5.185 increasing

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 $|\text{VARIABLES}| > 2$
range(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 $0..n$

Solution density for `increasing`

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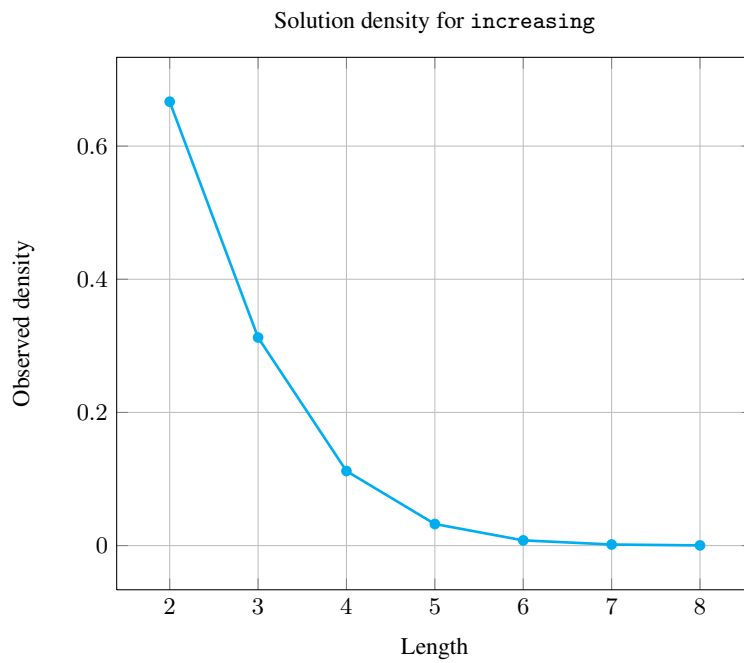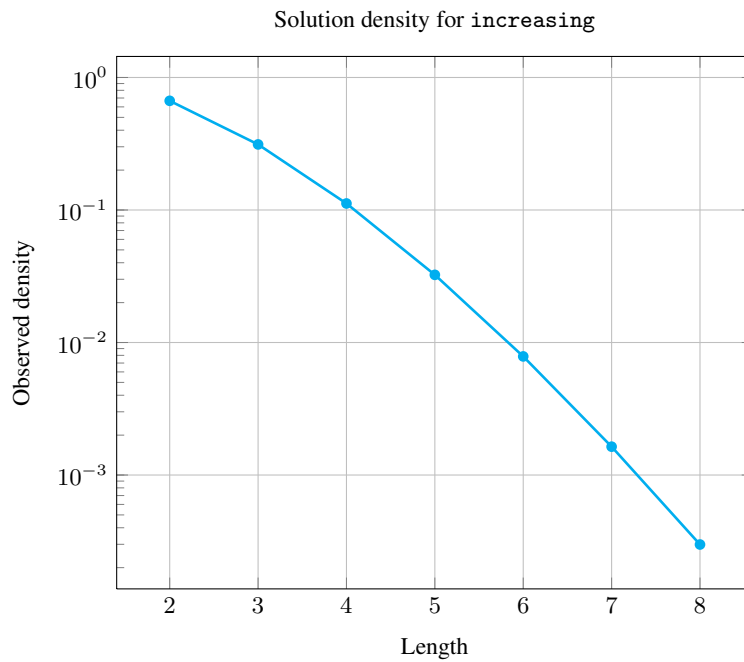
Systems increasingNValue in **Choco**, rel in **Gecode**, increasing in **MiniZinc**.

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	$PATH \mapsto \text{collection}(\texttt{variables1}, \texttt{variables2})$
Arc arity	2
Arc constraint(s)	variables1.var $\leq$ variables2.var
Graph property(ies)	$\mathbf{NARC} = |\texttt{VARIABLES}| - 1$

Graph model Parts (A) and (B) of Figure 5.410 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.
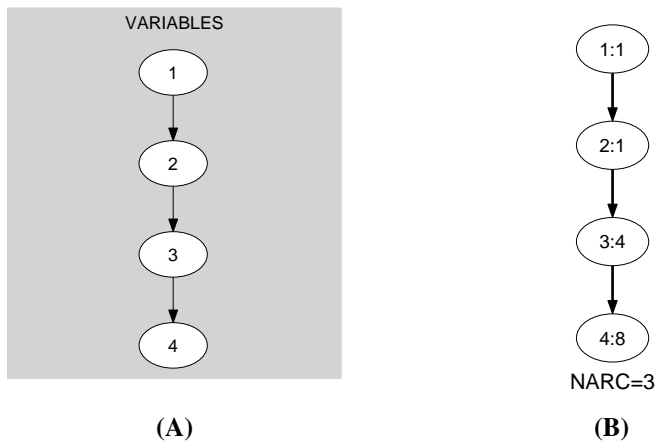

(A)   **(B)**

Figure 5.410: Initial and final graph of the increasing constraint

Automaton   Figure 5.411 depicts the automaton associated with the `increasing` constraint. To each pair of consecutive variables $(\text{VAR}_i, \text{VAR}_{i+1})$ of the collection VARIABLES corresponds a 0-1 signature variable S_i. The following signature constraint links VAR_i, VAR_{i+1} and S_i: $\text{VAR}_i \leq \text{VAR}_{i+1} \Leftrightarrow S_i$.

Figure 5.411: Automaton of the `increasing` constraint
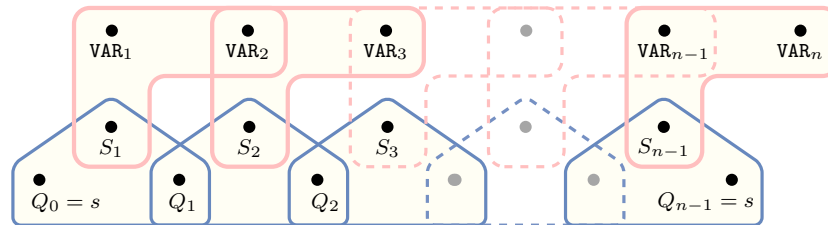
Figure 5.412: Hypergraph of the reformulation corresponding to the automaton of the `increasing` constraint