Chapter XLIX
Inconsistency, Logic Databases, and Ontologies

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INTRODUCTION

Nowadays, data management on the World Wide Web needs to consider very large knowledge databases (KDB). The larger is a KDB, the smaller the possibility of being consistent. Consistency in checking algorithms and systems fails to analyse very large KDBs, and so many have to work every day with inconsistent information.

Database revision—transformation of the KDB into another, consistent database—is a solution to this inconsistency, but the task is computationally untractable. Paraconsistent logics are also a useful option to work with inconsistent databases. These logics work on inconsistent KDBs but prohibit non desired inferences. From a philosophical (logical) point of view, the paraconsistent reasoning is a need that the self human discourse practices. From a computational, logical point of view, we need to design logical formalisms that allow us to extract useful information from an inconsistent database, taking into account diverse aspects of the semantics that are "attached" to deductive databases reasoning (see Table 1). The arrival of the semantic web (SW) will force the database users to work with a KDB that is expressed by

logic formulas with higher syntactic complexity than are classic logic databases.

BACKGROUND

Logic databases are based on the formalisms of first order logic (FOL); thus, they inherit a classical semantics that is based on models. Also, they can be interpreted within a proof–theoretic approach to logical consequence from the logic programming paradigm (Lloyd, 1987). The extended database semantics paradigm is developed to lay before the foundations of query-answering tasks and related questions (see Minker, 1999), but its aim is not to deal with inconsistencies. The data cleaning task may involve—in the framework of repairing logic databases—logical reasoning and automated theorem proving (Boskovitz, Goré, & Hegland, 2003).

On the other hand, new paradigms, such as SW, need new formalisms to reason about data. Description logics (DL) provide logic systems based on objects, concepts, and relationships, with which we can construct new concepts and relations for reasoning (Baader, Calvanese, McGuinnes, Nardi, & Patel- Schneider, 2003). Formally, DL are a subset of FOL, and the classical problems on consistency remains, but several sublogics of DL provide nice algorithms for reasoning services.

The ontology web language (OWL; its DL-sub-language) is a description logic language designed for automated reasoning, not only designed for the classical ask–tell paradigm. With languages such as OWL, ontologies exceed their traditional aspects (e.g., taxonomies and dictionaries) to be essential in frameworks as data integration.

The classical notion of inconsistency in databases mainly deals with the violation of integrity constraints. This notion must be expanded because of the new notion of logic databases in SW, in which ontologies and data both play the same role in knowledge management. Therefore, there are several sources of inconsistency (see Table 2). This role is not only limited to the database but also includes the verification and validation task of knowledge- based systems (Bench-Capon, 2001). Inconsistency arises in the initial steps of ontology building due to several reasons and not only by the updating of data. In general, the repair of a logic database involves the study of the soundness and perhaps completeness (i.e., the method output's only correct solutions and all the relevant solutions). Semantics would support reasoning services such as self-consistency, checking the relations between concepts (as subsumption), and classification of objects according to the ontology.

Systems exist in which both paradigms, classical and SW logic databases, are conciliated

Table 1. Semantics aspects to consider in logic databases

• Classical semantics for First Order Logic
Extended semantics for databases
Reiter's formalization of databases (Reiter, 1984). Closed World Assumption
Relations among a KDB, queries and integrity constraints
Expressive power of recursive definitions
Consistency checking versus intentional part of the KDB
Multivalued semantics
Contextualized semantics for ontologies or data

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