

# DLV: An Advanced System for Knowledge Representation and Reasoning

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DLV [5] is a KRR system which is based on Disjunctive Logic Programming (DLP) [6] under the stable model semantics (also called Answer Set Programming) [4]. Roughly, a DLP program is a set of disjunctive rules, i.e., clauses of the form

$$a_1 \vee \dots \vee a_n :- b_1, \dots, b_k, \text{not } b_{k+1}, \dots, \text{not } b_m$$

where atoms  $a_1, \dots, a_n, b_1, \dots, b_m$  may contain variables. The intuitive reading of such a rule is “If all  $b_1, \dots, b_k$  are true and none of  $b_{k+1}, \dots, b_m$  is true, then at least one atom in  $a_1, \dots, a_n$  must be true.” DLP has a very high expressive power – it allows to express all problems in the complexity class  $\Sigma_2^P$  (i.e.,  $NP^{NP}$ ) [3]. Thus, under usual complexity conjectures, DLP is strictly more expressive than both SAT and CSP, the power of which is “limited” to NP, and it can naturally represent a large class of relevant problems ranging from artificial intelligence to advanced database applications.

DLV is generally considered the state-of-the-art implementation of disjunctive logic programming. Its efficiency has been confirmed by the results of First Answer Set Programming System Competition (<http://asparagus.cs.uni-potsdam.de/contest/>), where DLV won the DLP category. Moreover, DLV turned out to be very efficient also on non-disjunctive logic programs, as it finished first also in the general category MGS (Modeling, Grounding, Solving – also called *royal* competition, open to all ASP systems).

The implementation of the DLV system is based on very solid theoretical foundations, and exploits major results that have been achieved in the area of logic programming and nonmonotonic reasoning in the last 15 years, ranging from database optimization techniques, to heuristics and new AI methods. The

system has been recently engineered for industrial exploitation, and is already employed in many challenging real-world applications, for instance in the area of Knowledge Management, and advanced Information Integration.

Among the many features of the system, it is worth remarking the following:

**Advanced knowledge modeling capabilities.** DLV provides support for declarative problem solving in several respects:

- High expressiveness in a formally precise sense ( $\Sigma_2^P$ ), so any such problem can be uniformly solved by a fixed program over varying input.
- Rich language for knowledge modeling, extending DLP with weak constraints (for preferences handling) [1], powerful aggregate functions [2], and other useful KR constructs.
- Full declarativeness: ordering of rules and subgoal is immaterial, the computation is sound and complete, and its termination is always guaranteed.
- Declarative problem solving following a “Guess&Check” paradigm [5] where a solution to a problem is guessed by one part of a program and then verified through another part of the program.
- A number of front-ends for dealing with specific AI applications.

**Solid Implementation.** Much effort has been spent on sophisticated algorithms and techniques for improving the performance, including

- database optimization techniques (join ordering methods, indexing, etc.), and
- artificial intelligence computation techniques (heuristics, backjumping, etc.).

DLV is able to solve complex problems and efficiently deal also with large input data.

**Database Interfaces.** The DLV system provides a general ODBC interface to relational database management systems.

For up-to-date information on the system and a full manual we refer to <http://www.dlvsystem.com>, where also download binaries of the current release and various examples are available.

## References

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