Journal of Automata, Languages and Combinatorics 1 (1996) 3, 219–235 © Otto-von-Guericke-Universität Magdeburg

## PATTERN GRAMMARS<sup>1</sup>

Gheorghe Păun

Institute of Mathematics of the Romanian Academy P. O. Box 1-764, R-70700 Bucureşti, Romania e-mail: gpaun@imar.ro

GRZEGORZ ROZENBERG Department of Computer Science, Leiden University NL-2300 RA Leiden, The Netherlands and Department of Computer Science, University of Colorado at Boulder Boulder, CO 80309, USA e-mail: rozenber@wi.leidenuniv.nl

 $\operatorname{and}$ 

ARTO SALOMAA University of Turku, Department of Mathematics SF-20014, Turku, Finland e-mail: asalomaa@sara.cc.utu.fi

## ABSTRACT

We consider rewriting systems based on production rules of the form  $u \rightarrow v$ , where u and v are patterns. Using such a rule means to find in the string to be rewritten a substring x which matches with the pattern u and to replace it with a string obtained by "interpreting" v according to the restrictions imposed by the matching of u with x. Free, maximal, and minimal use of left-hand patterns are considered. The generative capacity of the obtained grammars is investigated. A series of directions for further research are also mentioned.

Keywords: pattern, pattern grammar, Chomsky hierarchy, closure properties, pure grammars.

## 1. Introduction

The study of patterns of strings is of a basic interest in language theory and combinatorics on words. The very beginning of formal language theory is related to this topic, [15]. Here we do not consider *patterns* in the sense of [15, 2], but in the generative-like interpretation originated in [1] and followed in a series of subsequent papers, e. g. [4, 7, 8, 9, 10, 12, 13].

<sup>&</sup>lt;sup>1</sup>Research supported by the Academy of Finland, project 11281, and the ESPRIT Basic Research Working Group ASMICS II.