Todo list

1 Typing Rules

1.1 Literal

1. Integers:

$$\frac{i : \texttt{Integer}}{Integer[i] : \texttt{Literal Integer}} \tag{1}$$

2. Strings (Text):

$$\frac{s : \texttt{String}}{Str[s] : \texttt{Literal String}} \tag{2}$$

3. Real numbers:

$$\frac{d : \texttt{Double}}{Dbl[d] : \texttt{Literal Real}} \tag{3}$$

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

$$\frac{d : \texttt{Integer}}{ExactDbl[d] : \texttt{Literal Real}} \tag{4}$$

5. Percentages:

$$\frac{n : \texttt{Integer} \quad d : \texttt{Integer}}{Perc[n, d] : \texttt{Literal Real}} \tag{5}$$

1.2 Miscellaneous

1. Completeness:

$$\frac{}{Complete[] : \texttt{Completeness}} \tag{6}$$

$$\frac{}{Incomplete[] : \texttt{Completeness}} \tag{7}$$

2. AssocOp:

   (a) Numerics:

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

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

(b) Bool:

$$\frac{}{And[] : \texttt{AssocOp Bool}} \tag{10}$$

$$\frac{}{Or[] : \texttt{AssocOp Bool}} \tag{11}$$

3. UnaryOp:

(a) Numerics:

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

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

$$\frac{x : \texttt{Numerics(T)}}{Exp[] : \texttt{UnaryOp x Real}} \tag{14}$$

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:

$$\frac{}{\$TRG[] : \texttt{UnaryOp Real Real}} \tag{15}$$

$$\frac{}{RtoI[] : \texttt{UnaryOp Real Integer}} \tag{16}$$

$$\frac{}{ItoR[] : \texttt{UnaryOp Integer Real}} \tag{17}$$

$$\frac{}{Floor[] : \texttt{UnaryOp Real Integer}} \tag{18}$$

$$\frac{}{Ceil[] : \texttt{UnaryOp Real Integer}} \tag{19}$$

$$\frac{}{Round[] : \texttt{UnaryOp Real Integer}} \tag{20}$$

$$\frac{}{Trunc[] : \texttt{UnaryOp Real Integer}} \tag{21}$$

(b) Vectors:

$$\frac{x : \texttt{NumericsWithNegation(T)}}{NegV[] : \texttt{UnaryOp [x] [x]}} \tag{22}$$

$$\frac{x : \texttt{Numerics(T)}}{Norm[] : \texttt{UnaryOp [x] Real}} \tag{23}$$

$$\frac{\texttt{x} : \tau}{Dim[] : \texttt{UnaryOp [x] Integer}} \tag{24}$$

(c) Booleans:

$$\frac{}{Not[] : \texttt{UnaryOp Bool Bool}} \tag{25}$$

4. BinaryOp:

(a) Arithmetic:

$$\frac{}{FracR[] : \texttt{BinaryOp Real Real Real}} \tag{26}$$

(b) Bool:

$$\frac{}{Impl[] : \texttt{BinaryOp Bool Bool Bool}} \tag{27}$$

$$\frac{}{Iff[] : \texttt{BinaryOp Bool Bool Bool}} \tag{28}$$

(c) Equality:

$$\frac{\texttt{x} : \tau}{Eq[] : \texttt{BinaryOp x x Bool}} \tag{29}$$

$$\frac{\texttt{x} : \tau}{NEq[] : \texttt{BinaryOp x x Bool}} \tag{30}$$

(d) Ordering:

$$\frac{x : \texttt{Numerics(T)}}{Lt[] : \texttt{BinaryOp x x Bool}} \tag{31}$$

$$\frac{x : \texttt{Numerics(T)}}{Gt[] : \texttt{BinaryOp x x Bool}} \tag{32}$$

$$\frac{x : \texttt{Numerics(T)}}{LEq[] : \texttt{BinaryOp x x Bool}} \tag{33}$$

$$\frac{x : \texttt{Numerics(T)}}{GEq[] : \texttt{BinaryOp x x Bool}} \tag{34}$$

(e) Indexing:

$$\frac{\texttt{x} : \tau}{Index[] : \texttt{BinaryOp [x] Integer x}} \tag{35}$$

(f) Vectors:

discuss vectors in general

$$\frac{x : \texttt{Numerics(T)}}{Cross[] : \texttt{BinaryOp [x] [x] [x]}} \tag{36}$$

$$\frac{x : \texttt{Numerics(T)}}{Dot[] : \texttt{BinaryOp [x] [x] x}} \tag{37}$$

$$\frac{x : \texttt{Numerics(T)}}{Scale[] : \texttt{BinaryOp [x] x [x]}} \tag{38}$$

5. RTopology:

$$\frac{}{Discrete[] : \texttt{RTopology}} \tag{39}$$

$$\frac{}{Continuous[] : \texttt{RTopology}} \tag{40}$$

6. DomainDesc:

$$\frac{top : \tau_1 \quad bot : \tau_2 \quad s : \texttt{Symbol} \quad rtop : \texttt{RTopology}}{BoundedDD[s, rtop, top, bot] : \texttt{DomainDesc Discrete } \tau_1 \ \tau_2} \tag{41}$$

$$\frac{\texttt{topT} : \tau \quad \texttt{botT} : \tau \quad s : \texttt{Symbol} \quad rtop : \texttt{RTopology}}{AllDD[s, rtop] : \texttt{DomainDesc Continuous topT botT}} \tag{42}$$

7. Inclusive:

$$\frac{}{Inc[] : \texttt{Inclusive}} \tag{43}$$

$$\frac{}{Exc[] : \texttt{Inclusive}} \tag{44}$$

8. RealInterval:

$$\frac{\texttt{a} : \tau \quad \texttt{b} : \tau \quad top : \texttt{(Inclusive, a)} \quad bot : \texttt{(Inclusive, b)}}{Bounded[top, bot] : \texttt{RealInterval a b}} \tag{45}$$

$$\frac{\texttt{a} : \tau \quad \texttt{b} : \tau \quad top : \texttt{(Inclusive, a)}}{UpTo[top] : \texttt{RealInterval a b}} \tag{46}$$

$$\frac{\texttt{a} : \tau \quad \texttt{b} : \tau \quad bot : \texttt{(Inclusive, b)}}{UpFrom[bot] : \texttt{RealInterval a b}} \tag{47}$$

1.3 Expr

1. Literals:

$$\frac{\texttt{x} : \tau \quad l : \texttt{Literal x}}{Lit[l] : \texttt{Expr x}} \tag{48}$$

2. Associative Operations:

$$\frac{\texttt{x} : \tau \quad op : \texttt{AssocOp x} \quad args : \texttt{[Expr x]}}{Assoc[op, args] : \texttt{Expr x}} \tag{49}$$

3. Symbols:

$$\frac{\texttt{x} : \tau \quad u : \texttt{UID}}{C[u] : \texttt{Expr x}} \tag{50}$$

4. Function Call:

discuss functions in general

5. Case:

$$\frac{\texttt{x} : \tau \quad c : \texttt{Completeness} \quad ces : \texttt{[(Expr Bool, Expr x)]}}{Case[c, ces] : \texttt{Expr x}} \tag{51}$$

6. Matrices:

$$\frac{\texttt{x} : \tau \quad es : \texttt{[[Expr x]]}}{Matrix[es] : \texttt{Expr x}} \tag{52}$$

7. Unary Operations:

$$\frac{\texttt{x} : \tau \quad \texttt{y} : \tau \quad op : \texttt{UnaryOp x y} \quad e : \texttt{Expr x}}{Unary[op, e] : \texttt{Expr y}} \tag{53}$$

8. Binary Operations:

$$\frac{\texttt{x} : \tau \quad \texttt{y} : \tau \quad \texttt{z} : \tau \quad op : \texttt{BinaryOp x y z} \quad l : \texttt{Expr x} \quad r : \texttt{Expr y}}{Binary[op, l, r] : \texttt{Expr z}} \tag{54}$$

9. "Big" Operations:

$$\frac{\texttt{x} : \tau \quad op : \texttt{AssocOp x} \quad dom : \texttt{DomainDesc Discrete (Expr x) (Expr x)}}{BigOp[op, dom] : \texttt{Expr x}} \tag{55}$$

10. "Is in interval" operator:

$$\frac{\texttt{x} : \tau \quad u : \texttt{UID} \quad itvl : \texttt{RealInterval (Expr x) (Expr x)}}{RealI[u, itvl] : \texttt{Expr x}} \tag{56}$$

1.4 ModelExpr

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

1.5 CodeExpr

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