

Lindenmayer Systems: An Exercise

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Rendering

A metaphorical turtle draws lines on the screen, based on instructions given in a *word*.

Basic L-systems have words composed of three symbols, with the meaning noted:

F	move forward, while drawing a line
+	turn left by the specified angle
−	turn right by the specified angle

An *axiom*, or initial word, is specified. Based on *production rules*, symbols (also known as characters) are replaced in the axiom to produce a new word. A word can be re-written several times – by repeatedly applying the production rules to replace symbols.

To actually draw a figure on screen using an L-system, a computer program requires the following information:

length	The length of the line segments used to draw the axiom.
reduction	The factor by which to reduce the initial line segment length each time a word is re-written.
x	The initial horizontal position of the turtle on screen.
y	The initial vertical position of the turtle on screen.
direction	The initial direction that the turtle is facing; in degrees.
angle	The angle by which the turtle will turn left or right; in degrees.
axiom	The initial word (describes what turtle would draw without any symbol replacements based on production rules).
rules	A list of rules that describe how symbols will be replaced.
n	The number of times that a word must be re-written to produce the desired output.

Exercise

Here are the details required to render an L-system that produces a classic fractal:

length	`300`
reduction	3^n
	So, after one level of replacement, line segment length would be $length \div (3^n)$
	$= 300 \div (3^1)$
	$= 300 \div 3$
	$= 100$
x	`100`
y	`400`
direction	`0`
angle	`60`
axiom	F++F++F
rules	F=F−F++F−F
n	3

Given the details above, fill in the table on the next page.

What is the word after each re-write?

How would the word be rendered?

axiom	renders as…
F++F++F	

number of times production rules have been applied to re-write word	word	renders as…
1		
2		

number of times production rules have been applied to re-write word	word	renders as…
3		

References

Prusinkiewicz, Przemyslaw, and Aristid Lindenmayer. *The Algorithmic Beauty of Plants.* New York: Springer-Verlag, 1990. Print.

Note:

The above-referenced book is available online, free, in its complete form, at this address:

http://algorithmicbotany.org/papers/#abop