CSE 461: Programming Languages Concepts

Prof. G. Tan
Spring 2018

Homework 7: Memory Management
Due on Apr 23rd before class (12:20pm) in Canvas.

Submission: Please submit your homework via Canvas. It's okay if you submit a scanned version of your on-paper answers, but please make sure your scanned version is legible.

1. (4 points) For each of the following Scheme lists, draw its memory representation using atom and cons cells:

   (a) '(everyday (is a winding) road)
   (b) '((everyday) (is) (a) (winding) (road))

2. (4 points) For each of the following Scheme expressions, draw the memory representation after its evaluation:

   (a) (cons (cons 'a (list 'b 'c)) (list 'b 'c))
   (b) ((lambda (x) (cons (cons 'a x) x)) (list 'b 'c))

3. We have a Scheme program below:

```
(define lst '(Scheme (is fun)))
(define lst2 (car (cdr lst)))
(set-car! lst2 'has)
```

   (a) (2 points) Draw the memory layout in terms of cells for each execution step of the above program. Assume Garbage Collection does not run in intermediate steps.
   (b) (1 point) What is the value of lst at the end?
   (c) (1 point) Suppose the system decides to perform a Mark-and-Sweep Garbage Collection at the end, which memory cells would be recycled?

4. (3 points) C and C++ do not have garbage collection built in. Find out whether if there is an external package that provides garbage collection to C/C++ programmers. If there is, understand and describe briefly how a C/C++ programmer should use this package.