

# Project 1 Tutorial

In order to generate fractal structures recursively, you will need to use the software package that is available at:

<https://lsystems.scriptaaesthetica.com/>

This program requires that you specify:

1. The step size (which is 1 in all the cases that we will be interested in)
2. The number of iterations
3. The rotation angle
4. The base axiom
5. A production rule, that is defined by combining the following basic operations:

`"F" = Line , "f" = Move , "[" = Push , "]" = Pop ,  
"+" = Left , "-" = Right`

You can save or copy any of these fractals as .png image files by clicking on the "Save as PNG" button, and then right-clicking the rendered fractal.

**Note:** You may have to use the Auto-Center Camera feature to position the image to your liking before you copy it.

**Example 1.** Suppose you are given  $F$  as the axiom, and a rule of the form

$$F \rightarrow FF[+F[-F] + F] - F[-F] + F$$

where the angle is 45 degrees. A schematic interpretation of this rule is shown in Fig. 1, where the circled numbers indicate points where a new "push" occurs, and the other numbers indicate the order in which different elements of the structure are formed.

Note that a "pop" moves the cursor to the location that is stored at the top of the stack, and restores the direction that it had at the time of the "push". Thus, when we return to position 1, the cursor will point in the vertical direction, and when we return to position 3, it will point in a direction that is 45 degrees to the right.

Figs. 2-4 show what this object looks like after 1, 3 and 5 iterations.

**Example 2** Suppose you are given  $F$  as the axiom, and a rule of the form

$$F \rightarrow -F - F + F + F - F - F - F + F + F - F$$

where the angle is 90 degrees. A schematic interpretation of this rule is shown in Fig. 5, and Figs. 6-8 illustrate what this object looks like after 1, 3 and 5 iterations.

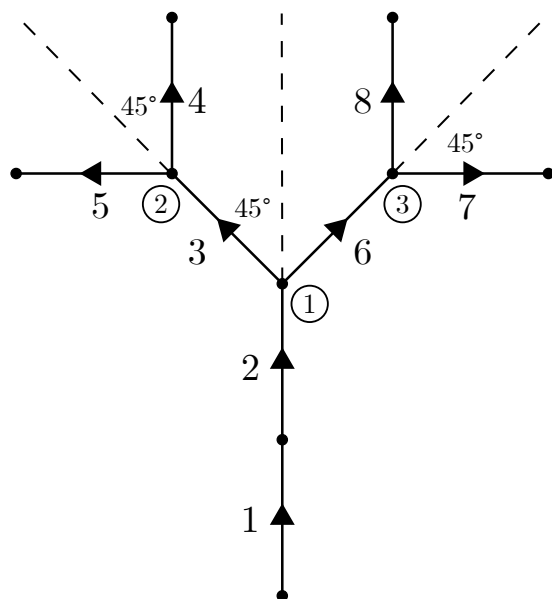


Figure 1: Schematic diagram for Example 1

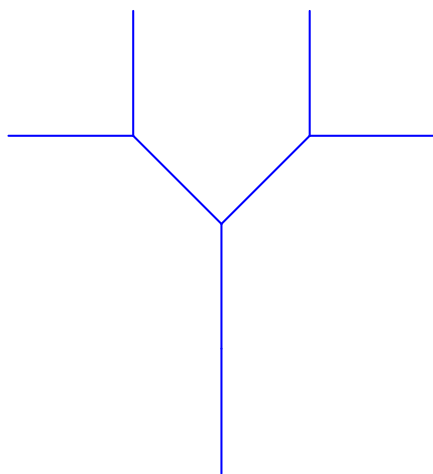


Figure 2: Iteration 1

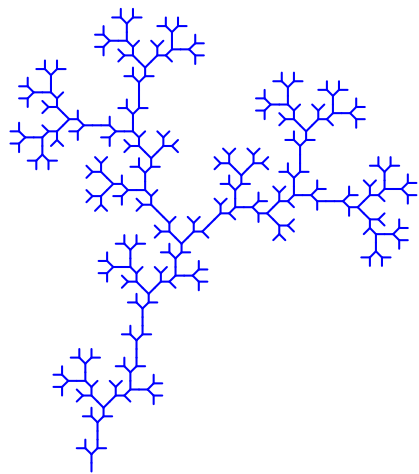


Figure 3: Iteration 3

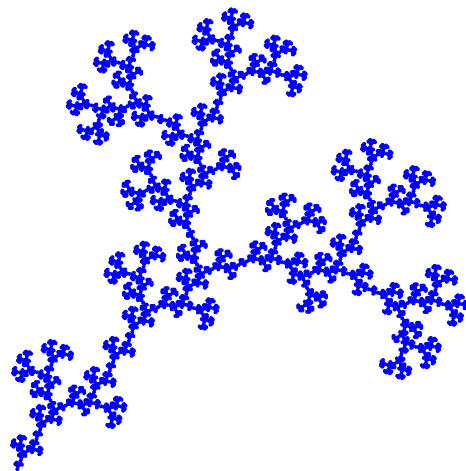


Figure 4: Iteration 5

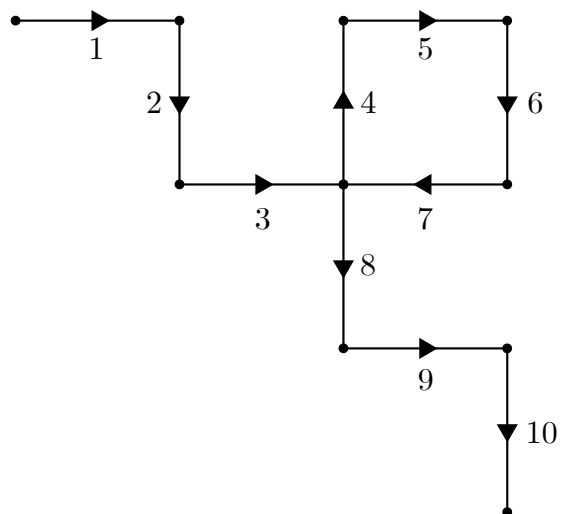


Figure 5: Schematic diagram for Example 2

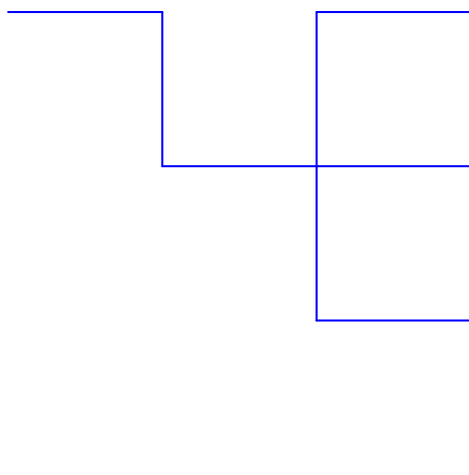


Figure 6: Iteration 1

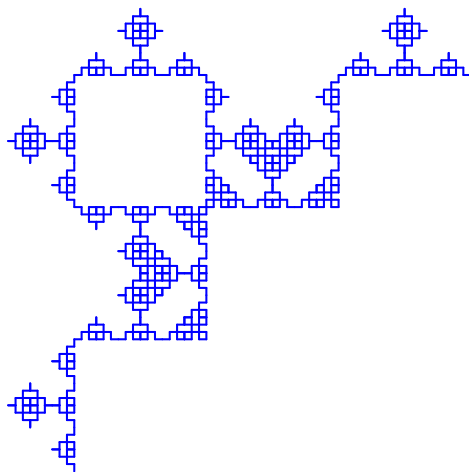


Figure 7: Iteration 3

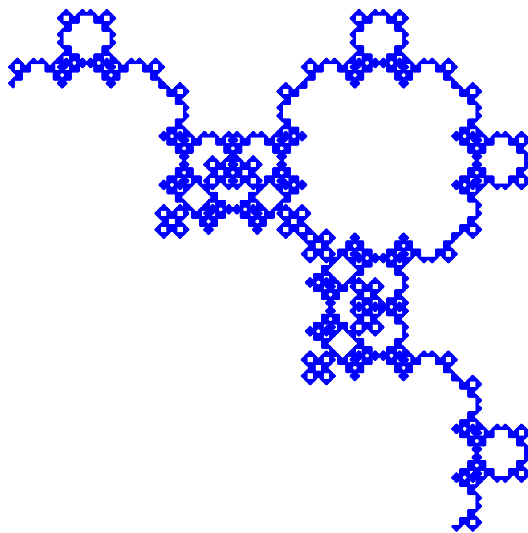


Figure 8: Iteration 5