Scheme Tutorial Exercises

Fall 2003

Problem Set 1: Basic Scheme

1. The local supermarket needs a program that can compute the value of a bag of coins. Define the program *sum-coins*. It consumes four numbers: the number of pennies, nickels, dimes, and quarters in the bag; it produces the amount of money in the bag. **(HtDP Exercise 2.3.2)**

2. Develop *area-cylinder*. The program consumes the radius of the cylinder's base disk and its height. Its result is the surface area of the cylinder. **(HtDP Exercise 3.3.3)**

3. Develop the function *area-pipe*. It computes the surface area of a pipe, which is an open cylinder. The program consumes three values: the pipe's inner radius, its length, and the thickness of its wall. **(HtDP Exercise 3.3.4)**

   Develop two versions: a program that consists of a single definition and a program that consists of several function definitions. Which one evokes more confidence?

4. Develop the function *tax*, which consumes the gross pay and produces the amount of tax owed. For a gross pay of $240 or less, the tax is 0%; for over $240 and $480 or less, the tax rate is 15%; and for any pay over $480, the tax rate is 28%. **(HtDP Exercise 4.4.2)**

   Also develop *netpay*. The function determines the net pay of an employee from the number of hours worked. The net pay is the gross pay minus the tax. Assume the hourly pay rate is $12.

   Hint: Remember to develop auxiliary functions when a definition becomes too large or too complex to manage.

5. Develop *what-kind*. The function consumes the coefficients a, b, and c of a quadratic equation. It then determines whether the equation is degenerate and, if not, how many solutions the equation has. The function produces one of four

symbols: 'degenerate, 'two, 'one, or 'none. An equation is degenerate if $a = 0$. **(HtDP Exercise 5.1.4)**

6. Provide a datatype definition for representing points in time since midnight. A point in time consists of three numbers: hours, minutes, and seconds. **(HtDP Exercise 6.4.2)**

   Now develop the function *time-diff*. It consumes two time structures, *t1* and *t2*, and returns the number of seconds from *t1* to *t2*. For example:

   (*time-diff* (*time-point* 1 2 3) (*time-point* 4 5 6))
   > 10983

7. Provide a datatype definition for a position, which is a two-dimensional location. Next, provide a datatype definition for shapes. There are three kinds of shapes:

   - a circle has a center (position) and a radius (number)

   - a square has an upper-left corner (position) and a length (number)

   - rectangle has an upper-left corner (position), width (number), and height (number)

8. Develop the function *area*, which consumes a shape and computes its area. **(HtDP Exercise 7.1.3)**

9. Develop *translate-shape*. The function consumes a shape and a number delta, and produces a shape whose key position is moved by delta pixels in the x direction. **(HtDP Exercise 7.4.3)**

10. Develop the function *in-shape?*, which consumes a shape and a position *p*, and returns *true* if *p* is within the shape, *false* otherwise.