5.185 increasing

DESCRIPTION LINKS GRAPH AUTOMATON

Origin KOALOG

Constraint increasing(VARIABLES)

Argument VARIABLES : collection(var−dvar)

Restriction required(VARIABLES, var)

Purpose The variables of the collection VARIABLES are increasing.

Example $(\langle 1, 1, 4, 8\rangle)$

The increasing constraint holds since $1 \leq 1 \leq 4 \leq 8$.

Typical $|\text{VARIABLES}| > 2$
$\text{range}(\text{VARIABLES.var}) > 1$

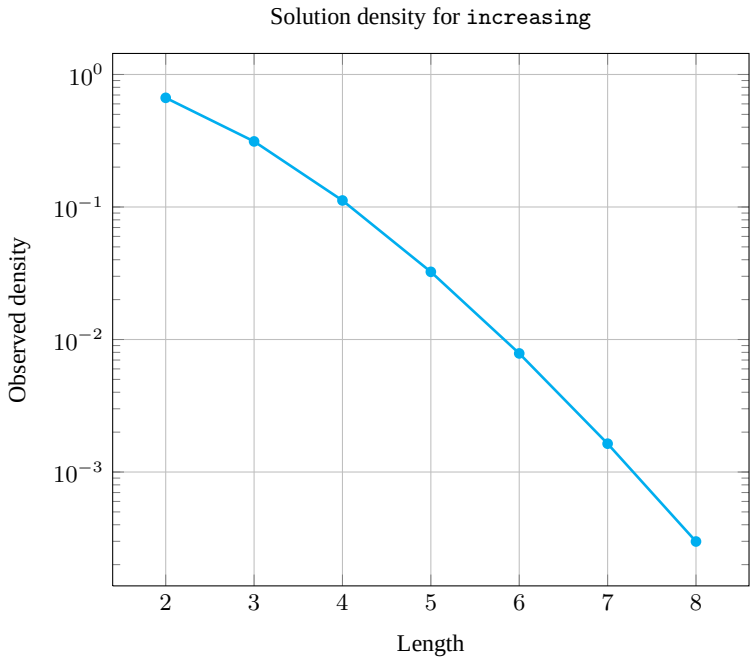
Symmetry One and the same constant can be added to the var attribute of all items of VARIABLES.

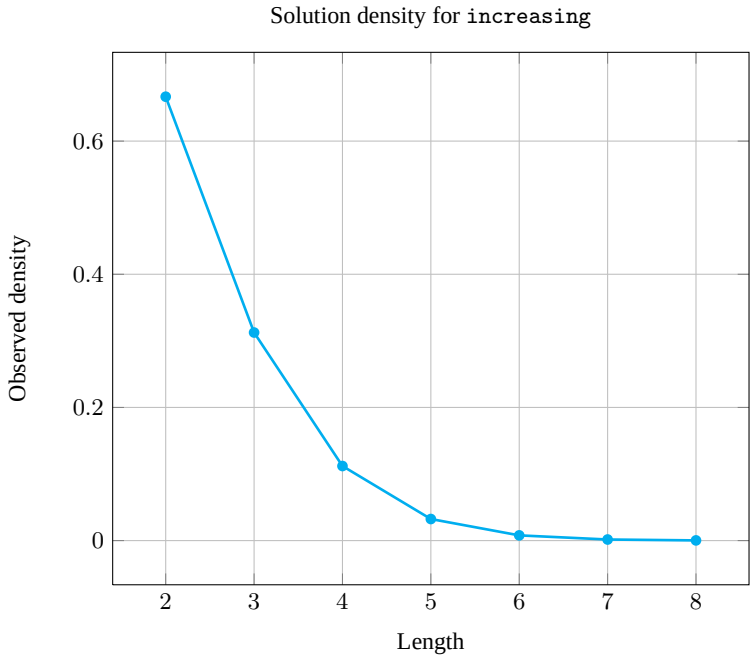
Arg. properties Contractible wrt. VARIABLES.

Counting

Length (n)	2	3	4	5	6	7	8
Solutions	6	20	70	252	924	3432	12870

Number of solutions for increasing: domains $0..n$





Systems `increasingNValue` in **Choco**, `rel` in **Gecode**, `increasing` in **MiniZinc**.

Used in `global_cardinality_low_up`, `increasing_global_cardinality`,

increasing_nvalue, increasing_sum, nvalue, sum_ctr.

See also

common keyword: precedence, strictly_decreasing *(order constraint)*.

comparison swapped: decreasing.

implied by: all_equal, increasing_global_cardinality, increasing_nvalue *(remove* NVAL *parameter from* increasing_nvalue*)*, increasing_sum *(remove* SUM *parameter from* increasing_sum*)*, strictly_increasing.

implies: multi_global_contiguity, no_peak, no_valley.

uses in its reformulation: sort_permutation.

Keywords

characteristic of a constraint: automaton, automaton without counters, reified automaton constraint.

constraint network structure: sliding cyclic(1) constraint network(1).

constraint type: decomposition, order constraint.

filtering: arc-consistency.

Arc input(s)	VARIABLES
Arc generator	$PATH \mapsto$ collection(variables1, variables2)
Arc arity	2
Arc constraint(s)	variables1.var $\leq$ variables2.var
Graph property(ies)	**NARC**$= \lvert$VARIABLES$\rvert - 1$

Graph model Parts (A) and (B) of Figure 5.427 respectively show the initial and final graph associated with the **Example** slot. Since we use the **NARC** graph property, the arcs of the final graph are stressed in bold.

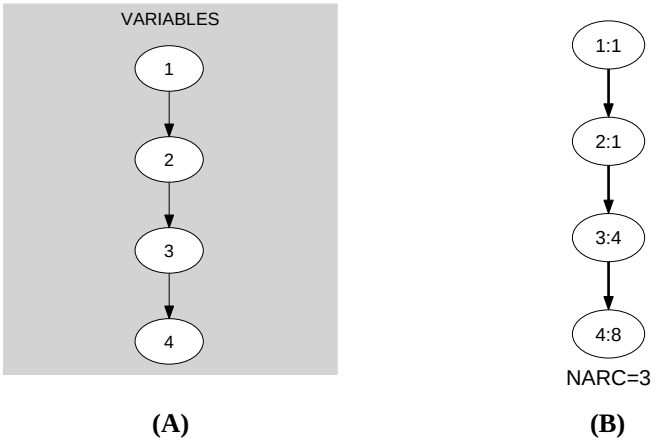


Figure 5.427: Initial and final graph of the increasing constraint

Automaton

Figure 5.428 depicts the automaton associated with the `increasing` constraint. To each pair of consecutive variables $(\texttt{VAR}_i, \texttt{VAR}_{i+1})$ of the collection `VARIABLES` corresponds a 0-1 signature variable S_i. The following signature constraint links $\texttt{VAR}_i$, $\texttt{VAR}_{i+1}$ and S_i: $\texttt{VAR}_i \leq \texttt{VAR}_{i+1} \Leftrightarrow S_i$.

Figure 5.428: Automaton of the `increasing` constraint

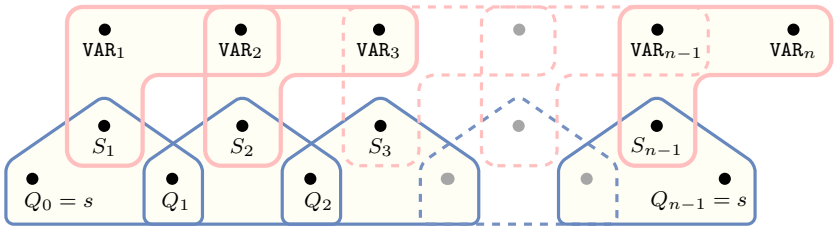


Figure 5.429: Hypergraph of the reformulation corresponding to the automaton of the `increasing` constraint