5.301   open_minimum

Origin   Derived from minimum

Constraint   open_minimum(MIN, VARIABLES)

Arguments   MIN   :   dvar
                     VARIABLES :   collection(var−dvar, bool−dvar)

Restrictions $|\text{VARIABLES}| > 0$
                     required(VARIABLES, [var, bool])
                     VARIABLES.bool ≥ 0
                     VARIABLES.bool ≤ 1

Purpose   MIN is the minimum value of the variables $\text{VARIABLES}[i].\text{var}$, $(1 \leq i \leq |\text{VARIABLES}|)$ for which $\text{VARIABLES}[i].\text{bool} = 1$ (at least one of the Boolean variables is set to 1).

Example
$$\left(3, \left\langle \begin{array}{ll} \text{var} - 3 & \text{bool} - 1, \\ \text{var} - 1 & \text{bool} - 0, \\ \text{var} - 7 & \text{bool} - 0, \\ \text{var} - 5 & \text{bool} - 1, \\ \text{var} - 5 & \text{bool} - 1 \end{array} \right\rangle \right)$$

The open_minimum constraint holds since its first argument MIN = 3 is set to the minimum value of values $3, 1, 7, 5, 5$ for which the corresponding Boolean $1, 0, 0, 1, 1$ is set to 1 (i.e., values $3, 5, 5$).

Typical $|\text{VARIABLES}| > 1$
                     range(VARIABLES.var) > 1

Symmetries   • Items of VARIABLES are permutable.

                     • One and the same constant can be added to MIN as well as to the var attribute of all items of VARIABLES.

Remark   The open_minimum constraint is used in the reformulation of the tree_range constraint.

See also   **comparison swapped:** open_maximum.

                     hard version: minimum.

                     used in graph description: in_set.

                     uses in its reformulation: tree_range.

Keywords   **characteristic of a constraint:**   minimum,   automaton,   automaton without counters, reified automaton constraint.

                     constraint network structure: centered cyclic(1) constraint network(1).

                     constraint type: order constraint, open constraint, open automaton constraint.

Automaton   Figure 5.619 depicts the automaton associated with the open_minimum constraint. Let VAR_i, B_i be the ith item of the VARIABLES collection. To each triple $(\text{MIN}, \text{VAR}_i, \text{B}_i)$ corresponds a signature variable S_i as well as the following signature constraint: $(\text{B}_i = 1 \wedge \text{MIN} < \text{VAR}_i \Leftrightarrow S_i = 0) \wedge (\text{B}_i = 1 \wedge \text{MIN} = \text{VAR}_i \Leftrightarrow S_i = 1) \wedge (\text{B}_i = 1 \wedge \text{MIN} > \text{VAR}_i \Leftrightarrow S_i = 2) \wedge (\text{B}_i = 0 \wedge \text{MIN} < \text{VAR}_i \Leftrightarrow S_i = 3) \wedge (\text{B}_i = 0 \wedge \text{MIN} = \text{VAR}_i \Leftrightarrow S_i = 4) \wedge (\text{B}_i = 0 \wedge \text{MIN} > \text{VAR}_i \Leftrightarrow S_i = 5)$.
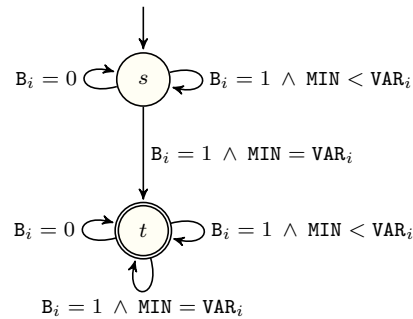

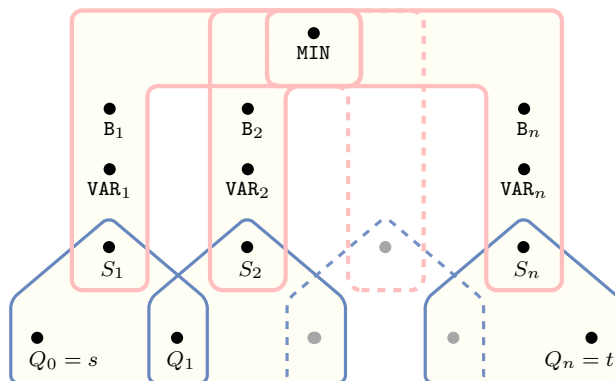Figure 5.619: Automaton of the open_minimum constraint

Figure 5.620: Hypergraph of the reformulation corresponding to the automaton of the open_minimum constraint