Hypothetical Datalog: Complexity and Expressibility

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Abstract

We present an extension of Horn-clause logic which can hypothetically add and delete tuples from a database. Such logics have been discussed in the literature, but their complexities and expressibilities have remained an open question. This paper examines two such logics in the function-free, predicate case. It is shown, in particular, that augmenting Horn-clause logic with hypothetical addition increases its data-complexity from PTIME to PSPACE. When deletions are added as well, complexity increases again, to EXPTIME. We then augment the logic with *negation-as-failure* and develop the notion of *stratified* hypothetical rulebases. It is shown that negation does not increase complexity. To establish expressibility, we view the logic as a query language for relational databases. It is shown that any typed generic query that is computable in PSPACE can be expressed as a stratified rulebase of hypothetical additions. Similarly, any typed generic query that is computable in EXPTIME can be expressed as a stratified rulebase of hypothetical additions and deletions. Neither of these results assumes the data domain is linearly ordered. In this way, we establish the expressive completeness of our logics for queries in PSPACE and EXPTIME, resp.