ATTRIBUTED CONTEXT-FREE HYPERGRAPH GRAMMARS [1]

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ABSTRACT

The concept of context-free hypergraph grammars (cfhg grammars) has been studied extensively over the past decade. In this paper we introduce attributed context-free hypergraph grammars (acfhg grammars) as an extension of cfhg grammars. An acfhg grammar consists of an underlying context-free hypergraph grammar G_0 and an attribution which associates attributes with the nonterminal symbols of G_0 analogous to the classical attribute grammars (ag's) by KNUTH. We show that acfhg grammars and ag's are closely related in such a way that an ag can be used to compute the attribute values of an acfhg grammar. Due to this relationship the known techniques for attribute evaluation for ag's can be exploited for acfhg grammars. Also we show that attributed tree grammars can be embedded into the concept of acfhg grammars, provided an appropriate semantics is associated with the acfhg grammar. Finally, we show how an acfhg grammar can be used to associate semantics with programs of some programming language P in such a way that non-context-free constraints of P are already checked in the syntactical phase, i.e., by the underlying cfhg grammar.

Keywords: graph grammar, attribute grammar, syntax-directed semantics.

1. Introduction

Graphs serve as a very general data structure in computer science. They can be used to model Petri nets, functional expressions, program flow diagrams, molecule structures, but also other simpler data structures such as strings or terms. Graph grammars can be used to express the generation, manipulation, and description of graphs. There is a large theory on graph grammars which was initiated more than 20 years ago and is well documented in the proceedings of the five workshops on graph grammars [7, 19, 20, 16, 6].

Attribute grammars (for short, ag's) were introduced by KNUTH [40] as a model for syntax-directed semantics (see also [42, 12, 11, 1, 41, 30]). That is, attribute grammars can be used as a way of assigning semantics to a syntactical object. The syntax of this

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