CS326 – Programming Languages, Concepts and Implementation

Homework 3

(Due October 8)

1. (28 pts) Using the C++ programming language, indicate the binding time (language design, language implementation, compilation, link, run, etc.) for each of the following attributes. Justify your answer.

   (a) The variable declaration that corresponds to a certain variable reference (use)
   (b) The range of possible values for integer numbers
   (c) The meaning of `char`
   (d) The address of a local variable
   (e) The address of a library function
   (f) The referencing environment of a function passed as a parameter
   (g) The total amount of memory needed by the data in a program

2. (24 pts) Can a language that uses dynamic scoping do type checking at compile time? Why? Can a language that uses static scoping do type checking at run time? Why?

3. (24 pts) Does Scheme use static or dynamic scoping? Write a short Scheme program that proves your answer.

4. (24 pts) Consider the following pseudo-code:

```
x : integer;     -- global

procedure set_x (n : integer)
      x := n;

procedure print_x
      write_integer (x);

procedure foo (S, P : procedure; n : integer)
      x : integer;
      if n in {1,3}
            set_x(n);
      else
            S(n);
      if n in {1,2}
            print_x;
      else
            P;
```

```
-- main program
set_x(0); foo (set_x, print_x, 1); print_x;
set_x(0); foo (set_x, print_x, 2); print_x;
set_x(0); foo (set_x, print_x, 3); print_x;
set_x(0); foo (set_x, print_x, 4); print_x;
```

Assume that the language uses dynamic scoping. What does this program print if the language uses shallow binding? Why? What does it print with deep binding? Why?
Note: At exactly one point during execution in the deep binding case, the program will attempt to print an uninitialized variable. Simply write a "?" for the value printed at that point.