CSC-4330/6330, Programming Language Concepts (Fall 2023)

Mid Term Exam

In-Class and Closed Book October 12, 2023

Name:

Panther #:

Put the answers on these sheets. Show how you derived your answer (this is required for full credit and helpful for partial credit). You can collect 100 points in total for this exam. Each question carries 5 points.

1. Is Python compiled or interpreted (or both)? How do you know?

2. Consider the following pseudocode:

```
x : integer        – – global

procedure set_x(n : integer)
      x := n

procedure print_x
      write_integer(x)

procedure first
      set_x(1)
      print_x

procedure second
      x : integer
      set_x(2)
      print_x

set_x(0)
first()
print_x
second()
print_x
```

What does this program print if the language uses static scoping? What does it print with dynamic scoping? Why?

3. What value does the program print?

Consider the following pseudo-code program:

```
x : integer /* global */
y : integer /* global */
procedure one(P : procedure)
   x : integer
   x := y
   y := 2
   P()
procedure two
   x := x+y
procedure three
   write_integer(x)
begin /* main program */
   x := 0
   y := 1
   one(two)
   three()
end /* main program */
```

Assuming static scoping or dynamic scoping rules are used (with shallow or deep bindings).

4. What will be the output of the given PROLOG program if the goal specified is count(5)?

```
predicates
        count(integer)
clauses
        count(0).
        count(N) :-
                write(" ",N),
                NN = N - 1,
                count(NN),
                write(N," ").
```

5. Consider the following sentences: “John likes all kinds of food. Apples are food. Chicken is food. Anything anyone eats and is still alive then whatever he ate was food. Sue eats everything bill eats. Bill eats peanuts and is still alive.” Write a PROLOG program to prove that “John likes peanuts”.

6. Write target code for the given Boolean expression using short-circuit evaluation rules:
   IF ((A < B) or (C > D)) and (E=F) THEN
   ```
       then_clause
   ```
   ELSE
   ```
       else_clause
   ```

7. Consider the following pseudocode:
   ```
   procedure foo(X:integer)
       print X * X * X
   begin /* main*/
       foo(2+2);
   end
   ```
   What will it print if the language uses normal-order (lazy) evaluation rules? Justify.

8. Apply tail recursion optimization to the following function and write the target code generated by the optimizing compiler.
   ```
   int foo(int n, int m) {
       if(n<1)
           return m+1;
       else
           return foo(n/2,m+1);
   }
   ```

9. Consider the following pseudocode:

```
procedure P(A, B : real)
        X : real
        procedure Q(B, C : real)
                Y : real
                procedure R(A, C : real)
                        Z : real
                        …                       ---- (*)
                …
        …
```

Assuming static scope, what is the referencing environment at the location marked by (*)?

10. Consider the following pseudocode written in some block structured programming language:

```
{
        int a,b,c,d;
        {
                int e,f;
                {
                        int g;
                }
        }
        {
                int h;
                {
                        int i,j,k;
                }
        }
}
```

Assuming that integer variable occupies 4 bytes, what will be the total memory required for the following piece of code. Elaborate your answer.