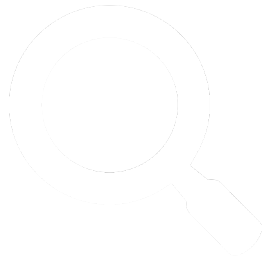


Theory of Answer Set Programming


Definite/Positive Programs in the
Language of clingo Allowing Intervals

Objective



Objective

Represent definite and positive programs allowing intervals in the language of clingo



Positive Programs in the Language of Clingo (Allowing Intervals)

Terms in Clingo Language [Allowing Intervals]

The input language of Clingo allows the notion of **terms**

Terms that do not contain variable are called **ground**.

Terms in Clingo language are

- Integers, symbolic constants (representing specific objects), and variables
 - 1, 2, 3, a, b, X
- $t_1 \circ t_2$ where \circ is an arithmetic operation, and t_1, t_2 are terms
 - 3 * 4, 3+4, 3**X
- $|t|$ where t is a term
 - |-3|
- $t_1..t_2$ where t_1, t_2 are terms
 - 1..10

Values of Ground Terms [Allowing Intervals]

| The set of values of a ground term is defined recursively.

- If t is an integer or a symbolic constant then the only value of t is t itself.
- If t is $t_1 \circ t_2$, where \circ is an arithmetic operation, then the values of t are integers $n_1 \circ n_2$, where the integer n_1 is a value of t_1 , and the integer n_2 is a value of t_2 .
- If t is $|t_1|$ then the values of t are integers of the form $|n_1|$, where the integer n_1 is a value of t_1 .
- If t is $t_1 .. t_2$ then the values of t are the integers n for which there exist integers n_1 and n_2 such that

- n_1 is a value of t_1 and n_2 is a value of t_2 ,

$1..10$ $\{1, 2, 3, \dots, 10\}$

- $\underline{n_1} \leq n \leq \underline{n_2}$.

$1..10 + 4$ $\{2, 3, \dots, 14\}$

Example

Term	Values
$2*2$	$\{4\}$
$2/0$	\emptyset
$2*a$	\emptyset
$\underbrace{(2..4)}_{\{2,3,4\}} * \underbrace{(2..4)}_{\{2,3,4\}}$	$\{4, 6, 8, 9, 12, 16\}$
$\underbrace{6..5}$	\emptyset
$a..(a+1)$	\emptyset
$2**(-2)$	$\{\}$

Q: Find a ground term with values 1, 3, 9.

$3**(0..2)$

Propositional Image of Head and Body Expressions

Expression	Propositional Image
atom $p(t_1, \dots, t_k)$ in the <u>head</u>	<u>conjunction</u> of all formulas of the form $p(v_1, \dots, v_k)$ where v_i is a value of t_i ($i=1, \dots, k$)
atom $p(t_1, \dots, t_k)$ in the <u>body</u>	<u>disjunction</u> of all formulas of the form $p(v_1, \dots, v_k)$ where v_i is a value of t_i ($i=1, \dots, k$)
Comparison $t_1 < t_2$ in the <u>head</u>	\perp if for every value v_1 of t_1 and every value v_2 of t_2 , $v_1 < v_2$; \perp otherwise
Comparison $t_1 < t_2$ in the <u>body</u>	\top if for <u>some</u> value v_1 of t_1 and <u>some</u> value v_2 of t_2 , $v_1 < v_2$; \perp otherwise

$1 < 2 \quad \top$

– $p(\overset{t_1}{\boxed{1..2}})$ in the head 31.24

$p(1) \wedge p(2)$

– $p(1..2)$ in the body

$p(1) \vee p(2)$

– $\overset{31.23}{\boxed{1..2}} = \overset{32.35}{\boxed{2..3}}$ in the head

$1=2 \quad \underline{2=2} \quad 1=3 \quad 2=3 \rightarrow \perp$

– $\underline{1..2} = \underline{2..3}$ in the body

$\rightarrow \top$

Propositional Image of Clingo Programs: Definition [Allowing Intervals]

The **propositional image** of a Clingo program consists of the instances of its rules rewritten as propositional formulas.

To rewrite a ground rule as a formula,

- | replace the symbol :- and all commas in the head and the body by propositional connectives as in the table shown;
- | **replace each of the expressions in the head in the body by its propositional image as in the previous slide**
- | replace the head of the rule by \perp if it is empty, and replace the body by T if it is empty.

Propositional image of

| square(1..2, 1..2)
 $\{1, 2\}$ $\{1, 2\}$

$$sg(1, 1) \wedge sg(1, 2) \wedge sg(2, 1) \wedge sg(2, 2)$$

| p(1..3).

$$p(1) \wedge p(2) \wedge p(3)$$

x = 1 :- p(x).

$$T \leftarrow p(1) \vee$$

$$\perp \leftarrow p(v) \text{ for all } v \in SU\mathbb{Z} \setminus \{1\}$$

| p(1), p(2), p(3).

$$p(1) \vee p(2) \vee p(3)$$

:- p(x), x > 2.

$$\perp \leftarrow p(v) \wedge T$$

$$\perp \leftarrow p(v) \wedge \perp$$

$$v > 2 \text{ and } v \in SU\mathbb{Z}$$

$$\text{for all other } v$$

Lecture Wrap-Up

