5.200 inverse_offset

DESCRIPTION LINKS GRAPH

Origin Gecode

Constraint inverse_offset(SOFFSET, POFFSET, NODES)

Synonym channel.

Arguments

SOFFSET	:	int
POFFSET	:	int
NODES	:	collection(index−int, succ−dvar, pred−dvar)

Restrictions

required(NODES, [index, succ, pred])
NODES.index ≥ 1
NODES.index $\leq$ |NODES|
distinct(NODES, index)
NODES.succ $\geq 1 +$ SOFFSET
NODES.succ $\leq$ |NODES| + SOFFSET
NODES.pred $\geq 1 +$ POFFSET
NODES.pred $\leq$ |NODES| + POFFSET

Purpose

Enforce each vertex of a digraph to have exactly one predecessor and one successor. In addition the following two statements are equivalent:

1. The successor of the i^{th} node minus **SOFFSET** is equal to j.
2. The predecessor of the j^{th} node minus **POFFSET** is equal to i.

I.e., NODES$[i]$.succ $-$ **SOFFSET** $= j \Leftrightarrow$ NODES$[j]$.pred $-$ **POFFSET** $= i$.

Example

$$\left(\begin{array}{c} -1, 0, \left\langle \begin{array}{lll} \texttt{index}-1 & \texttt{succ}-4 & \texttt{pred}-3, \\ \texttt{index}-2 & \texttt{succ}-2 & \texttt{pred}-5, \\ \texttt{index}-3 & \texttt{succ}-0 & \texttt{pred}-2, \\ \texttt{index}-4 & \texttt{succ}-6 & \texttt{pred}-8, \\ \texttt{index}-5 & \texttt{succ}-1 & \texttt{pred}-1, \\ \texttt{index}-6 & \texttt{succ}-7 & \texttt{pred}-7, \\ \texttt{index}-7 & \texttt{succ}-5 & \texttt{pred}-4, \\ \texttt{index}-8 & \texttt{succ}-3 & \texttt{pred}-6 \end{array} \right\rangle \end{array}\right)$$

The inverse_offset constraint holds since:

- NODES$[1]$.succ $-(-1) = 5 \Leftrightarrow$ NODES$[5]$.pred $- 0 = 1$,
- NODES$[2]$.succ $-(-1) = 3 \Leftrightarrow$ NODES$[3]$.pred $- 0 = 2$,
- NODES$[3]$.succ $-(-1) = 1 \Leftrightarrow$ NODES$[1]$.pred $- 0 = 3$,
- NODES$[4]$.succ $-(-1) = 7 \Leftrightarrow$ NODES$[7]$.pred $- 0 = 4$,
- NODES$[5]$.succ $-(-1) = 2 \Leftrightarrow$ NODES$[2]$.pred $- 0 = 5$.

- NODES[6].succ $-(-1) = 8 \Leftrightarrow$ NODES[8].pred $- 0 = 6$.
- NODES[7].succ $-(-1) = 6 \Leftrightarrow$ NODES[6].pred $- 0 = 7$.
- NODES[8].succ $-(-1) = 4 \Leftrightarrow$ NODES[4].pred $- 0 = 8$.

Figure 5.448 shows the board that can be associated with this example.

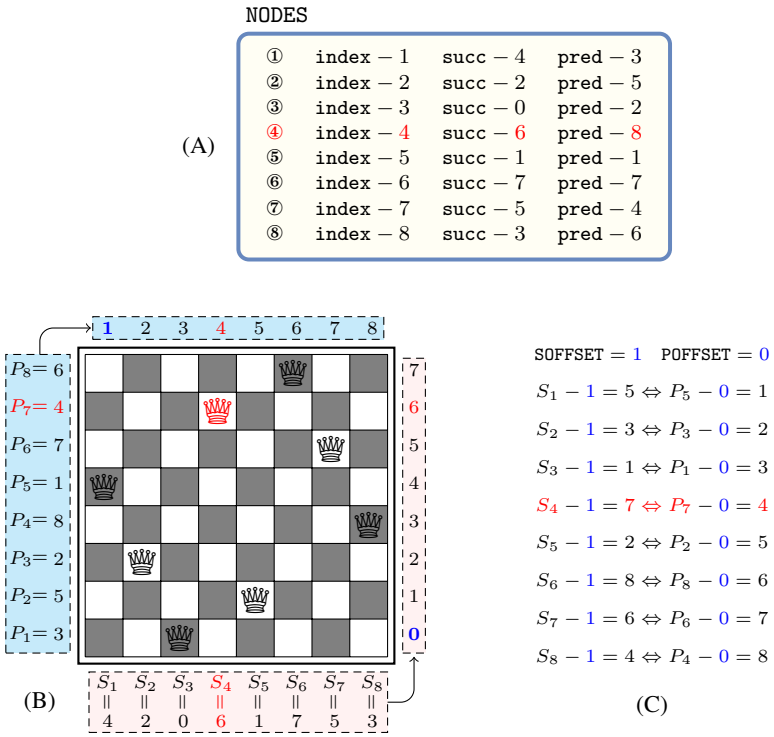

Figure 5.448: **Example** slot where we highlight the fourth item in red showing the relation between S_4 and P_7, where S_i and P_i (with $1 \leq i \leq 8$) respectively stands for the successor and predecessor attributes of the i^{th} item of the NODES collection (A) Collection of nodes passed to the `inverse_offset` constraint, (B) Corresponding board, (C) Conditions linking the successor and the predecessor attributes via the offsets SOFFSET $= 1$ and POFFSET $= 0$.

Typical

SOFFSET ≥ -1
SOFFSET ≤ 1
POFFSET ≥ -1
POFFSET ≤ 1
$|$NODES$| > 1$

Symmetry

Items of NODES are permutable.

Arg. properties

- Functional dependency: NODES.succ determined by SOFFSET, POFFSET, NODES.index and NODES.pred.
- Functional dependency: NODES.pred determined by SOFFSET, POFFSET, NODES.index and NODES.succ.

Remark The inverse_offset constraint is called channel in **Gecode** (http://www.gecode.org/). Having two offsets was motivated by the fact that it is possible to declare arrays at any position in the **MiniZinc** modelling language.

Systems inverseChanneling in **Choco**, channel in **Gecode**.

See also **specialisation:** inverse *(assume that* SOFFSET *and* POFFSET *are both equal to* 0*)*.

Keywords **constraint arguments:** pure functional dependency.

constraint type: graph constraint.

filtering: arc-consistency.

heuristics: heuristics.

modelling: channelling constraint, dual model, functional dependency.

Arc input(s)	NODES
Arc generator	$CLIQUE \mapsto$ collection(nodes1, nodes2)
Arc arity	2
Arc constraint(s)	• nodes1.succ − SOFFSET = nodes2.index • nodes2.pred − POFFSET = nodes1.index
Graph property(ies)	**NARC**= |NODES|

Graph model In order to express the binary constraint that links two vertices one has to make explicit the identifier of the vertices. This is why the inverse_offset constraint considers objects that have three attributes:

- One fixed attribute index that is the identifier of the vertex,
- One variable attribute succ that is the successor of the vertex,
- One variable attribute pred that is the predecessor of the vertex.

Parts (A) and (B) of Figure 5.449 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.

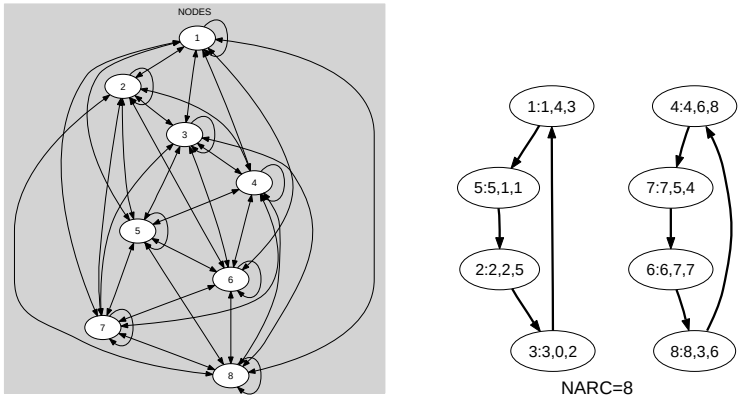

Figure 5.449: Initial and final graph of the inverse_offset constraint