5.342   scalar_product

<p align="center">DESCRIPTION   LINKS</p>

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.