

CS 4100, Spring 2012 – Programming Languages  
Final Exam  
May 18, 2012

- This is a take-home exam. All answers must be your own work. You may:
  - Discuss this exam with me,
  - Use our text book, class notes and handouts, books about Lisp,
  - **No other sources are allowed.**
  - **Any outside sources must be cited.**
- To receive full credit, **show your work** and **write legibly**.
- If you need clarification about any of the problems, please ask me.

Name: \_\_\_\_\_

For the next three problems you may talk to me, consult your textbook, course materials, books about Lisp, but **NOT** other students. Any outside consultations/sources must be cited.

1. Assume (because it is not strictly true in the real world) that an email address consists of a non-empty string of letters and digits, followed by an “at” sign (@), followed by a machine name made up of a series of one or more non-empty strings of letters and numbers separated by periods (.) and terminated by either “.com” or “.edu”. Write a BNF (**not** extended BNF) description of such an email address.

Examples:

myself@cs.csustan.edu

2million2@hotmail.com

1579@17.25.20.3.com

2bnot2b@hamlet.eggs.spam.edu

2. Write a recursive function `count` in LISP to count the number of atoms in a list no matter what their level of nesting. You may assume that `(atom x)` tests whether `x` is an atom and returns either true or false depending on the results of the test. For example:

```
(count '(a b (c 4) ((99)) nil t))
7
```

3. Consider the following segment of code:

```
Procedure M
var x: integer;

    Procedure A
    var a, b, c: integer;

        Procedure B (x: integer)
        var b, e: integer;
        Begin {B}
            ...
            a := b + c - e;
            ...
        End B;

    Begin {A}
        ...
        B(7)
        ...
    End A;

Begin {M}
    ...
    A()
    ...
End M;
```

Assuming the definition of `M` is at static nesting level 0. Draw the runtime stack that will be in effect at the execution of `"a := b + c - e;"`. Show the static and dynamic links, and the current positions of the EP and SP pointers.

What is the static distance to `c`'s environment of definition and the offset within the environment when `"a := b + c - e;"` is executed?