Logic & Databases

www.ruc.dk/~jv/ADB

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The objective of this course is to explore advanced topics in databases with emphasis on the logical aspects, knowledge representation and manipulation...

Course Material

GM *The Impact of Logic Programming on Databases* (15 pages / 1.485.735 bytes)

GGGM *Integrity Constraints: Semantics and Applications* (32 pages / 268.803 bytes)

Supplement - For Reference Use Only

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The Impact of Logic Programming on Databases

John Grant & Jack Minker

COMMUNICATIONS OF THE ACM 1992

The purpose of this article is to demonstrate the significant impact that logic programming has had on databases.

In particular, logic programming

- has contributed to the understanding of the semantics of a database,
- has extended the concept of relational databases,
- and has introduced new techniques in providing useful tools for database users.

...

A glimpse at these impacts...

Formalization of what constitutes a database, a query, and an answer to a query

Closed World Assumption

Facts not known to be true in a database, are assumed to be false

Unique Name Assumption

Any item in a database has a unique name (items with different names are different)

Domain Closure Assumption

There are no other items than those in the database (hence finite)

Add Completion Axioms & Equality Axioms to First-Order Logic:

Q(a) is an answer to a query Q(X), over a database DB
if Q(a) is a first-order-logical consequence of DB

Introduction of deductive databases in the 1970's

Relational databases – based on the relational algebra – have been shown to be a special case of deductive databases

A *deductive database* (DDB) may be considered as a theory in which the database consists of a set of ground assertions, referred to as the *extensional database* (EDB), and a set of rules (or axioms), referred to as the *intensional database* (IDB), of the form:

$$P \leftarrow Q1, \ldots, Qn$$

where P, Q1, ..., Qn are atomic formulas

Intensional ≠ Intentional

The generalization permits views to be defined that are recursive

In addition to defining a database in terms of an EDB and an IDB, it is also necessary to formalize what is meant by an integrity constraint (IC) – *There are several possibilities*

The semantics of deductive databases can be characterized in three distinct ways by model, fixpoint or proof theory – *These three characterizations lead to the same semantics*

Semantic query optimization and cooperative answering capabilities are also important contributions of deductive databases

How can queries doomed to fail because they violate integrity constraints be allowed to take up a significant amount of search time

... and how can one expect users to understand why deductions succeed or fail if such information is not provided?

Extended deductive databases allow

- Negation – or perhaps multiple versions of negation
- Disjunction

The field of deductive databases has contributed to providing an understanding of knowledge bases and their implementation