Computer Science Comprehensive Exam—Spring 1999
Programming Languages

Instructions: Please answer all the questions directly on the exam itself. Answer 9 of the following 13 questions in 5 or 6 sentences. Explain answers as fully as possible, give examples if appropriate, define terms.

1. Why study programming languages?

2. Describe an object-oriented language other than C++ or Java.

3. What are the three main approaches to defining programming language semantics?

4. The assignment statement `A:=B` can mean different things. Explain carefully the different possible meanings it can have.

5. Write a simple program that distinguishes call by reference and call by name. Explain.

6. How is passing procedures and functions as arguments implemented?

7. Write a very short C or C++ program that demonstrates that these languages do no inter-module type checking.

8. Name some differences in the way exception handling is done in different languages. Give examples from specific programming languages (do not use PL/I).

9. What does the following ML function do?

```
datatype T = n | lf of int * T * T;
fun f n = [] | f (lf (x,l,r)) =  (f l) @ (x :: (f r));
```

10. What is a higher-order function? Give an example.

11. Formulate in PROLOG the classical syllogism:

    All men are mortal;
    Socrates is a man;
    Therefore Socrates is mortal.

12. What is a unifying substitution? Give the most general unifying substitution for the following pair of terms:

$$g(f(a,b),h(x,y)) \qquad g(f(z,b),h(b,b))$$

13. Describe the support for object-oriented programming in Ada 95.