5.244 max_n

DESCRIPTION LINKS GRAPH

Origin [27]

Constraint max_n(MAX, RANK, VARIABLES)

Arguments

MAX	:	dvar
RANK	:	int
VARIABLES	:	collection(var−dvar)

Restrictions

RANK ≥ 0
RANK $<$ |VARIABLES|
|VARIABLES| > 0
required(VARIABLES, var)

Purpose MAX is the maximum value of rank RANK (i.e., the RANKth largest distinct value, identical values are merged) of the collection of domain variables VARIABLES. The maximum value has rank 0.

Example $(6, 1, \langle 3, 1, 7, 1, 6\rangle)$

The max_n constraint holds since its first argument MAX $= 6$ is fixed to the second (i.e., RANK $+ 1$) largest distinct value of the collection $\langle 3, 1, 7, 1, 6\rangle$.

Typical

RANK > 0
RANK $< |$VARIABLES$|$
|VARIABLES| > 1
range(VARIABLES.var) > 1

Symmetries

- Items of VARIABLES are permutable.
- One and the same constant can be added to MAX as well as to the var attribute of all items of VARIABLES.

Arg. properties

Functional dependency: MAX determined by RANK and VARIABLES.

Algorithm [27].

Reformulation The constraint among_var$(1, \langle$MAX$\rangle$, VARIABLES$)$ enforces MAX to be assigned one of the values of VARIABLES. The constraint nvalue(NVAL, VARIABLES) provides a hand on the number of distinct values assigned to the variables of VARIABLES. By associating to each variable V_i $(i \in [1, |$VARIABLES$|])$ of the VARIABLES collection a *rank* variable $R_i \in [0, |$VARIABLES$| - 1]$ with the reified constraint $R_i =$ RANK $\Leftrightarrow V_i =$ MAX, the inequality $R_i <$ NVAL, and by creating for each pair of variables V_i, V_j $(i, j < i \in [1, |$VARIABLES$|])$ the reified constraints

$V_i > V_j \Leftrightarrow R_i < R_j$,
$V_i = V_j \Leftrightarrow R_i = R_j$,
$V_i < V_j \Leftrightarrow R_i > R_j$,
one can reformulate the max_n constraint in term of $3 \cdot \frac{|\texttt{VARIABLES}| \cdot (|\texttt{VARIABLES}| - 1)}{2} + 1$ reified constraints.

See also **comparison swapped:** min_n.

generalisation: maximum *(absolute maximum replaced by maximum or order* n*).*

Keywords **characteristic of a constraint:** rank, maximum.

constraint arguments: pure functional dependency.

constraint type: order constraint.

modelling: functional dependency.

Arc input(s)	VARIABLES
Arc generator	$CLIQUE \mapsto$ collection(variables1, variables2)
Arc arity	2
Arc constraint(s)	$\bigvee \left(\begin{array}{l} \texttt{variables1.key} = \texttt{variables2.key}, \\ \texttt{variables1.var} > \texttt{variables2.var} \end{array} \right)$
Graph property(ies)	**ORDER**(RANK, MININT, var) = MAX

Graph model Parts (A) and (B) of Figure 5.535 respectively show the initial and final graph associated with the **Example** slot. Since we use the **ORDER** graph property, the vertex of rank 1 (without considering the loops) of the final graph is outlined with a thick circle.

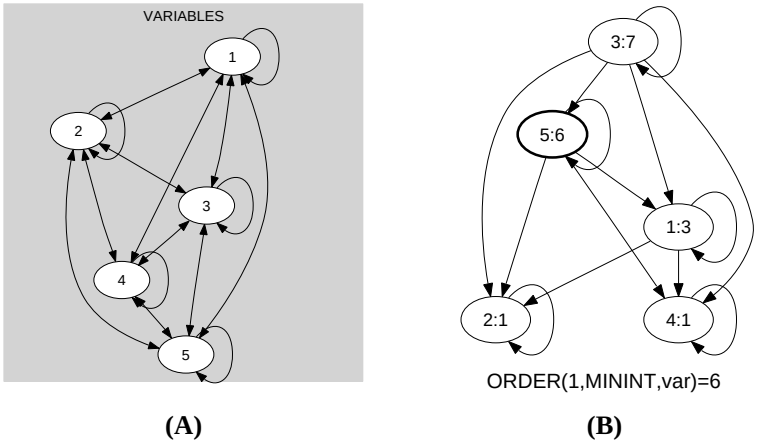

Figure 5.535: Initial and final graph of the max_n constraint