

Localizing Uniquely Determined Programs

Pascal Hitzler and Anthony Karel Seda

Department of Mathematics
University College, Cork, Ireland

One advantage a logic program P , or a disjunctive database, has over conventional imperative and object oriented programs is that it has a natural machine-independent meaning, namely, its logical meaning. This is often referred to as its declarative semantics, and is usually taken to be some “standard” model canonically associated with P . Unfortunately, it is often the case that there are many possible choices for the standard model such as the well-founded model, the stable model, the perfect model, the weakly perfect model, and so on, which are in general different and all of which have a claim to be “the natural choice” depending on one’s view of non-monotonic reasoning. It is therefore important and interesting to know when these various models coincide since this confirms coincidence of the various ways of considering non-monotonic reasoning.

A particular case of this is the study of classes of programs P which have a unique supported model or, in other words, have a unique fixed point for the associated single-step operator T_P . It is reasonable to expect that many of the standard models will coincide for such programs, and in this paper we present results which support this view and we also examine the extent to which it is so. Programs with unique supported models are called *uniquely determined*, and classes of such programs will be called here *unique supported model classes* or *usm classes*. Usm classes include some programs which have been studied in the context of termination, such as acyclic or acceptable programs, and some straightforward generalizations of these. In an earlier paper [1], we gave a unifying approach to some usm classes using operators in three-valued logics which, amongst other things, led to the definition of the usm class of all Φ -accessible programs and the class of all Φ^* -accessible programs. These classes are remarkable in that not only does each program in them have a unique supported model, but in addition they are computationally adequate in that every partial recursive function can be implemented, under Prolog, by such programs. This does not hold for the subclass of acceptable programs which always terminate under the Prolog selection rule. By working with unique supported model classes, one is therefore working in a setting which is, semantically, relatively unambiguous, and one may still study classes of programs which range from having strong termination properties to full computational adequacy.

The unifying approach mentioned earlier, using three-valued logic, led to a comparison of several usm classes and the determination of some of their distinguishing properties. In addition, work undertaken elsewhere by the authors has examined topological and related methods for showing existence and uniqueness of fixed points of various operators associated with programs; this includes the use of quasi-metrics, generalized ultrametrics, see for example [2], and the partial metrics of S.G. Matthews. It is the main objective of this paper to complement these results by considering how usm classes relate to other classes of programs and how the unique supported model semantics for them relates to other approaches to semantics. In particular, we focus on the following aspects of the problem: (i) obtaining unique supported models; (ii) comparison of usm classes with other classes of programs; (iii) the interplay between stable and supported models.

References

- [1] Hitzler, P. and Seda, A.K., *Characterizations of Classes of Programs by Three-Valued Operators*. In: Gelfond, M., Leone, N. and Pfeifer, G. (Eds.), *Logic Programming and Nonmonotonic Reasoning, Proceedings of the 5th International Conference on Logic Programming and Non-Monotonic Reasoning (LPNMR'99)*, El Paso, Texas, USA, December 1999. *Lecture Notes in Artificial Intelligence*, Vol. 1730. Springer, Berlin, 1999, pp. 357–371.
- [2] Hitzler, P. and Seda, A.K., *The Fixed-Point Theorems of Priess-Crampe and Ribenboim in Logic Programming*. *Proceedings of the International Conference and Workshop on Valuation Theory*, University of Saskatchewan in Saskatoon, Canada, July 1999. *Fields Institute Communications Series*, American Mathematical Society, Providence, R.I., 17 pages, to appear.