ON APPLICATIONS OF ALGORITHMIC LOGIC

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ABSTRACT

In this survey we contained a short presentation of algorithmic logic AL and two sections devoted to selected applications of algorithmic logic. First, we argue that the goal of formal definition of a programming language can be fully achieved with the tools offered by AL. Next, we show possible applications of AL in production of modular software. The interaction between theoretical tools (AL) and software ones (LOGLAN programming language) seems to provide a reasonable way toward creation of reliable software from prefabricated modules and their specifications. It seems that in this way one can speed up the task of production of software.

key words: program, computation, semantical properties, expressivity, algorithmic logic, axioms, inference rules, completeness, specification, verification, implementation, modules, extension, LOGLAN
AL algorithmic logic denotes in fact a family of logics. Every algorithmic logic consists of its language and of its axiomatic system. The language is an extension of a language of algorithms or a programming language. The system contains axioms and inference rules. Every algorithmic language contains three subsets: programs, terms and formulas. Formulas enable to express semantical properties of programs in this way that for a semantical property of program(s) there exists a formula $B$ such that the property holds iff the formula $B$ is valid. Next, the task of validation of formula can be replaced by a proof of it. In order to do so one need a sufficiently complete set of axioms and inference rules.

It turns out that this approach has many applications:
- one can study behaviour of programs a priori, before computation, by proving corresponding formulas that express semantical properties of programs,
- certain data structures can be specified as those algebraic systems which satisfy corresponding set of non-logical, specific axioms. This may seem too simple remark. However, in our case we allow that axioms can be algorithmic formulas beyond the set of first order formulas. This proposal has many consequences. On one hand it enables to axiomatize data structures which can not be axiomatized in first-order logic. Semantical property of a program can determine a data structure up to isomorphisms. On the other hand it simplifies the proofs of semantical properties, for it allows to hide the induction on the structure of elements of the data type and replaces it with inference rules which transform semantical property of a program into another semantical property.

I. AL - a short presentation

In this section we shall present logic of deterministic iterative programs. In spite of its simplicity it has many applications in more advanced fields like e.g. abstract data types.

LANGUAGE

In fact we shall deal with a class of languages. All languages have the same grammar. They can differ only due to the different sets of functional and relational signs. A language is a pair $L = (A, WFE)$ where

$A$ - the alphabet is the set of admissible signs,

$WFE$ - is the set of well formed expressions, it consists of terms, formulas and programs. We shall omit boring details (c.f. AL) for strict definitions. The structure of the set of programs will be seen below.