

linear decision

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The *linear decision* command solves predicates in linear arithmetic. Any predicate comprising only first-order logical connectives (\Leftrightarrow , \Rightarrow , \wedge , \vee , \bigvee , \neg), the predicates *true* and *false*, quantifiers provided that when the predicate is put into prenex normal form (quantifiers outermost) it does not use a mixture of both universal quantifiers and existential quantifiers, the arithmetic ordering relations ($<$, \leq , $=$, \geq , $>$), simple membership predicates to give information as to whether a variable is constrained to be a known numeric set (\mathbb{Z} , \mathbb{N} , \mathbb{N}_1 , \mathbb{Q} , \mathbb{Q}_+ , \mathbb{R} , but not \mathbb{A}), the arithmetic functions ($+$, $-$, $*$ by a constant, division by a constant), the if-then-else construct, numeric literals, and arithmetic variables bound by the quantifiers, is a linear arithmetic predicate. Linear arithmetic predicates can be decided by the *linear decision* command: it replaces each by either *true* or *false*.

All the numeric functions and relations used must have been declared in the *prelude*, or in sections called *numkit* or *numdefs* or *toolkit*.

For example, the *linear decision* command can decide the following predicate.

$$\forall x : \mathbb{Z} \mid \neg x = 0 \bullet x \in \mathbb{N}_1 \wedge x - 1 \in \mathbb{N} \wedge 2 * x > x$$

The algorithm implemented is Bledsoe's SUP-INF method with Shostak's improved method. See

- (1) Bledsoe W.W The SUP-INF method in Presburger arithmetic. Memo ATP-18, Math. Dept., U of Texas at Austin, Austin, Tex., Dec. 1974

and

(2) Shostak R.E. On the SUP-INF Method for Proving Presburger Formulas
JACM Vol 24 No 4 October 1977 pp 529-543.

See also the *linear solution* command.

1. Tactic example

“linear decision” p_1 p_2

This example applies the *linear decision* command to predicates p_1 and p_2 .

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