

Constraint Modeling in the Context of Academic Task Assignment

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We explore fundamental issues of the modeling, implementation, and processing of non-binary constraints. General techniques for reformulating non-binary constraints (i.e., hidden variable, dual graph [1]) are not practical for high-arity constraints [4]. In our study, we motivate our need to express practical requirements as non-binary constraints, then we explore reformulation methods to deal with them since the conventional methods [1] become impractical. Our work builds on the work of Gent et al. [2], while we motivate and anchor our investigations in the practical context of a real-world application. This is the assignment of graduate teaching assistants to courses in our department. This task is a critical responsibility that our department's administration has to drudge through every semester. The idea for this particular application is borrowed from Rina Dechter, at the UC Irvine. We model this application using 4 types of unary constraints, one type of binary constraint, and 3 types of non-binary constraints. Since in our application problems are over-constrained, a satisfactory assignment is one that maximizes the number of courses covered. For this purpose, we adopt a new consistency checking mechanism that allows variables to be assigned a `null` value during search. For two assignments that cover the same number of courses, we further discriminate between them by choosing the one of highest quality, obtained by a combination of the value of the preferences in each assignment. We experiment with two different criteria to maximize preferences. We establish that two of our non-binary constraints are decomposable into equivalent networks of binary constraints, which significantly improves the performance of search [3]. Our efforts have resulted in a prototype system under field-test since August 2001. This system has effectively reduced the number of conflicts, thus yielding a commensurate increase in course quality. It has also decreased the amount of time and effort spent on making the assignment and gained the approval and satisfaction of our staff, faculty and student body.

References

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