

A new algebraic model for implementing expert systems represented under the ‘Concept-Attribute-Value’ paradigm

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Abstract

This paper is concerned with expounding a new representation paradigm for modeling expert systems based on computing Groebner Bases. Previous research on Groebner Bases expert systems has so far been connected to modeling expert systems based on propositional logics. Our approach instead is based on the well-known Artificial Intelligence ‘Concept-Attribute-Value’ paradigm for representing knowledge. More precisely, our research is based on translating an already existent expert system described in terms of the ‘Concept-Attribute-Value’ paradigm to a new algebraic model which represents knowledge by means of polynomials. In this way, issues about consistence and inference within this expert system will be, through this new model, transformed into algebraic problems involving calculating Groebner Bases. By using this new model of ours, some interesting advantages ensue: on the one hand, knowledge representation may be performed in a more straightforward and intuitive way; on the other, calculating the Groebner Bases associated to our algebraic model is usually faster adopting this new ‘Concept-Attribute-Value’-based paradigm than it was in previous propositional logic-based expert systems.

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1. Introduction

Expert systems are computational programs on a certain domain which try to simulate the decisions that human experts on this domain would take. In the last years, much research has been focused on developing both techniques for representing the human knowledge in a computer and techniques for reasoning automatically.

An interesting way for representing knowledge in an expert system is based on propositional logic under which, the issue about the knowledge inference is completely related to the concept of Tautological consequence. Besides, by means of a mathematical result [13] based on previous work [1,5–7], this issue can be translated to an algebraic problem involving calculating certain Groebner bases [2,3]. In this way, expert systems based on propositional logic may be very easily implemented by means of a computer algebra system like CoCoA [4,12] or Maple [14]. Making use of this result, different expert systems have been so far developed in the last recent years [8,9,11,15].

The ‘Concept-Attribute-Value’ paradigm [10] provides another way for representing knowledge in Expert Systems which presents some advantages over propositional logic. However, there is so far no direct mathematical result

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