Antti Seitovirta – Talk 9

Modelling in CSP

Introduction

- Modelling is the way of transforming the problem into a Constraint Satisfaction Problem.
- There are many ways of modelling the same problem.

Introduction II

- Modelling can be solver dependant.
- Goal of modelling is to form a CSP that can be solved quickly.

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Viewpoints

- One problem can have multiple ways of looking it.
- Therefore one problem can yield multiple different CSPs depending on what the variables and domains represent.

  Next: Two different viewpoints for the n-queens problem.

N-queens, two approaches

- First approach: the variables q_1, q_2….,q_n correspond to the n queens and the domain of each variable is the set of integers {1,2,… n^2}, representing the squares; an assigment (q_i,a) means that the i:th queen is on square a.

N-queens, two approaches

- Second Approach: The variables $r_1, r_2 \ldots, r_n$ represent the rows of the board, and the domain of each variable is the set of integers $\{1,2,3,\ldots,n\}$ representing the columns; an assigment (r_i, c) means that the queen in row i is in column c;

Expressing the constraints

- How to write the constraints
- The way which constraints are written affects the effiency of the search model because it affects how constraints are going to propagate during the search.

Combining Constraints

- Combining constraints helps finding impossible solutions faster
- The combination of two constraints allows only tuples that are allowed by both constraints.
- Combining may not reduce running-time

Global Constraints

- Feature of constraint solvers
- Developed to replace particular set of constraints that occur often.
- Most frequently used global constraint might be the allDifferent constraint that replaces multiple ($c_1 \neq c_2$) constraints.

Extensional Constraints

- Extensional Constraints are not directly related to problem but can be used to find a solution for it.
- Some solvers can provide you the blacklist or whitelist for constraints

Meta Constraints

- Constraints over constraints
- For example, if you have constraints c_1 and c_2 and you want at least one of them satisfied, you add binary variables x_1 and x_2 to define wheter constraints c_1 and c_2 are satisfied and a meta-constraint c_3 that states that

  $x_1 + x_2 \geq 1$

Auxillary Variables

- Auxillary variables are variables that are added to the model for two main reasons.
- It might be difficult to express constraints using only the variables directly related to problem.
- It might help the propagation.

Implied Constraints

- Implied constraints are constraints that are implied by other constraints. For that reason they are allso called redundant constraints.
- The aim of using implied constraints is to reduce the search effort to solve the problem.

Something to take home

- When solving a problem, remember to think alternative ways of solving it.
- Do not hesitate to add own variables or constraints into the mix.
- Knowing your solver and effectively using the tools it provides may affect your workload.

Thank you

Thank you for participating to Talk 9, held by

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