

## Problem F.4

# Problem 220: Highway Dragon

Due Date: 5/3/2019

Folder: FinalProject

File Name: F4\_Prob220\_Name.py

Points: 20 points

## Problem Background

Begin by looking at the Project Euler page for this problem, [Problem 220](#). We start with a two letter string, such as  $D_0 = \text{"Fa"}$ . We define a sequence of strings  $D_n$  iteratively by the rules:

- For every “a” in the string, replace it with the string “aRbFR”
- For every “b” in the string, replace it with the string “LFaLb”

Thus after every iteration, the string obviously get longer. An example of this iterative process is given on the Project Euler page.

The resulting string, after  $N$  iterations, can be interpreted as a sequence of commands for a graphics program. Imagine there is a bug sitting at the origin  $(0,0)$  facing up the positive  $y$ -axis. Each character of the string tells the bug to make one movement. A character of “F” tells the bug to move one unit forward, the character “L” tells the bug to turn 90 degrees to the left, and the character “R” tells the bug to turn 90 degrees to the right. The bug follows the instructions of the string, and as it moves it leaves behind a trail which can be plotted on the screen.

Your goal will be to draw this trail, following the instructions of the string  $D_N$ . You can then answer questions such as how the plot changes as you increase  $N$ . Also, how does the plot change if you change the initial string.

## Program Criteria

Write a program that does the following:

- Create a variable  $N$  to represent the number of iterations to perform.
- Create a variable to contain the start string  $D_0$ .
- Generate the string  $D_N$  iteratively, and display the corresponding graph.

## Deliverables

Place the following in a folder named `FinalProject` in your repository:

- A Python file `F4_Prob220_Name.py` that satisfies the program criteria.
- A PDF file `F4_Prob220_Name.pdf` that describes how your program works. This should be a description of how you went about solving this problem. You should go into some detail about your solution method, but I don’t want to see something about every `if` statement and `for` loop. As an example of the type of description I’m looking for, see the file `Goldbach_explanation.doc` in the `Final Problem` folder of my repo.
- In the same PDF, explain how you translated the string into graphics. For instance, how did you keep track of the direction the bug was pointing, and how did you “turn” the bug in the code.

- List at least two full questions that you think could be asked about this problem. Here is an example, which you may not use as one of your questions
  - ★ “Do different values of  $D_0$  make the graph grow more like a line, while others make it grow more like a circle (looping back on itself) as  $n$  increases? Or is it some combination of the two, a looping line?”

State your questions just as fully as the one above. Then at least **try** to give some possible answer, using your code. I'm not looking for a proof.