Algorithmically Generated Plants

- Kristina Mkrtchyan -

INTRODUCTION

A brief overview of fractals, L-systems, and how we can generate more realistic plant life.

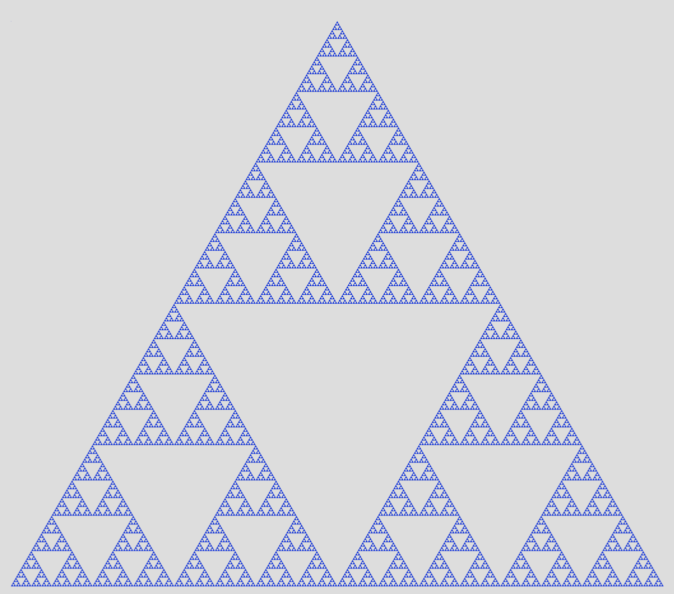
FRACTALS

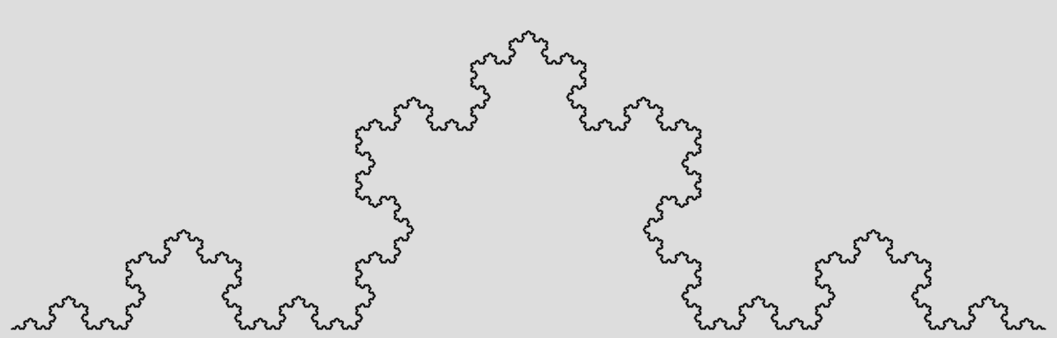
Coined in 1975 by Benoit Mandelbrot.

Fractals are a *self-similar* subset of Euclidean space.

Defined as a rough-edged figure whose dimension is some noninteger.

Fractals more closely relate to natural objects like snowflakes, plants, or the coastline of Britain.





L-SYSTEMS

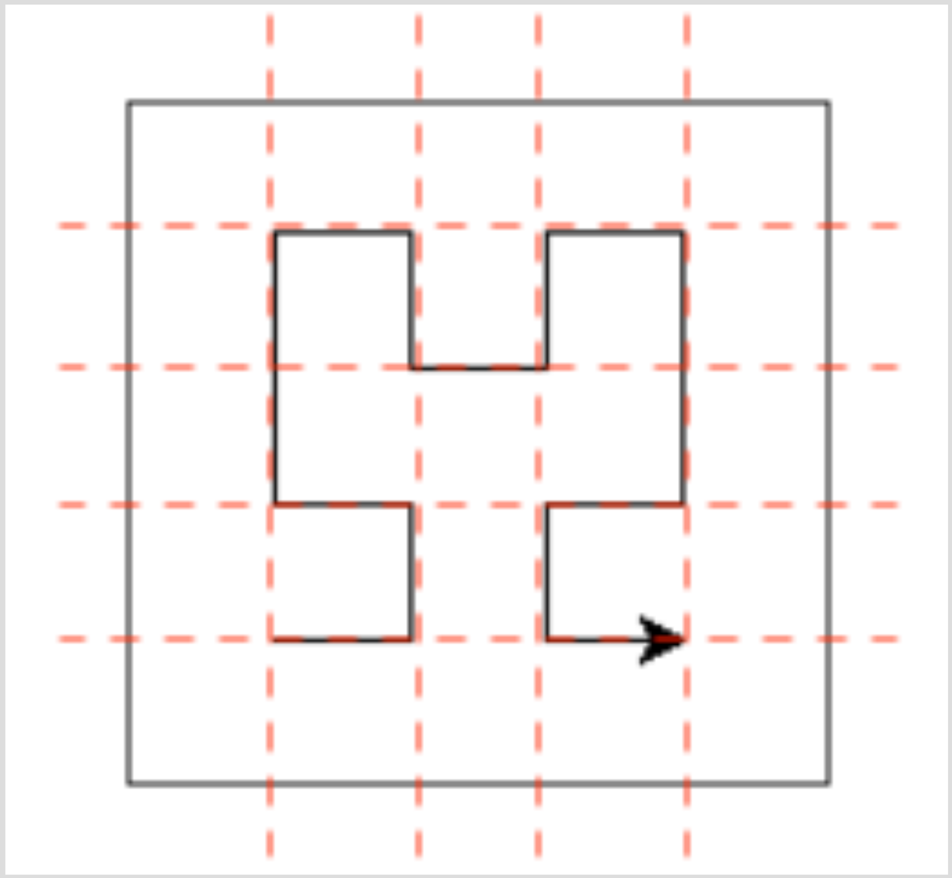


Figure **1**. Modified image of a 2nd order Hilbert Curve as interpreted by a Turtle

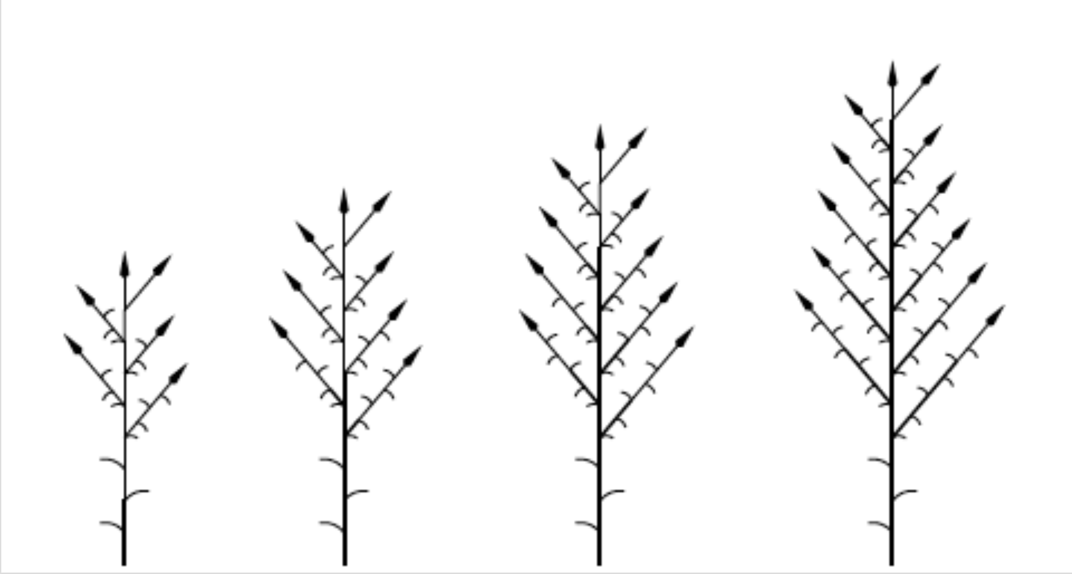
Lindenmeyer Systems, or L-Systems, were developed in 1968 for the explicit purpose of studying plant morphology and development.

A type of formal grammar, L-Systems are comprised of production rules that can be used to generate unique strings or models.

The following is an L-System that generates a Hilbert Curve:

$$
\begin{aligned}
\omega &: L \\
p_1 &: L \rightarrow +RF-LFL-FR+ \\
p_2 &: R \rightarrow -LF+RFR+FL-
\end{aligned}
$$

The recursive nature of L-systems allows for *self-similarity*. Whatever is generated will look natural as a result and increasing levels of recursion will result in what looks like growth.



Growth itself is determined by a function which describes the number of symbols in a string in terms of its derivation length.

To prevent artificial regularity, probability is introduced.

Stochastic L-Systems allow the plant more variation and can be used in an evolutionary context by randomizing either the Turtle interpretation or by modifying the L-System and affecting its topology and geometry.

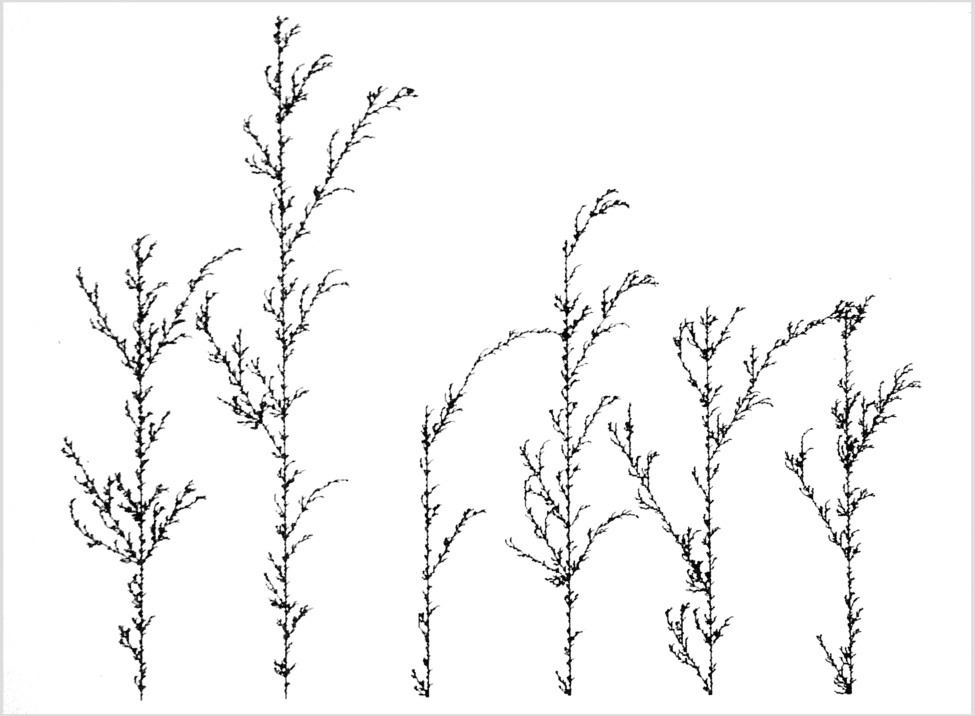


Figure **2**. Example of plants generated using Stochastic L-Systems

Context-sensitive L-Systems can be used in order to better simulate a plant's growth as is dependent on its flow of nutrients or hormones.

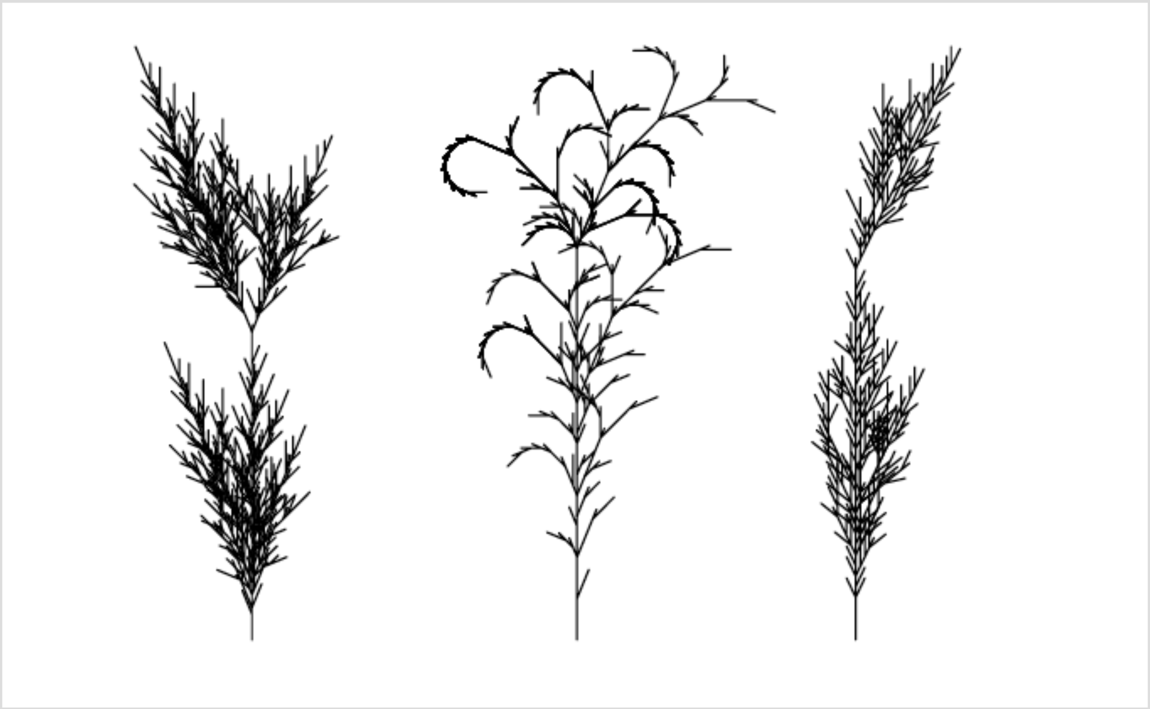


Figure **3**. Examples of branching structures

RESULTS

Figure **4**. Development of *Mycelis muralis* taken from Pusinkiewicz & Lindermayer's *The Algorithmic Beauty of Plants (1990)*

Figure **5.** Flower field

REFERENCES

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