5.343 scalar_product

DESCRIPTION LINKS

Origin Arithmetic constraint.

Constraint scalar_product(LINEARTERM, CTR, VAL)

Synonyms equation, linear, sum_weight, weightedSum.

Arguments

LINEARTERM	:	collection(coeff−int, var−dvar)
CTR	:	atom
VAL	:	dvar

Restrictions

required(LINEARTERM, [coeff, var])
CTR $\in [=, \neq, <, \geq, >, \leq]$

Purpose Constraint a linear term defined as the sum of products of coefficients and variables. More precisely, let S denote the sum of the product between a coefficient and its variable of the different items of the LINEARTERM collection. Enforce the following constraint to hold: S CTR VAL.

Example $\left(\langle \texttt{coeff} - 1\ \texttt{var} - 1, \texttt{coeff} - 3\ \texttt{var} - 1, \texttt{coeff} - 1\ \texttt{var} - 4 \rangle, =, 8 \right)$

The scalar_product constraint holds since the condition $1 \cdot 1 + 3 \cdot 1 + 1 \cdot 4 = 8$ is satisfied.

Typical

$|\texttt{LINEARTERM}| > 1$
$\texttt{range}(\texttt{LINEARTERM.coeff}) > 1$
$\texttt{range}(\texttt{LINEARTERM.var}) > 1$
$\texttt{CTR} \in [=, <, \geq, >, \leq]$

Symmetries

- Items of LINEARTERM are permutable.
- Attributes of LINEARTERM are permutable w.r.t. permutation (coeff, var) (*permutation not necessarily applied to all items*).

Arg. properties

- Contractible wrt. LINEARTERM when CTR $\in [<, \leq]$, minval(LINEARTERM.coeff) ≥ 0 and minval(LINEARTERM.var) ≥ 0.
- Extensible wrt. LINEARTERM when CTR $\in [\geq, >]$, minval(LINEARTERM.coeff) ≥ 0 and minval(LINEARTERM.var) ≥ 0.
- Aggregate: LINEARTERM(union), CTR(id), VAL(+).

Remark The scalar_product constraint is called linear in **Gecode** (http://www.gecode.org/). It is called sum_weight in **JaCoP** (http://www.jacop.eu/). In the 2008 CSP solver competition the scalar_product constraint was called weightedSum and required VAL to be fixed.

Algorithm Most filtering algorithms first merge multiple occurrences of identical variables in order to potentially make more deductions. When `CTR` corresponds to the *less than or equal to* constraint, a filtering algorithm achieving bound-consistency for the `scalar_product` constraint with large numbers of variables is described in [203].

Systems `equation` in **Choco**, `linear` in **Gecode**, `sumweight` in **JaCoP**, `scalar_product` in **SICStus**.

See also **specialisation:** `sum_ctr` *(arithmetic constraint where all coefficients are equal to* 1*)*.

Keywords **characteristic of a constraint:** sum.

constraint type: predefined constraint, arithmetic constraint.

filtering: duplicated variables.