5.34 atmost_nvalue

DESCRIPTION LINKS GRAPH

Origin [56]

Constraint atmost_nvalue(NVAL, VARIABLES)

Synonyms soft_alldiff_max_var, soft_alldifferent_max_var, soft_alldistinct_max_var.

Arguments

NVAL	:	dvar
VARIABLES	:	collection(var−dvar)

Restrictions

NVAL ≥ min(1, |VARIABLES|)
required(VARIABLES, var)

Purpose The number of distinct values taken by the variables of the collection VARIABLES is less than or equal to NVAL.

Example $(4, \langle 3, 1, 3, 1, 6 \rangle)$

The atmost_nvalue constraint holds since the collection $\langle 3, 1, 3, 1, 6 \rangle$ involves at most 4 distinct values (i.e., in fact 3 distinct values).

Typical

NVAL > 1
NVAL < |VARIABLES|
|VARIABLES| > 1

Symmetries

- NVAL can be increased.
- Items of VARIABLES are permutable.
- All occurrences of two distinct values of VARIABLES.var can be swapped; all occurrences of a value of VARIABLES.var can be renamed to any unused value.
- An occurrence of a value of VARIABLES.var can be replaced by any value of VARIABLES.var.

Remark This constraint was introduced together with the atleast_nvalue constraint by C. Bessière *et al.* in a article [56] providing filtering algorithms for the nvalue constraint.

It was shown in [63] that, finding out whether a atmost_nvalue constraint has a solution or not is NP-hard. This was achieved by reduction from 3-SAT.

Algorithm [26] provides an algorithm that achieves bound consistency. [36] provides two filtering algorithms, while [56] provides a greedy algorithm and a graph invariant for evaluating the minimum number of distinct values. [56] also gives a linear relaxation for approximating the minimum number of distinct values.

Systems `atMostNValue` in **Choco**.

See also **comparison swapped:** `atleast_nvalue`.

implied by: `nvalue` *($\leq$* `NVAL` *replaced by* $=$ `NVAL`*)*.

related: `soft_all_equal_max_var`, `soft_all_equal_min_ctr`, `soft_all_equal_min_var`, `soft_alldifferent_ctr`, `soft_alldifferent_var`.

Keywords **complexity:** 3-SAT.

constraint type: counting constraint, value partitioning constraint.

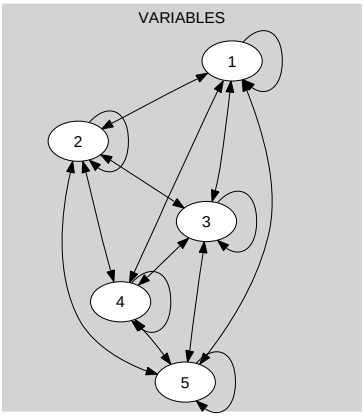
filtering: bound-consistency.

final graph structure: strongly connected component, equivalence.

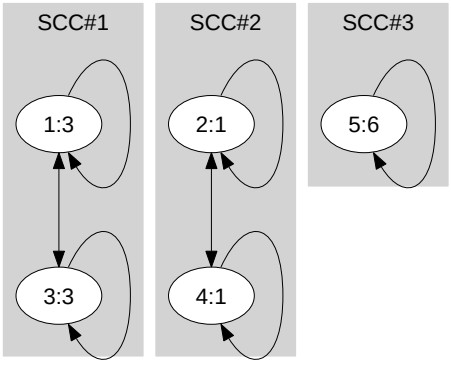
modelling: number of distinct equivalence classes, number of distinct values.

Arc input(s)	VARIABLES
Arc generator	$CLIQUE \mapsto$ collection(variables1, variables2)
Arc arity	2
Arc constraint(s)	variables1.var = variables2.var
Graph property(ies)	NSCC $\leq$ NVAL
Graph class	EQUIVALENCE

Graph model Parts (A) and (B) of Figure 5.63 respectively show the initial and final graph associated with the **Example** slot. Since we use the NSCC graph property we show the different strongly connected components of the final graph. Each strongly connected component corresponds to a specific value that is assigned to some variables of the VARIABLES collection. The 3 following values 1, 3 and 6 are used by the variables of the VARIABLES collection.



(A)



(B)

Figure 5.63: Initial and final graph of the atmost_nvalue constraint