

Todo list

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1 Typing Rules

1.1 Literal

1. Integers:

$$\frac{i : \text{Integer}}{\text{Integer}[i] : \text{Literal Integer}} \quad (1)$$

2. Strings (Text):

$$\frac{s : \text{String}}{\text{Str}[s] : \text{Literal String}} \quad (2)$$

3. Real numbers:

$$\frac{d : \text{Double}}{\text{Dbl}[d] : \text{Literal Real}} \quad (3)$$

4. Whole numbered reals ($\mathbb{Z} \subset \mathbb{R}$):

$$\frac{d : \text{Integer}}{\text{ExactDbl}[d] : \text{Literal Real}} \quad (4)$$

5. Percentages:

$$\frac{n : \text{Integer} \quad d : \text{Integer}}{\text{Perc}[n, d] : \text{Literal Real}} \quad (5)$$

1.2 Miscellaneous

1. Completeness:

$$\overline{\text{Complete}[]} : \text{Completeness} \quad (6)$$

$$\overline{\text{Incomplete}[]} : \text{Completeness} \quad (7)$$

2. AssocOp:

- (a) Numerics:

$$\frac{x : \text{Numerics}(T)}{\text{Add}[] : \text{AssocOp } x} \quad (8)$$

$$\frac{x : \text{Numerics}(T)}{\text{Mul}[] : \text{AssocOp } x} \quad (9)$$

(b) Bool:

$$\overline{And[] : AssocOp Bool} \quad (10)$$

$$\overline{Or[] : AssocOp Bool} \quad (11)$$

3. UnaryOp:

(a) Numerics:

$$\frac{x : NumericsWithNegation(T)}{Neg[] : UnaryOp x x} \quad (12)$$

$$\frac{x : NumericsWithNegation(T)}{Abs[] : UnaryOp x x} \quad (13)$$

Discuss Numerics-(T) and Numerics-With-Negation-(T)

For Log, Ln, Sin, Cos, Tan, Sec, Csc, Cot, Arcsin, Arccos, Arctan, and Sqrt, please use the following template, replacing “\$TRG” with the desired operator:

$$\overline{\$TRG[] : UnaryOp Real Real} \quad (14)$$

(b) Vectors:

$$\frac{x : NumericsWithNegation(T)}{NegV[] : UnaryOp [x] [x]} \quad (15)$$

$$\frac{x : Numerics(T)}{Norm[] : UnaryOp [x] Real} \quad (16)$$

$$\frac{x : \tau}{Dim[] : UnaryOp [x] Integer} \quad (17)$$

Add “casting” between numerics

(c) Booleans:

$$\overline{Not[] : UnaryOp Bool Bool} \quad (18)$$

4. BinaryOp:

(a) Arithmetic:

$$\overline{FracR[] : BinaryOp Real Real Real} \quad (19)$$

(b) Bool:

$$\overline{Impl[] : BinaryOp Bool Bool Bool} \quad (20)$$

$$\overline{If f[] : BinaryOp Bool Bool Bool} \quad (21)$$

(c) Equality:

$$\frac{x : \tau}{Eq[] : \text{BinaryOp } x \ x \ \text{Bool}} \quad (22)$$

$$\frac{x : \tau}{NEq[] : \text{BinaryOp } x \ x \ \text{Bool}} \quad (23)$$

(d) Ordering:

$$\frac{x : \text{Numerics}(T)}{Lt[] : \text{BinaryOp } x \ x \ \text{Bool}} \quad (24)$$

$$\frac{x : \text{Numerics}(T)}{Gt[] : \text{BinaryOp } x \ x \ \text{Bool}} \quad (25)$$

$$\frac{x : \text{Numerics}(T)}{LEq[] : \text{BinaryOp } x \ x \ \text{Bool}} \quad (26)$$

$$\frac{x : \text{Numerics}(T)}{GEq[] : \text{BinaryOp } x \ x \ \text{Bool}} \quad (27)$$

(e) Indexing:

$$\frac{x : \tau}{Index[] : \text{BinaryOp } [x] \ \text{Integer } x} \quad (28)$$

(f) Vectors:

$$\frac{x : \text{Numerics}(T)}{Cross[] : \text{BinaryOp } [x] \ [x] \ [x]} \quad (29)$$

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$$\frac{x : \text{Numerics}(T)}{Dot[] : \text{BinaryOp } [x] \ [x] \ x} \quad (30)$$

5. RTopology:

$$\overline{Discrete[] : \text{RTopology}} \quad (31)$$

$$\overline{Continuous[] : \text{RTopology}} \quad (32)$$

6. DomainDesc:

$$\frac{top : \tau_1 \quad bot : \tau_2 \quad s : \text{Symbol} \quad rtop : \text{RTopology}}{BoundedDD[s, rtop, top, bot] : \text{DomainDesc Discrete } \tau_1 \ \tau_2} \quad (33)$$

$$\frac{topT : \tau \quad botT : \tau \quad s : \text{Symbol} \quad rtop : \text{RTopology}}{AllDD[s, rtop] : \text{DomainDesc Continuous topT botT}} \quad (34)$$

7. Inclusive:

$$\frac{}{Inc[] : \text{Inclusive}} \quad (35)$$

$$\frac{}{Exc[] : \text{Inclusive}} \quad (36)$$

8. RealInterval:

$$\frac{a : \tau \quad b : \tau \quad top : (\text{Inclusive}, a) \quad bot : (\text{Inclusive}, b)}{Bounded[top, bot] : \text{RealInterval } a \ b} \quad (37)$$

$$\frac{a : \tau \quad b : \tau \quad top : (\text{Inclusive}, a)}{UpTo[top] : \text{RealInterval } a \ b} \quad (38)$$

$$\frac{a : \tau \quad b : \tau \quad bot : (\text{Inclusive}, b)}{UpFrom[bot] : \text{RealInterval } a \ b} \quad (39)$$

1.3 Expr

1. Literals:

$$\frac{x : \tau \quad l : \text{Literal } x}{Lit[l] : \text{Expr } x} \quad (40)$$

2. Associative Operations:

$$\frac{x : \tau \quad op : \text{AssocOp } x \quad args : [\text{Expr } x]}{Assoc[op, args] : \text{Expr } x} \quad (41)$$

3. Symbols:

$$\frac{x : \tau \quad u : \text{UID}}{C[u] : \text{Expr } x} \quad (42)$$

4. Function Call:

5. Case:

$$\frac{x : \tau \quad c : \text{Completeness} \quad ces : [(\text{Expr Bool}, \text{Expr } x)]}{Case[c, ces] : \text{Expr } x} \quad (43)$$

6. Matrices:

$$\frac{x : \tau \quad es : [[\text{Expr } x]]}{Matrix[es] : \text{Expr } x} \quad (44)$$

7. Unary Operations:

$$\frac{x : \tau \quad y : \tau \quad op : \text{UnaryOp } x \ y \quad e : \text{Expr } x}{Unary[op, e] : \text{Expr } y} \quad (45)$$

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8. Binary Operations:

$$\frac{x : \tau \quad y : \tau \quad z : \tau \quad op : \text{BinaryOp } x \ y \ z \quad l : \text{Expr } x \quad r : \text{Expr } y}{\text{Binary}[op, l, r] : \text{Expr } z} \quad (46)$$

9. “Big” Operations:

$$\frac{x : \tau \quad op : \text{AssocOp } x \quad dom : \text{DomainDesc Discrete (Expr } x) \text{ (Expr } x)}{\text{BigOp}[op, dom] : \text{Expr } x} \quad (47)$$

10. “Is in interval” operator:

$$\frac{x : \tau \quad u : \text{UID} \quad itvl : \text{RealInterval (Expr } x) \text{ (Expr } x)}{\text{RealI}[u, itvl] : \text{Expr } x} \quad (48)$$

1.4 ModelExpr

1.

$$\frac{B \quad C}{A}$$

1.5 CodeExpr

1.

$$\frac{B \quad C}{A}$$