Exercise 1: 5 programming problems in Textbook A.

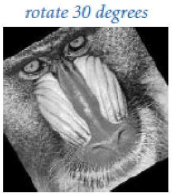
Please Sent your programs to program06@yeah.net before (including) March 3.

3.1.36 *Rotation filter.* Write a program that takes two command-line arguments (the name of an image file and a real number θ) and rotates the image θ degrees counterclockwise. To rotate, copy the color of each pixel (s_i, s_j) in the source image to a target pixel (t_i, t_j) whose coordinates are given by the following formulas:

$$t_i = (s_i - c_i)\cos\theta - (s_j - c_j)\sin\theta + c_i$$
$$t_j = (s_i - c_i)\sin\theta + (s_j - c_j)\cos\theta + c_j$$

where (c_i, c_j) is the center of the image.

rotate 30 degrees

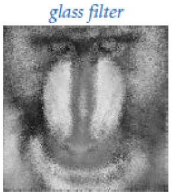


3.1.37 *Swirl filter.* Creating a swirl effect is similar to rotation, except that the angle changes as a function of distance to the center of the image. Use the same formulas as in the previous exercise, but compute θ as a function of (s_i, s_j), specifically π/256 times the distance to the center.

swirl filter

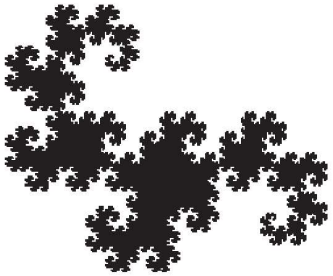
3.1.39 *Glass filter.* Write a program that takes the name of an image file as a command-line argument and applies a *glass filter*: set each pixel *p* to the color of a random neighboring pixel (whose pixel coordinates both differ from *p*'s coordinates by at most 5).

glass filter



3.2.27 *Dragon curves.* Write a recursive `Turtle` client `Dragon` that draws dragon curves (see EXERCISE 1.2.35 and EXERCISE 1.5.9).

```
% java Dragon 15
```



Answer: These curves, which were originally discovered by three NASA physicists, were popularized in the 1960s by Martin Gardner and later used by Michael Crichton in the book and movie *Jurassic Park*. This exercise can be solved with remarkably compact code, based on a pair of mutually recursive methods derived directly from the definition in EXERCISE 1.2.35. One of them, `dragon()`, should draw the curve as you expect; the other, `nogard()`, should draw the curve in *reverse* order. See the booksite for details.

3.2.28 *Hilbert curves.* A *space-filling curve* is a continuous curve in the unit square that passes through every point. Write a recursive `Turtle` client that produces these recursive patterns, which approach a space-filling curve that was defined by the mathematician David Hilbert at the end of the 19th century.