5.15 alldifferent_cst

DESCRIPTION LINKS GRAPH

Origin

CHIP

Constraint

alldifferent_cst(VARIABLES)

Synonyms

alldiff_cst, alldistinct_cst.

Argument

VARIABLES : collection(var−dvar, cst−int)

Restriction

required(VARIABLES, [var, cst])

Purpose

For all pairs of items (VARIABLES$[i]$, VARIABLES$[j]$) ($i \neq j$) of the collection VARIABLES enforce VARIABLES$[i]$.var + VARIABLES$[i]$.cst $\neq$ VARIABLES$[j]$.var + VARIABLES$[j]$.cst.

Example

$$\left(\left\langle\begin{array}{ll} \texttt{var}-5 & \texttt{cst}-0, \\ \texttt{var}-1 & \texttt{cst}-1, \\ \texttt{var}-9 & \texttt{cst}-0, \\ \texttt{var}-3 & \texttt{cst}-4 \end{array}\right\rangle\right)$$

The alldifferent_cst constraint holds since all the expressions $5 + 0 = 5$, $1 + 1 = 2$, $9 + 0 = 9$ and $3 + 4 = 7$ correspond to distinct values.

All solutions

Figure 5.33 gives all solutions to the following non ground instance of the alldifferent_cst constraint: $V_1 \in [0, 2]$, $V_2 \in [4, 5]$, $V_3 \in [4, 4]$, $V_4 \in [0, 1]$, alldifferent_cst($\langle\langle V_1, 0\rangle, \langle V_2, 1\rangle, \langle V_3, 2\rangle, \langle V_3, 3\rangle\rangle$).

① $(\langle 0{+}0, 4{+}1, 4{+}2, 0{+}3\rangle)$
② $(\langle 0{+}0, 4{+}1, 4{+}2, 1{+}3\rangle)$
③ $(\langle 1{+}0, 4{+}1, 4{+}2, 0{+}3\rangle)$
④ $(\langle 1{+}0, 4{+}1, 4{+}2, 1{+}3\rangle)$
⑤ $(\langle 2{+}0, 4{+}1, 4{+}2, 0{+}3\rangle)$
⑥ $(\langle 2{+}0, 4{+}1, 4{+}2, 1{+}3\rangle)$

Figure 5.33: All solutions corresponding to the non ground example of the alldifferent_cst constraint of the **All solutions** slot

Typical

$|\texttt{VARIABLES}| > 2$
range(VARIABLES.var) > 1
$2*$range(VARIABLES.var) $< 3 * |\texttt{VARIABLES}|$
range(VARIABLES.cst) > 1

Symmetries

- Items of VARIABLES are permutable.
- Attributes of VARIABLES are permutable w.r.t. permutation (var, cst) (*permutation not necessarily applied to all items*).
- One and the same constant can be added to the var attribute of all items of VARIABLES.
- One and the same constant can be added to the cst attribute of all items of VARIABLES.

Arg. properties

Contractible wrt. VARIABLES.

Usage

The alldifferent_cst constraint was originally introduced in **CHIP** in order to express the n-queen problem with 3 global constraints (see the **Usage** slot of the alldifferent constraint).

Algorithm

See the filtering algorithms of the alldifferent constraint.

Systems

linear in **Gecode**.

See also

implies (items to collection): lex_alldifferent.

specialisation: alldifferent *(*variable + constant *replaced by* variable*)*.

Keywords

characteristic of a constraint: all different, disequality, sort based reformulation.

constraint type: value constraint.

filtering: bipartite matching, bipartite matching in convex bipartite graphs, convex bipartite graph, arc-consistency.

final graph structure: one_succ.

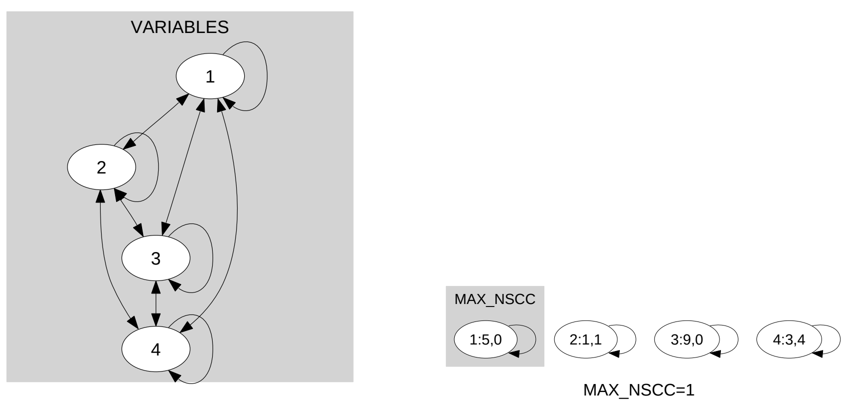
modelling exercises: n-Amazons.

puzzles: n-Amazons, n-queens.

Arc input(s)	`VARIABLES`
Arc generator	*CLIQUE*$\mapsto$`collection(variables1, variables2)`
Arc arity	2
Arc constraint(s)	`variables1.var` + `variables1.cst` = `variables2.var` + `variables2.cst`
Graph property(ies)	**MAX_NSCC** ≤ 1
Graph class	`ONE_SUCC`

Graph model We generate a *clique* with an *equality* constraint between each pair of vertices (including a vertex and itself) and state that the size of the largest strongly connected component should not exceed one.

Parts (A) and (B) of Figure 5.34 respectively show the initial and final graph associated with the **Example** slot. Since we use the **MAX_NSCC** graph property we show one of the largest strongly connected components of the final graph. The `alldifferent_cst` holds since all the strongly connected components have at most one vertex: a value is used at most once.



(A) **(B)**

Figure 5.34: Initial and final graph of the `alldifferent_cst` constraint