5.85 connect_points

DESCRIPTION LINKS GRAPH

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Constraint $\texttt{connect\_points}(\texttt{SIZE1}, \texttt{SIZE2}, \texttt{SIZE3}, \texttt{NGROUP}, \texttt{POINTS})$

Arguments

SIZE1	:	int
SIZE2	:	int
SIZE3	:	int
NGROUP	:	dvar
POINTS	:	collection(p−dvar)

Restrictions

$\texttt{SIZE1} > 0$
$\texttt{SIZE2} > 0$
$\texttt{SIZE3} > 0$
$\texttt{NGROUP} \geq 0$
$\texttt{NGROUP} \leq |\texttt{POINTS}|$
$\texttt{SIZE1} * \texttt{SIZE2} * \texttt{SIZE3} = |\texttt{POINTS}|$
$\texttt{required}(\texttt{POINTS}, \texttt{p})$

Purpose On a 3-dimensional grid of variables, number of groups, where a group consists of a connected set of variables that all have a same value distinct from 0.

Example

$$\left(\begin{array}{c}
\mathtt{p}-0,\mathtt{p}-0,\\
\mathtt{p}-1,\mathtt{p}-1,\\
\mathtt{p}-0,\mathtt{p}-2,\\
\mathtt{p}-0,\mathtt{p}-0,\\
\mathtt{p}-0,\mathtt{p}-0,\\
\mathtt{p}-0,\mathtt{p}-1,\\
\mathtt{p}-0,\mathtt{p}-2,\\
\mathtt{p}-0,\mathtt{p}-0,\\
\mathtt{p}-0,\mathtt{p}-0,\\
\mathtt{p}-0,\mathtt{p}-1,\\
\mathtt{p}-1,\mathtt{p}-1,\\
\mathtt{p}-1,\mathtt{p}-1,\\
\mathtt{p}-0,\mathtt{p}-2,\\
\mathtt{p}-0,\mathtt{p}-1,\\
8,4,2,2,\left\langle\begin{array}{c}\mathtt{p}-0,\mathtt{p}-2,\\ \mathtt{p}-0,\mathtt{p}-0,\\ \mathtt{p}-0,\mathtt{p}-0,\end{array}\right\rangle\\
\mathtt{p}-0,\mathtt{p}-0,\\
\mathtt{p}-0,\mathtt{p}-0,\\
\mathtt{p}-0,\mathtt{p}-0,\\
\mathtt{p}-0,\mathtt{p}-0,\\
\mathtt{p}-0,\mathtt{p}-2,\\
\mathtt{p}-0,\mathtt{p}-0,\\
\mathtt{p}-0,\mathtt{p}-2,\\
\mathtt{p}-2,\mathtt{p}-2,\\
\mathtt{p}-2,\mathtt{p}-2,\\
\mathtt{p}-0,\mathtt{p}-0,\\
\mathtt{p}-0,\mathtt{p}-2,\\
\mathtt{p}-0,\mathtt{p}-0,\\
\mathtt{p}-0,\mathtt{p}-2,\\
\mathtt{p}-0,\mathtt{p}-0
\end{array}\right)$$

Figure 5.212 corresponds to the solution where we describe separately each layer of the grid. The `connect_points` constraint holds since we have two groups (`NGROUP` $= 2$): a first one for the variables of the `POINTS` collection assigned to value 1, and a second one for the variables assigned to value 2.

0	0	**1**	**1**	0	**2**	0	0
0	0	0	**1**	0	**2**	0	0
0	0	0	**1**	**1**	**1**	**1**	**1**
0	**2**	0	**1**	0	**2**	0	0

0	0	0	0	0	0	0	0
0	0	0	0	0	**2**	0	0
0	**2**	**2**	**2**	**2**	**2**	0	0
0	**2**	0	0	0	**2**	0	0

Figure 5.212: The two layers of the solution

Typical

SIZE1 > 1
SIZE2 > 1
NGROUP > 0
NGROUP $<$ |POINTS|
|POINTS| > 3

Symmetry

All occurrences of two distinct values of POINTS.p that are both different from 0 can be swapped; all occurrences of a value of POINTS.p that is different from 0 can be renamed to any unused value that is also different from 0.

Arg. properties

Functional dependency: NGROUP determined by SIZE1, SIZE2, SIZE3 and POINTS.

Usage

Wiring problems [382], [450].

Algorithm

Since the graph corresponding to the 3-dimensional grid is symmetric one could certainly use as a starting point the filtering algorithm associated with the *number of connected components* graph property described in [52] (see the paragraphs "*Estimating* NCC" and "*Estimating* NCC"). One may also try to take advantage of the fact that the considered initial graph is a grid in order to simplify the previous filtering algorithm.

Keywords

characteristic of a constraint: joker value.

final graph structure: strongly connected component, symmetric.

geometry: geometrical constraint.

modelling: functional dependency.

problems: channel routing.

Arc input(s)	POINTS
Arc generator	$GRID$([SIZE1, SIZE2, SIZE3]) $\mapsto$ collection(points1, points2)
Arc arity	2
Arc constraint(s)	• points1.p $\neq 0$ • points1.p = points2.p
Graph property(ies)	**NSCC** = NGROUP
Graph class	SYMMETRIC

Graph model Figure 5.213 gives the initial graph constructed by the $GRID$ arc generator associated with the **Example** slot.

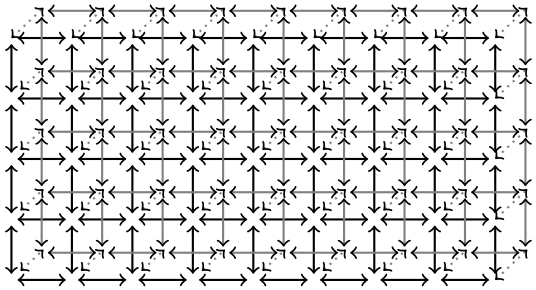

Figure 5.213: Graph generated by $GRID$([8,4,2])