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GENERALIZED FINITE AUTOMATA AND TRANSDUCERS [1]

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ABSTRACT
We introduce generalized finite automata as language acceptors, and we prove that they are not more powerful than finite automata. Their purpose is to give a more compact description of regular sets. They can be particularly useful for image description and compression. Generalized finite transducers are presented. They are more powerful than finite transducers, however, they still preserve regular sets. We show how (generalized) finite transducers are used to specify image manipulation.

Keywords: generalized finite automaton, finite transducer, image description, image compression.

1. Introduction

In [2, 3, 6, 20] it was shown how languages over a four letter alphabet can be interpreted as images. In particular, finite automata specifying regular languages have been used to describe (regular) images. In [16] the generalized finite automata (GFA) that allow more concise description of (regular) images were introduced and an efficient inference algorithm for GFA was described. This algorithm was used together with vector quantization to obtain an efficient method for compression of bi-level images. Here we consider GFA as language acceptors and give a more precise definition of how they specify finite resolution, multiresolution and infinite resolution images.

Section 2 starts with the formal definition of GFA. We show that every GFA accepts a regular set so GFA are not a more general tool than finite automata, their power is in allowing more concise description of many regular sets. We also show a normal form for GFA, they can accept every regular set containing the empty word without having nonfinal states. In Section 3 we give the formal definition of bi-level images of finite resolution, multiresolution or infinite resolution. Then we discuss how languages (automata) specify bi-level images (see [11, 16, 17, 18]) and we describe image compression based on (generalized) finite automata (see [8, 9]).

In Section 4 we introduce the *generalized finite transducers* (GFT) which generalize finite transduction as a tool for the specification of mappings on strings. We show

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