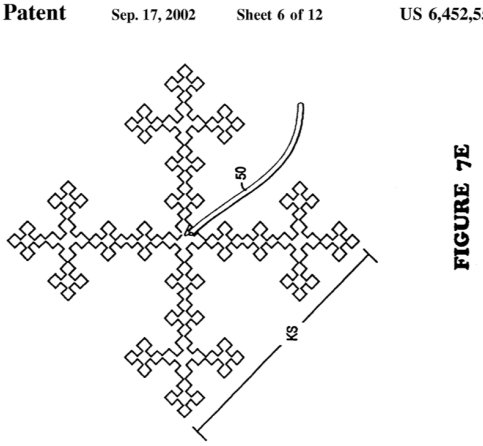
Computational Problem Solving CSCI-603
Fractal Antennas Lab 3

1 Problem

According to Wikipedia, a fractal antenna "is an antenna that uses a fractal, self-similar design to maximize the length, or increase the perimeter" and "are very compact, multiband or wideband, and have useful applications in cellular telephone and microwave communications." One example of a fractal antenna is given as shown below:

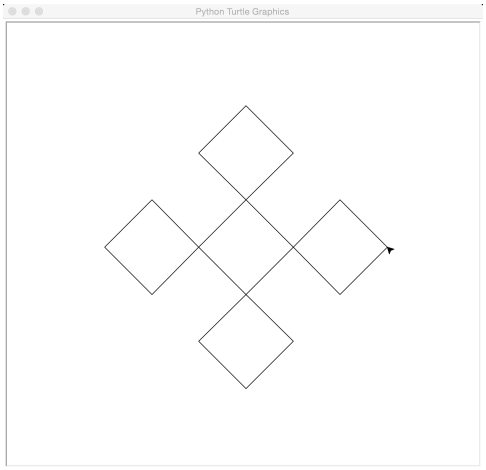


In this lab, you will use Python's turtle package to draw fractal antennas.

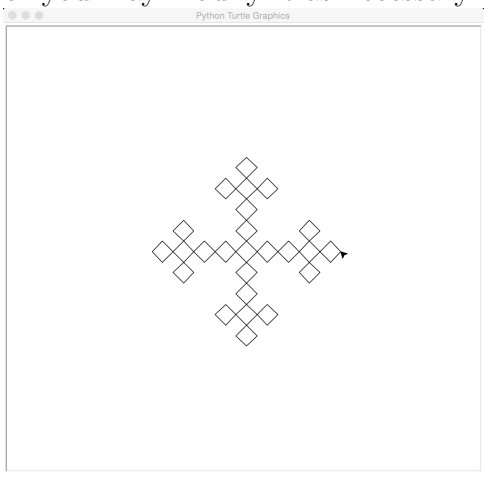
1.1 Problem-solving Session (20%)

You will work in a group of three or four students as determined by the instructor. Each group will work together to complete the following activities.

Here is the initial shape of this fractal antenna:



1. How would you draw this figure, based on drawing a series of squares? You may pick the turtle's pen up as required but do not use goto. Write turtle code, but feel free to use abbreviations as long as your meaning is clear.
2. It is also possible to draw the shape by following the perimeter. See the first figure for some inspiration. Again, write the turtle code for this strategy. You should be using at least one loop in your answer!
3. Here is how a "second-level" antenna design would look. Based on **one** of your two answers above, give the code for how to draw it — you may be able to use your previous function as is, or you may modify it as necessary.

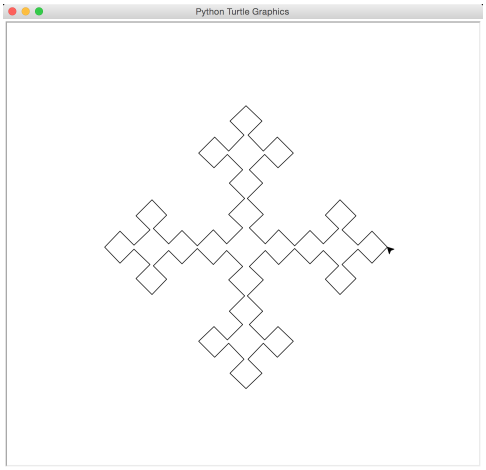


At the end of problem-solving, put all group members' names on the sheet, number each item and hand in your work, one copy per group.

1.2 Implementation (80%)

For complete implementation of this lab, your code must be able to draw fractal antennas of any depth and size, and draw them either as a single line or as a sequence of squares. In particular, your main function should prompt the user for the overall size of the antenna, the depth, and whether it should be drawn as a single path.

In addition, for the version of the antenna that is drawn as a single line, you should also modify your solution so that it draws it more like this image, in which the corners of the edges do not touch:



Note that getting this version to be perfectly symmetric, especially at higher depths, is extremely challenging and is not expected. Simply leave a small amount of space so it is clear that this antenna could be constructed from a single piece of wire.

1.3 Grading

- Problem-Solving Grade, 20%
- Design, 20%
  Your code should be properly recursive and use loops as necessary to generate the different versions of the antenna.
- Functionality, 50%
  Your code should generate proper shapes for any (visible!) size and depth. (25% for first method, 20% for second method, 5% for second method with gaps)
- Style, 10 %
  The code follows the style guidelines on the course web site.

1.4 Submission

Transfer your program to the CS machines. Submit your program (one submission per team!) before the deadline using try:

```
try grd-603 lab3-1 antenna.py
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