THIRD QUIZ

You have 15 minutes from the start of class to complete this quiz. Read the problems with care; work with deliberate speed. Don’t give us more than we ask for. The usual instructions apply. Good luck!

You may show lists in any of three ways: (cons ’AC (cons ’DC empty)), (list ’AC ’DC), or ’(AC DC).

Problem 1 (5 points)
Evaluate each of the following expressions. Use this definition independently for each of the five parts:
(define L (cons ’beet (cons ’turnip (cons ’carrot (cons ’radish empty)))))
(a) (first L)
(b) (rest L)
(c) (first (rest L))
(d) (rest (rest (rest L)))
(e) (cond
   ((empty? L) ’rutabaga)
   ((equal? ’carrot (rest (rest L))) ’daikon)
   (else ’gobo))

Problem 2 (2 points)
What are the two main advantages of the functional programming approach over conventional imperative programming, as described in class? (You can answer this with just a few words, if they’re the right words; in no case should you take more space than is available here.)

Functional programming (1) is easier to reason about (formally or informally) and (2) makes it easier to exploit the parallelism in a problem automatically. 1 point each. For point (1), they could say it makes programs easier to understand, or gives you more confidence that your code is correct, or helps with program proofs. For point (2), to get the full point they should say something about parallelism or simultaneity or multiple processors and also something about using software or a compiler or something automated to derive what can be done in parallel. If they show they have the basic ideas, that’s enough. Feel free to check with me on any tough cases.

Problem 3 (13 points)
We define a song as a structure
(define-struct song (title artist year length))
where title and artist are strings and year and length are numbers (representing the year the song was recorded and the length in seconds of the recording).
(a) (2 points) Write an expression that will create the 215-second-long song “America,” recorded in 1968 by “Simon & Garfunkel.” (Note that we’re not asking you to define a function here.)

ANSWER: (make-song "America" "Simon & Garfunkel" 1968 215). 1 point for (make-song W X Y Z) with any expressions W X Y Z; 1/2 point for the correct four expressions in any order; 1/2 point for everything else correct.
(b) (3 points) Fill in the blanks in the function described below. (Hint: Each vertical column contains the same thing on every line.)

;;;; song-decade: song -> symbol
;;;; Return a symbol indicating the decade in which the song was recorded.
(define song-decade
  (lambda (S)
    (cond
      ;; first column:  <        second column:  song-year       third column:   S        1 point for each column correct.
      ;; 1950) ; songs before 1950
      ((_________ (_________ _________) 1950) 'ancient)
      ((_________ (_________ _________) 1960) 'fifties)
      ((_________ (_________ _________) 1970) 'sixties)
      ((_________ (_________ _________) 1980) 'seventies)
      ((_________ (_________ _________) 1990) 'eighties)
      ((_________ (_________ _________) 2000) 'nineties)
      (else 'modern)))) ; songs after 1999

(c) (8 points) Define the function song-longer? that takes two songs as inputs and returns true if the first song is longer (in seconds) than the second song (and false otherwise).

Write a contract, a brief purpose statement, and the Scheme function definition. You do not have to write examples or tests.

Problem 4 (2 points)

In class we discussed circuit-switched networks and packet-switched networks.

(a) One describes message routing on the internet; the other describes conventional telephone service. Which is which?

(b) A transmission typically gets split up into pieces that may take different routes to the destination. Does this describe circuit-switching or packet-switching?