Over-Constrained Systems

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Over-constrained systems are unsolvable by traditional methods with respect to the existing contradictory constraints in a problem definition. Solutions of such systems are defined and computed by giving some preferences or weights to the individual constraints and minimizing the violations of constraints using these preferences. The complexity and size of solved problem is often very large and computing of optimal solution requires use of sophisticated methods.

Standard methods for solving over-constrained problems apply constraint preferences for definition of optimal solution. There are, however, over-constrained problems with partially or even completely ordered variables and this ordering creates natural preferences for given problem. I developed a new constraint solving environment, where these preferences (variables' annotations) dependent on variable occurence in constraint are applied (Rudová 1998b).

The proposed solution allows to define mapping of variable's annotations to existing over-constrained systems – constraint hierarchies (Rudová 1998a) and to possibilistic CSPs. With that an algorithm for solving constraints with annotations through mapping to constraint hierarchy was described. This algorithm for acyclic set of inequality constraints was implemented in SICStus Prolog. This part of thesis will conclude with description of some examples demonstrating advantages and scope of annotations and implemented algorithm.

The properties of variables' annotations were still explored on the small or artificial (toy) examples. Currently I try to apply variables' annotations for solving timetabling problem in our faculty. The working with timetabling problem is a bit more complex than usual, because I would like to create individual timetable for every student – as (s)he registers for a set of courses. Also the number of required courses is small, majority of courses are optional and so the sets of registered courses for each student can be very different. Preferences of variables express how important are given teachers and their requirements (professors, assistants, ...), lecture halls (small or large, with special equipment), and which courses are (not) allowed to overlap in dependency on the type and the number of students registered for the course. I would like to compare through this timetabling application variables' annotations with standard constraint preferences in constraint hierarchies, possibilistic CSPs, and weighted CSPs.

Based on a precise definition of our timetabling problem and comparisons of different approaches I should obtain basic interpretation of annotations (not depending on a constraint preferences) as a theoretical background for system design issued from annotations. At this point I should also consider possible combination of annotations with constraint preferences. This part will be concluded by implementation of proposed system.

Variables' annotations seem to be interesting framework for expressing preferences of global constraints as for example all-different. Trivially the annotations of global constraints can be combined with standard constraint preferences. Their broader application depends on a proposed interpretation of annotations. When the global soft constraints are applied in target application solution, I should seriously consider complexity of an algorithm to provide an implementation – research in the area of global constraints offering partial solutions is still very narrow in scope.

Properties and scope of proposed system will be verified by realization of original timetabling problem and also by other selected problems within the area of digital typesetting and natural language processing. As a consequence of these realizations I will try to define classes of problems which can be successfully solved by annotations.

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References

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