CS 480/580 Midterm 1  
Winter 1999

The exam has 100 points total, 20 points for each of the five questions. (120 points for 580 students).  
Closed book, closed notes, closed neighbors.  

Name:  

Student ID Number:  

1. One of the following grammars is ambiguous, the other is not. First, define what it means for a grammar to be ambiguous. Then indicate which one is ambiguous. Finally, demonstrate that it is ambiguous.

```
Expr -> Term  
   -> Term < Term
Term -> id  
   -> not Expr
```

```
Expr -> Term  
   -> Term < Term
Term -> id  
   -> not Term
```

2. What does it mean for a grammar to be LL(1)? Take the grammar that is not ambiguous in the previous question, and rewrite it so that it is LL(1).

3. Take the same grammar (the non-ambiguous one) and show the DFA that the LR parsing algorithm would construct. Number your states.

4. Show the shift/reduce steps the LR parser would go through in recognizing the input “not a < b”
5. Consider the following program:
   var a : int
   class b
   begin
     var c : int
     function d (e : int)
     var f : int
     begin
       print(e);
     end
     end
     var g : b
     function main()
     begin
       g.e()
     end
   end

   Indicate the various symbol tables that would exist at the time we are
   parsing the function e, and show what variables will be held in each symbol
   table.

   Indicate the state of memory when we are executing the function e, and
   where in memory each of the variables a, b, c, d, e will be found.

6. (580 only) Explain the upward and downward funarg problems. Under
   what circumstances do the problems arise? What are the solutions to these
   problems?