5.68 circular_change

DESCRIPTION LINKS GRAPH AUTOMATON

Origin Derived from change.

Constraint circular_change(NCHANGE, VARIABLES, CTR)

Arguments

NCHANGE	:	dvar
VARIABLES	:	collection(var−dvar)
CTR	:	atom

Restrictions

NCHANGE ≥ 0
NCHANGE $\leq |$VARIABLES$|$
required(VARIABLES, var)
CTR $\in [=, \neq, <, \geq, >, \leq]$

Purpose NCHANGE is the number of times that CTR holds on consecutive variables of the collection VARIABLES. The last and the first variables of the collection VARIABLES are also considered to be consecutive.

Example $(4, \langle 4, 4, 3, 4, 1\rangle, \neq)$

In the example the changes within the VARIABLES $= \langle 4, 4, 3, 4, 1\rangle$ collection are located between values 4 and 3, 3 and 4, 4 and 1, and 1 and 4 (i.e., since the third argument CTR of the circular_change constraint is set to $\neq$, we count one change for each disequality constraint between two consecutive variables that holds). Consequently, the corresponding circular_change constraint holds since its first argument NCHANGE is fixed to 4.

Typical

NCHANGE > 0
$|$VARIABLES$| > 1$
range(VARIABLES.var) > 1
CTR $\in [\neq]$

Symmetries

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

Arg. properties

Functional dependency: NCHANGE determined by VARIABLES and CTR.

See also **common keyword:** change (*number of changes*).

Keywords

characteristic of a constraint: cyclic, automaton, automaton with counters.
constraint arguments: pure functional dependency.
constraint network structure: circular sliding cyclic(1) constraint network(2).
constraint type: timetabling constraint.
modelling: number of changes, functional dependency.

Arc input(s)	VARIABLES
Arc generator	$CIRCUIT \mapsto$ collection(variables1, variables2)
Arc arity	2
Arc constraint(s)	variables1.var CTR variables2.var
Graph property(ies)	**NARC**= NCHANGE

Graph model Since we are also interested in the constraint that links the last and the first variable we use the arc generator *CIRCUIT* to produce the arcs of the initial graph.

Parts (A) and (B) of Figure 5.168 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.

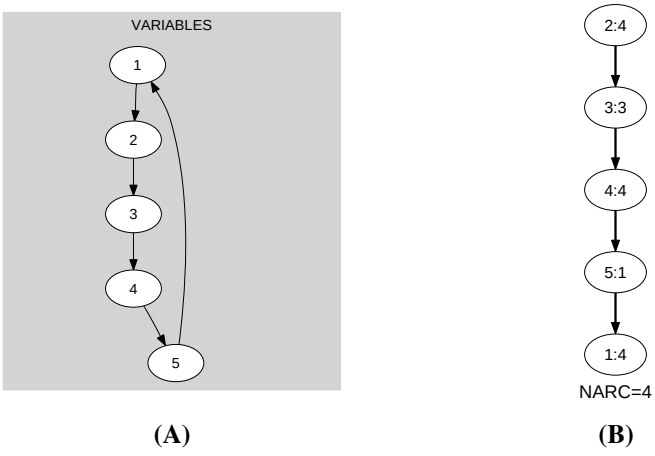

Figure 5.168: Initial and final graph of the circular_change constraint

Automaton

Figure 5.169 depicts the automaton associated with the `circular_change` constraint. To each pair of consecutive variables $(\texttt{VAR}_i, \texttt{VAR}_{(i \bmod |\texttt{VARIABLES}|)+1})$ of the collection VARIABLES corresponds a 0-1 signature variable S_i. The following signature constraint links $\texttt{VAR}_i$, $\texttt{VAR}_{(i \bmod |\texttt{VARIABLES}|)+1}$ and S_i: $\texttt{VAR}_i$ CTR $\texttt{VAR}_{(i \bmod |\texttt{VARIABLES}|)+1} \Leftrightarrow S_i$.

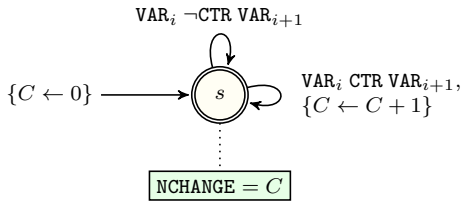

Figure 5.169: Automaton of the `circular_change` constraint

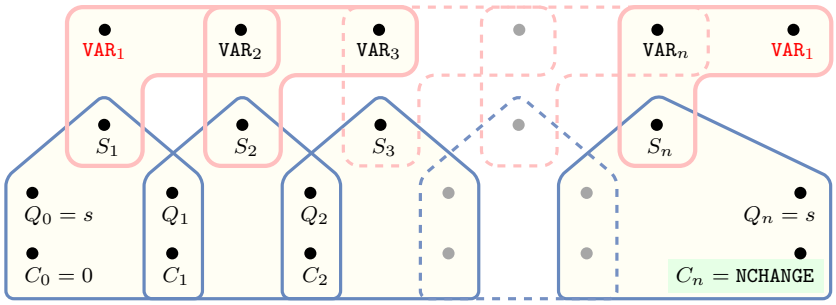

Figure 5.170: Hypergraph of the reformulation corresponding to the automaton of the `circular_change` constraint