5.54 bin_packing_capa

DESCRIPTION LINKS

Origin

Derived from `bin_packing`.

Constraint

$\texttt{bin\_packing\_capa}(\texttt{BINS}, \texttt{ITEMS})$

Arguments

$$\begin{array}{lll}\texttt{BINS} & : & \texttt{collection}(\texttt{id}-\texttt{int}, \texttt{capa}-\texttt{int})\\ \texttt{ITEMS} & : & \texttt{collection}(\texttt{bin}-\texttt{dvar}, \texttt{weight}-\texttt{int})\end{array}$$

Restrictions

$|\texttt{BINS}| > 0$
$\texttt{required}(\texttt{BINS}, [\texttt{id}, \texttt{capa}])$
$\texttt{distinct}(\texttt{BINS}, \texttt{id})$
$\texttt{BINS.id} \geq 1$
$\texttt{BINS.id} \leq |\texttt{BINS}|$
$\texttt{BINS.capa} \geq 0$
$\texttt{required}(\texttt{ITEMS}, [\texttt{bin}, \texttt{weight}])$
$\texttt{in\_attr}(\texttt{ITEMS}, \texttt{bin}, \texttt{BINS}, \texttt{id})$
$\texttt{ITEMS.weight} \geq 0$

Purpose

Given several items of the collection ITEMS (each of them having a specific weight), and different bins described the the items of collection BINS (each of them having a specific capacity capa), assign each item to a bin so that the total weight of the items in each bin does not exceed the capacity of the bin.

Example

$$\left(\begin{array}{l}\left\langle\begin{array}{ll}\texttt{id}-1 & \texttt{capa}-4,\\ \texttt{id}-2 & \texttt{capa}-3,\\ \texttt{id}-3 & \texttt{capa}-5,\\ \texttt{id}-4 & \texttt{capa}-3,\\ \texttt{id}-5 & \texttt{capa}-3\end{array}\right\rangle,\\ \left\langle\begin{array}{ll}\texttt{bin}-3 & \texttt{weight}-4,\\ \texttt{bin}-1 & \texttt{weight}-3,\\ \texttt{bin}-3 & \texttt{weight}-1\end{array}\right\rangle\end{array}\right)$$

The `bin_packing_capa` constraint holds since the sum of the height of items that are assigned to bins 1 and 3 is respectively equal to 3 and 5. The previous quantities are respectively less than or equal to the maximum capacities 4 and 5 of bins 1 and 3. Figure 5.140 shows the solution associated with the example.

Typical

$|\texttt{BINS}| > 1$
$\texttt{range}(\texttt{BINS.capa}) > 1$
$\texttt{BINS.capa} > \texttt{maxval}(\texttt{ITEMS.weight})$
$\texttt{BINS.capa} \leq \texttt{sum}(\texttt{ITEMS.weight})$
$|\texttt{ITEMS}| > 1$
$\texttt{range}(\texttt{ITEMS.bin}) > 1$
$\texttt{range}(\texttt{ITEMS.weight}) > 1$
$\texttt{ITEMS.weight} > 0$

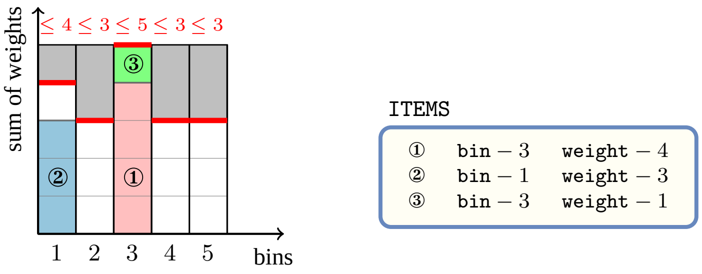

Figure 5.140: Bin-packing solution to the **Example** slot

Symmetries

- Items of BINS are permutable.
- Items of ITEMS are permutable.
- BINS.capa can be increased.
- ITEMS.weight can be decreased to any value ≥ 0.
- All occurrences of two distinct values in BINS.id or ITEMS.bin can be swapped; all occurrences of a value in BINS.id or ITEMS.bin can be renamed to any unused value.

Arg. properties

Contractible wrt. ITEMS.

Remark

In **MiniZinc** (http://www.minizinc.org/) there is also a constraint called bin_packing_load which, for each bin has a domain variable that is equal to the sum of the weights assigned to the corresponding bin.

Systems

pack in **Choco**, binpacking in **Gecode**, bin_packing_capa in **MiniZinc**.

See also

generalisation: indexed_sum *(negative contribution also allowed)*.

specialisation: bin_packing *(non-fixed capacity replaced by fixed overall capacity)*.

Keywords

application area: assignment.

constraint type: predefined constraint, resource constraint.

modelling: assignment dimension, assignment to the same set of values.

modelling exercises: assignment to the same set of values.