LAST NAME: FIRST NAME: PERSON#:

CSE341 SPRING 2018 – HOMEWORK 3 DUE: 02/26/2018 10am (Updated 2/20/18)

1. Main routine M1 calls a procedure P1 (The return address is a value RM. Assume the initial stack pointer has a 32 bit value of 0x0700C. Procedure P1 will be using $s0, $s1, $s2 and need to be saved on the stack. RM (which is in $ra) need to be saved on the stack (since there is a call to another procedure). In P1, there is a call of procedure P2 (return address is a value RP1). Procedure P2 is likely to use $s4, $s5 (and hence need to be saved on stack). Show the SP value right after $s5 is saved. Also, show the stack contents (updated in this sequence).
Bonus question: Write down all the instructions that performs all the saves in P1 and P2; Also, assume P2 calls another procedure P3. Assuming this procedure P3, does not use any save registers, state if any other register need to be saved on stack and show the updated stack at P3 entry and the SP value. (will be +20% additional points for the homework (10 pts))

2. Assume $t0 initially holds the value 0x00101000.

```
        slt $t2, $0, $t0
        bne $t2, $0, ELSE
        j DONE
ELSE: addi $t2, $t2, 5
DONE:
```

a) What is the value of $t2 after the execution of the above instruction sequence?

b) Write the corresponding machine code for ‘bne’ and ‘addi’ in this program.

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3. Consider the following MIPS loop:

```
LOOP: slt $t2, $0, $t1
      beq $t2, $0, DONE
      addi $t1, $t1, -1
      addi $s2, $s2, 2
      j LOOP
DONE:
```

(a) Assume that the initial value in register $t1 is 10 and $s2 is 0. What is the value in register $s2 after the above program sequence is executed?

(b) Express the function implemented by the program sequence using a high level language sequence (such as using C code). Assume that the registers $s1, $s2, $t1, and $t2 are integers A, B, i, and j, respectively.

(c) If register $t1 is initialized to the value N, how many times is the addi s2, s2, 2 instruction executed?