

## CS 357: Declarative Programming Homework 4 (Spring '09)

1. Exercises 7.12, 7.13, 7.18, 7.22, 7.26, 7.30, 7.31
2. The higher-order function, *tail-recur*, takes the following arguments:
  - *bpred* - a procedure of *x* which returns #t if the terminating condition is satisfied and #f otherwise
  - *xproc* - a procedure of *x* which updates *x*
  - *aproc* - a procedure of *x* and *acc* which updates *acc*
  - *acc0* - an initial value for *acc*

and returns a tail recursive function of *x*. For example, it can be used to write the function, *factorial* as follows:

```
(define factorial
  (tail-recur zero? (lambda (x) (- x 1)) * 1))
```

Write *tail-recur*.

3. Use *tail-recur* to write *reverse*.
4. Use *tail-recur* to write *iota*.
5. The function *any?* takes a predicate, *pred*, as its first argument and applies this predicate to each of its remaining arguments. If any of these satisfy the predicate, *any?* returns #t otherwise *any?* returns #f. For example,

```
> (any? number? #f 1 'foo)
#t
> (any? (lambda (x) (and (even? x) (> x 7))) 1 2 9)
#f
```

Use *tail-recur* to write a function, *any?-c*, which takes a predicate, *pred*, as its only argument and returns a function of a variable number of arguments. Use *any?-c* to define *any?*.

6. Define a function *clock-maker* which creates instances of a class, *clock*, representing a 12 hour clock, using three *restricted-counter* objects (See Exercise 12.4 in Springer and Friedman) to represent hours, minutes, and seconds. Clock instances should recognize the following methods:
  - *type* - Returns *'clock*.

- *tic!* - Advances the time by one second.
- *seconds!* - Set the second hand to the value of the first optional argument. Displays an error message if the argument is less than 0 or greater than 59.
- *minutes!* - Set the minute hand to the value of the first optional argument. Displays an error message if the argument is less than 0 or greater than 59.
- *hours!* - Set the hour hand to the value of the first optional argument. Displays an error message if the argument is less than 0 or greater than 11.
- *display* - Displays the current time in a HH:MM:SS format.

You can test your clock class using the following test routine:

```
(define clock-tester
  (lambda ()
    (let ((clock (clock-maker)))
      (letrec
        ((loop
          (lambda (seconds)
            (if (< seconds 3601)
                (begin
                  (clock 'tic!)
                  (loop (+ 1 seconds)))))))
         (clock 'hours! 11)
         (clock 'minutes! 3)
         (clock 'seconds! 47)
         (loop 0)
         (clock 'display))))))
```

If your clock is working correctly, it should display 00:03:48.