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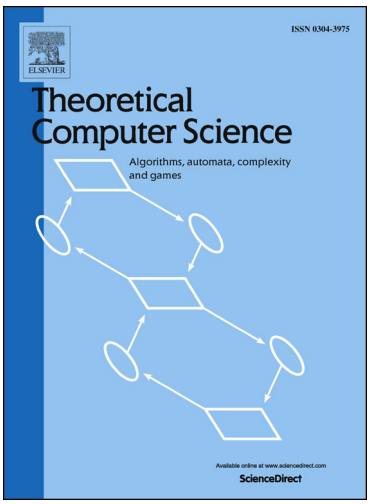

Directed Hypergraphs: Introduction and fundamental algorithms—a survey

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Directed Hypergraphs: Introduction and Fundamental Algorithms - A Survey

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Abstract

Just as ordinary hypergraphs are a generalization of graphs, directed hypergraphs (DH) are a natural generalization of digraphs. A DH consists of a set of vertices V and a set of hyperarcs H, where a hyperarc is a pair $< S, v >$, S non empty subset of V and $v \in V$. DHs have a variety of applications: they have been used to represent functional dependency in databases, Horn formulae in propositional logic, and-or graphs, context free grammars etc. In the paper, after providing a brief historical introduction on the notion of DH and some relevant applications, various problems regarding DHs are surveyed and analyzed. In particular we consider the complexity of the reachability problem (together with its application in the related satisfiability problem for Horn CNF formulae) and the computation of transitive closure and transitive reduction of directed hypergraphs (together with its application to the computation of minimum coverings for a set of functional dependencies). Finally a short introduction to the problem of computing shortest hyperpaths in directed hypergraphs is provided.

Keywords: Directed Hypergraphs, Transitive Closure, Transitive Reduction, Shortest Hyperpaths.

1. Hypergraphs in Computer Science

Hypergraphs [11] are frequently used in computer science in order to represent families of non empty sets and in order to describe and discuss optimization problems over such structures (e.g. covering, exact covering and

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