Computer Science Comprehensive Exam—Spring 2001
Programming Languages

Instructions: Do *not* put your name on the exam, please answer all the questions directly on the exam itself. Answer **all** the questions; you have 60 minutes. Explain answers as fully as possible, give examples if appropriate, define terms. Answer first, the questions you know best.

1. What is garbage collection?

2. What is the loop/exit statement?

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

4. What is the difference between overloading and dynamic dispatch?

5. Suppose we were to modify Ada, Java, or some language that uses dynamic exception propagation so that whenever an exception is raised a handler is located *statically*. What syntactic changes would be needed? What would be the advantages and disadvantages of the static versus the dynamic approach?

6. What is the type of the following ML function? Describe in a few words what the function does.

```
datatype T = n | lf of T * T * T * int;
fun f g n e = e | f g (lf (l,c,r,x)) e =  g ((f g l e), g ((f g c e), (f g r e)))
```

7. What is a unifying substitution? Give the most general unifying substitution for each of the following pairs of terms (x, y, and z are variables):

$k(x, a, b)$	$k(c, a, y)$
$g(a, x)$	$h(y, b)$
$g(y, x)$	$g(h(a, x), y)$
$f(g(a, b), h(x, y))$	$f(g(z, b), h(y, b))$

8. Consider the following PROLOG program where `A`, `B`, `C` are nullary predicate symbols:

```
A :- B,A.
A :- B.
B.
C :- A,B.
```

Show the entire search space for the query `A,B?`.