Lesson #1: Introduction to L Systems

What's It All About?

The basic concepts associated with L Systems are presented in this lesson.

Definition

An **L-system**, or **Lindenmayer system**, is a parallel rewriting system and formal grammar involving the following three components:

1. an alphabet of symbols
2. a start string of alphabetic symbols (often just one symbol)
3. a production for each alphabet symbol that maps the symbol into a string of symbols

L-system example: Algae

The Algae L-system:

1. Alphabet: {A,B}
2. Start symbol: A
3. Productions
   (a) A $\rightarrow$ A B
   (b) B $\rightarrow$ A

Evolution of an L-system

The basic form of computation for L-systems is the evolution of successive "generations" of strings. The initial generation, generally references as G0, is simply the start string. Each successor generation is obtained by replacing, in parallel, each symbol in the current generation with the string on the right hand side of its production.

Evolution of the Algae L-system

The first 5 generations of the Algae L-system:

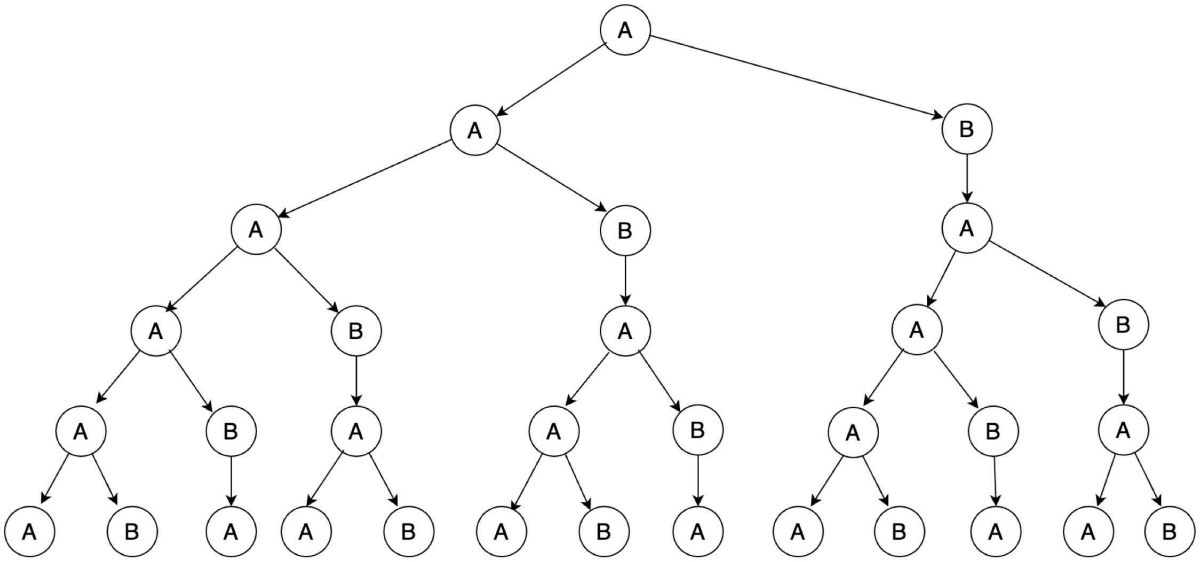
- G0: A

- G1: A B
- G2: A B A
- G3: A B A A B
- G4: A B A A B A B A
- G4: A B A A B A B A A B A A B

L-Trees

An **L-tree** is a visual representations of an L-system in which nodes of the tree correspond to symbols of the alphabet. The tree is grown according to a sprouting process in which the children of a node correspond to the right hand side of the production that transforms the node's symbol. If the starting string is just one symbol, take that to be the root of the tree. If not, crate an artificial root whose children are the start string.

Algae Subtree for 5 Generations of the Algae L-System



L-system example: Cantor Dust

The Cantor Dust L-system:

1. Alphabet: {A,B}
2. Start symbol: A
3. Productions
   (a) A → A B A

(b) B → B B B

Evolution of the Cantor Dust L-system

The first 4 generations of the Cantor Dust L-system:

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Cantor Dust Subtree for 3 Generations of the Cantor Dust L-System

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L-system example: Koch Curve

The Koch Curve L-system:

1. Alphabet: {F,L,R}
2. Start symbol: F
3. Productions
   (a) F → F L F R F R F L F
   (b) L → L
   (c) R → R

Evolution of the Koch Curve L-system

The first 2+ generations of the Koch Curve L-system:

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Koch Curve Subtree for 2+ Generations of the Koch Curve L-System

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L-system example: M34

The M34 L-system:

1. Alphabet: {1,2,3}
2. Start symbol: 1
3. Productions
   (a) $1 \rightarrow 1\ 1\ 2\ 1$
   (b) $2 \rightarrow 2\ 3\ 3\ 2$
   (c) $3 \rightarrow 3\ 2\ 3\ 2$

Exercise - Generate the first 4 generations of the M34 L-system

Please generate the first 4 generations of the M34 L-system.

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