Systems Comparison

Peter F. Patel-Schneider
Bell Labs Research, Murray Hill, NJ, U.S.A.
pfps@research.bell-labs.com

The systems comparison of the 1999 Description Logics Workshop was organized somewhat differently than previous systems comparisons. This year the comparison emphasizes features instead of performance, because there have been a large number of performance comparisons recently, including the comparison at the 1998 Description Logics Workshop [Horrocks and Patel-Schneider, 1998] and several comparisons of modal decision procedures where Description Logic systems have been prominent [Balsiger and Heuerding, 1998; Massacci, 1999].

Developers of Description Logics systems were invited to provide a short description of their system, detailing the logic that the system implemented and mentioning the characteristics of the input that the system accepts, other interesting features of the system, interesting aspects of the implementation of the system, the performance of the system, the availability of the system, and future plans for the system.

Responses were received from six systems, shown in Table 1. The systems are all available for research use and can be easily downloaded. Several other description logic systems exist, including DFL, a hybrid system that incorporates frame logic.

Language

All of the systems implement supersets of the description logic $\mathcal{ALC}$. The extensions include transitive roles, regular expressions on roles, converse roles, and strings and numbers.

Two of the systems allow individual reasoning with an expressive description logic. This is a new increment in the expressive power of implemented description logic systems.

Implementation

All of the systems are built around a highly-optimized decision procedure for an expressive description logic (or, equivalently, a propositional modal logic). *SAT is based on a highly-optimized decision procedure for propositional logic, modified and extended into a decision procedure for modal logics. DLP, FaCT, RACE, and CICLOP were all built from scratch. The MSPASS system uses a translation approach, which employs a powerful first-order prover to determine the satisfiability of descriptions.

Performance

The high level of optimization found in the systems makes them much faster than previous systems from previous Description Logic systems such as KRIS. They can reason rapidly on older knowledge bases, which were impractical to run under KRIS. Several of the systems have been tested on a modified version of the GALEN KB, a large medial terminology, and can load this KB in a reasonable amount of time.

Many systems are also rapid reasoners for various proposional modal logics. In fact, the only current method for really investigating their speed is by generating random propositional modal formulae.

It would be much better if there were new description logic KBs that could be used to test out this current generation of description logic systems. Now that there are a variety of systems available, it should be possible to work with larger and more complex description logic terminology KBs.

Limitations

Some of the systems are just satisfiability engines for descriptions, and do not even have any features for building KBs. Other systems have a reasonably full interface for creating KBs and a simple interface for examining the KB.

The main limitation with most of the systems is their lack of sophisticated user-interface and KB-developement capabiblities. These capabilities include explanation and graphical user interfaces. (Some of the systems, notably CICLOP, have graphical user interfaces, but none of them are at the level of commercial AI systems.)

Nevertheless, there are now mature systems that can be used in a research setting to create and examine KBs

Name	Source
*SAT	http://www.mrg.dist.unige.it/~tac/StarSAT.html
CICLOP	http://www-ensais.u-strasbg.fr/liia/ciclop/ciclop.htm
DLP	http://www.bell-labs.com/user/pfps
FaCT and iFaCT	http://www.cs.man.ac.uk/~horrocks
MSPASS	http://spass.mpi-sb.mpg.de
RACE	http://kogs-www.informatik.uni-hamburg.de/~moeller

Table 1: System Availability

for various description logics.

Future Plans

Many of the implementors have started work on an architecture for a Description Logic system that would allow replaceable components to be used. In this way, future designers would not have to implement a complete Description Logic system, instead concentrating on one portion of the system. Hopefully, this will allow the development of the missing interface and development features.

References

[Balsiger and Heuerding, 1998] P. Balsiger and A. Heuerding. Comparison of theorem provers for modal logics — introduction and summary. In H. de Swart, editor, *Automated Reasoning with Analytic Tableaux and Related Methods: International Conference Tableaux'98*, number 1397 in Lecture Notes in Artificial Intelligence, pages 25–26. Springer-Verlag, May 1998.

[Horrocks and Patel-Schneider, 1998] I. Horrocks and P. F. Patel-Schneider. DL systems comparison. In E. Franconi, G. De Giacomo, R. M. MacGregor, W. Nutt, C. A. Welty, and F. Sebastiani, editors, *Collected Papers from the International Description Logics Workshop (DL'98)*, pages 55–57, 1998.

[Massacci, 1999] F. Massacci. Design and results of the tableaux-99 non-classical (modal) systems comparison. In *Automated Reasoning with Analytic Tableaux and Related Methods: International Conference Tableaux'99*, Lecture Notes in Artificial Intelligence. Springer-Verlag, June 1999.