

Keys and Armstrong Databases in Trees with Restructuring

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Abstract

The definition of keys, antikeys, Armstrong-instances are extended to complex values in the presence of several constructors. These include tuple, list, set and a union constructor. Nested data structures are built using the various constructors in a tree-like fashion. The union constructor complicates all results and proofs significantly. The reason for this is that it comes along with non-trivial restructuring rules. Also, so-called counter attributes need to be introduced. It is shown that keys can be identified with closed sets of subattributes under a certain closure operator. Minimal keys correspond to closed sets minimal under set-wise containment. The existence of Armstrong databases for given minimal key systems is investigated. A sufficient condition is given and some necessary conditions are also exhibited. Weak keys can be obtained if functional dependency is replaced by weak functional dependency in the definition. It is shown, that this leads to the same concept. Strong keys are defined as principal ideals in the subattribute lattice. Characterization of antikeys for strong keys is given. Some numerical necessary conditions for the existence of Armstrong databases in case of degenerate keys are shown. This leads to the theory of bounded domain attributes. The complexity of the problem is shown through several examples.

1 Introduction

The relational datamodel gave rise to theoretical research in several directions. Dependency structures were investigated as first-order logical sentences that are supposed to hold for all database instances [3]. On the other hand, their combinatorial investigations were fruitful resulting in nice problems, concepts, even as far topics as design and coding theory [8, 9, 12, 5].

The relational model has been extended or generalized to nested relational model [19], object oriented models [23], and object-relational models. The important structures of all these were captured by the higher-order Entity-Relationship

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