

ON THE DESCRIPTIONAL COMPLEXITY OF k -UNIFORMLY-LIMITED LINDENMAYER SYSTEMS

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ABSTRACT

We investigate and compare the descriptonal complexity of languages generated by Lindenmayer systems whose parallel replacement of letters is k -uniformly-limited. The considered measure of descriptonal complexity is the number of rules. We compare this measure for variants of Lindenmayer systems which are characterized by a restriction on the choice of rules. We consider propagating (no rule to empty word), deterministic (exactly one rule per letter) and tabled (tables of rules) variants. The comparison focuses on the question whether families of Lindenmayer systems generating a larger set of languages also allow a more compact description of languages. We will show that this is true for many cases.

Keywords: Lindenmayer systems, descriptonal complexity, number of productions, k -uniformly-limited

1. Introduction

Named after the originator – the Hungarian theoretic biologist ARISTID LINDENMAYER – Lindenmayer systems were proposed in 1968 as model of biological development of organisms like algas and plants [7]. It is about a kind of formal grammar which in contrast to sequential Chomsky grammars has a derivation process where replacement of letters is done in parallel. Lindenmayer systems (L systems for short) generate languages, too. We refer to [8] for an overview of the topic.

Recently, some papers related to Lindenmayer systems are concerned with the descriptonal complexity of those systems, e.g. [2], [1], [3], [9] and [4]. As measures the number of rules and the number of symbols are considered. Thereby, one investigates families of L systems that are characterized by restrictions on the rules and focuses on the question whether families of L systems generating a larger set of languages also allow a more compact description of languages. One compares the complexity of description of languages which are generated with different variants of L systems. As restrictions for instance the interdiction of rules deriving to the empty word or the reduction to exactly one rule per letter in the alphabet are used. A constraint of the parallel replacement was made for example in [3] or [9], too. There, k -limited Lindenmayer systems introduced in 1988 by WÄTJEN were examined. With this