CSE1729 - Introduction to Programming	September 29, 2020

Laboratory Assignment 4

Activities

1. (Windchill Temperature) When the weather becomes cold, the windchill temperature is used to quantify the effect of wind on the perceived temperature. If W is the wind speed measured in miles per hour, F is the ambient temperature in degrees Fahrenheit, the windchill temperature is given by the formula:
$$T = 1.05 + 0.93F - 3.65W + 3.62\sqrt{W} + 0.103F\sqrt{W} + 0.0439W^2$$
Define a SCHEME function, named `(windchill W F)`, which computes the windchill factor for a Fahrenheit temperature, `F`, and wind speed in mph, `W`. Use a `let` form to create a local variable for the square root of the wind speed.

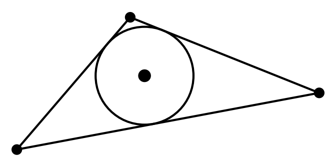

Figure 1: The circle inscribed in a triangle.

2. The radius R of the circle inscribed in a triangle with edge lengths A, B, and C is given by the formula
$$R = \sqrt{\frac{(S-A)(S-B)(S-C)}{S}} \qquad \text{where} \qquad S = \frac{A+B+C}{2}.$$
Define a SCHEME function `iradius` which takes three parameters for the side lengths (perhaps call them A, B, and C) and returns the radius as given by the formula above. (You may use the built-in scheme function `sqrt` for this purpose. A `let` construct can save you a lot of typing.)

3. **Using the special form** `let`, we can declare some substitutions for use within an expression. To illustrate this, we use an equation relating atmospheric pressure p to altitude h and other parameters:
$$p = p_0 \cdot (1 - \frac{L \cdot h}{T_0})^{(\frac{g \cdot M}{R \cdot L})}$$
This function has several constant parameters as detailed in the table below. For a more detailed introduction, see http://en.wikipedia.org/wiki/Atmospheric_pressure#Altitude_atmospheric_pressure_variation.

Parameter	Description	Value
p_0	sea level standard atmospheric pressure	101325 Pa
L	temperature lapse rate	0.0065 K/m
T_0	sea level standard temperature	288.15 K
g	Earth-surface gravitational acceleration	9.80665 m/s^2
M	molar mass of dry air	0.0289644 kg/mol
R	universal gas constant	8.31447 $J/(mol \cdot K)$

For our own convenience, you can define these constants within the function for this equation, establishing local bindings the interpreter can use during evaluation of the function. In order to make the expression in the function body easier to read, we can also add bindings for the base and exponent portions of the body expression. To do this, we must use nested `let` statements here since none of the variables are bound to values until the entire list has been evaluated. Define a SCHEME function, named `(pressure h)`, using the `let` form to simplify the function body.

4. **SICP Exercise 1.42** Let f and g be two one-argument functions. The composition f after g is defined to be the function $x \mapsto f(g(x))$. Define a procedure, named `(compose f g)`, that implements composition. For example, if `inc` is a procedure that adds 1 to its argument,

   ```
   ((compose square inc) 6)
   49
   ```

   Note: Your procedure should return a *function* that performs the composition of f and g.

5. **SICP Exercise 1.43** If f is a numerical function and n is a positive integer, then we can form the n^{th} repeated application of f, which is defined to be the function whose value at x is $f(f(...(f(x))...))$. For example, if f is the function $x \mapsto x + 1$, then the n^{th} repeated application of f is the function $x \mapsto x + n$. If f is the operation of squaring a number, then the n^{th} repeated application of f is the function that raises its argument to the 2^n th power. Write a procedure named `(repeated f n)`, that takes as inputs a procedure that computes f and a positive integer n and returns the procedure that computes the n^{th} repeated application of f. Your procedure should be able to be used as follows:

   ```
   ((repeated square 2) 5)
   625
   ```

   You may want to take advantage of the `compose` function you wrote.