- Problems are **due by 2pm, Monday, March 19th, front desk (1st floor), SDSC.**

- There will be a revision section; time/location: TBD (probably Mon. or Tue. evening, finals week)

(Small) Individual Assignment 5

Problem 1 (Static vs. Dynamic Scoping) Consider the following program:

```
program main()
    var A, B, C: integer;

    procedure p1()
        var X: integer;
    begin
        X:= A; A:= B; B:= C; C:= X;
    end;

    procedure p2()
        var B: integer;
    begin
        B:= A; p1();
    end;

  begin (*main*)
    A:= 1; B:= 2; C:= 3;
    p1();
    p2();
    output(A, B, C);
  end.
```

a) First assume *static scoping* of variables: what is the *environment* inside the procedures p1 and p2? Hint: for all variable occurrences in p1 and p2 say whether they are binding occurrences or applied occurrences; in the latter case say to which binding occurrence (here: declaration) they belong to.

b) Under *static scoping*, what is the output of main()?

c) What is the output with *dynamic scoping* of variables?

d) With static scoping, local variables "hide" all other variables with the same name from enclosing scopes. How can they be made visible again?

Problem 2 (Parameter Passing) Consider the following program:

```
program main()
  var i: integer;
  var a: array[0..9] of integer;

  procedure swap(<pp_mode> x,y: integer)
    var tmp: integer;
    begin
      tmp := x; x := y; y := tmp
    end;

begin (*main*)
  i := 2; a[i] := 30;
  swap(i, a[i]);
end;
```

a) Trace the program execution assuming the parameters are passed *by reference* (i.e., <pp_mode = "call by reference").

b) Like (a) but assume parameters are passed *by name* (i.e., <pp_mode = "call by name/call by macro").