n-1)

 lw $ra,0($sp) # restore return address

 addi $sp, $sp, 4 # free stack frame

 jr $ra # return to caller