## 5.56 bipartite

DESCRIPTION LINKS GRAPH

**Origin** [142]

**Constraint** bipartite(NODES)

**Argument** NODES : collection(index−int, succ−svar)

**Restrictions**
required(NODES, [index, succ])
NODES.index ≥ 1
NODES.index ≤ |NODES|
distinct(NODES, index)
NODES.succ ≥ 1
NODES.succ ≤ |NODES|

**Purpose** Consider a digraph $G$ described by the NODES collection. Select a subset of arcs of $G$ so that the corresponding graph is symmetric (i.e., if there is an arc from $i$ to $j$, there is also an arc from $j$ to $i$) and bipartite (i.e., there is no cycle involving an odd number of vertices).

**Example**

$$\left\langle \begin{array}{ll} \texttt{index} - 1 & \texttt{succ} - \{2,3\}, \\ \texttt{index} - 2 & \texttt{succ} - \{1,4\}, \\ \texttt{index} - 3 & \texttt{succ} - \{1,4,5\}, \\ \texttt{index} - 4 & \texttt{succ} - \{2,3,6\}, \\ \texttt{index} - 5 & \texttt{succ} - \{3,6\}, \\ \texttt{index} - 6 & \texttt{succ} - \{4,5\} \end{array} \right\rangle$$

The bipartite constraint holds since the NODES collection depicts a symmetric graph with no cycle involving an odd number of vertices. The corresponding graph is depicted by Figure 5.127.

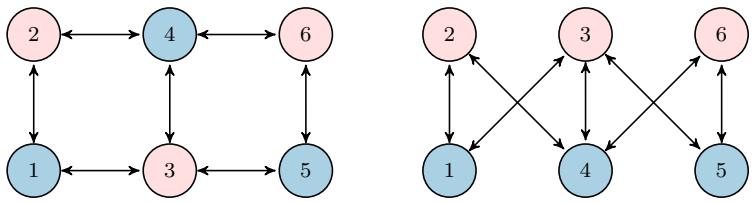


Figure 5.127: Two ways of looking at the bipartite graph given in the **Example** slot

**Typical** |NODES| > 2

**Symmetry** Items of NODES are permutable.

**Algorithm** The sketch of a filtering algorithm for the `bipartite` constraint is given in [142, page 91]. Beside enforcing the fact that the graph is symmetric, it checks that the subset of mandatory vertices and arcs is bipartite and removes all potential arcs that would make the previous graph non-bipartite.

**See also** **used in graph description:** `in_set`.

**Keywords** **constraint arguments:** constraint involving set variables.

**constraint type:** graph constraint.

**filtering:** DFS-bottleneck.

**final graph structure:** bipartite, symmetric.

| | |
|---|---|
| **Arc input(s)** | NODES |
| **Arc generator** | $CLIQUE \mapsto$ collection(nodes1, nodes2) |
| **Arc arity** | 2 |
| **Arc constraint(s)** | in_set(nodes2.index, nodes1.succ) |
| **Graph class** | • SYMMETRIC<br>• BIPARTITE |

**Graph model** Part (A) of Figure 5.128 shows the initial graph from which we start. It is derived from the set associated with each vertex. Each set describes the potential values of the succ attribute of a given vertex. Part (B) of Figure 5.128 gives the final graph associated with the **Example** slot.

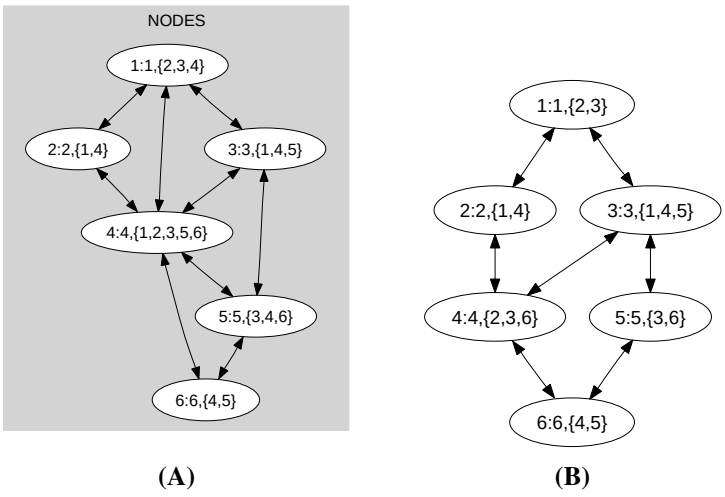


Figure 5.128: Initial and final graph of the bipartite set constraint