

Automata Theory (CS1.302)

Monsoon 2021, IIIT Hyderabad
14 October, Thursday (Tutorial 2)

L-Systems

Origins

Lindenmayer system or L-systems were created as a way to formalise patterns of bacteria growth. They are used as a recursive string-rewriting framework.

They are a parallel rewriting system and a type of formal grammar. They describe how to form “valid” strings.

Structure

An axiom is a starting point in the system. A theorem is a string produced by the rules of the system. The rules are the rules of production or inference.

Suppose we have the symbols M, I and U, and we describe our system as:

Axiom: MI

Rules:

$xI \rightarrow xIU$

$Mx \rightarrow Mxx$

$xIIIy \rightarrow xUy$

$xUUy \rightarrow xy$

Problem: Is MU a theorem?

Formally, an L-system is defined as a 3-tuple $G = (V, w, P)$, where

- V is the alphabet set (variables + terminals).
- w is the start/axiom/initiator is a string over V .
- P is the set of production rules.

If N is the set of nonterminals and T the set of terminals, then $V = N \cup T$, and a production rule has the form (V^*NV^*, V^*) . The first element is called the predecessor and the second the successor.

L-systems have a recursive nature that leads to self-similarity.

Types

L-systems can be context-free or context-sensitive, and probabilistic or deterministic. In a probabilistic system, the probabilities of production rules with the same predecessor and context must add up to one.