CSE1729 - Introduction to Programming	October 12, 2020

Laboratory Assignment 5

Objectives

Work with pairs and lists

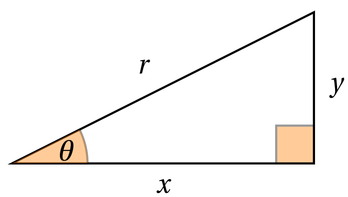
Activities

1. Define a SCHEME function, named `square-pair`, to take a number, and return a pair with the number and its square.

2. Define a SCHEME function, named `(rev p)`, which takes a pair as an argument and evaluates to another pair with the first and second elements in the pair `p` in reverse order. For instance,

```
> (rev (cons 1 2))
(2 . 1)
```

3. There are two main systems of defining points on a two-dimensional plane. One consists of a distance from the origin and an angle from the positive x-axis, referred to as polar coordinates. The other, more familiar system, consists of two components corresponding to the distance along the x-axis and the distance along the y-axis from the origin, referred to as Cartesian coordinates.



   (a) Converting to polar coordinates: Define a SCHEME function named `(c->p p)` which accepts a point in the Cartesian coordinate system as a *pair* and returns another pair representing the same point in the polar coordinate system. That is, if the function receives the pair `(x . y)` as a parameter, it should evaluate to the pair `(r . `θ`)`, where $r = \sqrt{x^2 + y^2}$ and $\theta = tan^{-1}(\frac{y}{x})$. Your function should take a SCHEME pair as a parameter and return a SCHEME pair. Note: the arctan function in SCHEME is named `atan`.

   (b) Converting to Cartesian coordinates: Define a SCHEME function named `(p->c p)` which accepts a point in the polar coordinate system as a *pair* and returns another pair representing the same point in the Cartesian coordinate system. That is, if the function receives the pair `( r . `θ`)` as a parameter, it should evaluate to the pair `(x . y)`, where $x = r \cdot cos(\theta)$ and $y = r \cdot sin(\theta)$. Your function should take a SCHEME pair as a parameter and return a SCHEME pair.

4. You may recall that, given two points, (x_1, y_1) and (x_2, y_2), one can find the slope, m, of a straight line through these two points with the equation:

$$m = \frac{y_2 - y_1}{x_2 - x_1}$$

Furthermore, the function that defines a straight line in "slope intercept form" has the form $y = mx + b$ where b is the *y-intercept*. Given the slope, m, of a line and a point, (x_1, y_1), on the line, one can find the y-intercept by the equation $b = y_1 - mx_1$.

Define a SCHEME function, named `(y p1 p2)`, that takes two points, `p1` and `p2` (each point stored in a SCHEME pair), as parameters and evaluates to a function of one parameter that, given x, will return the corresponding y for a point on the straight line between `p1` and `p2`.

Hint: If you want to define variables for m and b, using the variable m in the expression that defines b, you can avoid using nested `let` *forms by using* `let*` *instead.*