COMP311 Extra Practice 5 Name: _____

Question 1: Advanced Procedure Calls and State Persistence Consider a procedure `process_data(int n)` that computes a result using the formula:

$$\text{result} = n + \text{transform\_value}(n - 1)$$

This procedure must preserve the value of `n` across the call to `transform_value`. Assume `transform_value` expects its argument in `a0` and returns its result in `a0`.

1.1. **Conceptual Fill-in-the-Blank:** To implement this procedure, `process_data` must store `n` (which is initially in `a0`) into a saved register (e.g., `s1`) before the function call. List the registers that must be saved on the stack in the prologue.

1.2. **Assembly Implementation:** Write the complete assembly for `process_data`. Include the prologue, the preservation of `n`, the call to `transform_value`, the addition, and the epilogue. (Hint: Use `addi` with the zero register `x0` to perform register-to-register moves).

Question 2: Stack Tracing In Assembly Trace through the following assembly program and answer the questions below.

```
main:
80:  addi a0, x0, 8
84:  jal  ra, foo
88:  halt

foo:
100: addi sp, sp, -4
104: sw   ra, 0(sp)

108: beq  a0, x0, bar
112: addi a0, a0, -2
116: jal  ra, foo
120: j    baz

bar:
124: addi a0, x0, 7

baz:
128: lw   ra, 0(sp)
132: addi sp, sp, 4
136: jr   ra
```

2.1. List the sequence of a0 values at the moment each call to foo begins execution.

2.2. At the deepest point of recursion what saved return addresses are on the stack from oldest frame to newest?

2.3. How many active foo frames are on the stack at the deepest point?

2.4. What value is in a0 when the program reaches label bar?

2.5. What value is in a0 when control returns to main?

For the following question assume a0 is intiated to 9.

2.6. Will the current code ever terminate? Explain your reson why. If you believe it won't create a fix for the problem.

To get more practice with assembly writing, check out the **RISC-V Assembly Practice** on the course website here: `https://github.com/kakiryan/comp-311-assembly-practice-problems`!