5.226 lex_chain_less

DESCRIPTION **LINKS** **GRAPH**

Origin [95]

Constraint lex_chain_less(VECTORS)

Usual name lex_chain

Type VECTOR : collection(var−dvar)

Argument VECTORS : collection(vec − VECTOR)

Restrictions
|VECTOR| ≥ 1
required(VECTOR, var)
required(VECTORS, vec)
same_size(VECTORS, vec)

Purpose For each pair of consecutive vectors $\texttt{VECTOR}_i$ and $\texttt{VECTOR}_{i+1}$ of the VECTORS collection we have that $\texttt{VECTOR}_i$ is lexicographically strictly less than $\texttt{VECTOR}_{i+1}$. Given two vectors, $\vec{X}$ and $\vec{Y}$ of n components, $\langle X_0, \ldots, X_{n-1}\rangle$ and $\langle Y_0, \ldots, Y_{n-1}\rangle$, $\vec{X}$ is *lexicographically strictly less than* $\vec{Y}$ if and only if $X_0 < Y_0$ or $X_0 = Y_0$ and $\langle X_1, \ldots, X_{n-1}\rangle$ is lexicographically strictly less than $\langle Y_1, \ldots, Y_{n-1}\rangle$.

Example $(\langle \texttt{vec} - \langle 5,2,3,9\rangle, \texttt{vec} - \langle 5,2,6,2\rangle, \texttt{vec} - \langle 5,2,6,3\rangle\rangle)$

The lex_chain_less constraint holds since:

- The first vector $\langle 5,2,3,9\rangle$ of the VECTORS collection is lexicographically strictly less than the second vector $\langle 5,2,6,2\rangle$ of the VECTORS collection.
- The second vector $\langle 5,2,6,2\rangle$ of the VECTORS collection is lexicographically strictly less than the third vector $\langle 5,2,6,3\rangle$ of the VECTORS collection.

Typical
|VECTOR| > 1
|VECTORS| > 1

Arg. properties
- Contractible wrt. VECTORS.
- Suffix-extensible wrt. VECTORS.vec (*add items at same position*).

Usage This constraint was motivated for breaking symmetry: more precisely when one wants to lexicographically order the consecutive columns of a matrix of decision variables. A further motivation is that using a set of lexicographic ordering constraints between two vectors does usually not allows to come up with a complete pruning.

Algorithm

A filtering algorithm achieving arc-consistency for a chain of lexicographical ordering constraints is presented in [95].

Six different ways of integrating a chain of lexicographical ordering constraints within non-overlapping constraints like `diffn` or `geost` and within their corresponding necessary condition like the `cumulative` constraint are shown in [3].

Systems

`lexChain` in **Choco**, `lex_chain` in **SICStus**.

See also

common keyword: `geost` *(symmetry, lexicographic ordering on the origins of* `tasks`*,* `rectangles`*, ...)*, `lex_between`, `lex_greater`, `lex_greatereq`, `lex_lesseq` *(lexicographic order)*.

implied by: `strict_lex2`.

implies: `lex_alldifferent`, `lex_chain_lesseq`.

part of system of constraints: `lex_less`.

related: `cumulative`, `diffn` *(lexicographic ordering on the origins of* `tasks`*,* `rectangles`*, ...)*.

system of constraints: `strict_lex2`.

used in graph description: `lex_less`.

Keywords

application area: floor planning problem.

characteristic of a constraint: vector.

constraint type: decomposition, order constraint, system of constraints.

filtering: arc-consistency.

heuristics: heuristics and lexicographical ordering.

modelling: degree of diversity of a set of solutions.

modelling exercises: degree of diversity of a set of solutions.

symmetry: symmetry, matrix symmetry, lexicographic order.

Arc input(s)	VECTORS
Arc generator	*PATH* $\mapsto$ collection(vectors1, vectors2)
Arc arity	2
Arc constraint(s)	lex_less(vectors1.vec, vectors2.vec)
Graph property(ies)	$\mathbf{NARC} = \lvert\mathtt{VECTORS}\rvert - 1$

Graph model Parts (A) and (B) of Figure 5.499 respectively show the initial and final graph associated with the **Example** slot. Since we use the $\mathbf{NARC}$ graph property, the arcs of the final graph are stressed in bold. The lex_chain_less constraint holds since all the arc constraints of the initial graph are satisfied.

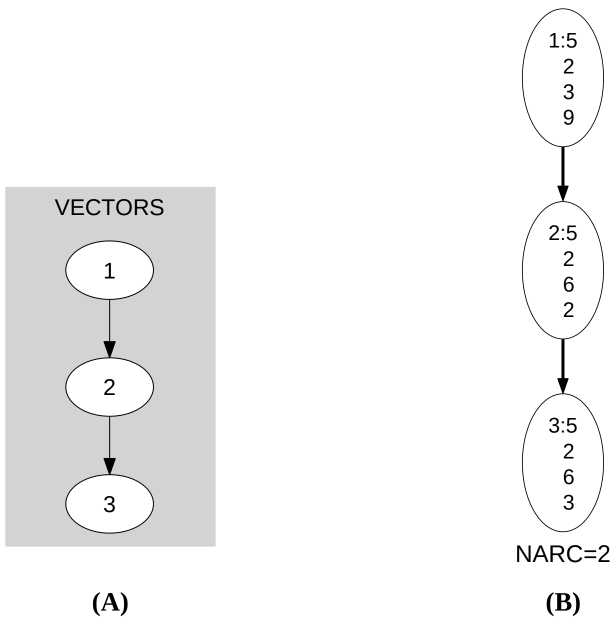

Figure 5.499: Initial and final graph of the lex_chain_less constraint

Signature Since we use the *PATH* arc generator on the VECTORS collection the number of arcs of the initial graph is equal to $\lvert\mathtt{VECTORS}\rvert - 1$. For this reason we can rewrite $\mathbf{NARC} = \lvert\mathtt{VECTORS}\rvert - 1$ to $\mathbf{NARC} \geq \lvert\mathtt{VECTORS}\rvert - 1$ and simplify $\underline{\overline{\mathbf{NARC}}}$ to $\overline{\mathbf{NARC}}$.