A Hands-on Approach to FLA with JFLAP

L-Systems

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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
Example – lsys-samp1 (cont)

• Derivation of strings

\[\begin{align*}
X \\
gggX+Y \\
gggggX+Y+g \\
gggggggggX+Y+g+g \\
gggggggggggggX+Y+g+g+g
\end{align*}\]
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

Axiom: X

<table>
<thead>
<tr>
<th>Name</th>
<th>Parameter</th>
</tr>
</thead>
<tbody>
<tr>
<td>lineWidth</td>
<td>4</td>
</tr>
<tr>
<td>lineIncrement</td>
<td>1</td>
</tr>
<tr>
<td>distance</td>
<td>18</td>
</tr>
<tr>
<td>color</td>
<td>black</td>
</tr>
<tr>
<td>angle</td>
<td>30</td>
</tr>
</tbody>
</table>
Example – lsys-samp2 (cont)

g[~+Yg]gX

g[~++Yg]gg[~+Yg]gX

g[~+++Yg]gg[~++Yg]gg[~+Yg]gX

...
Example - tree
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 8th derivation
Exercises

• Render any of the L-system files that start with ex10

• Write L-systems for each of the pictures below