

CHURCH-ROSSER PICTURE LANGUAGES AND THEIR APPLICATIONS IN PICTURE RECOGNITION

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ABSTRACT

In image processing, there is a need for efficient methods that complement statistical models by structural information about the spatial scene arrangement and compositional hierarchy. In order to recognise the structure of locally detected features, we propose a two-dimensional Church-Rosser picture language that facilitates the evaluation of local information compared to one-dimensional languages. Although Church-Rosser languages are able to represent certain types of context-sensitivity, the word problem is solvable in linear time. We describe how the concept of local replacements used in rewriting systems and restarting automata, helps in pattern and picture recognition. It is shown that the Church-Rosser picture language can be recognised by a deterministic shrinking two-dimensional restarting automaton. The practical application of the Church-Rosser picture language in object recognition is illustrated.

Keywords: Church-Rosser Languages, Picture Recognition, Restarting Automata, Locality, Picture Languages

1. Introduction

In image processing the use of formal models with defined properties simplifies to a certain extent the interpretation of algorithms and mechanisms which are often characterised by heuristics and hidden approximations.

There are different approaches to use methods from formal languages to recognise patterns or pictures. The first approaches date back to the 1960s and 1970s [46, 7]. The used models range from context-free to context sensitive grammars. While the first ones are not expressive enough to represent relevant visual patterns, the latter cannot be used in practice. Often the goal is to find extensions of context-free languages that achieve a balance between complexity and expressive power.

In this paper, we address three particular problems of context-free grammars: First, a grammar generates words of a language instead of accepting them. Secondly, context-free grammars are nondeterministic, and third, the word problem of context-free grammars is cubic, extensions are even worse.