

## Midterm 2, November 12<sup>th</sup> 2001

### CSCI 5535

This is a closed-book exam. You have 50 minutes to answer these questions. We recommend that you read all questions before starting. The points for a question are evenly divided amongst its subparts.

1. (i) Give an example that demonstrates Lackwit's polymorphic type inference (ii) Explain how Lackwit computes and uses the polymorphic types in your example.
2. In Smalltalk, even control constructs are implemented using objects and message passing. (i) Give an example of how to do an if-then-else in Smalltalk and explain your example. (ii) What messages will be sent in your example and what will be their outcome?
3. The *environment* component of a closure allows the *code* component to access all the non-local variables that it needs. One way to implement an environment is with a static link. Another implementation of environment is a record that contains one field for each non-local variable. For example, if function **g** is nested inside of function **f**, and **g** accesses variables **int i**, and **int j** of **f**, then the environment could be a record such as: **struct { int i; int j; }**. When **f** needs to create a closure for **g**, it creates an instance of this record and initializes its fields to the current values of **i** and **j**. When **g** needs to access **i** or **j** it can do so through this record. Is this implementation of environment as powerful as the static link? Why or why not? Illustrate with an example.
4. Snyder argues that using inheritance for both subtyping and code reuse causes problems with encapsulation. (i) Give an example that illustrates this problem. (ii) Explain and illustrate how interfaces in Java address this problem.