**Title**  
Backdoors to Tractability of Disjunctive Answer Set Programming

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**Abstract**  
Answer set programming (ASP) is an increasingly popular framework for declarative programming that admits the description of problems by means of atoms, rules, and constraints that form a logic program. The solutions of an answer set program are called answer sets. Many problems in artificial intelligence such as non-monotonic reasoning can be directly formulated in ASP. Reasoning problems for propositional disjunctive programs, which is the focus of this thesis, are of high computational complexity. For instance, the problems of deciding whether a program has at least one answer set or whether a given atom is contained in at least one answer set, are complete for the second level of the Polynomial Hierarchy.

In this thesis we tackle these hard problems using backdoors in problem instances, which are sets of atoms that can be used as clever reasoning shortcuts through the search space. The concept of backdoors has widely been used in theoretical investigations in the areas of propositional satisfiability and constraint satisfaction, we show that backdoors can be fruitfully adapted to ASP.

We develop a rigorous theory of backdoors for ASP and carry out a fine-grained asymptotic computational complexity analysis that takes backdoors into account. We establish new algorithms that can detect and take advantage of small backdoors to solve or to significantly simplify problem instances. More precisely, certain backdoors allow us to solve ASP reasoning problems efficiently for instances with small backdoors (fixed-parameter tractability), other backdoors allow us to significantly simplify the problem instance (complexity barrier breaking reduction), and some backdoors cannot even be used to simplify the problem instance (intractability). Particularly, our simplifications break the complexity barrier between the second level of the Polynomial Hierarchy and the first level by means of reductions that work efficiently for instances with small backdoors. Further, we elaborate upon a detailed comparison where we compare the size of certain types of backdoors with each other. We show that backdoors can serve as a unifying framework for restrictions that have been identified in the literature under which ASP problems significantly simplify and become tractable or NP-complete.