

## 5.2 all\_differ\_from\_at\_least\_k\_pos

|                     | DESCRIPTION   | LINKS | GRAPH |
|---------------------|---|-------|-------|
| <b>Origin</b>       | Inspired by [157].  |       |       |
| <b>Constraint</b>   | <code>all_differ_from_at_least_k_pos(K, VECTORS)</code>   |       |       |
| <b>Type</b>         | VECTOR : <code>collection</code> (var-dvar)   |       |       |
| <b>Arguments</b>    | K : <code>int</code><br>VECTORS : <code>collection</code> (vec - VECTOR)  |       |       |
| <b>Restrictions</b> | <code>required</code> (VECTOR, var)<br>$K \geq 0$<br><code>required</code> (VECTORS, vec)<br><code>same_size</code> (VECTORS, vec)  |       |       |
| <b>Purpose</b>      | Enforce all pairs of distinct vectors of the VECTORS collection to differ from at least K positions.  |       |       |
| <b>Example</b>      | $\left( 2, \left\langle \begin{array}{l} \text{vec} - \langle 2, 5, 2, 0 \rangle, \\ \text{vec} - \langle 3, 6, 2, 1 \rangle, \\ \text{vec} - \langle 3, 6, 1, 0 \rangle \end{array} \right\rangle \right)$ <p>The <code>all_differ_from_at_least_k_pos</code> constraint holds since:</p> <ul style="list-style-type: none"> <li>• The first and second vectors differ from 3 positions, which is greater than or equal to <math>K = 2</math>.</li> <li>• The first and third vectors differ from 3 positions, which is greater than or equal to <math>K = 2</math>.</li> <li>• The second and third vectors differ from 2 positions, which is greater than or equal to <math>K = 2</math>.</li> </ul> |       |       |
| <b>Typical</b>      | $K > 0$<br>$ \text{VECTORS}  > 1$   |       |       |
| <b>Symmetries</b>   | <ul style="list-style-type: none"> <li>• Items of VECTORS are <code>permutable</code>.</li> <li>• Items of VECTORS.vec are <code>permutable</code> (<i>same permutation used</i>).</li> </ul>   |       |       |
| <b>See also</b>     | <p><b>part of system of constraints:</b> <code>differ_from_at_least_k_pos</code>.</p> <p><b>used in graph description:</b> <code>differ_from_at_least_k_pos</code>.</p>   |       |       |
| <b>Keywords</b>     | <p><b>application area:</b> bioinformatics.</p> <p><b>characteristic of a constraint:</b> disequality, vector.</p> <p><b>constraint type:</b> system of constraints, decomposition.</p> <p><b>final graph structure:</b> no loop, symmetric.</p>  |       |       |

|                            |   |
|----------------------------|---|
| <b>Arc input(s)</b>        | VECTORS   |
| <b>Arc generator</b>       | $CLIQUE(\neq) \mapsto \text{collection}(\text{vectors1}, \text{vectors2})$            |
| <b>Arc arity</b>           | 2   |
| <b>Arc constraint(s)</b>   | $\text{differ\_from\_at\_least\_k\_pos}(K, \text{vectors1.vec}, \text{vectors2.vec})$ |
| <b>Graph property(ies)</b> | $NARC =  \text{VECTORS}  *  \text{VECTORS}  -  \text{VECTORS} $                       |
| <b>Graph class</b>         | <ul style="list-style-type: none"> <li>• NO_LOOP</li> <li>• SYMMETRIC</li> </ul>      |

**Graph model**

The **Arc constraint(s)** slot uses the `differ_from_at_least_k_pos` constraint defined in this catalogue.

Parts (A) and (B) of Figure 5.1 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. The previous constraint holds since exactly  $3 \cdot (3 - 1) = 6$  arc constraints hold.

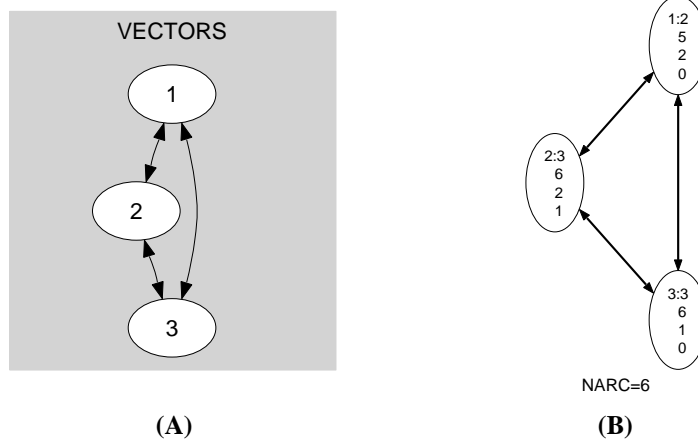


Figure 5.1: Initial and final graph of the `all_differ_from_at_least_k_pos` constraint

**Signature**

Since we use the `CLIQUE( $\neq$ )` arc generator on the items of the `VECTORS` collection, the expression  $|\text{VECTORS}| \cdot |\text{VECTORS}| - |\text{VECTORS}|$  corresponds to the maximum number of arcs of the final graph. Therefore we can rewrite the graph property  $NARC = |\text{VECTORS}| \cdot |\text{VECTORS}| - |\text{VECTORS}|$  to  $NARC \geq |\text{VECTORS}| \cdot |\text{VECTORS}| - |\text{VECTORS}|$ . This leads to simplify  $\underline{NARC}$  to  $\overline{NARC}$ .