CS 2500, Lab 9—The Dragon Fractal

- Work in pairs
- Change roles often!
- Follow the design recipe and/or the abstraction recipe for every problem.

The Dragon Fractal...

Today you will design functions to draw (and iterate) an interesting fractal design called the *Dragon*. This was used on the headings of chapters in the book *Jurassic Park* (if anyone is old enough to remember that...).

We start off building a simple line drawing program. Then we'll combine pieces into the fractal's (generative) recursion.

First, a direction (`Dir`) is a Symbol, one of: `'left`, `'right`, `'up`, or `'down`.

Exercise 1: Write the function, `rotate-dir`, that rotates a given `Dir` 90 degrees *counter-clockwise* (rotate to the `left`). What are the four cases of `Dir` and what should you return?

```
;; rotate-dir :  Dir -> Dir
;; Rotate the given direction to the 'left' (counter-clockwise)
(define (rotate-dir dir) ...)
```

Exercise 2: Write the function, `rotate-dirs`, that rotates all the `Dirs` in a `[Listof Dir]` *counter-clockwise*. Hint: Which loop function can you use?

```
;; rotate-dirs :  [Listof Dir] -> [Listof Dir]
```

Exercise 3: Write the function, `move-posn`, that returns a `Posn` that is the result of moving the given x and y in the given `Dir`-ection, the given amount, `amt`.

```
;; move-posn :  Number Number Symbol Number -> Posn]
```

Exercise 4: Write the function, `draw-dirs`, that draws lines of a desired color given a list of directions (in order) starting at the given x and y into the given scene.

Hint: Use structural recursion here, and choose some constant amount for `move-posn` (say 3). You can use `line` to create the lines. You'll need a bit of an accumulator too.

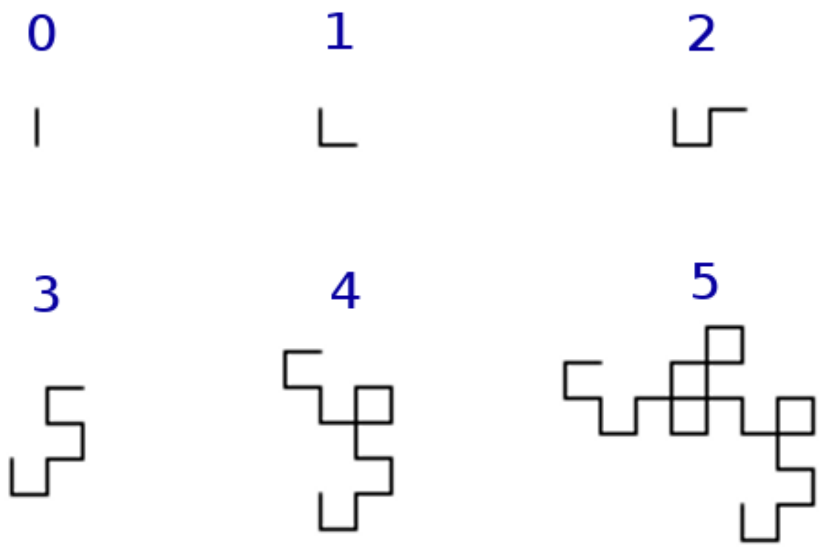
```
;; draw-dirs :  [Listof Dir] Number Number Color Scene -> Scene
;; Draw lines of given color, following the given directions starting at (x,y)
;; into the given Scene.
```

Here's some interactive stuff to test your functions...use the arrow keys to create a path (a `[Listof Dir]`). You can hit `r` to rotate all the points to the left.

```
;; Screen Size...
(define W 400)
(define H 400)

;; Draw wrapper
(define (draw w)
   (local ((define lst (reverse w)))
       (draw-dirs lst (/ W 2) (/ H 2) "red" (empty-scene W H))))

;; Key Handler
(define (key w ke)
   (cond
      [(key=?  ke "up") (cons 'up w)]
      [(key=?  ke "down") (cons 'down w)]
      [(key=?  ke "left") (cons 'left w)]
      [(key=?  ke "right") (cons 'right w)]
      [(key=?  ke "r") (rotate-dirs w)]
      [else w]))

(big-bang '()
       (to-draw draw)
       (on-key key))
```

Onward

Now... We need to generate the fractal. Here's the pattern; the blue number is the number of iterations run.



The algorithm takes a `[Listof Dir]` and a `Number` that is the *iterations* left to be done. To start the algorithm off we will pass it the list `'(down)`, and the number of iterations we want.
It goes like this:

- If `iter` is 0, then leave the list alone
- Otherwise, return a new list modified as follows:
  1. Rotate all the `Dirs` from the old list
  2. Reverse the rotated list (remember (`reverse ...`)?)
  3. Append the new reversed/rotated list on the end of the old list
  4. Recurse on the new list, and with one less `iter`

Exercise 5: Write the function `jurassic` that implements the algorithm above. You can use `local` to `define` each step separately, then it will be clear that your function follows the specification.

```
;; jurassic:  [Listof Dir] Number -> [Listof Dir]
;; Compute the next iteration of the Jurassic Fractal, given a [Listof Dir]
;; and the number of iterations left.
(define (jurassic lod iter) ...)
```

Test your function out, starting with the list '(down), using it to generate a [Listof Dir] and draw it using `draw-dirs`.

If you're done early...

When drawing the directions (`draw-dirs`) try accumulating and changing the current color, or modifying the size of the lines to create interesting drawings.

If you're done *really* early...

Try doing the Koch Snowflake fractal... that one's pretty fun, and a nice challenge.