Towards a Semantical Hierarchy of Logic Programming Classes

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Work on developing reasonable declarative meanings for logic programs with negation has lead to a large variety of semantic operators and associated semantics, and also to the identification of classes of programs which correspond to the respective semantical approaches. We present old and new results on relationships between some of these approaches, especially such involving the Fitting semantics (Fitting, 1985).

The Fitting semantics is given by the least fixed point of an operator using three-valued logic, and is a three-valued version of the supported model semantics used for positive programs. The underlying logic is Kleene's strong three-valued logic. Alternative "Fitting-style" operators and semantics are defined by changing the truth tables of the underlying logic. Given such an operator, we can associate with it the class of programs for which this operator has a classical, two-valued, least fixed point. It is remarkable that among the classes which can be defined in this way are some which are well-known in logic programming and are actually strongly related to termination properties, such as the acceptable (Apt and Pedreschi, 1993) and the acyclic programs (Cavedon, 1989), and also the locally hierarchical programs (Cavedon, 1989). It further gives rise to the class of Φ^*-accessible programs, which is computationally universal although it does not contain all positive programs.

We can also obtain an alternative characterization for programs which have a two-valued Fitting semantics, called Φ-accessible programs, in the style of acceptable programs. This characterization allows us to show that every program with a total Fitting semantics is weakly stratified, in the sense of Przymusinsky and Przymusinska, 1990, which strengthens a result by Protti and Zaverucha, 1998. Our result neatly connects Fitting-style semantics with weak stratification and in turn with the well-founded (van Gelder, Ross and Schlipf, 1991) and the stable semantics (Gelfond and Lifschitz, 1988).

We also show that the stable and supported models of a given program P coincide provided that a certain derived positive program is Φ^*-accessible. This is obtained by employing a result by Fages, 1994.