

# Termination analysis of first order programs

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# Overview

# The syntax of $\Delta$

```
<program> ::= <clause>+ <expression>
<expression> ::= <element> ( '.' <expression> ) ?
<element> ::= '0' | '(' <element> ')' | <name> | <application>
<application> ::= <name> <expression>*
<clause> ::= <name> <pattern>* ':' <expression> ';'
<pattern> ::= <pattern-element> ( '.' <pattern> ) ?
<pattern-element> ::= '0' | '_' | '(' <pattern> ')' | <name>
<name> ::= ['a'-'z'] ( ['-','a'-'z']* ['a'-'z'] ) ?
```

(14)

# Symbols

Description	Instance	Finite list	Space
Expression	$x$	$X$	$\mathbb{X}$
Element (of an expression)	$e$	$E$	$\mathbb{E}$
Function	$f$	$F$	$\mathbb{F}$
Clause	$c$	$C$	$\mathbb{C}$
Pattern	$p$	$P$	$\mathbb{P}$
Value (think “binary”)	$b$	$B$	$\mathbb{B}$
Name (think “variable”)	$v$	$V$	$\mathbb{V}$
Program ( $p$ was taken)	$r$	$R$	$\mathbb{R}$

(15)

# The syntax of $\Delta$

$\langle \text{program} \rangle ::= \langle \text{clause} \rangle^+ \langle \text{expression} \rangle$	
$\langle \text{expression} \rangle ::= \langle \text{element} \rangle ( \text{'.'} \langle \text{expression} \rangle ) ?$	$x$
$\langle \text{element} \rangle ::= \text{'0'} \mid \text{'('} \langle \text{element} \rangle \text{'})' \mid \langle \text{name} \rangle \mid \langle \text{application} \rangle$	$e$
$\langle \text{application} \rangle ::= \langle \text{name} \rangle \langle \text{expression} \rangle^*$	$\langle v, X \rangle$
$\langle \text{clause} \rangle ::= \langle \text{name} \rangle \langle \text{pattern} \rangle^* \text{' := ' } \langle \text{expression} \rangle \text{' ; '}$	$c = \langle v, P, x \rangle$
$\langle \text{pattern} \rangle ::= \langle \text{pattern-element} \rangle ( \text{'.'} \langle \text{pattern} \rangle ) ?$	$p$
$\langle \text{pattern-element} \rangle ::= \text{'0'} \mid \text{'_'} \mid \text{'('} \langle \text{pattern} \rangle \text{'})' \mid \langle \text{name} \rangle$	$p$
$\langle \text{name} \rangle ::= [ \text{'a'} - \text{'z'} ] ( [ \text{'-' } \text{'a'} - \text{'z'} ]^* [ \text{'a'} - \text{'z'} ] ) ?$	$v$

(14)

# Functions in $\Delta$

$$f = \langle v, C \rangle \quad \text{s.t.} \quad \forall \langle v_1, P_1, \_ \rangle, \langle v_2, P_2, \_ \rangle \in C \ (v_1 = v_2 = v) \wedge (|P_1| = |P_2|)$$

Pattern matching is ensured **exhaustive** at compile time.

$$\forall b \in \mathbb{B} \ \exists c \in C \ c \succ b$$