# 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* 
 So, after one level of replacement, line segment length
 would be 
 *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** |  |  |
| **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>