

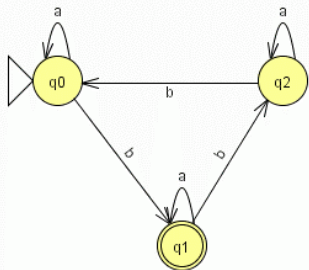
# A Hands-on Approach to FLA with JFLAP

## L-Systems

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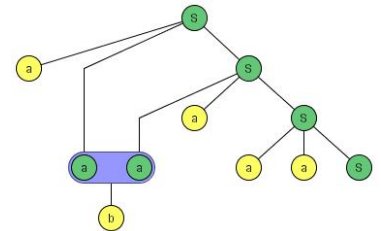
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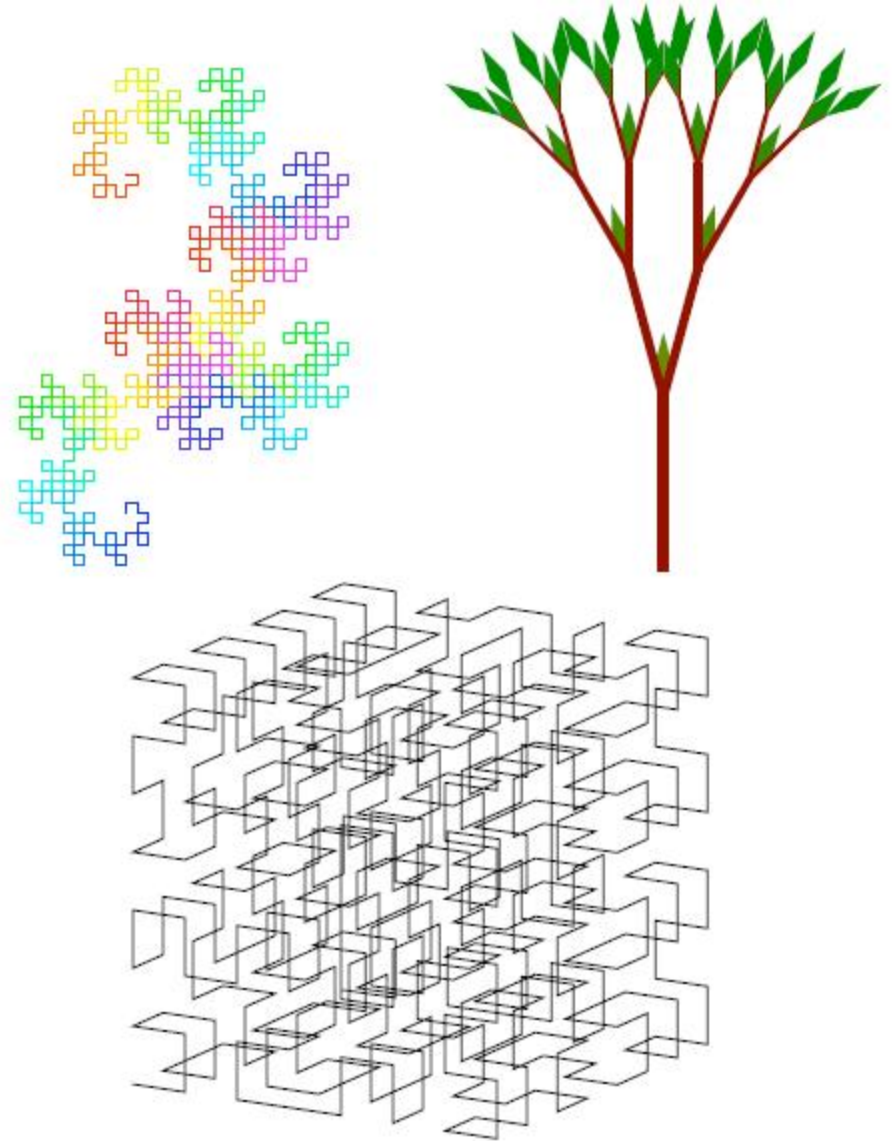
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# L-Systems

- Model biological systems and create fractals
- Similar to Chomsky grammars, except all variables are replaced in each step, not just one!
- Successive strings are interpreted as strings of render commands and displayed graphically



# Parts of an L-System

- Defined over an alphabet
- Three parts
  - Axiom
  - Replacement rules
  - Geometric rules
    - g means move forward one unit with pen down
    - f means move forward one unit with pen up
    - + means turn right by the default angle
    - - means turn left by the default angle

# Example – lsys-samp1

- Axiom

- Replacement Rules

- Geometric Rules

The screenshot shows the JFLAP software interface for the file 'lsys-samp1.jff'. The window has a menu bar with 'File', 'Input', and 'Help'. Below the menu bar is a tab labeled 'Editor'. The editor contains the following content:

Axiom: X

X	→	g g g X + Y
Y	→	g

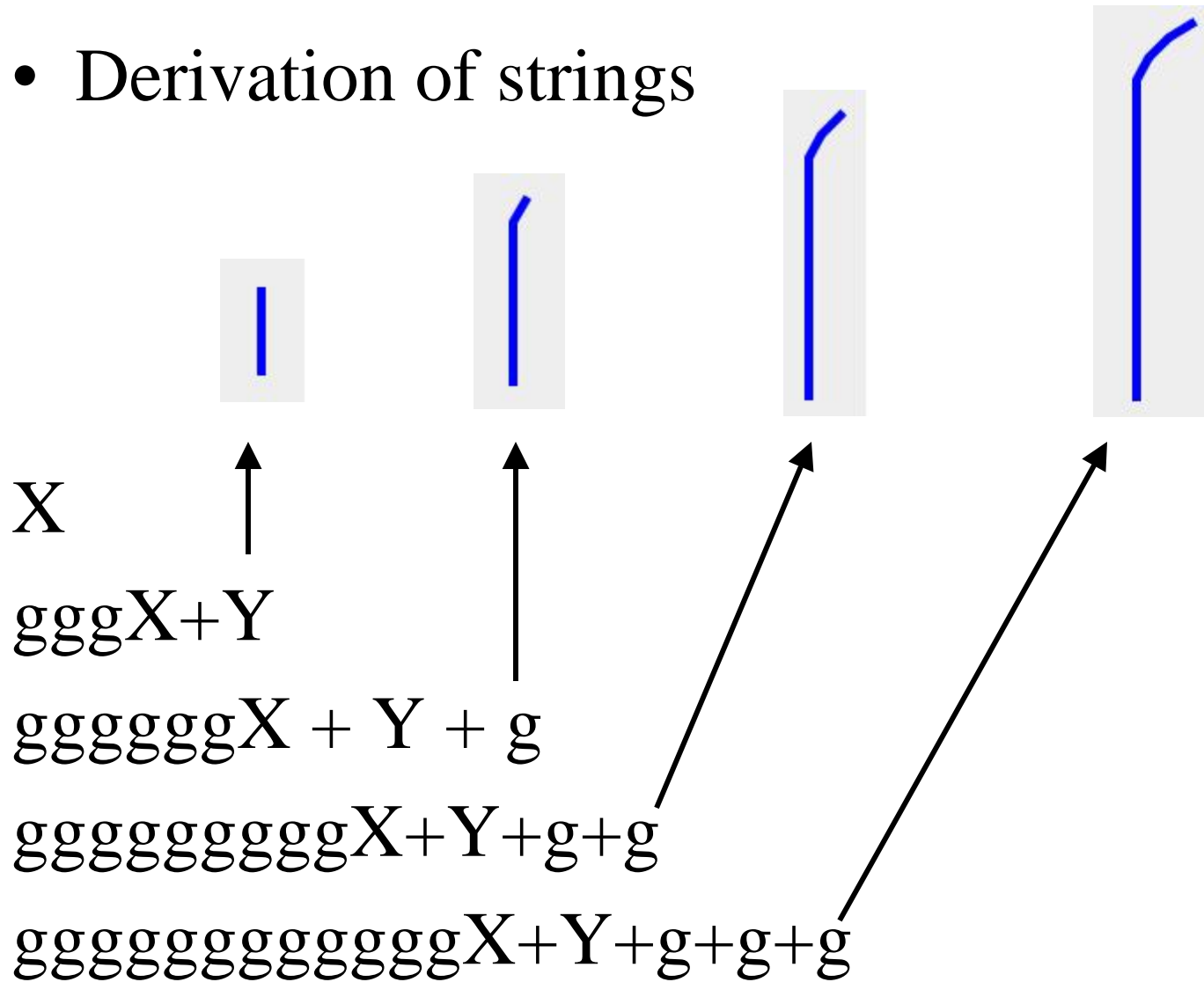
Below the replacement rules is a table of geometric rules:

Name	Parameter
lineWidth	5
distance	15
color	blue
angle	15

Arrows from the text on the left point to the 'Axiom: X' field, the replacement rules table, and the geometric rules table.

# Example – lsys-samp1(cont)

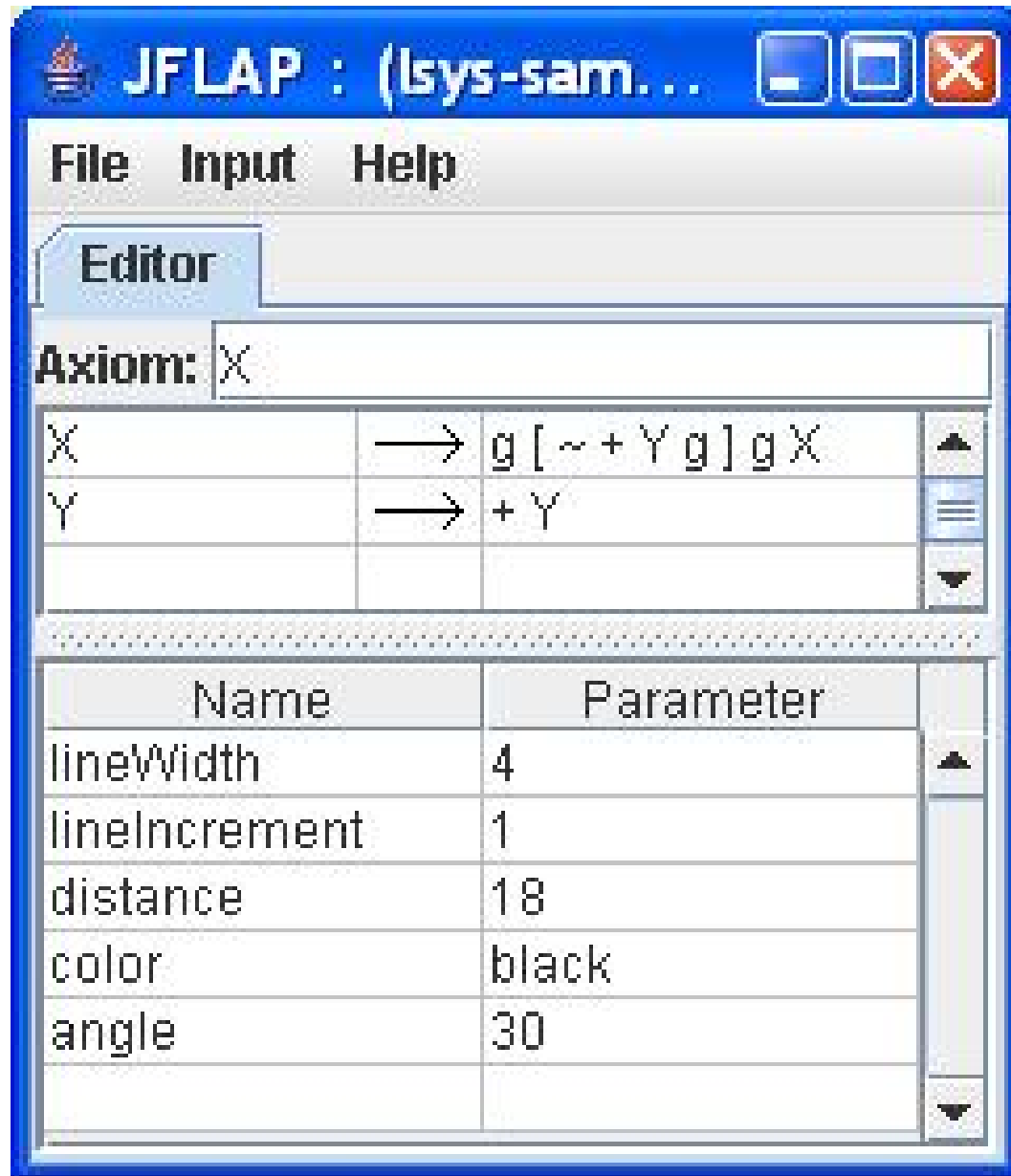
- Derivation of strings



# More Geometric rules

- % change direction 180 degrees
- ~ decrement the width of the next lines
- [ save in stack current state info
- ] recover from stack state info
- { start filled in polygon
- } end filled in polygon

# Example – lsys-samp2



The screenshot shows the JFLAP software interface. The window title is "JFLAP : (lsys-sam...". The menu bar includes "File", "Input", and "Help". The "Editor" tab is active, showing the "Axiom: X" section. Below this, there are two rows of grammar rules:

X	→	g[~+Yg]gX
Y	→	+Y

Below the grammar rules is a table of parameters:

Name	Parameter
lineWidth	4
lineIncrement	1
distance	18
color	black
angle	30

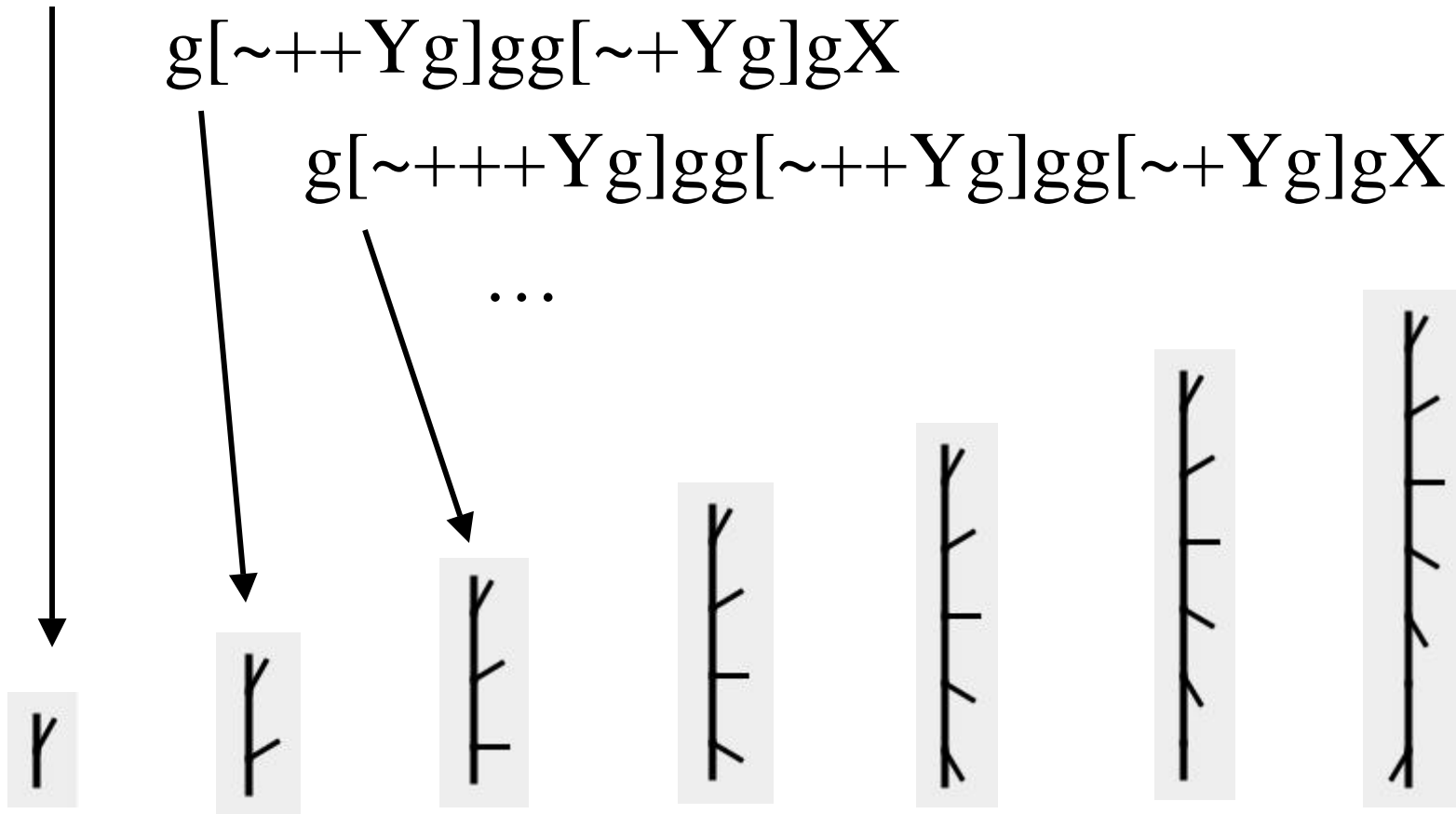
# Example – lsys-samp2 (cont)

$g[\sim+Yg]gX$

$g[\sim++Yg]gg[\sim+Yg]gX$

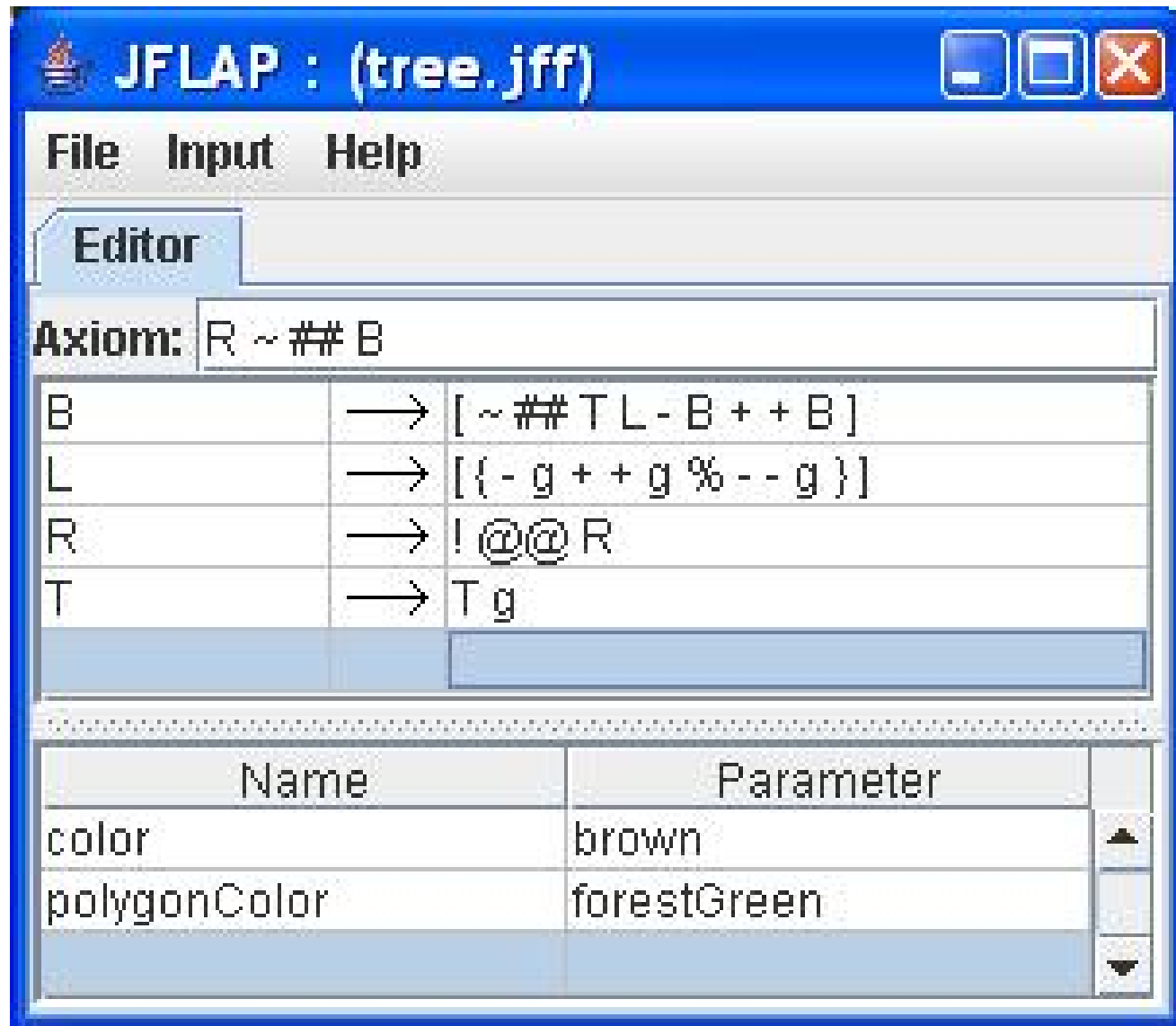
$g[\sim+++Yg]ggg[\sim++Yg]gg[\sim+Yg]gX$

...





# Example - tree



The screenshot shows the JFLAP software window titled "JFLAP : (tree.jff)". The window has a menu bar with "File", "Input", and "Help". Below the menu bar is a tab labeled "Editor". The main editing area contains the following grammar rules:

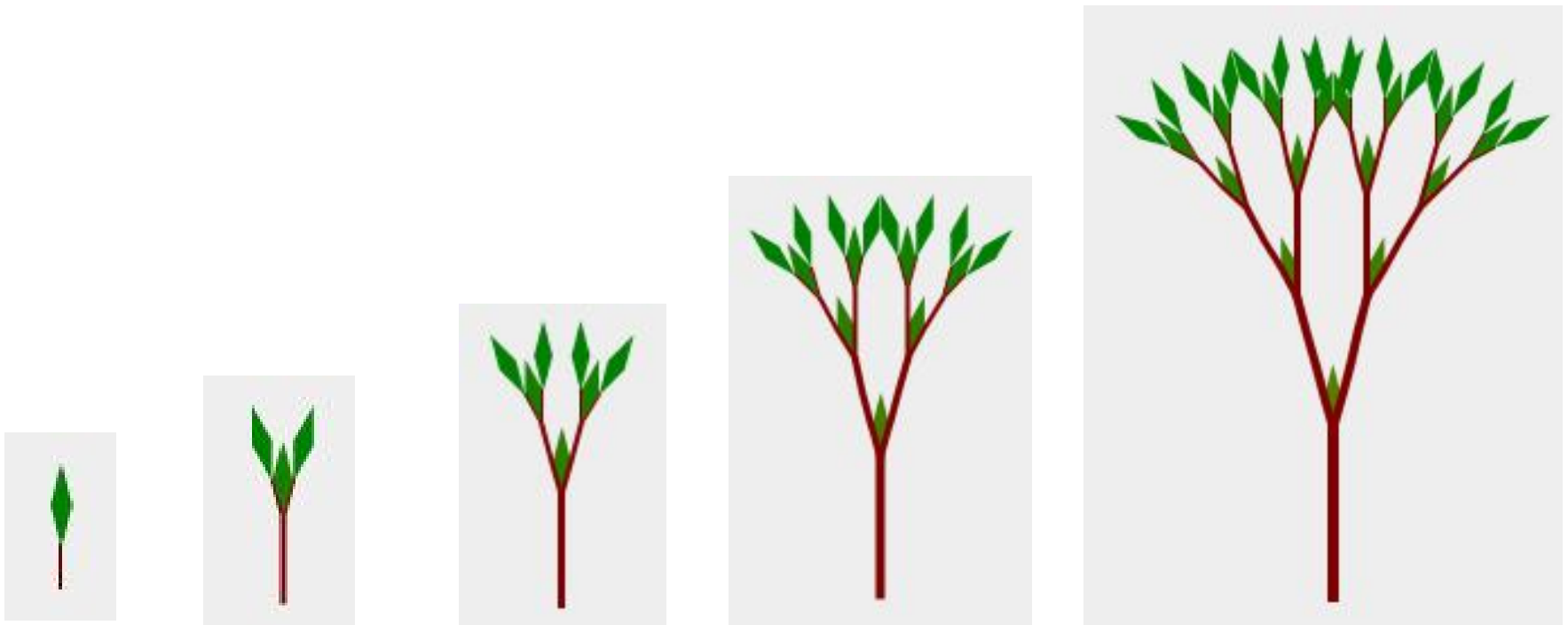
**Axiom:**  $R \sim \#\# B$

B	→	$[\sim \#\# T L - B + + B]$
L	→	$\{ - g + + g \% - - g \}$
R	→	$! @ @ R$
T	→	$T g$

Below the editor area is a table with two columns: "Name" and "Parameter".

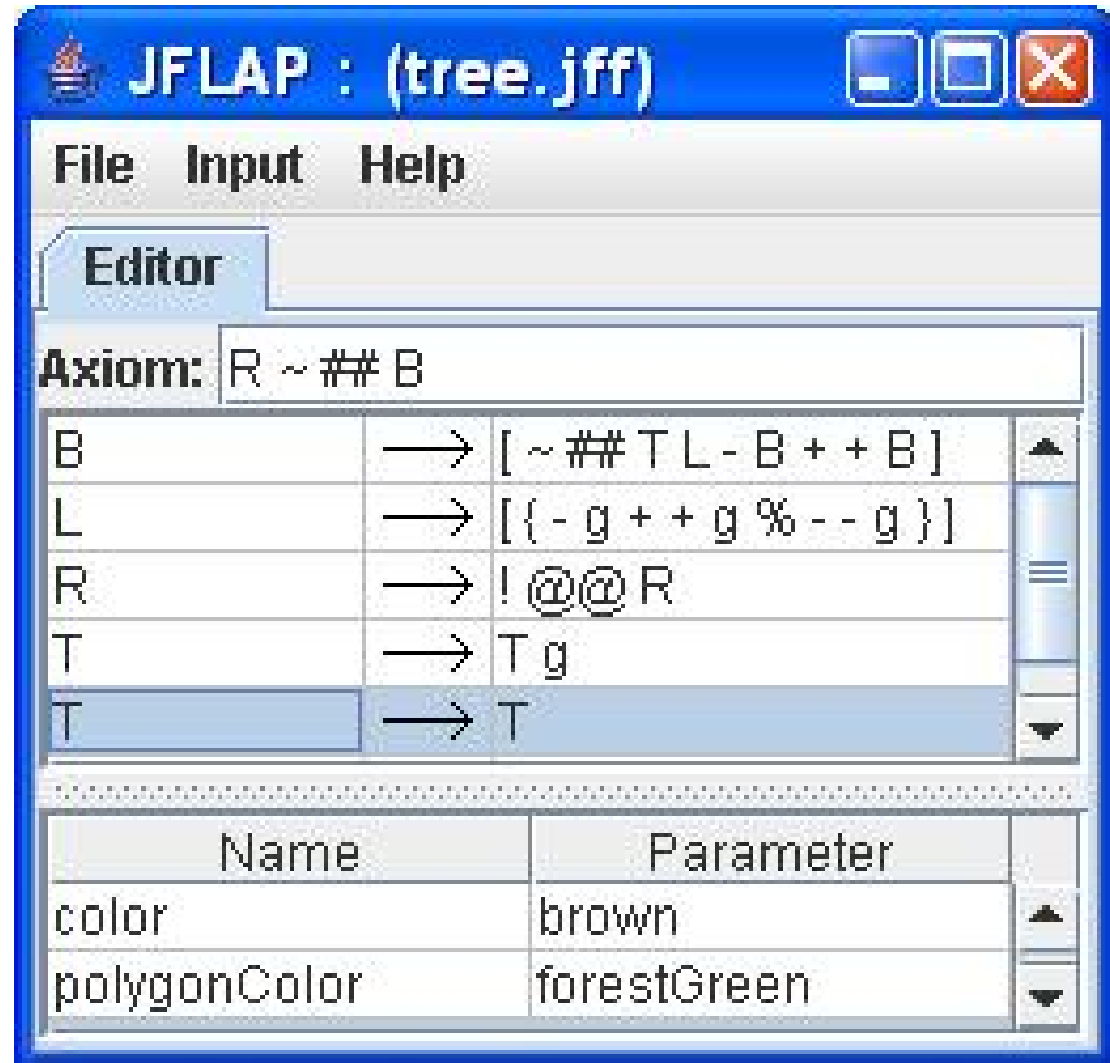
Name	Parameter
color	brown
polygonColor	forestGreen

# Example – tree rendered



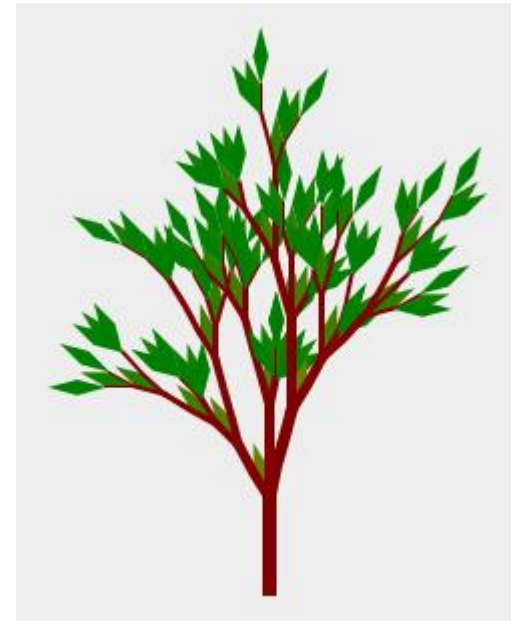
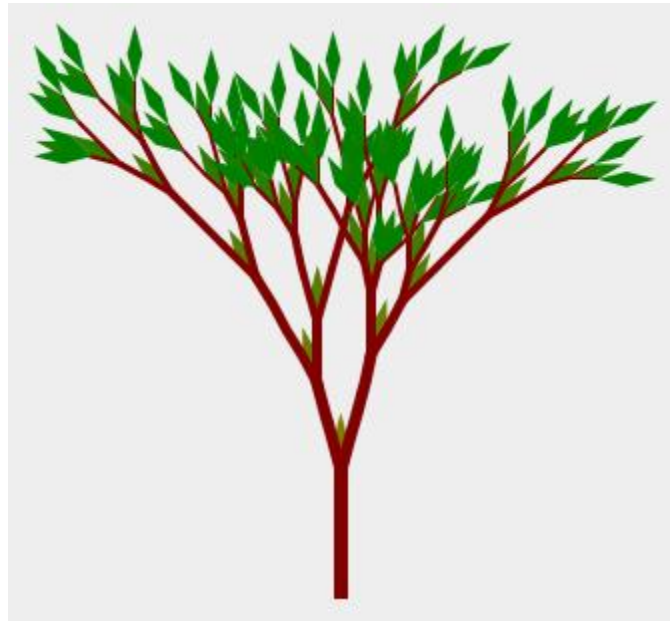
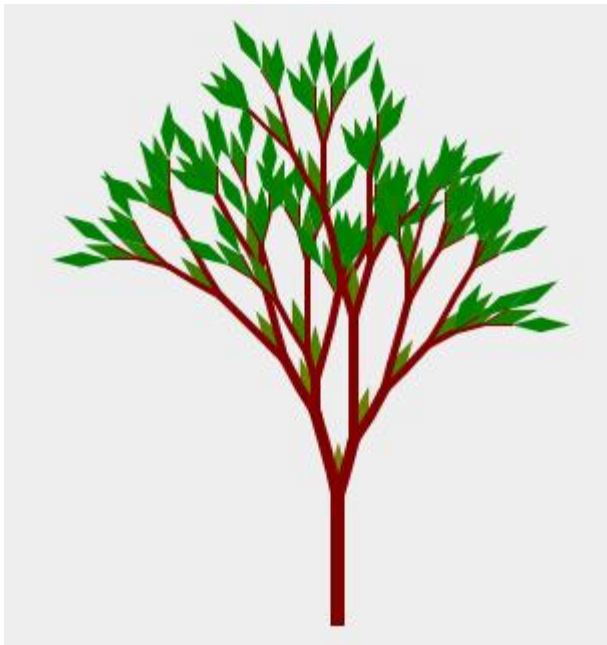
# Stochastic Tree

- Add a rule  
 $T \rightarrow T$
- Now there is a choice for T, draw a line or don't



# Same Stochastic L-System

- Rendered 3 times, each at 8<sup>th</sup> derivation



# Exercises

- Render any of the L-system files that start with ex10
- Write L-systems for each of the pictures below

