CS326 – Programming Languages, Concepts and Implementation

Homework 4

(Due October 17)

1. (10 pts) The `if` statement in Pascal has the syntax:

   ```
   if boolean_expression then statement else statement
   ```

   In Ada, the syntax for the `if` statement is:

   ```
   if boolean_expression then statement else statement end if
   ```

   What are the advantages of introducing an explicit terminator, such as the **`end if`** in Ada?

2. (20 pts) Write a grammar that describes arithmetic expressions in *prefix* notation, where possible operators are + and *, and possible operands are numbers or identifiers. You do not need to specify the internal structure of numbers and identifiers – assume that they are returned by the scanner as terminal symbols `nr` and `id`. Also assume that each operator takes exactly two operands. Is your grammar ambiguous? Why?

3. (20 pts) Suppose that we try to write a short-circuit version of `and` (with two operands) in C as:

   ```
   int sc_and (int a, int b)
   {
        return a ? b : 0;
   }
   ```

   Explain why this does *not* produce a short-circuit behavior. Would it work if normal-order evaluation were used? Why?

4. (30 pts) In the C programming language:

   (a) (10 pts) Show how to simulate a `do` statement (shown below) with a `while` statement.

   ```
   do
      s;
   while(c);
   ```

(b) (10 pts) Show how to simulate a `while` statement (shown below) with a `do` statement.

```
while(c)
   s;
```

(c) (10 pts) Show how to simulate a `for` statement (shown below) with a `do` statement.

```
for(s1;c;s2)
   s;
```

5. (20 pts) Using the Scheme programming language, write a *tail-recursive* function that returns the sum of all elements in a list of numbers. You will probably want to also define a "helper" function, as shown in Section 6.6.1 of the textbook.

6. (Extra Credit - 10 pts) Show (in low-level pseudo-code, as illustrated in the textbook) what would be the target code generated for the *tail-recursive* function from problem 5.