5.30 atleast_nvalue

DESCRIPTION LINKS GRAPH

Origin [308]

Constraint atleast_nvalue(NVAL, VARIABLES)

Synonym k_diff.

Arguments

NVAL	:	dvar
VARIABLES	:	collection(var−dvar)

Restrictions

NVAL ≥ 0
NVAL $\leq$ |VARIABLES|
required(VARIABLES, var)

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

Example $(2, \langle 3, 1, 7, 1, 6\rangle)$

The atleast_nvalue constraint holds since the collection $\langle 3, 1, 7, 1, 6\rangle$ involves at least 2 distinct values (i.e., in fact 4 distinct values).

Typical

NVAL > 0
NVAL $<$ |VARIABLES|
|VARIABLES| > 1

Symmetries

- NVAL can be decreased to any value ≥ 0.
- 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.

Remark The atleast_nvalue constraint was first introduced by J.-C. Régin under the name k_diff in [308]. Later on the atleast_nvalue constraint was introduced together with the atmost_nvalue constraint by C. Bessière *et al.* in a article [56] providing filtering algorithms for the nvalue constraint.

Algorithm [56] provides a sketch of a filtering algorithm enforcing arc-consistency for the atleast_nvalue constraint. This algorithm is based on the maximal matching in a bipartite graph.

See also **comparison swapped:** atmost_nvalue.

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

uses in its reformulation: not_all_equal.

Keywords

constraint type: counting constraint, value partitioning constraint.

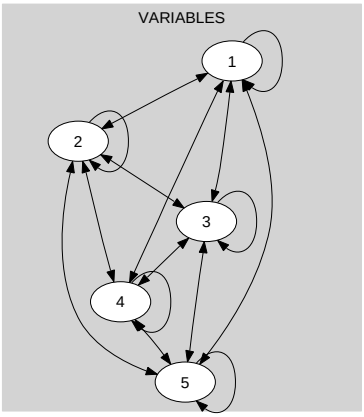
filtering: bipartite matching, arc-consistency.

final graph structure: strongly connected component, equivalence.

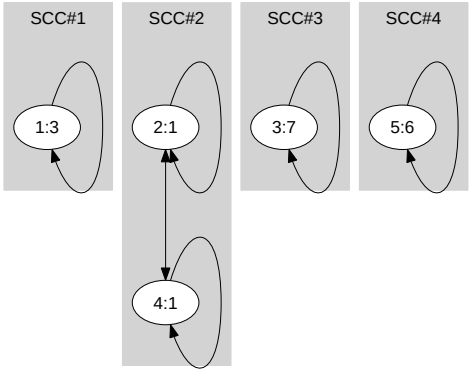
modelling: number of distinct equivalence classes, number of distinct values.

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 $\geq$ NVAL
Graph class	EQUIVALENCE

Graph model Parts (A) and (B) of Figure 5.58 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 4 following values 1, 3, 6 and 7 are used by the variables of the VARIABLES collection.



(A)



(B)

Figure 5.58: Initial and final graph of the atleast_nvalue constraint