5.22 allperm

DESCRIPTION LINKS GRAPH

Origin [168]

Constraint `allperm(MATRIX)`

Synonyms `all_perm`, `all_permutations`.

Type `VECTOR : collection(var-dvar)`

Argument `MATRIX : collection(vec - VECTOR)`

Restrictions

$|\texttt{VECTOR}| \geq 1$
`required(VECTOR, var)`
`required(MATRIX, vec)`
`same_size(MATRIX, vec)`

Purpose

Given a matrix $\mathcal{M}$ of domain variables, enforces that the first row is lexicographically less than or equal to all permutations of all other rows. Note that the components of a given vector of the matrix $\mathcal{M}$ may be equal.

Example

$(\langle \texttt{vec} - \langle 1,2,3\rangle, \texttt{vec} - \langle 3,1,2\rangle\rangle)$

The `allperm` constraint holds since vector $\langle 1,2,3\rangle$ is lexicographically less than or equal to all the permutations of vector $\langle 3,1,2\rangle$ (i.e., $\langle 1,2,3\rangle$, $\langle 1,3,2\rangle$, $\langle 2,1,3\rangle$, $\langle 2,3,1\rangle$, $\langle 3,1,2\rangle$, $\langle 3,2,1\rangle$).

All solutions

Figure 5.52 gives all solutions to the following non ground instance of the `allperm` constraint: $\texttt{U}_1 \in [1,2]$, $\texttt{U}_2 \in [1,2]$, $\texttt{U}_3 \in [1,3]$, $\texttt{V}_1 \in [0,1]$, $\texttt{V}_2 \in [1,2]$, $\texttt{V}_3 \in [0,2]$, $\texttt{allperm}(\langle\langle \texttt{U}_1,\texttt{U}_2,\texttt{U}_3\rangle, \langle \texttt{V}_1,\texttt{V}_2,\texttt{V}_3\rangle\rangle)$.

① $(\langle\langle 1,1,1\rangle, \langle 1,1,1\rangle\rangle)$
② $(\langle\langle 1,1,1\rangle, \langle 1,1,2\rangle\rangle)$
③ $(\langle\langle 1,1,1\rangle, \langle 1,2,1\rangle\rangle)$
④ $(\langle\langle 1,1,1\rangle, \langle 1,2,2\rangle\rangle)$
⑤ $(\langle\langle 1,1,2\rangle, \langle 1,1,2\rangle\rangle)$

⑥ $(\langle\langle 1,1,2\rangle, \langle 1,2,1\rangle\rangle)$
⑦ $(\langle\langle 1,1,2\rangle, \langle 1,2,2\rangle\rangle)$
⑧ $(\langle\langle 1,1,3\rangle, \langle 1,2,2\rangle\rangle)$
⑨ $(\langle\langle 1,2,1\rangle, \langle 1,2,2\rangle\rangle)$
⑩ $(\langle\langle 1,2,2\rangle, \langle 1,2,2\rangle\rangle)$

Figure 5.52: All solutions corresponding to the non ground example of the `allperm` constraint of the **All solutions** slot

Typical

$|\texttt{VECTOR}| > 1$
$|\texttt{MATRIX}| > 1$

Symmetry One and the same constant can be added to the `var` attribute of all items of `MATRIX.vec`.

Arg. properties Suffix-contractible wrt. `MATRIX.vec` (*remove items from same position*).

Usage A *symmetry-breaking* constraint.

See also **common keyword:** `lex2`, `lex_chain_lesseq` *(matrix symmetry,lexicographic order)*, `lex_lesseq` *(lexicographic order)*, `lex_lesseq_allperm` *(matrix symmetry,lexicographic order)*, `strict_lex2` *(lexicographic order)*.

part of system of constraints: `lex_lesseq_allperm`.

used in graph description: `lex_lesseq_allperm`.

Keywords **characteristic of a constraint:** sort based reformulation, vector.

constraint type: order constraint, system of constraints.

final graph structure: acyclic, bipartite.

modelling: matrix, matrix model.

symmetry: matrix symmetry, symmetry, lexicographic order.

Arc input(s)	`MATRIX`
Arc generator	$CLIQUE(<) \mapsto$ `collection`(`matrix1`, `matrix2`)
Arc arity	2
Arc constraint(s)	• `matrix1.key` $= 1$ • `matrix2.key` > 1 • `lex_lesseq_allperm`(`matrix1.vec`, `matrix2.vec`)
Graph property(ies)	**NARC**$= |$`MATRIX`$| - 1$
Graph class	• `ACYCLIC` • `BIPARTITE` • `NO_LOOP`

Graph model We generate a graph with an arc constraint `lex_lesseq_allperm` between the vertex corresponding to the first item of the `MATRIX` collection and the vertices associated with all other items of the `MATRIX` collection. This is achieved by specifying that (1) an arc should start from the first item (i.e., `matrix1.key` $= 1$) and (2) an arc should not end on the first item (i.e., `matrix2.key` > 1). We finally state that all these arcs should belong to the final graph. Parts (A) and (B) of Figure 5.53 respectively show the initial and final graph associated with the **Example** slot.

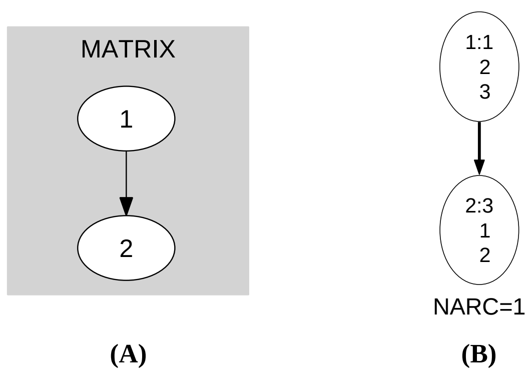

Figure 5.53: Initial and final graph of the `allperm` constraint