

Up Help

base, $[* \bowtie *]$, “*”, , * then *, $[*]*$, **Preassociative** *, *,
Postassociative *, *, $[*]$, *, priority * end,
 *, *, $(*)^t$, string(*) + *, string(*) ++ *, bracket * end bracket,
 big bracket * end bracket, math * end math, **flush left** $[*]$, x, y, z, $[* \xrightarrow{*} *]$,
 pyk, tex, name, prio, T, if(*, *, *), $[* \xRightarrow{*} *]$, val, claim, *, !*, ”*, #*, \$*, %*,
 &*, ’*, (*,)*, **, +*, ,*, -*, .*, /*, 0*, 1*, 2*, 3*, 4*, 5*, 6*, 7*, 8*, 9*, :*, ;*,
 <*, =*, >*, ?*, @*, A*, B*, C*, D*, E*, F*, G*, H*, I*, J*, K*, L*, M*, N*,
 O*, P*, Q*, R*, S*, T*, U*, V*, W*, X*, Y*, Z*, $[*, \backslash *,]^*$, ^*, _*, ‘*, a*, b*,
 c*, d*, e*, f*, g*, h*, i*, j*, k*, l*, m*, n*, o*, p*, q*, r*, s*, t*, u*, v*, w*,
 x*, y*, z*, {*, |*, }*, ~*, $\perp$, f(*), $(*)^I$, F, 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 0, 1, 2, 3, 4,
 5, 6, 7, 8, 9, a, b, c, d, e, f, g, h, i, j, k, l, m, n, o, p, q, r, s, t, u, v, w, $(*)^M$, If(*,
 *, *), array{**} * end array, l, c, r, empty, $(*|* := *)$, $\mathcal{M}(*)$, $\tilde{U}(*)$, $U(*)$, $U^M(*)$,
apply(*, *), **apply**₁(*, *), identifier(*), identifier₁(*, *), array-plus(*, *), array-
 remove(*, *, *), array-put(*, *, *, *), array-add(*, *, *, *, *), bit(*, *), bit₁(*, *),
 rack, "vector", "bibliography", "dictionary", "body", "codex", "expansion",
 "code", "cache", "diagnose", "pyk", "tex", "texname", "value", "message",
 "macro", "definition", "unpack", "claim", "priority", "lambda", "apply",
 "true", "if", "quote", "proclaim", "define", "introduce", "hide", "pre",
 "post", $\mathcal{E}(*, *, *)$, $\mathcal{E}_2(*, *, *, *, *)$, $\mathcal{E}_3(*, *, *, *, *)$, $\mathcal{E}_4(*, *, *, *, *)$, **lookup**(*, *, *),
abstract(*, *, *, *), $[*]$, $\mathcal{M}(*, *, *)$, $\mathcal{M}_2(*, *, *, *)$, $\mathcal{M}^*(*, *, *)$, macro, s₀,
zip(*, *), **assoc**₁(*, *, *), $(*)^P$, self, $[* \doteq *]$, $[* \dot{=} *]$, $[* \dot{=} *]$, $[* \stackrel{\text{pyk}}{=} *]$, $[* \stackrel{\text{tex}}{=} *]$,
 $[* \stackrel{\text{name}}{=} *]$, **Priority table***, $\tilde{\mathcal{M}}_1$, $\tilde{\mathcal{M}}_2(*)$, $\tilde{\mathcal{M}}_3(*)$, $\tilde{\mathcal{M}}_4(*, *, *, *)$, $\tilde{\mathcal{M}}(*, *, *)$,
 $\tilde{Q}(*, *, *)$, $\tilde{Q}_2(*, *, *)$, $\tilde{Q}_3(*, *, *, *)$, $\tilde{Q}^*(*, *, *)$, (*), **aspect**(*, *),
aspect(*, *, *), $\langle * \rangle$, **tuple**₁(*), **tuple**₂(*), let₂(*, *), let₁(*, *), $[* \stackrel{\text{claim}}{=} *]$,
 checker, **check**(*, *), **check**₂(*, *, *), **check**₃(*, *, *), **check**^{*}(*, *),
check₂^{*}(*, *, *), $[*]^*$, $[*]^*$, $[*]^*$, msg, $[* \stackrel{\text{msg}}{=} *]$, <stmt>, stmt, $[* \stackrel{\text{stmt}}{=} *]$,
 HeadNil’, HeadPair’, Transitivity’, $\perp$, Contra’, T’_E, L₁, $\mathcal{A}$, $\mathcal{B}$, $\mathcal{C}$, $\mathcal{D}$, $\mathcal{E}$, $\mathcal{F}$, $\mathcal{G}$,
 $\mathcal{H}$, $\mathcal{I}$, $\mathcal{J}$, $\mathcal{K}$, $\mathcal{L}$, $\mathcal{M}$, $\mathcal{N}$, $\mathcal{O}$, $\mathcal{P}$, $\mathcal{Q}$, $\mathcal{R}$, $\mathcal{S}$, $\mathcal{T}$, $\mathcal{U}$, $\mathcal{V}$, $\mathcal{W}$, $\mathcal{X}$, $\mathcal{Y}$, $\mathcal{Z}$, $\langle *|* := * \rangle$,
 $\langle *^*|* := * \rangle$, $\emptyset$, Remainder, $(*)^v$, error(*, *), error₂(*, *), proof(*, *, *),
 proof₂(*, *), $\mathcal{S}(*, *)$, $\mathcal{S}^I(*, *)$, $\mathcal{S}^\triangleright(*, *)$, $\mathcal{S}_1^\triangleright(*, *, *)$, $\mathcal{S}^E(*, *)$, $\mathcal{S}_1^E(*, *, *)$,
 $\mathcal{S}^+(*, *, *)$, $\mathcal{S}_1^+(*, *, *)$, $\mathcal{S}^-(*, *, *)$, $\mathcal{S}_1^-(*, *, *)$, $\mathcal{S}^*(*, *)$, $\mathcal{S}_1^*(*, *, *)$, $\mathcal{S}_2^*(*, *, *, *)$,
 $\mathcal{S}^\textcircled{*}(*, *)$, $\mathcal{S}_1^\textcircled{*}(*, *, *)$, $\mathcal{S}^+(*, *)$, $\mathcal{S}_1^+(*, *, *, *)$, $\mathcal{S}^\#(*, *)$, $\mathcal{S}_1^\#(*, *, *, *)$, $\mathcal{S}^{\text{i.e.}}(*, *)$,
 $\mathcal{S}_1^{\text{i.e.}}(*, *, *, *)$, $\mathcal{S}_2^{\text{i.e.}}(*, *, *, *, *)$, $\mathcal{S}^\vee(*, *)$, $\mathcal{S}_1^\vee(*, *, *, *)$, $\mathcal{S}^i(*, *)$, $\mathcal{S}_1^i(*, *, *)$,
 $\mathcal{S}_2^i(*, *, *, *)$, $\mathcal{T}(*)$, claims(*, *, *), claims₂(*, *, *), <proof>, proof,
[Lemma *:], **[Proof of *:]**, **[* lemma *:]**, **[* antilemma *:]**,
[* rule *:], **[* antirule *:]**, verifier, $\mathcal{V}_1(*)$, $\mathcal{V}_2(*, *)$, $\mathcal{V}_3(*, *, *, *)$, $\mathcal{V}_4(*, *)$,
 $\mathcal{V}_5(*, *, *, *)$, $\mathcal{V}_6(*, *, *, *)$, $\mathcal{V}_7(*, *, *, *)$, Cut(*, *), Head_⊕*, Tail_⊕*,
 rule₁(*, *), rule(*, *), Rule tactic, Plus(*, *), **[Theory *]**, theory₂(*, *),

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$[[* \stackrel{\text{pyk}}{=} *]], [[* \stackrel{\text{tex}}{=} *]], [[* \stackrel{\text{name}}{=} *]], [\text{Priority table}[*]], [\tilde{\mathcal{M}}_1], [\tilde{\mathcal{M}}_2(*)], [\tilde{\mathcal{M}}_3(*)],$
 $[\tilde{\mathcal{M}}_4(*, *, *, *)], [\mathcal{M}(*, *, *)], [\mathcal{Q}(*, *, *)], [\mathcal{Q}_2(*, *, *)], [\mathcal{Q}_3(*, *, *, *)], [\mathcal{Q}^*(*, *, *)],$
 $[*], [\text{aspect}(*, *)], [\text{aspect}(*, *, *)], [\langle * \rangle], [\text{tuple}_1(*)], [\text{tuple}_2(*)], [\text{let}_2(*, *)],$
 $[\text{let}_1(*, *)], [[* \stackrel{\text{claim}}{=} *]], [\text{checker}], [\text{check}(*, *)], [\text{check}_2(*, *, *)], [\text{check}_3(*, *, *)],$
 $[\text{check}^*(*, *)], [\text{check}_2^*(*, *, *)], [[*]'], [[*]^-], [[*]^\circ], [\text{msg}], [[* \stackrel{\text{msg}}{=} *]], [<\text{stmt}>],$
 $[\text{stmt}], [[* \stackrel{\text{stmt}}{=} *]], [\text{HeadNil}'], [\text{HeadPair}'], [\text{Transitivity}'], [\perp], [\text{Contra}'], [\text{T}_E],$
 $[\text{L}_1], [\text{L}_2], [\mathcal{A}], [\mathcal{B}], [\mathcal{C}], [\mathcal{D}], [\mathcal{E}], [\mathcal{F}], [\mathcal{G}], [\mathcal{H}], [\mathcal{I}], [\mathcal{J}], [\mathcal{K}], [\mathcal{L}], [\mathcal{M}], [\mathcal{N}], [\mathcal{O}], [\mathcal{P}], [\mathcal{Q}],$
 $[\mathcal{R}], [\mathcal{S}], [\mathcal{T}], [\mathcal{U}], [\mathcal{V}], [\mathcal{W}], [\mathcal{X}], [\mathcal{Y}], [\mathcal{Z}], [[* | * := *]], [[* * | * := *]], [\emptyset], [\text{Remainder}],$
 $[(*)^\vee], [\text{error}(*, *)], [\text{error}_2(*, *)], [\text{proof}(*, *, *)], [\text{proof}_2(*, *)], [\mathcal{S}(*, *)], [\mathcal{S}^I(*, *)],$
 $[\mathcal{S}^\triangleright(*, *)], [\mathcal{S}_1^\triangleright(*, *, *)], [\mathcal{S}^E(*, *)], [\mathcal{S}_1^E(*, *, *)], [\mathcal{S}^+(*, *)], [\mathcal{S}_1^+(*, *, *)],$
 $[\mathcal{S}^-(*, *)], [\mathcal{S}_1^-(*, *, *)], [\mathcal{S}^*(*, *)], [\mathcal{S}_1^*(*, *, *)], [\mathcal{S}_2^*(*, *, *, *)], [\mathcal{S}^\textcircled{*}(*, *)],$
 $[\mathcal{S}_1^\textcircled{*}(*, *, *)], [\mathcal{S}^\vdash(*, *)], [\mathcal{S}_1^\vdash(*, *, *, *)], [\mathcal{S}^\sharp(*, *)], [\mathcal{S}_1^\sharp(*, *, *, *)], [\mathcal{S}^{\text{i.e.}}(*, *)],$
 $[\mathcal{S}_1^{\text{i.e.}}(*, *, *, *)], [\mathcal{S}_2^{\text{i.e.}}(*, *, *, *, *)], [\mathcal{S}^\vee(*, *)], [\mathcal{S}_1^\vee(*, *, *, *)], [\mathcal{S}^i(*, *)],$
 $[\mathcal{S}_1^i(*, *, *)], [\mathcal{S}_2^i(*, *, *, *)], [\mathcal{T}(*)], [\text{claims}(*, *, *)], [\text{claims}_2(*, *, *)], [<\text{proof}>],$
 $[\text{proof}], [[\text{Lemma } *: *]], [[\text{Proof of } *: *]], [[* \text{ lemma } *: *]],$
 $[[* \text{ antilemma } *: *]], [[* \text{ rule } *: *]], [[* \text{ antirule } *: *]], [\text{verifier}], [\mathcal{V}_1(*)],$
 $[\mathcal{V}_2(*, *)], [\mathcal{V}_3(*, *, *, *)], [\mathcal{V}_4(*, *)], [\mathcal{V}_5(*, *, *, *)], [\mathcal{V}_6(*, *, *, *)], [\mathcal{V}_7(*, *, *, *)],$
 $[\text{Cut}(*, *)], [\text{Head}_\oplus(*)], [\text{Tail}_\oplus(*)], [\text{rule}_1(*, *)], [\text{rule}(*, *)], [\text{Rule tactic}],$
 $[\text{Plus}(*, *)], [[\text{Theory } *]], [\text{theory}_2(*, *)], [\text{theory}_3(*, *)], [\text{theory}_4(*, *, *)],$
 $[\text{HeadNil}''], [\text{HeadPair}''], [\text{Transitivity}''], [\text{Contra}''], [\text{HeadNil}], [\text{HeadPair}],$
 $[\text{Transitivity}], [\text{Contra}], [\text{T}_E], [\text{ragged right}], [\text{ragged right expansion}],$
 $[\text{parm}(*, *, *)], [\text{parm}^*(*, *, *)], [\text{inst}(*, *)], [\text{inst}^*(*, *)], [\text{occur}(*, *, *)],$
 $[\text{occur}^*(*, *, *)], [\text{unify}(* = *, *)], [\text{unify}^*(* = *, *)], [\text{unify}_2(* = *, *)], [\text{L}_a], [\text{L}_b],$
 $[\text{L}_c], [\text{L}_d], [\text{L}_e], [\text{L}_f], [\text{L}_g], [\text{L}_h], [\text{L}_i], [\text{L}_j], [\text{L}_k], [\text{L}_l], [\text{L}_m], [\text{L}_n], [\text{L}_o], [\text{L}_p], [\text{L}_q], [\text{L}_r],$
 $[\text{L}_s], [\text{L}_t], [\text{L}_u], [\text{L}_v], [\text{L}_w], [\text{L}_x], [\text{L}_y], [\text{L}_z], [\text{L}_A], [\text{L}_B], [\text{L}_C], [\text{L}_D], [\text{L}_E], [\text{L}_F], [\text{L}_G],$
 $[\text{L}_H], [\text{L}_I], [\text{L}_J], [\text{L}_K], [\text{L}_L], [\text{L}_M], [\text{L}_N], [\text{L}_O], [\text{L}_P], [\text{L}_Q], [\text{L}_R], [\text{L}_S], [\text{L}_T], [\text{L}_U], [\text{L}_V],$
 $[\text{L}_W], [\text{L}_X], [\text{L}_Y], [\text{L}_Z], [\text{L}_?], [\text{Reflexivity}], [\text{Reflexivity}_1], [\text{Commutativity}],$
 $[\text{Commutativity}_1], [<\text{tactic}>], [\text{tactic}], [[* \stackrel{\text{tactic}}{=} *]], [\mathcal{P}(*, *, *)], [\mathcal{P}^*(*, *, *)], [p_0],$
 $[\text{conclude}_1(*, *)], [\text{conclude}_2(*, *, *)], [\text{conclude}_3(*, *, *, *)];$

Preassociative

$[*_{-}\{*\}], [*'], [*[*]], [*[* \rightarrow *]], [*[* \Rightarrow *]];$

Preassociative

$["*"], [], [(*)^t], [\text{string}(*) + *], [\text{string}(*) ++ *], [$
 $*, [*, [!*, [!*, [\#*], [*], [%*], [&*], [!*, [(*)], [!*, [**], [+*], [*, [-*], [.*], [/ *],$
 $[0*], [1*], [2*], [3*], [4*], [5*], [6*], [7*], [8*], [9*], [:*], [; *], [< *], [= *], [> *], [? *],$
 $[@*], [A*], [B*], [C*], [D*], [E*], [F*], [G*], [H*], [I*], [J*], [K*], [L*], [M*], [N*],$
 $[O*], [P*], [Q*], [R*], [S*], [T*], [U*], [V*], [W*], [X*], [Y*], [Z*], [[*], [\setminus *], [! *], [\wedge *],$
 $[_ *], [^ *], [a *], [b *], [c *], [d *], [e *], [f *], [g *], [h *], [i *], [j *], [k *], [l *], [m *], [n *], [o *],$
 $[p *], [q *], [r *], [s *], [t *], [u *], [v *], [w *], [x *], [y *], [z *], [\{ *], [| *], [} *], [\sim *],$
 $[\text{Preassociative } *; *], [\text{Postassociative } *; *], [[*], [*], [\text{priority } * \text{ end}],$
 $[\text{newline } *], [\text{macro newline } *];$

Preassociative

$[*0], [*1], [0b], [*-\text{color}(*)], [*-\text{color}^*(*)];$

Preassociative

$[* ' *], [* ' *];$

Preassociative

$[*^H], [*^T], [*^U], [*^h], [*^t], [*^s], [*^c], [*^d], [*^a], [*^C], [*^M], [*^B], [*^r], [*^i], [*^d], [*^R], [*^0],$
 $[*^1], [*^2], [*^3], [*^4], [*^5], [*^6], [*^7], [*^8], [*^9], [*^E], [*^V], [*^C], [*^{C*}];$

Preassociative

$[* \cdot *], [* \cdot_0 *];$

Preassociative

$[* + *], [* +_0 *], [* +_1 *], [* - *], [* -_0 *], [* -_1 *];$

Preassociative

$[* \cup \{*\}], [* \cup *], [* \setminus \{*\}];$

Postassociative

$[* \dot{:} *], [* \dot{:} *], [* \ddot{:} *], [* \underline{+2*}], [* \ddot{:} *], [* +2* *];$

Postassociative

$[*, *];$

Preassociative

$[* \overset{B}{\sim} *], [* \overset{D}{\sim} *], [* \overset{C}{\sim} *], [* \overset{P}{\sim} *], [* \approx *], [* = *], [* \overset{+}{\vdash} *], [* \overset{t}{\vdash} *], [* \overset{t*}{\vdash} *], [* \overset{r}{\vdash} *],$
 $[* \in_t *], [* \subseteq_T *], [* \overset{T}{=} *], [* \overset{s}{=} *], [* \text{free in } *], [* \text{free in}^* *], [* \text{free for } * \text{ in } *],$
 $[* \text{free for}^* * \text{ in } *], [* \in_c *], [* < *], [* <' *], [* \leq' *];$

Preassociative

$[\neg *];$

Preassociative

$[* \wedge *], [* \ddot{\wedge} *], [* \tilde{\wedge} *], [* \wedge_c *];$

Preassociative

$[* \vee *], [* \parallel *], [* \ddot{\vee} *];$

Postassociative

$[* \ddot{\Rightarrow} *];$

Postassociative

$[* : *], [* !*];$

Preassociative

$[* \left\{ \begin{array}{c} * \\ * \end{array} \right\}];$

Preassociative

$[\lambda *. *], [\Lambda *], [\text{if } * \text{ then } * \text{ else } *], [\text{let } * = * \text{ in } *], [\text{let } * \ddot{=} * \text{ in } *];$

Preassociative

$[*^I], [*^\triangleright], [*^V], [*^+], [*^-], [*^*];$

Preassociative

$[* @ *], [* \triangleright *], [* \blacktriangleright *], [* \gg *];$

Postassociative

$[* \vdash *], [* \Vdash *], [* \text{i.e. } *];$

Preassociative

$[\forall *: *];$

Postassociative

$[* \oplus *];$

Postassociative

$[*, *];$

Preassociative

[* proves *];

Preassociative

[* **proof of** * : *], [Line * : * $\gg$ *; *], [Last line * $\gg$ * $\square$],
[Line * : Premise $\gg$ *; *], [Line * : Side-condition $\gg$ *; *], [Arbitrary $\gg$ *; *],
[Local $\gg$ * = *; *];

Postassociative

[* then *], [* [*]*];

Preassociative

[*&*];

Preassociative

[* \ \ *];]

[base $\xrightarrow{\text{macro}}$ $\lambda t. \lambda c. \mathcal{M}(t, s_0, c)$]

[base $\xrightarrow{\text{claim}}$ checker $\wedge_c$ verifier]

[base $\xrightarrow{\text{pyk}}$ “base”]

[* $\bowtie$ *]

Predef: proclaim

[[x $\bowtie$ y] $\xrightarrow{\text{tex}}$ “
[#1/tex name/tex.
\bowtie#2.
]”]

[[x $\bowtie$ y] $\xrightarrow{\text{pyk}}$ “proclaim * as * end proclaim”]

“ * ”

Predef: hide

[“x” $\xrightarrow{\text{name}}$ “
\mbox{“}#1.
\mbox{”}”]

[“x” $\xrightarrow{\text{macro}}$ $\lambda t. \lambda s. \lambda c. t$]

[“x” $\xrightarrow{\text{tex}}$ “#1.”]

[“x” $\xrightarrow{\text{pyk}}$ “unicode start of text * end unicode text”]

```
[ $\xrightarrow{\text{tex}}$  “”]  
[ $\xrightarrow{\text{pyk}}$  “unicode end of text”]
```

* then *

```
[x then y  $\xrightarrow{\text{name}}$  “#1.  
\mathrel{\{\mathrm{then}\}}\#2.”]  
[x then y  $\xrightarrow{\text{val}}$  [*]*R :: [ x :: [ y :: T ] ] ]  
[x then y  $\xrightarrow{\text{tex}}$  “#1.#2.”]  
[x then y  $\xrightarrow{\text{pyk}}$  “*  
then *”]
```

*[*]*

```
[x[y]z  $\xrightarrow{\text{name}}$  “#1.  
{[]}\#2.  
{[]}\#3.”]  
[x[y]z  $\xrightarrow{\text{tex}}$  “#1.#2.#3.”]  
[x[y]z  $\xrightarrow{\text{pyk}}$  “*  
begin *  
end *”]
```

Preassociative *; *

```
Predef: pre  
[Preassociative x; y  $\xrightarrow{\text{name}}$  “  
\mathbf{Preassociative}\, \#1.  
; \#2.”]  
[Preassociative x; y  $\xrightarrow{\text{tex}}$  “  
\newline \mathbf{Preassociative} \newline \#1.  
; \#2.”]
```

[**Preassociative** x; y $\xrightarrow{\text{pyk}}$ “preassociative * greater than *”]

Postassociative *; *

Predef: post

[**Postassociative** x; y $\xrightarrow{\text{name}}$ “
\mathbf{Postassociative}\, #1.
; #2.”]

[**Postassociative** x; y $\xrightarrow{\text{tex}}$ “
\newline\mathbf{Postassociative} \newline #1.
; #2.”]

[**Postassociative** x; y $\xrightarrow{\text{pyk}}$ “postassociative * greater than *”]

[*], *

[[x], y $\xrightarrow{\text{name}}$ “
#1.
] , \linebreak [0] #2.”]

[[x], y $\xrightarrow{\text{tex}}$ “
#1/tex name/tex.
] , \linebreak [0] #2.”]

[[x], y $\xrightarrow{\text{pyk}}$ “priority * equal *”]

priority * end

[priority x end $\xrightarrow{\text{name}}$ “
\mathrm{priority} \, \, #1.
\, \mathrm{end}”]

[priority x end $\xrightarrow{\text{tex}}$ “
#1/tex name/tex.
”]

[priority x end $\xrightarrow{\text{pyk}}$ “priority * end priority”]

$*$

[
x $\xrightarrow{\text{name}}$ “
\newline #1.”]

[
x $\xrightarrow{\text{tex}}$ “
#1.”]

[
x $\xrightarrow{\text{pyk}}$ “
unicode newline *”]

$*$

[* $\xrightarrow{\text{tex}}$ “
\ast ”]

[* $\xrightarrow{\text{pyk}}$ “X”]

$(*)^{\mathbf{t}}$

[(x) $^{\mathbf{t}}$ $\xrightarrow{\text{name}}$ “
(#1.
)^{\bf t}”]

[(x) $^{\mathbf{t}}$ $\xrightarrow{\text{val}}$ [*]^R :: [x :: T]]

[(x) $^{\mathbf{t}}$ $\xrightarrow{\text{tex}}$ “#1/tex name.”]

[(x) $^{\mathbf{t}}$ $\xrightarrow{\text{pyk}}$ “text * end text”]

string($*$) + $*$

[string(x) + y $\xrightarrow{\text{name}}$ “
\mbox{string}{#1.
)+#2.”]

[string(x) + y $\xrightarrow{\text{tex}}$ “
\mathrm{#1/tex name.
}+\newline#2.”]

[string(x) + y $\xrightarrow{\text{pyk}}$ “text * plus *”]

string(*) ++ *

[string(x) ++ y $\xrightarrow{\text{name}}$ “\mbox{string}(\#1.
)\mathrel{++}\#2.”]

[string(x) ++ y $\xrightarrow{\text{tex}}$ “
\mathrm{\#1/tex name.
}\; \{++\}\newline{\}\qqquad\#2.”]

[string(x) ++ y $\xrightarrow{\text{pyk}}$ “text * plus indent *”]

bracket * end bracket

[bracket x end bracket $\xrightarrow{\text{name}}$ “
\mbox{bracket \$\#1.\$ end bracket}”]

[bracket x end bracket $\xrightarrow{\text{tex}}$ “\$[\#1.]\$”]

[bracket x end bracket $\xrightarrow{\text{pyk}}$ “bracket * end bracket”]

big bracket * end bracket

[big bracket x end bracket $\xrightarrow{\text{name}}$ “
\mbox{big bracket \$\#1.\$ end bracket}”]

[big bracket x end bracket $\xrightarrow{\text{tex}}$ “\$\left[\#1.\right]\$”]

[big bracket x end bracket $\xrightarrow{\text{pyk}}$ “big bracket * end bracket”]

math * end math

[math x end math $\xrightarrow{\text{name}}$ “
\mbox{math \$\#1.\$ end math}”]

[math x end math $\xrightarrow{\text{tex}}$ “\$\#1.\$”]

[math x end math $\xrightarrow{\text{pyk}}$ “math * end math”]

flush left [***]

[**flush left** [*x*] $\xrightarrow{\text{name}}$ “
\mathbf{flush\ left\ }[*#1*.
]”]

[**flush left** [*x*] $\xrightarrow{\text{tex}}$ “
\begin {flushleft}*#1*.
\end {flushleft}”]

[**flush left** [*x*] $\xrightarrow{\text{pyk}}$ “flush left * end left”]

X

[*x* $\xrightarrow{\text{tactic}}$ *y*]

[*x* $\xrightarrow{\text{stmt}}$ *x*]

[*x* $\xrightarrow{\text{msg}}$ *y*]

[*x* $\xrightarrow{\text{claim}}$ *y*]

[*x* $\xrightarrow{\text{tex}}$ “
\mathsf{x}”]

[*x* $\xrightarrow{\text{pyk}}$ “var *x*”]

y

[*y* $\xrightarrow{x}$ *z*]

[*y* $\xrightarrow{\text{tex}}$ “
\mathsf{y}”]

[*y* $\xrightarrow{\text{pyk}}$ “var *y*”]

Z

[*z* $\xrightarrow{\text{tex}}$ “
\mathsf{z}”]

[*z* $\xrightarrow{\text{pyk}}$ “var *z*”]

$[* \overset{*}{\rightarrow} *]$

Predef: define

$[[y \overset{x}{\rightarrow} z] \overset{\text{tex}}{\rightarrow} “$
[$\#2/\text{tex name}/\text{tex}.$
 $\backslash\text{stackrel}\{\#1.$
 $\}\{\backslash\text{rightarrow}\}\#3.$
 $]”]$
 $[[y \overset{x}{\rightarrow} z] \overset{\text{pyk}}{\rightarrow} “\text{define } * \text{ of } * \text{ as } * \text{ end define}”]$

pyk

Predef: pyk

$[\text{pyk} \overset{\text{tex}}{\rightarrow} “$
 $\backslash\text{mathrm}\{\text{pyk}\}”]$
 $[\text{pyk} \overset{\text{pyk}}{\rightarrow} “\text{pyk}”]$

tex

Predef: tex

$[\text{tex} \overset{\text{tex}}{\rightarrow} “$
 $\backslash\text{mathrm}\{\text{tex}\}”]$
 $[\text{tex} \overset{\text{pyk}}{\rightarrow} “\text{tex}”]$

name

Predef: texname

$[\text{name} \overset{\text{tex}}{\rightarrow} “$
 $\backslash\text{mathrm}\{\text{name}\}”]$
 $[\text{name} \overset{\text{pyk}}{\rightarrow} “\text{tex name}”]$

prio

Predef: priority

```
[prio  $\overset{\text{tex}}{\rightarrow}$  “  
\mathrm{prio}”]  
[prio  $\overset{\text{pyk}}{\rightarrow}$  “priority”]
```

T

Predef: true

```
[T  $\overset{\text{tex}}{\rightarrow}$  “  
\mathsf{T}”]  
[T  $\overset{\text{pyk}}{\rightarrow}$  “true”]
```

if(*, *, *)

Predef: if

```
[if(*, *, *)  $\overset{\text{tex}}{\rightarrow}$  “  
\mathrm{if}\{ \#1.  
, \linebreak [0]\#2.  
, \linebreak [0]\#3.  
}”]  
[if(*, *, *)  $\overset{\text{pyk}}{\rightarrow}$  “if * then * else * end if”]
```

[* $\overset{*}{\Rightarrow}$ *]

Predef: introduce

```
[[*  $\overset{*}{\Rightarrow}$  *]  $\overset{\text{tex}}{\rightarrow}$  “  
[\#2/tex name/tex.  
\stackrel{\mathrm{rel}}{\{ \#1.  
\}\{\backslash\rightarrow \} \#3.  
}”]  
[[*  $\overset{*}{\Rightarrow}$  *]  $\overset{\text{pyk}}{\rightarrow}$  “introduce * of * as * end introduce”]
```

val

Predef: value

```
[val  $\overset{\text{tex}}{\rightarrow}$  “  
\mathrm{val}\{ \}
```

[val $\xrightarrow{\text{pyk}}$ “value”]

claim

Predef: claim

[claim $\xrightarrow{\text{tex}}$ “
\mathrm {claim}”]

[claim $\xrightarrow{\text{pyk}}$ “claim”]

*

[x $\xrightarrow{\text{name}}$ “
\linebreak [0]\ \hskip0em plus2.0em{\}#1.”]

[x $\xrightarrow{\text{tex}}$ “ #1.”]

[x $\xrightarrow{\text{pyk}}$ “unicode space *”]

!*

[!x $\xrightarrow{\text{tex}}$ “!#1.”]

[!x $\xrightarrow{\text{pyk}}$ “unicode exclamation mark *”]

” *

[”x $\xrightarrow{\text{tex}}$ “”#1.”]

[”x $\xrightarrow{\text{pyk}}$ “unicode quotation mark *”]

#*

[#x $\xrightarrow{\text{name}}$ “
\#. #1.”]

[#x $\xrightarrow{\text{tex}}$ “#. #1.”]

[#x $\xrightarrow{\text{pyk}}$ “unicode number sign *”]

§*

$[\$x \xrightarrow{\text{name}} “\backslash\$ \#1.”]$

$[\$x \xrightarrow{\text{tex}} “\$ \#1.”]$

$[\$x \xrightarrow{\text{pyk}} “\text{unicode dollar sign } *”]$

‰*

$[\%x \xrightarrow{\text{name}} “\backslash\% \#1.”]$

$[\%x \xrightarrow{\text{tex}} “\% \#1.”]$

$[\%x \xrightarrow{\text{pyk}} “\text{unicode percent } *”]$

&*

$[\&x \xrightarrow{\text{name}} “\backslash\& \#1.”]$

$[\&x \xrightarrow{\text{tex}} “\& \#1.”]$

$[\&x \xrightarrow{\text{pyk}} “\text{unicode ampersand } *”]$

’*

$[\text{'}x \xrightarrow{\text{name}} “\backslash\text{mbox } \{ \text{'} \} \#1.”]$

$[\text{'}x \xrightarrow{\text{tex}} “\text{' } \#1.”]$

$[\text{'}x \xrightarrow{\text{pyk}} “\text{unicode apostrophe } *”]$

(*

$[(x \xrightarrow{\text{tex}} “(\#1.”]$

$[(x \xrightarrow{\text{pyk}} “\text{unicode left parenthesis } *”]$

)*

[$\times \xrightarrow{\text{tex}}$ “)#1.”]

[$\times \xrightarrow{\text{pyk}}$ “unicode right parenthesis *”]

**

[$\ast \times \xrightarrow{\text{name}}$ “
{*}#1.”]

[$\ast \times \xrightarrow{\text{tex}}$ “*#1.”]

[$\ast \times \xrightarrow{\text{pyk}}$ “unicode asterisk *”]

+*

[$+\times \xrightarrow{\text{name}}$ “
{+}#1.”]

[$+\times \xrightarrow{\text{tex}}$ “+#1.”]

[$+\times \xrightarrow{\text{pyk}}$ “unicode plus sign *”]

, *

[$\times \xrightarrow{\text{tex}}$ “, #1.”]

[$\times \xrightarrow{\text{pyk}}$ “unicode comma *”]

−*

[$-\times \xrightarrow{\text{name}}$ “
\mbox{-}#1.”]

[$-\times \xrightarrow{\text{tex}}$ “-#1.”]

[$-\times \xrightarrow{\text{pyk}}$ “unicode hyphen *”]

.*

[$\times \xrightarrow{\text{tex}}$ “.#1.”]

$[\text{x} \xrightarrow{\text{pyk}} \text{“unicode period *}”}]$

$/\ast$

$[/\text{x} \xrightarrow{\text{tex}} \text{“/#1.”}]$

$[/\text{x} \xrightarrow{\text{pyk}} \text{“unicode slash *}”}]$

$0\ast$

$[0\text{x} \xrightarrow{\text{tex}} \text{“0\#1.”}]$

$[0\text{x} \xrightarrow{\text{pyk}} \text{“unicode zero *}”}]$

$1\ast$

$[1\text{x} \xrightarrow{\text{tex}} \text{“1\#1.”}]$

$[1\text{x} \xrightarrow{\text{pyk}} \text{“unicode one *}”}]$

$2\ast$

$[2\text{x} \xrightarrow{\text{tex}} \text{“2\#1.”}]$

$[2\text{x} \xrightarrow{\text{pyk}} \text{“unicode two *}”}]$

$3\ast$

$[3\text{x} \xrightarrow{\text{tex}} \text{“3\#1.”}]$

$[3\text{x} \xrightarrow{\text{pyk}} \text{“unicode three *}”}]$

$4\ast$

$[4\text{x} \xrightarrow{\text{tex}} \text{“4\#1.”}]$

$[4\text{x} \xrightarrow{\text{pyk}} \text{“unicode four *}”}]$

5*

$[5x \xrightarrow{\text{tex}} \text{“}5\#1.\text{”}]$

$[5x \xrightarrow{\text{pyk}} \text{“unicode five *}”]$

6*

$[6x \xrightarrow{\text{tex}} \text{“}6\#1.\text{”}]$

$[6x \xrightarrow{\text{pyk}} \text{“unicode six *}”]$

7*

$[7x \xrightarrow{\text{tex}} \text{“}7\#1.\text{”}]$

$[7x \xrightarrow{\text{pyk}} \text{“unicode seven *}”]$

8*

$[8x \xrightarrow{\text{tex}} \text{“}8\#1.\text{”}]$

$[8x \xrightarrow{\text{pyk}} \text{“unicode eight *}”]$

9*

$[9x \xrightarrow{\text{tex}} \text{“}9\#1.\text{”}]$

$[9x \xrightarrow{\text{pyk}} \text{“unicode nine *}”]$

:*

$[:x \xrightarrow{\text{name}} \text{“}\{:\}\#1.\text{”}]$

$[:x \xrightarrow{\text{tex}} \text{“}:\#1.\text{”}]$

$[:x \xrightarrow{\text{pyk}} \text{“unicode colon *}”]$

;*

[;x^{tex}→ “;#1.”]

[;x^{pyk}→ “unicode semicolon *”]

<*

[<x^{name}→ “
{<}#1.”]

[<x^{tex}→ “<#1.”]

[<x^{pyk}→ “unicode less than *”]

=*

[=x^{name}→ “
{=}#1.”]

[=x^{tex}→ “=#1.”]

[=x^{pyk}→ “unicode equal sign *”]

>*

[>x^{name}→ “
{>}#1.”]

[>x^{tex}→ “>#1.”]

[>x^{pyk}→ “unicode greater than *”]

?*

[?x^{tex}→ “?#1.”]

[?x^{pyk}→ “unicode question mark *”]

@*

[@x^{tex}→ “@#1.”]

$[\textcircled{A}x \xrightarrow{\text{pyk}} \text{“unicode commercial at *”}]$

A*

$[Ax \xrightarrow{\text{tex}} \text{“A\#1.”}]$

$[Ax \xrightarrow{\text{pyk}} \text{“unicode capital a *”}]$

B*

$[Bx \xrightarrow{\text{tex}} \text{“B\#1.”}]$

$[Bx \xrightarrow{\text{pyk}} \text{“unicode capital b *”}]$

C*

$[Cx \xrightarrow{\text{tex}} \text{“C\#1.”}]$

$[Cx \xrightarrow{\text{pyk}} \text{“unicode capital c *”}]$

D*

$[Dx \xrightarrow{\text{tex}} \text{“D\#1.”}]$

$[Dx \xrightarrow{\text{pyk}} \text{“unicode capital d *”}]$

E*

$[Ex \xrightarrow{\text{tex}} \text{“E\#1.”}]$

$[Ex \xrightarrow{\text{pyk}} \text{“unicode capital e *”}]$

F*

$[Fx \xrightarrow{\text{tex}} \text{“F\#1.”}]$

$[Fx \xrightarrow{\text{pyk}} \text{“unicode capital f *”}]$

G*

$[Gx \xrightarrow{\text{tex}} \text{“G\#1.”}]$

$[Gx \xrightarrow{\text{pyk}} \text{“unicode capital g *”}]$

H*

$[Hx \xrightarrow{\text{tex}} \text{“H\#1.”}]$

$[Hx \xrightarrow{\text{pyk}} \text{“unicode capital h *”}]$

I*

$[Ix \xrightarrow{\text{tex}} \text{“I\#1.”}]$

$[Ix \xrightarrow{\text{pyk}} \text{“unicode capital i *”}]$

J*

$[Jx \xrightarrow{\text{tex}} \text{“J\#1.”}]$

$[Jx \xrightarrow{\text{pyk}} \text{“unicode capital j *”}]$

K*

$[Kx \xrightarrow{\text{tex}} \text{“K\#1.”}]$

$[Kx \xrightarrow{\text{pyk}} \text{“unicode capital k *”}]$

L*

$[Lx \xrightarrow{\text{tex}} \text{“L\#1.”}]$

$[Lx \xrightarrow{\text{pyk}} \text{“unicode capital l *”}]$

M*

$[Mx \xrightarrow{\text{tex}} \text{“M\#1.”}]$

[Mx $\xrightarrow{\text{pyk}}$ “unicode capital m *”]

N*

[Nx $\xrightarrow{\text{tex}}$ “N#1.”]

[Nx $\xrightarrow{\text{pyk}}$ “unicode capital n *”]

O*

[Ox $\xrightarrow{\text{tex}}$ “O#1.”]

[Ox $\xrightarrow{\text{pyk}}$ “unicode capital o *”]

P*

[Px $\xrightarrow{\text{tex}}$ “P#1.”]

[Px $\xrightarrow{\text{pyk}}$ “unicode capital p *”]

Q*

[Qx $\xrightarrow{\text{tex}}$ “Q#1.”]

[Qx $\xrightarrow{\text{pyk}}$ “unicode capital q *”]

R*

[Rx $\xrightarrow{\text{tex}}$ “R#1.”]

[Rx $\xrightarrow{\text{pyk}}$ “unicode capital r *”]

S*

[Sx $\xrightarrow{\text{tex}}$ “S#1.”]

[Sx $\xrightarrow{\text{pyk}}$ “unicode capital s *”]

T*

$[T_x \xrightarrow{\text{tex}} \text{“T\#1.”}]$

$[T_x \xrightarrow{\text{pyk}} \text{“unicode capital t *”}]$

U*

$[U_x \xrightarrow{\text{tex}} \text{“U\#1.”}]$

$[U_x \xrightarrow{\text{pyk}} \text{“unicode capital u *”}]$

V*

$[V_x \xrightarrow{\text{tex}} \text{“V\#1.”}]$

$[V_x \xrightarrow{\text{pyk}} \text{“unicode capital v *”}]$

W*

$[W_x \xrightarrow{\text{tex}} \text{“W\#1.”}]$

$[W_x \xrightarrow{\text{pyk}} \text{“unicode capital w *”}]$

X*

$[X_x \xrightarrow{\text{tex}} \text{“X\#1.”}]$

$[X_x \xrightarrow{\text{pyk}} \text{“unicode capital x *”}]$

Y*

$[Y_x \xrightarrow{\text{tex}} \text{“Y\#1.”}]$

$[Y_x \xrightarrow{\text{pyk}} \text{“unicode capital y *”}]$

Z*

$[Z_x \xrightarrow{\text{tex}} \text{“Z\#1.”}]$

[Zx $\xrightarrow{\text{pyk}}$ “unicode capital z *”]

[*

[x $\xrightarrow{\text{tex}}$ “[#1.”]

[x $\xrightarrow{\text{pyk}}$ “unicode left bracket *”]

*

[\x $\xrightarrow{\text{name}}$ “
\mbox {\${\backslash}\backslash\backslash\backslash \\$}\#1.”]

[\x $\xrightarrow{\text{tex}}$ “\#1.”]

[\x $\xrightarrow{\text{pyk}}$ “unicode backslash *”]

]*

[x $\xrightarrow{\text{tex}}$ “]#1.”]

[x $\xrightarrow{\text{pyk}}$ “unicode right bracket *”]

^*

[^x $\xrightarrow{\text{name}}$ “
\char94}\#1.”]

[^x $\xrightarrow{\text{tex}}$ “^#1.”]

[^x $\xrightarrow{\text{pyk}}$ “unicode circumflex *”]

_*

[_x $\xrightarrow{\text{name}}$ “
\-#1.”]

[_x $\xrightarrow{\text{tex}}$ “-#1.”]

[_x $\xrightarrow{\text{pyk}}$ “unicode underscore *”]

‘*

[‘x $\xrightarrow{\text{name}}$ “
\mbox {‘}#1.”]

[‘x $\xrightarrow{\text{tex}}$ ““#1.”]

[‘x $\xrightarrow{\text{pyk}}$ “unicode grave accent *”]

a*

[ax $\xrightarrow{\text{tex}}$ “a#1.”]

[ax $\xrightarrow{\text{pyk}}$ “unicode small a *”]

b*

[bx $\xrightarrow{\text{tex}}$ “b#1.”]

[bx $\xrightarrow{\text{pyk}}$ “unicode small b *”]

c*

[cx $\xrightarrow{\text{tex}}$ “c#1.”]

[cx $\xrightarrow{\text{pyk}}$ “unicode small c *”]

d*

[dx $\xrightarrow{\text{tex}}$ “d#1.”]

[dx $\xrightarrow{\text{pyk}}$ “unicode small d *”]

e*

[ex $\xrightarrow{\text{tex}}$ “e#1.”]

[ex $\xrightarrow{\text{pyk}}$ “unicode small e *”]

f*

$[f\text{x} \xrightarrow{\text{tex}} \text{“f\#1.”}]$

$[f\text{x} \xrightarrow{\text{pyk}} \text{“unicode small f *”}]$

g*

$[g\text{x} \xrightarrow{\text{tex}} \text{“g\#1.”}]$

$[g\text{x} \xrightarrow{\text{pyk}} \text{“unicode small g *”}]$

h*

$[h\text{x} \xrightarrow{\text{tex}} \text{“h\#1.”}]$

$[h\text{x} \xrightarrow{\text{pyk}} \text{“unicode small h *”}]$

i*

$[i\text{x} \xrightarrow{\text{tex}} \text{“i\#1.”}]$

$[i\text{x} \xrightarrow{\text{pyk}} \text{“unicode small i *”}]$

j*

$[j\text{x} \xrightarrow{\text{tex}} \text{“j\#1.”}]$

$[j\text{x} \xrightarrow{\text{pyk}} \text{“unicode small j *”}]$

k*

$[k\text{x} \xrightarrow{\text{tex}} \text{“k\#1.”}]$

$[k\text{x} \xrightarrow{\text{pyk}} \text{“unicode small k *”}]$

l*

$[l\text{x} \xrightarrow{\text{tex}} \text{“l\#1.”}]$

$[lx \xrightarrow{\text{pyk}} \text{“unicode small l *”}]$

m*

$[mx \xrightarrow{\text{tex}} \text{“m\#1.”}]$

$[mx \xrightarrow{\text{pyk}} \text{“unicode small m *”}]$

n*

$[nx \xrightarrow{\text{tex}} \text{“n\#1.”}]$

$[nx \xrightarrow{\text{pyk}} \text{“unicode small n *”}]$

o*

$[ox \xrightarrow{\text{tex}} \text{“o\#1.”}]$

$[ox \xrightarrow{\text{pyk}} \text{“unicode small o *”}]$

p*

$[px \xrightarrow{\text{tex}} \text{“p\#1.”}]$

$[px \xrightarrow{\text{pyk}} \text{“unicode small p *”}]$

q*

$[qx \xrightarrow{\text{tex}} \text{“q\#1.”}]$

$[qx \xrightarrow{\text{pyk}} \text{“unicode small q *”}]$

r*

$[rx \xrightarrow{\text{tex}} \text{“r\#1.”}]$

$[rx \xrightarrow{\text{pyk}} \text{“unicode small r *”}]$

S*

$[\text{sx} \xrightarrow{\text{tex}} \text{"s\#1."}]$

$[\text{sx} \xrightarrow{\text{pyk}} \text{"unicode small s *"}]$

t*

$[\text{tx} \xrightarrow{\text{tex}} \text{"t\#1."}]$

$[\text{tx} \xrightarrow{\text{pyk}} \text{"unicode small t *"}]$

u*

$[\text{ux} \xrightarrow{\text{tex}} \text{"u\#1."}]$

$[\text{ux} \xrightarrow{\text{pyk}} \text{"unicode small u *"}]$

v*

$[\text{vx} \xrightarrow{\text{tex}} \text{"v\#1."}]$

$[\text{vx} \xrightarrow{\text{pyk}} \text{"unicode small v *"}]$

w*

$[\text{wx} \xrightarrow{\text{tex}} \text{"w\#1."}]$

$[\text{wx} \xrightarrow{\text{pyk}} \text{"unicode small w *"}]$

x*

$[\text{xx} \xrightarrow{\text{tex}} \text{"x\#1."}]$

$[\text{xx} \xrightarrow{\text{pyk}} \text{"unicode small x *"}]$

y*

$[\text{yx} \xrightarrow{\text{tex}} \text{"y\#1."}]$

[yx $\xrightarrow{\text{pyk}}$ “unicode small y *”]

Z*

[zx $\xrightarrow{\text{tex}}$ “z#1.”]

[zx $\xrightarrow{\text{pyk}}$ “unicode small z *”]

{*

[{x $\xrightarrow{\text{name}}$ “
 \{#1.”]

[{x $\xrightarrow{\text{tex}}$ “{#1.”]

[{x $\xrightarrow{\text{pyk}}$ “unicode left brace *”]

|*

[|x $\xrightarrow{\text{tex}}$ “|#1.”]

[|x $\xrightarrow{\text{pyk}}$ “unicode vertical line *”]

}*

[}x $\xrightarrow{\text{name}}$ “
 \}#1.”]

[}x $\xrightarrow{\text{tex}}$ “}#1.”]

[}x $\xrightarrow{\text{pyk}}$ “unicode right brace *”]

~*

[~x $\xrightarrow{\text{name}}$ “
 \char126 #1.”]

[~x $\xrightarrow{\text{tex}}$ “~#1.”]

[~x $\xrightarrow{\text{pyk}}$ “unicode tilde *”]

$\perp$

$[\perp \overset{\text{val}}{\Rightarrow} (\lambda x. \text{ [x ' x] })^I , (\lambda x. \text{ [x ' x] })^I]$

$[\perp \overset{\text{tex}}{\rightarrow} “$
 $\backslash \text{bot} ”]$

$[\perp \overset{\text{pyk}}{\rightarrow} “\text{bottom}”]$

$f(∗)$

$[f(x) \overset{\text{val}}{\rightarrow} \text{if}(x, T, f(x \text{ ' } T))]$

$[f(∗) \overset{\text{tex}}{\rightarrow} “$
 $f(\#1.$
 $)”]$

$[f(∗) \overset{\text{pyk}}{\rightarrow} “\text{function } f \text{ of } ∗ \text{ end function}”]$

$(∗)^I$

$[(x)^I \overset{\text{val}}{\rightarrow} x]$

$[(∗)^I \overset{\text{tex}}{\rightarrow} “$
 $(\#1.$
 $)\{\}^{\wedge}\{I\} ”]$

$[(∗)^I \overset{\text{pyk}}{\rightarrow} “\text{identity } ∗ \text{ end identity}”]$

F

$[F \overset{\text{val}}{\Rightarrow} T \therefore T]$

$[F \overset{\text{tex}}{\rightarrow} “$
 $\backslash \text{mathsf } \{F\}”]$

$[F \overset{\text{pyk}}{\rightarrow} “\text{false}”]$

0

$[\underline{0} \overset{\text{val}}{\rightarrow} T]$

$[0 \xrightarrow{\text{tex}} \text{"}\underline{\{0\}}"]$
 $[0 \xrightarrow{\text{pyk}} \text{"untagged zero"}]$

1

$[1 \xrightarrow{\text{val}} \text{F } \underline{+2*} \text{ } 0]$
 $[1 \xrightarrow{\text{tex}} \text{"}\underline{\{1\}}"]$
 $[1 \xrightarrow{\text{pyk}} \text{"untagged one"}]$

2

$[2 \xrightarrow{\text{val}} \text{T } \underline{+2*} \text{ } 1]$
 $[2 \xrightarrow{\text{tex}} \text{"}\underline{\{2\}}"]$
 $[2 \xrightarrow{\text{pyk}} \text{"untagged two"}]$

3

$[3 \xrightarrow{\text{val}} \text{F } \underline{+2*} \text{ } 1]$
 $[3 \xrightarrow{\text{tex}} \text{"}\underline{\{3\}}"]$
 $[3 \xrightarrow{\text{pyk}} \text{"untagged three"}]$

4

$[4 \xrightarrow{\text{val}} \text{T } \underline{+2*} \text{ } 2]$
 $[4 \xrightarrow{\text{tex}} \text{"}\underline{\{4\}}"]$
 $[4 \xrightarrow{\text{pyk}} \text{"untagged four"}]$

5

[5 $\xrightarrow{\text{val}}$ F +2* 2]
[5 $\xrightarrow{\text{tex}}$ “
\underline {5}”]
[5 $\xrightarrow{\text{pyk}}$ “untagged five”]

6

[6 $\xrightarrow{\text{val}}$ T +2* 3]
[6 $\xrightarrow{\text{tex}}$ “
\underline {6}”]
[6 $\xrightarrow{\text{pyk}}$ “untagged six”]

7

[7 $\xrightarrow{\text{val}}$ F +2* 3]
[7 $\xrightarrow{\text{tex}}$ “
\underline {7}”]
[7 $\xrightarrow{\text{pyk}}$ “untagged seven”]

8

[8 $\xrightarrow{\text{val}}$ T +2* 4]
[8 $\xrightarrow{\text{tex}}$ “
\underline {8}”]
[8 $\xrightarrow{\text{pyk}}$ “untagged eight”]

9

[9 $\xrightarrow{\text{val}}$ F +2* 4]
[9 $\xrightarrow{\text{tex}}$ “
\underline {9}”]

$[9 \xrightarrow{\text{pyk}} \text{“untagged nine”}]$

0

$[0 \xrightarrow{\text{val}} \top \dot{\vdash} \top]$

$[0 \xrightarrow{\text{tex}} \text{“}$
 $0\text{”}]$

$[0 \xrightarrow{\text{pyk}} \text{“zero”}]$

1

$[1 \xrightarrow{\text{val}} \top + 2 * 0]$

$[1 \xrightarrow{\text{tex}} \text{“}$
 $1\text{”}]$

$[1 \xrightarrow{\text{pyk}} \text{“one”}]$

2

$[2 \xrightarrow{\text{val}} \top + 2 * 1]$

$[2 \xrightarrow{\text{tex}} \text{“}$
 $2\text{”}]$

$[2 \xrightarrow{\text{pyk}} \text{“two”}]$

3

$[3 \xrightarrow{\text{val}} \top + 2 * 1]$

$[3 \xrightarrow{\text{tex}} \text{“}$
 $3\text{”}]$

$[3 \xrightarrow{\text{pyk}} \text{“three”}]$

4

$[4 \xrightarrow{\text{val}} \top + 2 * 2]$

$[4 \xrightarrow{\text{tex}} \text{“} 4\text{”}]$

$[4 \xrightarrow{\text{pyk}} \text{“four”}]$

5

$[5 \xrightarrow{\text{val}} \mathsf{F} + 2 * 2]$

$[5 \xrightarrow{\text{tex}} \text{“} 5\text{”}]$

$[5 \xrightarrow{\text{pyk}} \text{“five”}]$

6

$[6 \xrightarrow{\text{val}} \mathsf{T} + 2 * 3]$

$[6 \xrightarrow{\text{tex}} \text{“} 6\text{”}]$

$[6 \xrightarrow{\text{pyk}} \text{“six”}]$

7

$[7 \xrightarrow{\text{val}} \mathsf{F} + 2 * 3]$

$[7 \xrightarrow{\text{tex}} \text{“} 7\text{”}]$

$[7 \xrightarrow{\text{pyk}} \text{“seven”}]$

8

$[8 \xrightarrow{\text{val}} \mathsf{T} + 2 * 4]$

$[8 \xrightarrow{\text{tex}} \text{“} 8\text{”}]$

$[8 \xrightarrow{\text{pyk}} \text{“eight”}]$

9

[9 $\xrightarrow{\text{val}}$ F +2* 4]

[9 $\xrightarrow{\text{tex}}$ “
9”]

[9 $\xrightarrow{\text{pyk}}$ “nine”]

a

[a $\xrightarrow{\text{tex}}$ “
 $\backslash\mathrm{mathsf}{a}$ ”]

[a $\xrightarrow{\text{pyk}}$ “var a”]

b

[b $\xrightarrow{\text{tex}}$ “
 $\backslash\mathrm{mathsf}{b}$ ”]

[b $\xrightarrow{\text{pyk}}$ “var b”]

c

[c $\xrightarrow{\text{tex}}$ “
 $\backslash\mathrm{mathsf}{c}$ ”]

[c $\xrightarrow{\text{pyk}}$ “var c”]

d

[d $\xrightarrow{\text{tex}}$ “
 $\backslash\mathrm{mathsf}{d}$ ”]

[d $\xrightarrow{\text{pyk}}$ “var d”]

e

[e $\xrightarrow{\text{tex}}$ “
 $\backslash\mathrm{mathsf}{e}$ ”]

[e $\xrightarrow{\text{pyk}}$ “var e”]

f

[f $\xrightarrow{\text{tex}}$ “
 $\backslash\mathrm{mathsf}\{f\}$ ”]

[f $\xrightarrow{\text{pyk}}$ “var f”]

g

[g $\xrightarrow{\text{tex}}$ “
 $\backslash\mathrm{mathsf}\{g\}$ ”]

[g $\xrightarrow{\text{pyk}}$ “var g”]

h

[h $\xrightarrow{\text{tex}}$ “
 $\backslash\mathrm{mathsf}\{h\}$ ”]

[h $\xrightarrow{\text{pyk}}$ “var h”]

i

[i $\xrightarrow{\text{tex}}$ “
 $\backslash\mathrm{mathsf}\{i\}$ ”]

[i $\xrightarrow{\text{pyk}}$ “var i”]

j

[j $\xrightarrow{\text{tex}}$ “
 $\backslash\mathrm{mathsf}\{j\}$ ”]

[j $\xrightarrow{\text{pyk}}$ “var j”]

k

[$\overset{\text{tex}}{\text{k}} \rightarrow$ “
 $\backslash\mathrm{mathsf}{k}$ ”]

[$\overset{\text{pyk}}{\text{k}} \rightarrow$ “var k”]

l

[$\overset{\text{tex}}{\text{l}} \rightarrow$ “
 $\backslash\mathrm{mathsf}{l}$ ”]

[$\overset{\text{pyk}}{\text{l}} \rightarrow$ “var l”]

m

[$\overset{\text{tex}}{\text{m}} \rightarrow$ “
 $\backslash\mathrm{mathsf}{m}$ ”]

[$\overset{\text{pyk}}{\text{m}} \rightarrow$ “var m”]

n

[$\overset{\text{tex}}{\text{n}} \rightarrow$ “
 $\backslash\mathrm{mathsf}{n}$ ”]

[$\overset{\text{pyk}}{\text{n}} \rightarrow$ “var n”]

o

[$\overset{\text{tex}}{\text{o}} \rightarrow$ “
 $\backslash\mathrm{mathsf}{o}$ ”]

[$\overset{\text{pyk}}{\text{o}} \rightarrow$ “var o”]

p

[$\overset{\text{tex}}{\text{p}} \rightarrow$ “
 $\backslash\mathrm{mathsf}{p}$ ”]

[$\overset{\text{pyk}}{\text{p}} \rightarrow$ “var p”]

q

[$\text{q} \xrightarrow{\text{tex}}$ “
 $\backslash\mathrm{mathsf}\{q\}$ ”]

[$\text{q} \xrightarrow{\text{pyk}}$ “var q”]

r

[$\text{r} \xrightarrow{\text{tex}}$ “
 $\backslash\mathrm{mathsf}\{r\}$ ”]

[$\text{r} \xrightarrow{\text{pyk}}$ “var r”]

s

[$\text{s} \xrightarrow{\text{tex}}$ “
 $\backslash\mathrm{mathsf}\{s\}$ ”]

[$\text{s} \xrightarrow{\text{pyk}}$ “var s”]

t

[$\text{t} \xrightarrow{\text{tex}}$ “
 $\backslash\mathrm{mathsf}\{t\}$ ”]

[$\text{t} \xrightarrow{\text{pyk}}$ “var t”]

u

[$\text{u} \xrightarrow{\text{tex}}$ “
 $\backslash\mathrm{mathsf}\{u\}$ ”]

[$\text{u} \xrightarrow{\text{pyk}}$ “var u”]

v

[$\text{v} \xrightarrow{\text{tex}}$ “
 $\backslash\mathrm{mathsf}\{v\}$ ”]

[$\text{v} \xrightarrow{\text{pyk}}$ “var v”]

w

[w $\xrightarrow{\text{tex}}$ “
\mathsf {w}”]
[w $\xrightarrow{\text{pyk}}$ “var w”]

(*)^M

[(x)^M $\xrightarrow{\text{val}}$ x^M]
[(*)^M $\xrightarrow{\text{tex}}$ “
(#1.
)^M”]
[(*)^M $\xrightarrow{\text{pyk}}$ “tagged parenthesis * end tagged”]

If(*, *, *)

[If(x, y, z) $\xRightarrow{\text{val}}$ if(x^M, y^M, z^M)]
[If(*, *, *) $\xrightarrow{\text{tex}}$ “
\mathrm {If}(\#1.
, \linebreak [0]\#2.
, \linebreak [0]\#3.
)”]
[If(*, *, *) $\xrightarrow{\text{pyk}}$ “tagged if * then * else * end if”]

array{*} * end array

[array{*} * end array $\xrightarrow{\text{name}}$ “\mathrm {array}\{\#1.
\}\#2.
\mathrm {end\ array}”]
[array{*} * end array $\xrightarrow{\text{tex}}$ “
\begin {array}\{\#1.
\}\#2.
\end {array}”]
[array{*} * end array $\xrightarrow{\text{pyk}}$ “array * is * end array”]

l

[l $\overset{\text{tex}}{\rightarrow}$ “
l”]
[l $\overset{\text{pyk}}{\rightarrow}$ “left”]

c

[c $\overset{\text{tex}}{\rightarrow}$ “
c”]
[c $\overset{\text{pyk}}{\rightarrow}$ “center”]

r

[r $\overset{\text{tex}}{\rightarrow}$ “
r”]
[r $\overset{\text{pyk}}{\rightarrow}$ “right”]

empty

[empty $\overset{\text{name}}{\rightarrow}$ “
\mathrm {empty}”]
[empty $\overset{\text{tex}}{\rightarrow}$ “
”]
[empty $\overset{\text{pyk}}{\rightarrow}$ “empty”]

$\langle * \mid * := * \rangle$

[$\langle * \mid * := * \rangle$ $\overset{\text{tex}}{\rightarrow}$ “
\langle #1.
\, \{\} \#2.
\{:=\}\, \#3.
\rangle ”]
[$\langle * \mid * := * \rangle$ $\overset{\text{pyk}}{\rightarrow}$ “substitute * set * to * end substitute”]

$$\mathcal{M}(\ast)$$

$$[\mathcal{M}(x) \stackrel{\text{val}}{\rightarrow} (0 \dot{=} [\, 1 \dot{=} T \,])^I \dot{=} x]$$

$$[\mathcal{M}(\ast) \stackrel{\text{tex}}{\rightarrow} “\{\backslash\text{cal } M\}(\#1.)”]$$

$$[\mathcal{M}(\ast) \stackrel{\text{pyk}}{\rightarrow} “\text{map tag } \ast \text{ end tag}”]$$

$$\tilde{\mathcal{U}}(\ast)$$

$$[\tilde{\mathcal{U}}(x) \stackrel{\text{val}}{\rightarrow} \text{if}(x^d, x, x^T)]$$

$$[\tilde{\mathcal{U}}(\ast) \stackrel{\text{tex}}{\rightarrow} “\backslash\text{tilde } \{\{\backslash\text{cal } U\}\}(\#1.)”]$$

$$[\tilde{\mathcal{U}}(\ast) \stackrel{\text{pyk}}{\rightarrow} “\text{raw map untag } \ast \text{ end untag}”]$$

$$\mathcal{U}(\ast)$$

$$[\mathcal{U}(x) \stackrel{\text{val}}{\rightarrow} \tilde{\mathcal{U}}(x^M)]$$

$$[\mathcal{U}(\ast) \stackrel{\text{tex}}{\rightarrow} “\{\backslash\text{cal } U\}(\#1.)”]$$

$$[\mathcal{U}(\ast) \stackrel{\text{pyk}}{\rightarrow} “\text{map untag } \ast \text{ end untag}”]$$

$$\mathcal{U}^M(\ast)$$

$$[\mathcal{U}^M(x) \stackrel{\text{val}}{\Rightarrow} \mathcal{U}(x)^M]$$

$$[\mathcal{U}^M(\ast) \stackrel{\text{tex}}{\rightarrow} “\{\backslash\text{cal } U\}^M(\#1.)”]$$

$$[\mathcal{U}^M(\ast) \stackrel{\text{pyk}}{\rightarrow} “\text{normalizing untag } \ast \text{ end untag}”]$$

apply(*,*)

[**apply**(f,x) $\overset{\text{val}}{\Rightarrow}$ **apply**₁(f^M,x^M)]

[**apply**(*,*) $\overset{\text{tex}}{\rightarrow}$ “
\mathbf {apply}(\#1.
,\#2.
)”]

[**apply**(*,*) $\overset{\text{pyk}}{\rightarrow}$ “apply * to * end apply”]

apply₁(*,*)

[**apply**₁(f,x) $\overset{\text{val}}{\rightarrow}$ f^d $\left\{ \begin{array}{l} \text{If}(x^d, f, f) \\ \text{If}(x^d, \mathcal{M}(f^T, x), \mathcal{M}(f^T, (x^T)^I)) \end{array} \right.$]

[**apply**₁(*,*) $\overset{\text{tex}}{\rightarrow}$ “
\mathbf {apply}_1(\#1.
,\#2.
)”]

[**apply**₁(*,*) $\overset{\text{pyk}}{\rightarrow}$ “apply one * to * end apply”]

identifier(*)

[**identifier**(x) $\overset{\text{val}}{\rightarrow}$ If(x^t, 0, **identifier**₁(xⁱ, **identifier**(x¹)))]

[**identifier**(x) $\overset{\text{tex}}{\rightarrow}$ “
identifier(\#1.
)”]

[**identifier**(x) $\overset{\text{pyk}}{\rightarrow}$ “identifier * end identifier”]

identifier₁(*,*)

[**identifier**₁(x,y) $\overset{\text{val}}{\rightarrow}$ If(x⁶, y, x⁰ +2* [x¹ +2* [x² +2* [x³ +2* [x⁴ +2* [x⁵ +2* [F +2* [T +2* y]]]]]])]

[**identifier**₁(x,y) $\overset{\text{tex}}{\rightarrow}$ “
identifier_{1}(\#1.
, \#2.
)”]

$[\text{identifier}_1(x, y) \xrightarrow{\text{pyk}} \text{“identifier one * plus id * end identifier”}]$

array-plus(*, *)

$$[\text{array-plus}(x, y) \xrightarrow{\text{val}} x^a \left\{ \begin{array}{l} y^a \left\{ \begin{array}{l} T \\ y^{hc} \left\{ \begin{array}{l} y \\ x :: y \end{array} \right. \end{array} \right. \\ y^a \left\{ \begin{array}{l} x^{hc} \left\{ \begin{array}{l} x \\ x :: y \end{array} \right. \end{array} \right. \\ x :: y \end{array} \right. \right\}]$$

$[\text{array-plus}(x, y) \xrightarrow{\text{tex}} \text{“}$
 $\text{array}\backslash\text{mbox}\{-\}\backslash\text{linebreak}[0]\text{plus(\#1.}$
 $\text{, \#2.}$
 $\text{)”}]$

$[\text{array-plus}(x, y) \xrightarrow{\text{pyk}} \text{“array plus * and * end plus”}]$

array-remove(*, *, *)

$$[\text{array-remove}(i, a, l) \xrightarrow{\text{val}} [[i] ! [! [a^a]]] \left\{ \begin{array}{l} T \\ a^{hc} \left\{ \begin{array}{l} [a^h \approx i] \left\{ \begin{array}{l} T \\ a \end{array} \right. \\ \text{bit}(l, i) \left\{ \begin{array}{l} \text{array-plus}(\text{array-remove}(i, a^h, l + 1), a^t) \\ \text{array-plus}(a^h, \text{array-remove}(i, a^t, l + 1)) \end{array} \right. \end{array} \right. \end{array} \right\}]$$

$[\text{array-remove}(i, a, l) \xrightarrow{\text{tex}} \text{“}$
 $\text{array}\backslash\text{mbox}\{-\}\backslash\text{linebreak}[0]\text{remove(\#1.}$
 $\text{, \#2.}$
 $\text{, \#3.}$
 $\text{)”}]$

$[\text{array-remove}(i, a, l) \xrightarrow{\text{pyk}} \text{“array remove * array * level * end remove”}]$

array-put(*, *, *, *)

$$\begin{aligned}
 & [\text{array-put}(i, v, a, l) \xrightarrow{\text{val}} [[\\
 & \quad l] ! [a^a]] \left\{ \begin{array}{l} i :: v \\ a^{hc} \left\{ \begin{array}{l} [a^h \approx i] \left\{ \begin{array}{l} i :: v \\ \text{array-add}(i, v, a^h, a^t, 0) \end{array} \right. \\ \text{bit}(l, i) \left\{ \begin{array}{l} \text{array-put}(i, v, a^h, l + 1) :: [a^t] \\ a^h :: \text{array-put}(i, v, a^t, l + 1) \end{array} \right. \end{array} \right. \end{array} \right\}] \\
 & [\text{array-put}(i, v, a, l) \xrightarrow{\text{tex}} \text{“} \\
 & \text{array}\backslash\text{mbox}\{-\}\backslash\text{linebreak}[0]\text{put}(\#1. \\
 & , \#2. \\
 & , \#3. \\
 & , \#4. \\
 & \text{)”}] \\
 & [\text{array-put}(i, v, a, l) \xrightarrow{\text{pyk}} \text{“array put * value * array * level * end put”}]
 \end{aligned}$$

array-add(*, *, *, *, *)

$$\begin{aligned}
 & [\text{array-add}(i, v, i', v', l) \xrightarrow{\text{val}} [\\
 & \quad \text{bit}(l, i)] \left\{ \begin{array}{l} \text{bit}(l, i') \left\{ \begin{array}{l} \text{array-add}(i, v, i', v', l + 1) :: T \\ (i :: v)^M :: (i' :: [v'])^M \end{array} \right. \\ \text{bit}(l, i') \left\{ \begin{array}{l} (i' :: [v'])^M :: (i :: v)^M \\ T :: \text{array-add}(i, v, i', v', l + 1) \end{array} \right. \end{array} \right\}] \\
 & [\text{array-add}(i, v, i', v', l) \xrightarrow{\text{tex}} \text{“} \\
 & \text{array}\backslash\text{mbox}\{-\}\backslash\text{linebreak}[0]\text{add}(\#1. \\
 & , \#2. \\
 & , \#3. \\
 & , \#4. \\
 & , \#5. \\
 & \text{)”}] \\
 & [\text{array-add}(i, v, i', v', l) \xrightarrow{\text{pyk}} \text{“array add * value * index * value * level * end add”}]
 \end{aligned}$$

bit(*, *)

$$\begin{aligned}
 & [\text{bit}(x, y) \xrightarrow{\text{val}} \text{If}(x^c \wedge [y^c] , \text{bit}_1(x, y), T)] \\
 & [\text{bit}(x, y) \xrightarrow{\text{tex}} \text{“} \\
 & \text{bit}(\#1. \\
 & , \#2. \\
 & \text{)”}]
 \end{aligned}$$

[bit(x,y) $\xrightarrow{\text{pyk}}$ “bit * of * end bit”]

bit₁(*,*)

[bit₁(x,y) $\xrightarrow{\text{val}}$ If(x^s,y^h, bit(x − 1,y^t))]

[bit₁(x,y) $\xrightarrow{\text{tex}}$ “
bit_1(#1.
, #2.
)”]

[bit₁(x,y) $\xrightarrow{\text{pyk}}$ “bit one * of * end bit”]

rack

[rack $\xrightarrow{\text{val}}$ base[base[0]]]

[rack $\xrightarrow{\text{tex}}$ “
rack”]

[rack $\xrightarrow{\text{pyk}}$ “example rack”]

"vector"

["vector" $\xrightarrow{\text{val}}$ identifier(⌈“vector”⌋)]

["vector" $\xrightarrow{\text{tex}}$ “
\mbox {\tt \char34}\mathrm {vector}\mbox {\tt \char34}”]

["vector" $\xrightarrow{\text{pyk}}$ “vector hook”]

"bibliography"

["bibliography" $\xrightarrow{\text{val}}$ identifier(⌈“bibliography”⌋)]

["bibliography" $\xrightarrow{\text{tex}}$ “
\mbox {\tt \char34}\mathrm {bibliography}\mbox {\tt \char34}”]

["bibliography" $\xrightarrow{\text{pyk}}$ “bibliography hook”]

"dictionary"

```
["dictionary"  $\xrightarrow{\text{val}}$  identifier(⌈“dictionary”⌋)]  
["dictionary"  $\xrightarrow{\text{tex}}$  “  
\mbox {\tt \char34}\mathrm {dictionary}\mbox {\tt \char34}”]  
["dictionary"  $\xrightarrow{\text{pyk}}$  “dictionary hook”]
```

"body"

```
["body"  $\xrightarrow{\text{val}}$  identifier(⌈“body”⌋)]  
["body"  $\xrightarrow{\text{tex}}$  “  
\mbox {\tt \char34}\mathrm {body}\mbox {\tt \char34}”]  
["body"  $\xrightarrow{\text{pyk}}$  “body hook”]
```

"codex"

```
["codex"  $\xrightarrow{\text{val}}$  identifier(⌈“codex”⌋)]  
["codex"  $\xrightarrow{\text{tex}}$  “  
\mbox {\tt \char34}\mathrm {codex}\mbox {\tt \char34}”]  
["codex"  $\xrightarrow{\text{pyk}}$  “codex hook”]
```

"expansion"

```
["expansion"  $\xrightarrow{\text{val}}$  identifier(⌈“expansion”⌋)]  
["expansion"  $\xrightarrow{\text{tex}}$  “  
\mbox {\tt \char34}\mathrm {expansion}\mbox {\tt \char34}”]  
["expansion"  $\xrightarrow{\text{pyk}}$  “expansion hook”]
```

"code"

```
["code"  $\xrightarrow{\text{val}}$  identifier(⌈“code”⌋)]  
["code"  $\xrightarrow{\text{tex}}$  “  
\mbox {\tt \char34}\mathrm {code}\mbox {\tt \char34}”]
```

[`"code"` $\xrightarrow{\text{pyk}}$ `"code hook"`]

`"cache"`

[`"cache"` $\xrightarrow{\text{val}}$ `identifier(⌈"cache"⌋)`]

[`"cache"` $\xrightarrow{\text{tex}}$ `"`
`\mbox {\tt \char34}\mathrm {cache}\mbox {\tt \char34}"`]

[`"cache"` $\xrightarrow{\text{pyk}}$ `"cache hook"`]

`"diagnose"`

[`"diagnose"` $\xrightarrow{\text{val}}$ `identifier(⌈"diagnose"⌋)`]

[`"diagnose"` $\xrightarrow{\text{tex}}$ `"`
`\mbox {\tt \char34}\mathrm {diagnose}\mbox {\tt \char34}"`]

[`"diagnose"` $\xrightarrow{\text{pyk}}$ `"diagnose hook"`]

`"pyk"`

[`"pyk"` $\xrightarrow{\text{val}}$ `identifier(⌈"pyk"⌋)`]

[`"pyk"` $\xrightarrow{\text{tex}}$ `"`
`\mbox {\tt \char34}\mathrm {pyk}\mbox {\tt \char34}"`]

[`"pyk"` $\xrightarrow{\text{pyk}}$ `"pyk aspect"`]

`"tex"`

[`"tex"` $\xrightarrow{\text{val}}$ `identifier(⌈"tex"⌋)`]

[`"tex"` $\xrightarrow{\text{tex}}$ `"`
`\mbox {\tt \char34}\mathrm {tex}\mbox {\tt \char34}"`]

[`"tex"` $\xrightarrow{\text{pyk}}$ `"tex aspect"`]

`"texname"`

[`"texname"` $\xrightarrow{\text{val}}$ `identifier(⌈"texname"⌋)`]

[`"texname"` $\xrightarrow{\text{tex}}$ “`\mbox {\tt \char34}\mathrm {texname}\mbox {\tt \char34}`”]
[`"texname"` $\xrightarrow{\text{pyk}}$ “texname aspect”]

"value"

[`"value"` $\xrightarrow{\text{val}}$ `identifier(⌈“value”⌋)`]
[`"value"` $\xrightarrow{\text{tex}}$ “`\mbox {\tt \char34}\mathrm {value}\mbox {\tt \char34}`”]
[`"value"` $\xrightarrow{\text{pyk}}$ “value aspect”]

"message"

[`"message"` $\xrightarrow{\text{val}}$ `identifier(⌈“message”⌋)`]
[`"message"` $\xrightarrow{\text{tex}}$ “`\mbox {\tt \char34}\mathrm {message}\mbox {\tt \char34}`”]
[`"message"` $\xrightarrow{\text{pyk}}$ “message aspect”]

"macro"

[`"macro"` $\xrightarrow{\text{val}}$ `identifier(⌈“macro”⌋)`]
[`"macro"` $\xrightarrow{\text{tex}}$ “`\mbox {\tt \char34}\mathrm {macro}\mbox {\tt \char34}`”]
[`"macro"` $\xrightarrow{\text{pyk}}$ “macro aspect”]

"definition"

[`"definition"` $\xrightarrow{\text{val}}$ `identifier(⌈“definition”⌋)`]
[`"definition"` $\xrightarrow{\text{tex}}$ “`\mbox {\tt \char34}\mathrm {definition}\mbox {\tt \char34}`”]
[`"definition"` $\xrightarrow{\text{pyk}}$ “definition aspect”]

"unpack"

```
["unpack"  $\xrightarrow{\text{val}}$  identifier(⌈“unpack”⌋)]  
["unpack"  $\xrightarrow{\text{tex}}$  “  
\mbox {\tt \char34}\mathrm {unpack}\mbox {\tt \char34}”]  
["unpack"  $\xrightarrow{\text{pyk}}$  “unpack aspect”]
```

"claim"

```
["claim"  $\xrightarrow{\text{val}}$  identifier(⌈“claim”⌋)]  
["claim"  $\xrightarrow{\text{tex}}$  “  
\mbox {\tt \char34}\mathrm {claim}\mbox {\tt \char34}”]  
["claim"  $\xrightarrow{\text{pyk}}$  “claim aspect”]
```

"priority"

```
["priority"  $\xrightarrow{\text{val}}$  identifier(⌈“priority”⌋)]  
["priority"  $\xrightarrow{\text{tex}}$  “  
\mbox {\tt \char34}\mathrm {priority}\mbox {\tt \char34}”]  
["priority"  $\xrightarrow{\text{pyk}}$  “priority aspect”]
```

"lambda"

```
["lambda"  $\xrightarrow{\text{val}}$  identifier(⌈“lambda”⌋)]  
["lambda"  $\xrightarrow{\text{tex}}$  “  
\mbox {\tt \char34}\mathrm {\lambda}\mbox {\tt \char34}”]  
["lambda"  $\xrightarrow{\text{pyk}}$  “lambda identifier”]
```

"apply"

```
["apply"  $\xrightarrow{\text{val}}$  identifier(⌈“apply”⌋)]  
["apply"  $\xrightarrow{\text{tex}}$  “  
\mbox {\tt \char34}\mathrm {apply}\mbox {\tt \char34}”]
```


`["apply"  $\xrightarrow{\text{pyk}}$  "apply identifier"]`

`"true"`

`["true"  $\xrightarrow{\text{val}}$  identifier(["true"])]`

`["true" $\xrightarrow{\text{tex}}$ "
\mbox {\tt \char34}\mathrm {true}\mbox {\tt \char34}"]`

`["true"  $\xrightarrow{\text{pyk}}$  "true identifier"]`

`"if"`

`["if"  $\xrightarrow{\text{val}}$  identifier(["if"])]`

`["if" $\xrightarrow{\text{tex}}$ "
\mbox {\tt \char34}\mathrm {if}\mbox {\tt \char34}"]`

`["if"  $\xrightarrow{\text{pyk}}$  "if identifier"]`

`"quote"`

`["quote"  $\xrightarrow{\text{val}}$  identifier(["quote"])]`

`["quote" $\xrightarrow{\text{tex}}$ "
\mbox {\tt \char34}\mathrm {quote}\mbox {\tt \char34}"]`

`["quote"  $\xrightarrow{\text{pyk}}$  "quote identifier"]`

`"proclaim"`

`["proclaim"  $\xrightarrow{\text{val}}$  identifier(["proclaim"])]`

`["proclaim" $\xrightarrow{\text{tex}}$ "
\mbox {\tt \char34}\mathrm {proclaim}\mbox {\tt \char34}"]`

`["proclaim"  $\xrightarrow{\text{pyk}}$  "proclaim identifier"]`

`"define"`

`["define"  $\xrightarrow{\text{val}}$  identifier(["define"])]`

[`"define"` $\xrightarrow{\text{tex}}$ “`\mbox {\tt \char34}\mathrm {define}\mbox {\tt \char34}`”]
[`"define"` $\xrightarrow{\text{pyk}}$ “define identifier”]

`"introduce"`

[`"introduce"` $\xrightarrow{\text{val}}$ identifier(`["introduce"]`)]
[`"introduce"` $\xrightarrow{\text{tex}}$ “`\mbox {\tt \char34}\mathrm {introduce}\mbox {\tt \char34}`”]
[`"introduce"` $\xrightarrow{\text{pyk}}$ “introduce identifier”]

`"hide"`

[`"hide"` $\xrightarrow{\text{val}}$ identifier(`["hide"]`)]
[`"hide"` $\xrightarrow{\text{tex}}$ “`\mbox {\tt \char34}\mathrm {hide}\mbox {\tt \char34}`”]
[`"hide"` $\xrightarrow{\text{pyk}}$ “hide identifier”]

`"pre"`

[`"pre"` $\xrightarrow{\text{val}}$ identifier(`["pre"]`)]
[`"pre"` $\xrightarrow{\text{tex}}$ “`\mbox {\tt \char34}\mathrm {pre}\mbox {\tt \char34}`”]
[`"pre"` $\xrightarrow{\text{pyk}}$ “pre identifier”]

`"post"`

[`"post"` $\xrightarrow{\text{val}}$ identifier(`["post"]`)]
[`"post"` $\xrightarrow{\text{tex}}$ “`\mbox {\tt \char34}\mathrm {post}\mbox {\tt \char34}`”]
[`"post"` $\xrightarrow{\text{pyk}}$ “post identifier”]

$$\mathcal{E}(*, *, *)$$

$$[\mathcal{E}(t, s, c) \xrightarrow{\text{val}} \mathcal{E}_2(t, t^r, t^i, s, c)]$$

$$\begin{aligned} & [\mathcal{E}(*, *, *) \xrightarrow{\text{tex}} \text{“} \\ & \{\backslash \text{cal } E\}(\#1. \\ & , \#2. \\ & , \#3. \\ &)”] \end{aligned}$$

$$[\mathcal{E}(*, *, *) \xrightarrow{\text{pyk}} \text{“eval * stack * cache * end eval”}]$$

$$\mathcal{E}_2(*, *, *, *, *)$$

$$[\mathcal{E}_2(t, r, i, s, c) \xrightarrow{\text{val}} i^s \left\{ \begin{array}{l} t! \left[\textcolor{blue}{s!} \text{If}(r \approx \left[\textcolor{blue}{c[0]} \right], c, c[c[0]]["\text{cache}"][r]) \right] \\ \mathcal{E}_3(t, c[r]["\text{code}"][i], s, c) \end{array} \right\}]$$

$$\begin{aligned} & [\mathcal{E}_2(*, *, *, *, *) \xrightarrow{\text{tex}} \text{“} \\ & \{\backslash \text{cal } E\}_2(\#1. \\ & , \#2. \\ & , \#3. \\ & , \#4. \\ & , \#5. \\ &)”] \end{aligned}$$

$$[\mathcal{E}_2(*, *, *, *, *) \xrightarrow{\text{pyk}} \text{“eval two * ref * id * stack * cache * end eval”}]$$

$$\mathcal{E}_3(*, *, *, *)$$

$$[\mathcal{E}_3(t, f, s, c) \xrightarrow{\text{val}} f^c \left\{ \begin{array}{l} f^s \left\{ \begin{array}{l} \mathbf{abstract}(t^1, t^2, s, c) \\ c! \left[\textcolor{blue}{s!} \left[\textcolor{blue}{t^1} \right] \right] \end{array} \right. \\ f \left\{ \begin{array}{l} c!\mathbf{lookup}(t, s, T) \\ \mathcal{E}_4(f, t^t, s, c) \end{array} \right. \end{array} \right\}]$$

$$\begin{aligned} & [\mathcal{E}_3(*, *, *, *) \xrightarrow{\text{tex}} \text{“} \\ & \{\backslash \text{cal } E\}_3(\#1. \\ & , \#2. \\ & , \#3. \\ & , \#4. \\ &)”] \end{aligned}$$

$$[\mathcal{E}_3(*, *, *, *) \xrightarrow{\text{pyk}} \text{“eval three * function * stack * cache * end eval”}]$$

$\mathcal{E}_4(*, *, *, *)$

$[\mathcal{E}_4(f, a, s, c) \xrightarrow{\text{val}} \text{If}(a, s! \text{ [c!f] }, \mathcal{E}_4(\mathbf{apply}(f, \mathcal{E}(a^h, s, c)), a^t, s, c))]$

$[\mathcal{E}_4(*, *, *, *) \xrightarrow{\text{tex}} “$
 $\{\backslash\text{cal E}\}_4(\#1.$
 $, \#2.$
 $, \#3.$
 $, \#4.$
 $)”]$

$[\mathcal{E}_4(*, *, *, *) \xrightarrow{\text{pyk}} “\text{eval four } * \text{ arguments } * \text{ stack } * \text{ cache } * \text{ end eval}”]$

$\mathbf{lookup}(*, *, *)$

$[\mathbf{lookup}(v, s, d) \xrightarrow{\text{val}} v! \text{ [d!If}(s, d, \text{If}(v \stackrel{t}{=} \text{ [s}^{hh} \text{] }, s^{ht}, \mathbf{lookup}(v, s^t, d))) \text{] }]$

$[\mathbf{lookup}(*, *, *) \xrightarrow{\text{tex}} “$
 $\backslash\text{mathbf {lookup}}(\#1.$
 $, \#2.$
 $, \#3.$
 $)”]$

$[\mathbf{lookup}(*, *, *) \xrightarrow{\text{pyk}} “\text{lookup } * \text{ stack } * \text{ default } * \text{ end lookup}”]$

$\mathbf{abstract}(*, *, *, *)$

$[\mathbf{abstract}(v, t, s, c) \xrightarrow{\text{val}} v! \text{ [t! [s! [c!\Lambda\lambda x. \mathcal{E}(t, (v :: x)^M :: s, c)]]] }]$

$[\mathbf{abstract}(*, *, *, *) \xrightarrow{\text{tex}} “$
 $\backslash\text{mathbf {abstract}}(\#1.$
 $, \#2.$
 $, \#3.$
 $, \#4.$
 $)”]$

$[\mathbf{abstract}(*, *, *, *) \xrightarrow{\text{pyk}} “\text{abstract } * \text{ term } * \text{ stack } * \text{ cache } * \text{ end abstract}”]$

$[*]$

Predef: quote

$[[*] \xrightarrow{\text{tex}} “$

\lceil #1.

\rceil ”]

[[*] $\xrightarrow{\text{pyk}}$ “quote * end quote”]

$\mathcal{M}(*, *, *)$

$[\mathcal{M}(t, s, c) \xrightarrow{\text{val}} s! \text{ [c!If}(t^{\text{is}}, t, \mathcal{M}_2(t, \text{aspect}(\text{"macro"}, t, c), s, c)) \text{] }]$

$[\mathcal{M}(*, *, *) \xrightarrow{\text{tex}}$ “
 $\{\backslash\text{cal M}\}(\#1.$
 $, \#2.$
 $, \#3.$
 $)”]$

$[\mathcal{M}(*, *, *) \xrightarrow{\text{pyk}}$ “expand * state * cache * end expand”]

$\mathcal{M}_2(*, *, *, *)$

$[\mathcal{M}_2(t, d, s, c) \xrightarrow{\text{val}} d \left\{ \begin{array}{l} t^h :: \mathcal{M}^*(t^t, s, c) \\ \mathcal{U}^M(\text{ [[} \mathcal{E}(d^3, T, c) \text{ ‘ } t \text{ ‘ } s \text{ ‘ } c) \text{] }] \end{array} \right.$

$[\mathcal{M}_2(*, *, *, *) \xrightarrow{\text{tex}}$ “
 $\{\backslash\text{cal M}\}_2(\#1.$
 $, \#2.$
 $, \#3.$
 $, \#4.$
 $)”]$

$[\mathcal{M}_2(*, *, *, *) \xrightarrow{\text{pyk}}$ “expand two * definition * state * cache * end expand”]

$\mathcal{M}^*(*, *, *)$

$[\mathcal{M}^*(a, s, c) \xrightarrow{\text{val}} s! \text{ [c!If}(a, T, \mathcal{M}(a^h, s, c) :: \mathcal{M}^*(a^t, s, c)) \text{] }]$

$[\mathcal{M}^*(*, *, *) \xrightarrow{\text{tex}}$ “
 $\{\backslash\text{cal M}\}^*(\#1.$
 $, \#2.$
 $, \#3.$
 $)”]$

$[\mathcal{M}^*(*, *, *) \xrightarrow{\text{pyk}}$ “expand list * state * cache * end expand”]

macro

Predef: macro

[macro $\overset{\text{tex}}{\rightarrow}$ “
\mathrm {macro}”]

[macro $\overset{\text{pyk}}{\rightarrow}$ “macro”]

S₀

[s₀ $\overset{\text{val}}{\rightarrow}$ $\mathcal{M}(\lambda t.\lambda s.\lambda c.\mathcal{M}(t,s,c)) :: T$]

[s₀ $\overset{\text{tex}}{\rightarrow}$ “
s_0”]

[s₀ $\overset{\text{pyk}}{\rightarrow}$ “macro state”]

zip(*,*)

[**zip**(p,a) $\overset{\text{val}}{\rightarrow}$ a!If(p,T,(p^h :: [a^h])^M :: **zip**(p^t,a^t))]

[**zip**(*,*) $\overset{\text{tex}}{\rightarrow}$ “
\mathbf {zip}(\#1.
,\#2.
)”]

[**zip**(*,*) $\overset{\text{pyk}}{\rightarrow}$ “zip * with * end zip”]

assoc₁(*,*,*)

[**assoc**₁(a,d,i) $\overset{\text{val}}{\rightarrow}$ a^a $\left\{ \begin{array}{l} d! [i!T] \\ a^{hc} \left\{ \begin{array}{l} [i \approx [a^h]] \left\{ \begin{array}{l} d! [a^t] \\ d!T \end{array} \right\} \\ d^h \left\{ \begin{array}{l} \text{assoc}_1(a^h,d^t,i) \\ \text{assoc}_1(a^t,d^t,i) \end{array} \right\} \end{array} \right\} \end{array} \right]$

[**assoc**₁(*,*,*) $\overset{\text{tex}}{\rightarrow}$ “
\mathbf {assoc}_1(\#1.
,\#2.
,\#3.
)”]

[**assoc**₁(*,*,*) $\overset{\text{pyk}}{\rightarrow}$ “assoc one * address * index * end assoc”]

$(*)^{\mathbf{P}}$

$[(x)^{\mathbf{P}} \xrightarrow{\text{macro}} \lambda t. \lambda s. \lambda c. \textcolor{blue}{[t^1]})]$

$[(*)^{\mathbf{P}} \xrightarrow{\text{tex}} “(\#1.$
 $)^{\wedge \{\backslash\mathrm{mathbf}{p}\}}”]$

$[(*)^{\mathbf{P}} \xrightarrow{\text{pyk}} “\text{protect } * \text{ end protect}”]$

self

$[\text{self} \xrightarrow{\text{macro}} \lambda t. \lambda s. \lambda c. \textcolor{blue}{[(c[0] :: [0 :: \textcolor{blue}{[t^d]}])^I :: \mathbf{T}]}]$

$[\text{self} \xrightarrow{\text{pyk}} “\text{self}”]$

$[* \ddot{=} *]$

$[[x \ddot{=} y] \xrightarrow{\text{macro}} \lambda t. \lambda s. \lambda c. \tilde{\mathcal{M}}_3(t)]$

$[[* \ddot{=} *] \xrightarrow{\text{tex}} “$
 $[\#1/\text{tex name}/\text{tex.}$
 $\backslash\mathrm{mathrel}{\{\ddot{=}\}}\#2.$
 $]”]$

$[[* \ddot{=} *] \xrightarrow{\text{pyk}} \text{macrodefine } * \text{ as } * \text{ enddefine}]$

$[* \dot{=} *]$

$[[x \dot{=} y] \xrightarrow{\text{macro}} \lambda t. \lambda s. \lambda c. \tilde{\mathcal{M}}_4(t, s, c, [[x \dot{=} y] \ddot{=} [(x)^{\mathbf{P}} \xrightarrow{\text{val}} y]])]$

$[[* \dot{=} *] \xrightarrow{\text{tex}} “$
 $[\#1/\text{tex name}/\text{tex.}$
 $\backslash\mathrm{mathrel}{\{\dot{=}\}}\#2.$
 $]”]$

$[[* \dot{=} *] \xrightarrow{\text{pyk}} “\text{value define } * \text{ as } * \text{ end define}”]$

$[* \acute{=} *]$

$[[x \acute{=} y] \xrightarrow{\text{macro}} \lambda t. \lambda s. \lambda c. \tilde{\mathcal{M}}_4(t, s, c, [[x \acute{=} y] \ddot{=} [(x)^{\mathbf{P}} \xrightarrow{\text{val}} y]])]$

$[[* \acute{=} *] \xrightarrow{\text{tex}} “$

[#1/tex name/tex.

\mathrel {\acute {=}}\}#2.

]”]

[[* $\stackrel{\text{pyk}}{=}$ *] $\stackrel{\text{pyk}}{\rightarrow}$ “intro define * as * end define”]

[* $\stackrel{\text{pyk}}{=}$ *]

[[x $\stackrel{\text{pyk}}{=}$ y] $\stackrel{\text{macro}}{\rightarrow}$ $\lambda t.\lambda s.\lambda c.\tilde{\mathcal{M}}_4(t, s, c, \llbracket [x \stackrel{\text{pyk}}{=}$ y] $\doteq$ [(x)^p $\stackrel{\text{pyk}}{\rightarrow}$ y]]\rrbracket)]

[[* $\stackrel{\text{pyk}}{=}$ *] $\stackrel{\text{tex}}{\rightarrow}$ “

[#1/tex name/tex.

\stackrel{\text{pyk}}{=}\{\mathrm {pyk}\}\{=\} \} #2/tex name.

]”]

[[* $\stackrel{\text{pyk}}{=}$ *] $\stackrel{\text{pyk}}{\rightarrow}$ “pyk define * as * end define”]

[* $\stackrel{\text{tex}}{=}$ *]

[[x $\stackrel{\text{tex}}{=}$ y] $\stackrel{\text{macro}}{\rightarrow}$ $\lambda t.\lambda s.\lambda c.\tilde{\mathcal{M}}_4(t, s, c, \llbracket [x \stackrel{\text{tex}}{=}$ y] $\doteq$ [(x)^p $\stackrel{\text{tex}}{\rightarrow}$ y]]\rrbracket)]

[[* $\stackrel{\text{tex}}{=}$ *] $\stackrel{\text{tex}}{\rightarrow}$ “

[#1/tex name/tex.

\stackrel{\text{tex}}{=}\{\mathrm {tex}\}\{=\} \} #2/tex name.

]”]

[[* $\stackrel{\text{tex}}{=}$ *] $\stackrel{\text{pyk}}{\rightarrow}$ “tex define * as * end define”]

[* $\stackrel{\text{name}}{=}$ *]

[[x $\stackrel{\text{name}}{=}$ y] $\stackrel{\text{macro}}{\rightarrow}$ $\lambda t.\lambda s.\lambda c.\tilde{\mathcal{M}}_4(t, s, c, \llbracket [x \stackrel{\text{name}}{=}$ y] $\doteq$ [(x)^p $\stackrel{\text{name}}{\rightarrow}$ y]]\rrbracket)]

[[* $\stackrel{\text{name}}{=}$ *] $\stackrel{\text{tex}}{\rightarrow}$ “

[#1/tex name/tex.

\stackrel{\text{name}}{=}\{\mathrm {name}\}\{=\} \} #2/tex name.

]”]

[[* $\stackrel{\text{name}}{=}$ *] $\stackrel{\text{pyk}}{\rightarrow}$ “tex name define * as * end define”]

Priority table[*]

[Priority table[x] $\xrightarrow{\text{name}}$ “
\mathbf{Priority\ table} [#1.
]”]

[Priority table[x] $\xrightarrow{\text{macro}}$ $\lambda t.\lambda s.\lambda c.\tilde{\mathcal{M}}_4(t, s, c, \lceil [\text{Priority table}[x] \doteq [\text{self} \xrightarrow{\text{prio}}$
(x)^p]]])]

[Priority table[x] $\xrightarrow{\text{tex}}$ “
\mathbf{Priority\ table} #1.
\mathbf{End\ table}”]

[Priority table[x] $\xrightarrow{\text{pyk}}$ “priority table * end table”]

$\tilde{\mathcal{M}}_1$

[$\tilde{\mathcal{M}}_1 \xrightarrow{\text{val}}$ $\lceil [x \xrightarrow{\text{macro}} \lambda t.\lambda s.\lambda c.\tilde{\mathcal{M}}_4(t, s, c, \lceil d \rceil)] \rceil]$]

[$\tilde{\mathcal{M}}_1 \xrightarrow{\text{tex}}$ “
\tilde { {\cal M} }_1”]

[$\tilde{\mathcal{M}}_1 \xrightarrow{\text{pyk}}$ “macro define one”]

$\tilde{\mathcal{M}}_2(*)$

[$\tilde{\mathcal{M}}_2(t) \xrightarrow{\text{val}}$ $([x] :: [\textcolor{blue}{t}^1])^M :: [([d] :: t)^M :: \textcolor{blue}{T}]$]

[$\tilde{\mathcal{M}}_2(*) \xrightarrow{\text{tex}}$ “
\tilde { {\cal M} }_2(#1.
)”]

[$\tilde{\mathcal{M}}_2(*) \xrightarrow{\text{pyk}}$ “macro define two * end define”]

$\tilde{\mathcal{M}}_3(*)$

[$\tilde{\mathcal{M}}_3(t) \xrightarrow{\text{val}}$ $\tilde{\mathcal{Q}}(t, \tilde{\mathcal{M}}_1, \tilde{\mathcal{M}}_2(t))]$

[$\tilde{\mathcal{M}}_3(*) \xrightarrow{\text{tex}}$ “
\tilde { {\cal M} }_3(#1.
)”]

[$\tilde{\mathcal{M}}_3(*) \xrightarrow{\text{pyk}}$ “macro define three * end define”]

$$\tilde{\mathcal{M}}_4(*, *, *, *)$$

$$[\tilde{\mathcal{M}}_4(\mathbf{t}, \mathbf{s}, \mathbf{c}, \mathbf{d}) \xrightarrow{\text{val}} \tilde{\mathcal{M}}(\tilde{Q}(\mathbf{t}, \mathbf{d}^2, \mathbf{zip}(\mathbf{d}^{1\mathbf{t}}, \mathbf{t}^{\mathbf{t}})), \mathbf{s}, \mathbf{c})]$$

$$[\tilde{\mathcal{M}}_4(*, *, *, *) \xrightarrow{\text{tex}} “$$

$$\backslash\text{tilde} \{ \{ \backslash\text{cal M} \} \}_4(\#1.$$

$$, \#2.$$

$$, \#3.$$

$$, \#4.$$

$$)”]$$

$$[\tilde{\mathcal{M}}_4(*, *, *, *) \xrightarrow{\text{pyk}} “\text{macro define four } * \text{ state } * \text{ cache } * \text{ definition } * \text{ end define}”]$$

$$\tilde{\mathcal{M}}(*, *, *)$$

$$[\tilde{\mathcal{M}}(\mathbf{t}, \mathbf{s}, \mathbf{c}) \xrightarrow{\text{val}} \mathcal{U}([[\text{ s}^{\text{h}} \text{ ‘ t }] \text{ ‘ s }] \text{ ‘ c})]$$

$$[\tilde{\mathcal{M}}(*, *, *) \xrightarrow{\text{tex}} “$$

$$\backslash\text{tilde} \{ \{ \backslash\text{cal M} \} \}(\#1.$$

$$, \#2.$$

$$, \#3.$$

$$)”]$$

$$[\tilde{\mathcal{M}}(*, *, *) \xrightarrow{\text{pyk}} “\text{state expand } * \text{ state } * \text{ cache } * \text{ end expand}”]$$

$$\tilde{Q}(*, *, *)$$

$$[\tilde{Q}(\mathbf{r}, \mathbf{t}, \mathbf{s}) \xrightarrow{\text{val}} \tilde{Q}_2(\mathbf{r}^{\mathbf{d}}, \mathbf{t}, \mathbf{s})]$$

$$[\tilde{Q}(*, *, *) \xrightarrow{\text{tex}} “$$

$$\backslash\text{tilde} \{ \{ \backslash\text{cal Q} \} \}(\#1.$$

$$, \#2.$$

$$, \#3.$$

$$)”]$$

$$[\tilde{Q}(*, *, *) \xrightarrow{\text{pyk}} “\text{quote expand } * \text{ term } * \text{ stack } * \text{ end expand}”]$$

$$\tilde{Q}_2(*, *, *)$$

$$[\tilde{Q}_2(\mathbf{r}, \mathbf{t}, \mathbf{s}) \xrightarrow{\text{val}} \tilde{Q}_3(\mathbf{r}, \mathbf{t}, \mathbf{s}, \mathbf{lookup}(\mathbf{t}, \mathbf{s}, \mathbf{T}))]$$

$$[\tilde{Q}_2(*, *, *) \xrightarrow{\text{tex}} “$$

$$\backslash\text{tilde} \{ \{ \backslash\text{cal Q} \} \}_2(\#1.$$

, #2.
, #3.
)”]

[$\tilde{Q}_2(*, *, *) \xrightarrow{\text{pyk}}$ “quote expand two * term * stack * end expand”]

$\tilde{Q}_3(*, *, *, *)$

[$\tilde{Q}_3(r, t, s, v) \xrightarrow{\text{val}} v \left\{ \begin{array}{l} (t^r :: [t^i :: r])^M :: \tilde{Q}^*(r, t^t, s) \\ r! [t! [s!v]] \end{array} \right\}$]

[$\tilde{Q}_3(*, *, *, *) \xrightarrow{\text{tex}}$ “
\tilde { {\cal Q} }_3(#1.
, #2.
, #3.
, #4.
)”]

[$\tilde{Q}_3(*, *, *, *) \xrightarrow{\text{pyk}}$ “quote expand three * term * stack * value * end expand”]

$\tilde{Q}^*(*, *, *)$

[$\tilde{Q}^*(r, t, s) \xrightarrow{\text{val}} t \left\{ \begin{array}{l} r! [t! [s!T]] \\ \tilde{Q}_2(r, t^h, s) :: \tilde{Q}^*(r, t^t, s) \end{array} \right\}$]

[$\tilde{Q}^*(*, *, *) \xrightarrow{\text{tex}}$ “
\tilde { {\cal Q} }^*(#1.
, #2.
, #3.
)”]

[$\tilde{Q}^*(*, *, *) \xrightarrow{\text{pyk}}$ “quote expand star * term * stack * end expand”]

(*)

[$(x) \xrightarrow{\text{macro}} \lambda t. \lambda s. \lambda c. \tilde{\mathcal{M}}_4(t, s, c, [[(x) \doteq x]])$]

[$(*) \xrightarrow{\text{tex}}$ “
(#1.
)”]

[$(*) \xrightarrow{\text{pyk}}$ “parenthesis * end parenthesis”]

aspect(*,*)

[**aspect**(a,c) $\xrightarrow{\text{val}}$ a^c { c[0][a]
c[a^r][aⁱ] }]

[**aspect**(a,c) $\xrightarrow{\text{tex}}$ “
\mathbf{aspect}(\ #1.
, \ #2.
)”]

[**aspect**(a,c) $\xrightarrow{\text{pyk}}$ “aspect * subcodex * end aspect”]

aspect(*,*,*)

[**aspect**(a,t,c) $\xrightarrow{\text{val}}$ **aspect**(a,c[t^r][“codex”][t^r][tⁱ])]

[**aspect**(*,*,*) $\xrightarrow{\text{tex}}$ “
\mathbf{aspect}(\ #1.
, \ #2.
, \ #3.
)”]

[**aspect**(a,t,c) $\xrightarrow{\text{pyk}}$ “aspect * term * cache * end aspect”]

⟨*⟩

[⟨x⟩ $\xrightarrow{\text{macro}}$ λt.λs.λc. $\tilde{\mathcal{M}}$ (**tuple**₁(t),s,c)]

[⟨*⟩ $\xrightarrow{\text{tex}}$ “
\langle \ #1.
\rangle ”]

[⟨x⟩ $\xrightarrow{\text{pyk}}$ “tuple * end tuple”]

tuple₁(*)

[**tuple**₁(t) $\xrightarrow{\text{val}}$ [t¹ $\stackrel{\text{r}}{=}$ [x,y]] { $\tilde{\mathcal{Q}}$ (t,[x :: ⟨y⟩],**tuple**₂(t¹))
 $\tilde{\mathcal{Q}}$ (t,[x :: T], [[x] :: [t¹]] :: T) }]

[**tuple**₁(*) $\xrightarrow{\text{tex}}$ “
\mathbf{tuple}_1(\ #1.
)”]

[**tuple**₁(t) $\xrightarrow{\text{pyk}}$ “tuple one * end tuple”]

tuple₂(*)

[**tuple₂**(t) $\xrightarrow{\text{val}}$ [[x] :: [t¹]] :: [[[y] :: [t²]] :: T]]

[**tuple₂**(*) $\xrightarrow{\text{tex}}$ “
\mathbf {tuple}_2(#1.
) ”]

[**tuple₂**(t) $\xrightarrow{\text{pyk}}$ “tuple two * end tuple”]

let₂(*, *)

[let₂(f, y) $\xrightarrow{\text{val}}$ (y! [f ’ y])^I]

[let₂(f, y) $\xrightarrow{\text{tex}}$ “
let_2(#1.
, #2.
)”]

[let₂(f, y) $\xrightarrow{\text{pyk}}$ “let two * apply * end let”]

let₁(*, *)

[let₁(f, y) $\xRightarrow{\text{val}}$ let₂(f, y^M)^M]

[let₁(f, y) $\xrightarrow{\text{tex}}$ “
let_1(#1.
, #2.
)”]

[let₁(f, y) $\xrightarrow{\text{pyk}}$ “let one * apply * end let”]

[* $\stackrel{\text{claim}}{=}$ *]

[[x $\stackrel{\text{claim}}{=}$ y] $\xrightarrow{\text{macro}}$ λt.λs.λc. $\tilde{\mathcal{M}}_4$ (t, s, c, [[x $\stackrel{\text{claim}}{=}$ y] $\ddot{=}$ [x $\xrightarrow{\text{claim}}$ y]])]

[[* $\stackrel{\text{claim}}{=}$ *] $\xrightarrow{\text{tex}}$ “
[#1/tex name/tex.
\stackrel{rel}{\{claim\}}{=} #2.
]”]

[[x $\stackrel{\text{claim}}{=}$ y] $\xrightarrow{\text{pyk}}$ “claim define * as * end define”]

checker

[checker $\overset{\text{val}}{\rightarrow} \lambda t. \lambda c. \mathbf{check}(t, c)$]

[checker $\overset{\text{pyk}}{\rightarrow}$ “checker”]

check(*, *)

[**check**(t, c) $\overset{\text{val}}{\rightarrow}$ If(t^{is} , c! T , **check**₂(t, c, **aspect**(“claim”, t, c)))]

[**check**(*, *) $\overset{\text{tex}}{\rightarrow}$ “
\mathbf{check}(#1.
, #2.
)”]

[**check**(t, c) $\overset{\text{pyk}}{\rightarrow}$ “check * cache * end check”]

check₂(*, *, *)

[**check**₂(t, c, d) $\overset{\text{val}}{\rightarrow}$ d { **check**₃(t, c, **aspect**(“definition”, t, c))
 $\mathcal{U}^M([\mathcal{E}(d^3, T, c) \text{ ‘ t ’ } c)$ }]

[**check**₂(*, *, *) $\overset{\text{tex}}{\rightarrow}$ “
\mathbf{check}_2(#1.
, #2.
, #3.
)”]

[**check**₂(t, c, d) $\overset{\text{pyk}}{\rightarrow}$ “check two * cache * def * end check”]

check₃(*, *, *)

[**check**₃(t, c, d) $\overset{\text{val}}{\rightarrow}$ If(d, **check**^{*}(t^t, c), t! [c! T])]

[**check**₃(*, *, *) $\overset{\text{tex}}{\rightarrow}$ “
\mathbf{check}_3(#1.
, #2.
, #3.
)”]

[**check**₃(t, c, d) $\overset{\text{pyk}}{\rightarrow}$ “check three * cache * def * end check”]

check^{*}(*,*)

[**check^{*}**(t,c) $\xrightarrow{\text{val}}$ If(t,c! $\top$,**check₂^{*}**(t^t,c,**check**(t^h,c)))]

[**check^{*}**(*,*) $\xrightarrow{\text{tex}}$ “
\mathbf{check}^{*}(#1.
, #2.
)”]

[**check^{*}**(t,c) $\xrightarrow{\text{pyk}}$ “check list * cache * end check”]

check₂^{*}(*,*,*)

[**check₂^{*}**(t,c,v) $\xrightarrow{\text{val}}$ If($\neg$ v,t! [c! $\vee$], **check^{*}**(t,c))]

[**check₂^{*}**(*,*,*) $\xrightarrow{\text{tex}}$ “
\mathbf{check}^{*}₂(#1.
, #2.
, #3.
)”]

[**check₂^{*}**(t,c,v) $\xrightarrow{\text{pyk}}$ “check list two * cache * value * end check”]

[*].

[[t]. $\xrightarrow{\text{claim}}$ $\lambda t.\lambda c.\text{if}(\mathcal{U}(\mathcal{E}(t^1, \top, c)), \top, t)$]

[[*]. $\xrightarrow{\text{tex}}$ “
\relax [#1.
\relax]^{\cdot}”]

[[t]. $\xrightarrow{\text{pyk}}$ “test * end test”]

[*]−

[[x]− $\xrightarrow{\text{claim}}$ $\lambda t.\lambda c.\text{if}(\mathcal{U}(\mathcal{E}(t^1, \top, c)), t, \top)$]

[[x]− $\xrightarrow{\text{tex}}$ “
\relax [#1.
\relax]^{-}”]

[[x]− $\xrightarrow{\text{pyk}}$ “false test * end test”]

$[*]^\circ$

$[[t]^\circ \xrightarrow{\text{claim}} \lambda t. \lambda c. \mathcal{U}(\mathcal{E}(t^1, T, c))]$

$[[*]^\circ \xrightarrow{\text{tex}} “$
 $\backslash\text{relax } [\#1.$
 $\backslash\text{relax }]^{\wedge}\{\backslash\text{circ}\} ”]$

$[[t]^\circ \xrightarrow{\text{pyk}} “\text{raw test } * \text{ end test}”]$

msg

Predef: message

$[\text{msg} \xrightarrow{\text{tex}} “$
 $\text{msg}”]$

$[\text{msg} \xrightarrow{\text{pyk}} “\text{message}”]$

$[* \stackrel{\text{msg}}{=} *]$

$[[x \stackrel{\text{msg}}{=} y] \xrightarrow{\text{macro}} \lambda t. \lambda s. \lambda c. \tilde{\mathcal{M}}_4(t, s, c, [[[x \stackrel{\text{msg}}{=} y] \ddot{=} [(x)^{\mathbf{p}} \xrightarrow{\text{msg}} y]]])]$

$[[x \stackrel{\text{msg}}{=} y] \xrightarrow{\text{tex}} “$
 $\#1/\text{tex name}/\text{tex}.$
 $\backslash\text{stackrel } \{\text{msg}\}\{=\} \#2.$
 $]”]$

$[[x \stackrel{\text{msg}}{=} y] \xrightarrow{\text{pyk}} “\text{message define } * \text{ as } * \text{ end define}”]$

<stmt>

$[<\text{stmt}> \xrightarrow{\text{val}} [<\text{stmt}>]]$

$[<\text{stmt}> \xrightarrow{\text{tex}} “$
 $\{<\} \text{stmt}\{>\}”]$

$[<\text{stmt}> \xrightarrow{\text{pyk}} “\text{the statement aspect}”]$

stmt

$[\text{stmt} \xrightarrow{\text{msg}} <\text{stmt}>]$

[stmt $\xrightarrow{\text{tex}}$ “
stmt”]

[stmt $\xrightarrow{\text{pyk}}$ “statement”]

[* $\stackrel{\text{stmt}}{=} *$]

[[x $\stackrel{\text{stmt}}{=} y$] $\xrightarrow{\text{macro}}$ $\lambda t.\lambda s.\lambda c.\tilde{\mathcal{M}}_4(t, s, c, [[x \stackrel{\text{stmt}}{=} y] \doteq [(x)^{\mathbf{p}} \stackrel{\text{stmt}}{\rightarrow} y]])]$

[[x $\stackrel{\text{stmt}}{=} y$] $\xrightarrow{\text{tex}}$ “
#1/tex name/tex.
\stackrel{rel}{\{stmt\}}\{=\}\#2.
]”]

[[x $\stackrel{\text{stmt}}{=} y$] $\xrightarrow{\text{pyk}}$ “statement define * as * end define”]

HeadNil'

[HeadNil' $\xrightarrow{\text{macro}}$ $\lambda t.\lambda s.\lambda c.\tilde{\mathcal{M}}_4(t, s, c, [[\text{HeadNil}' \doteq \mathbf{T}^{\mathbf{h}} = \mathbf{T}]]])]$

[HeadNil' $\xrightarrow{\text{tex}}$ “
HeadNil'”]

[HeadNil' $\xrightarrow{\text{pyk}}$ “example axiom”]

HeadPair'

[HeadPair' $\xrightarrow{\text{macro}}$ $\lambda t.\lambda s.\lambda c.\tilde{\mathcal{M}}_4(t, s, c, [[\text{HeadPair}' \doteq \forall \mathcal{A}:\forall \mathcal{B}: [(\mathcal{A} :: \mathcal{B})^{\mathbf{h}} = \mathcal{A}]]])]$

[HeadPair' $\xrightarrow{\text{tex}}$ “
HeadPair'”]

[HeadPair' $\xrightarrow{\text{pyk}}$ “example scheme”]

Transitivity'

[Transitivity' $\xrightarrow{\text{macro}}$ $\lambda t.\lambda s.\lambda c.\tilde{\mathcal{M}}_4(t, s, c, [[\text{Transitivity}' \doteq \forall \mathcal{A}:\forall \mathcal{B}:\forall \mathcal{C}: [[\mathcal{A} = \mathcal{B}] \vdash [[\mathcal{A} = \mathcal{C}] \vdash [\mathcal{B} = \mathcal{C}]]]]])]$

[Transitivity' $\xrightarrow{\text{tex}}$ “
Transitivity'”]

[Transitivity' $\xrightarrow{\text{pyk}}$ “example rule”]

$\perp\!\!\!\perp$

$[\perp \xrightarrow{\text{val}} [\perp]^R :: \mathsf{T}]$

$[\perp \xrightarrow{\text{tex}} “\makebox[0mm][l]{\$\bot \$}\,,\{\bot\}”]$

$[\perp \xrightarrow{\text{pyk}} “\text{absurdity}”]$

Contra'

$[\text{Contra}' \xrightarrow{\text{macro}} \lambda t.\lambda s.\lambda c.\tilde{\mathcal{M}}_4(t,s,c,[[[\text{Contra}' \doteq [\ [\mathsf{T} :: \mathsf{T}] = \mathsf{T}] \vdash \perp]])]$

$[\text{Contra}' \xrightarrow{\text{tex}} “\text{Contra}”]$

$[\text{Contra}' \xrightarrow{\text{pyk}} “\text{contraexample}”]$

T'_{E}

$[\mathsf{T}'_{\text{E}} \xrightarrow{\text{stmt}} [\mathsf{T}^h = \mathsf{T}] \oplus [\ [\forall \underline{a}:\forall \underline{b}:\ [\ [\underline{a} :: \underline{b}]^h = \underline{a}]] \oplus [\ [\forall \underline{a}:\forall \underline{b}:\forall \underline{c}:\ [\ [\underline{a} = \underline{b}] \vdash [\ [\underline{a} = \underline{c}] \vdash [\underline{b} = \underline{c}]]]]] \oplus [\ [\ [\mathsf{T} :: \mathsf{T}] = \mathsf{T}] \vdash \perp]]]]$

$[\mathsf{T}'_{\text{E}} \xrightarrow{\text{tex}} “\mathsf{T}'_{\text{-}\{E\}}”]$

$[\mathsf{T}'_{\text{E}} \xrightarrow{\text{pyk}} “\text{example theory primed}”]$

L_1

$[\mathsf{L}_1 \xrightarrow{\text{stmt}} \mathsf{T}'_{\text{E}} \vdash \forall \underline{a}:\forall \underline{b}:\ [\ [\underline{a} = \underline{b}] \vdash [\underline{b} = \underline{a}]]]]$

$[\mathsf{L}_1 \xrightarrow{\text{tex}} “\mathsf{L}_{\text{-}\{1\}}”]$

$[\mathsf{L}_1 \xrightarrow{\text{pyk}} “\text{example lemma}”]$

$\ast$

$[\underline{x} \xrightarrow{\text{tex}} “\underline{\text{\#1.}}”]$

$[\underline{x} \xrightarrow{\text{pyk}} “\text{metavar } \ast \text{ end metavar}”]$

$\mathcal{A}$

$$[\mathcal{A} \xrightarrow{\text{macro}} \lambda t. \lambda s. \lambda c. \tilde{\mathcal{M}}_4(t, s, c, \llbracket [\mathcal{A} \doteq \underline{a}] \rrbracket)]$$

$$[\mathcal{A} \xrightarrow{\text{tex}} “\{\backslash\text{cal } \mathcal{A}\}”]$$

$$[\mathcal{A} \xrightarrow{\text{pyk}} “\text{meta } a”]$$

$\mathcal{B}$

$$[\mathcal{B} \xrightarrow{\text{macro}} \lambda t. \lambda s. \lambda c. \tilde{\mathcal{M}}_4(t, s, c, \llbracket [\mathcal{B} \doteq \underline{b}] \rrbracket)]$$

$$[\mathcal{B} \xrightarrow{\text{tex}} “\{\backslash\text{cal } \mathcal{B}\}”]$$

$$[\mathcal{B} \xrightarrow{\text{pyk}} “\text{meta } b”]$$

$\mathcal{C}$

$$[\mathcal{C} \xrightarrow{\text{macro}} \lambda t. \lambda s. \lambda c. \tilde{\mathcal{M}}_4(t, s, c, \llbracket [\mathcal{C} \doteq \underline{c}] \rrbracket)]$$

$$[\mathcal{C} \xrightarrow{\text{tex}} “\{\backslash\text{cal } \mathcal{C}\}”]$$

$$[\mathcal{C} \xrightarrow{\text{pyk}} “\text{meta } c”]$$

$\mathcal{D}$

$$[\mathcal{D} \xrightarrow{\text{macro}} \lambda t. \lambda s. \lambda c. \tilde{\mathcal{M}}_4(t, s, c, \llbracket [\mathcal{D} \doteq \underline{d}] \rrbracket)]$$

$$[\mathcal{D} \xrightarrow{\text{tex}} “\{\backslash\text{cal } \mathcal{D}\}”]$$

$$[\mathcal{D} \xrightarrow{\text{pyk}} “\text{meta } d”]$$

$\mathcal{E}$

$$[\mathcal{E} \xrightarrow{\text{macro}} \lambda t. \lambda s. \lambda c. \tilde{\mathcal{M}}_4(t, s, c, \llbracket [\mathcal{E} \doteq \underline{e}] \rrbracket)]$$

$$[\mathcal{E} \xrightarrow{\text{tex}} “\{\backslash\text{cal } \mathcal{E}\}”]$$

$$[\mathcal{E} \xrightarrow{\text{pyk}} “\text{meta } e”]$$

$\mathcal{F}$

$$[\mathcal{F} \xrightarrow{\text{macro}} \lambda t. \lambda s. \lambda c. \tilde{\mathcal{M}}_4(t, s, c, \llbracket [\mathcal{F} \doteq \underline{f}] \rrbracket)]$$

$$[\mathcal{F} \xrightarrow{\text{tex}} “\{\backslash\text{cal F}\}”]$$

$$[\mathcal{F} \xrightarrow{\text{pyk}} “\text{meta f}”]$$

$\mathcal{G}$

$$[\mathcal{G} \xrightarrow{\text{macro}} \lambda\text{t}.\lambda\text{s}.\lambda\text{c}.\tilde{\mathcal{M}}_4(\text{t}, \text{s}, \text{c}, \llbracket [\mathcal{G} \doteq \underline{\text{g}}] \rrbracket)]$$

$$[\mathcal{G} \xrightarrow{\text{tex}} “\{\backslash\text{cal G}\}”]$$

$$[\mathcal{G} \xrightarrow{\text{pyk}} “\text{meta g}”]$$

$\mathcal{H}$

$$[\mathcal{H} \xrightarrow{\text{macro}} \lambda\text{t}.\lambda\text{s}.\lambda\text{c}.\tilde{\mathcal{M}}_4(\text{t}, \text{s}, \text{c}, \llbracket [\mathcal{H} \doteq \underline{\text{h}}] \rrbracket)]$$

$$[\mathcal{H} \xrightarrow{\text{tex}} “\{\backslash\text{cal H}\}”]$$

$$[\mathcal{H} \xrightarrow{\text{pyk}} “\text{meta h}”]$$

$\mathcal{I}$

$$[\mathcal{I} \xrightarrow{\text{macro}} \lambda\text{t}.\lambda\text{s}.\lambda\text{c}.\tilde{\mathcal{M}}_4(\text{t}, \text{s}, \text{c}, \llbracket [\mathcal{I} \doteq \underline{\text{i}}] \rrbracket)]$$

$$[\mathcal{I} \xrightarrow{\text{tex}} “\{\backslash\text{cal I}\}”]$$

$$[\mathcal{I} \xrightarrow{\text{pyk}} “\text{meta i}”]$$

$\mathcal{J}$

$$[\mathcal{J} \xrightarrow{\text{macro}} \lambda\text{t}.\lambda\text{s}.\lambda\text{c}.\tilde{\mathcal{M}}_4(\text{t}, \text{s}, \text{c}, \llbracket [\mathcal{J} \doteq \underline{\text{j}}] \rrbracket)]$$

$$[\mathcal{J} \xrightarrow{\text{tex}} “\{\backslash\text{cal J}\}”]$$

$$[\mathcal{J} \xrightarrow{\text{pyk}} “\text{meta j}”]$$

$\mathcal{K}$

$$[\mathcal{K} \xrightarrow{\text{macro}} \lambda\text{t}.\lambda\text{s}.\lambda\text{c}.\tilde{\mathcal{M}}_4(\text{t}, \text{s}, \text{c}, \llbracket [\mathcal{K} \doteq \underline{\text{k}}] \rrbracket)]$$

$$[\mathcal{K} \xrightarrow{\text{tex}} “\{\backslash\text{cal K}\}”]$$

$$[\mathcal{K} \xrightarrow{\text{pyk}} “\text{meta k}”]$$

$\mathcal{L}$

$$[\mathcal{L} \xrightarrow{\text{macro}} \lambda t. \lambda s. \lambda c. \tilde{\mathcal{M}}_4(t, s, c, [[\mathcal{L} \doteq \underline{l}]])]$$

$$[\mathcal{L} \xrightarrow{\text{tex}} “\{\backslash\text{cal L}\}”]$$

$$[\mathcal{L} \xrightarrow{\text{pyk}} “\text{meta l}”]$$

$\mathcal{M}$

$$[\mathcal{M} \xrightarrow{\text{macro}} \lambda t. \lambda s. \lambda c. \tilde{\mathcal{M}}_4(t, s, c, [[\mathcal{M} \doteq \underline{m}]])]$$

$$[\mathcal{M} \xrightarrow{\text{tex}} “\{\backslash\text{cal M}\}”]$$

$$[\mathcal{M} \xrightarrow{\text{pyk}} “\text{meta m}”]$$

$\mathcal{N}$

$$[\mathcal{N} \xrightarrow{\text{macro}} \lambda t. \lambda s. \lambda c. \tilde{\mathcal{M}}_4(t, s, c, [[\mathcal{N} \doteq \underline{n}]])]$$

$$[\mathcal{N} \xrightarrow{\text{tex}} “\{\backslash\text{cal N}\}”]$$

$$[\mathcal{N} \xrightarrow{\text{pyk}} “\text{meta n}”]$$

$\mathcal{O}$

$$[\mathcal{O} \xrightarrow{\text{macro}} \lambda t. \lambda s. \lambda c. \tilde{\mathcal{M}}_4(t, s, c, [[\mathcal{O} \doteq \underline{o}]])]$$

$$[\mathcal{O} \xrightarrow{\text{tex}} “\{\backslash\text{cal O}\}”]$$

$$[\mathcal{O} \xrightarrow{\text{pyk}} “\text{meta o}”]$$

$\mathcal{P}$

$$[\mathcal{P} \xrightarrow{\text{macro}} \lambda t. \lambda s. \lambda c. \tilde{\mathcal{M}}_4(t, s, c, [[\mathcal{P} \doteq \underline{p}]])]$$

$$[\mathcal{P} \xrightarrow{\text{tex}} “\{\backslash\text{cal P}\}”]$$

$$[\mathcal{P} \xrightarrow{\text{pyk}} “\text{meta p}”]$$

$\mathcal{Q}$

$$[\mathcal{Q} \xrightarrow{\text{macro}} \lambda t. \lambda s. \lambda c. \tilde{\mathcal{M}}_4(t, s, c, [[\mathcal{Q} \doteq \underline{q}]])]$$

$$[\mathcal{Q} \xrightarrow{\text{tex}} “\{\backslash\text{cal Q}\}”]$$

$$[\mathcal{Q} \xrightarrow{\text{pyk}} “\text{meta q}”]$$

$\mathcal{R}$

$$[\mathcal{R} \xrightarrow{\text{macro}} \lambda\mathbf{t}.\lambda\mathbf{s}.\lambda\mathbf{c}.\tilde{\mathcal{M}}_4(\mathbf{t}, \mathbf{s}, \mathbf{c}, [[\mathcal{R} \doteq \mathbf{r}]])]$$

$$[\mathcal{R} \xrightarrow{\text{tex}} “\{\backslash\text{cal R}\}”]$$

$$[\mathcal{R} \xrightarrow{\text{pyk}} “\text{meta r}”]$$

$\mathcal{S}$

$$[\mathcal{S} \xrightarrow{\text{macro}} \lambda\mathbf{t}.\lambda\mathbf{s}.\lambda\mathbf{c}.\tilde{\mathcal{M}}_4(\mathbf{t}, \mathbf{s}, \mathbf{c}, [[\mathcal{S} \doteq \mathbf{s}]])]$$

$$[\mathcal{S} \xrightarrow{\text{tex}} “\{\backslash\text{cal S}\}”]$$

$$[\mathcal{S} \xrightarrow{\text{pyk}} “\text{meta s}”]$$

$\mathcal{T}$

$$[\mathcal{T} \xrightarrow{\text{macro}} \lambda\mathbf{t}.\lambda\mathbf{s}.\lambda\mathbf{c}.\tilde{\mathcal{M}}_4(\mathbf{t}, \mathbf{s}, \mathbf{c}, [[\mathcal{T} \doteq \mathbf{t}]])]$$

$$[\mathcal{T} \xrightarrow{\text{tex}} “\{\backslash\text{cal T}\}”]$$

$$[\mathcal{T} \xrightarrow{\text{pyk}} “\text{meta t}”]$$

$\mathcal{U}$

$$[\mathcal{U} \xrightarrow{\text{macro}} \lambda\mathbf{t}.\lambda\mathbf{s}.\lambda\mathbf{c}.\tilde{\mathcal{M}}_4(\mathbf{t}, \mathbf{s}, \mathbf{c}, [[\mathcal{U} \doteq \mathbf{u}]])]$$

$$[\mathcal{U} \xrightarrow{\text{tex}} “\{\backslash\text{cal U}\}”]$$

$$[\mathcal{U} \xrightarrow{\text{pyk}} “\text{meta u}”]$$

$\mathcal{V}$

$$[\mathcal{V} \xrightarrow{\text{macro}} \lambda\mathbf{t}.\lambda\mathbf{s}.\lambda\mathbf{c}.\tilde{\mathcal{M}}_4(\mathbf{t}, \mathbf{s}, \mathbf{c}, [[\mathcal{V} \doteq \mathbf{v}]])]$$

$$[\mathcal{V} \xrightarrow{\text{tex}} “\{\backslash\text{cal V}\}”]$$

$$[\mathcal{V} \xrightarrow{\text{pyk}} “\text{meta v}”]$$

$\mathcal{W}$

$$\begin{aligned} &[\mathcal{W} \xrightarrow{\text{macro}} \lambda t. \lambda s. \lambda c. \tilde{\mathcal{M}}_4(t, s, c, \llbracket [\mathcal{W} \ddot{=} \underline{w}] \rrbracket)] \\ &[\mathcal{W} \xrightarrow{\text{tex}} “\{\backslash\text{cal } W\}”] \\ &[\mathcal{W} \xrightarrow{\text{pyk}} “\text{meta } w”] \end{aligned}$$

$\mathcal{X}$

$$\begin{aligned} &[\mathcal{X} \xrightarrow{\text{macro}} \lambda t. \lambda s. \lambda c. \tilde{\mathcal{M}}_4(t, s, c, \llbracket [\mathcal{X} \ddot{=} \underline{x}] \rrbracket)] \\ &[\mathcal{X} \xrightarrow{\text{tex}} “\{\backslash\text{cal } X\}”] \\ &[\mathcal{X} \xrightarrow{\text{pyk}} “\text{meta } x”] \end{aligned}$$

$\mathcal{Y}$

$$\begin{aligned} &[\mathcal{Y} \xrightarrow{\text{macro}} \lambda t. \lambda s. \lambda c. \tilde{\mathcal{M}}_4(t, s, c, \llbracket [\mathcal{Y} \ddot{=} \underline{y}] \rrbracket)] \\ &[\mathcal{Y} \xrightarrow{\text{tex}} “\{\backslash\text{cal } Y\}”] \\ &[\mathcal{Y} \xrightarrow{\text{pyk}} “\text{meta } y”] \end{aligned}$$

$\mathcal{Z}$

$$\begin{aligned} &[\mathcal{Z} \xrightarrow{\text{macro}} \lambda t. \lambda s. \lambda c. \tilde{\mathcal{M}}_4(t, s, c, \llbracket [\mathcal{Z} \ddot{=} \underline{z}] \rrbracket)] \\ &[\mathcal{Z} \xrightarrow{\text{tex}} “\{\backslash\text{cal } Z\}”] \\ &[\mathcal{Z} \xrightarrow{\text{pyk}} “\text{meta } z”] \end{aligned}$$

$\langle * \mid * := * \rangle$

$$\begin{aligned} &[\langle a \mid x := b \rangle \xrightarrow{\text{val}} x! \llbracket b! \\ &\text{If}(a^{\text{v}}, \text{If}(a \stackrel{\text{t}}{=} x, b, a), \\ &\text{If}(\neg \llbracket a \stackrel{\text{r}}{=} \llbracket \forall *: * \rrbracket \rrbracket, a^{\text{h}} :: \langle * a^{\text{t}} \mid x := b \rangle, \\ &\text{If}(a^1 \stackrel{\text{t}}{=} x, a, \\ &\llbracket a^0 :: \llbracket a^1 :: \llbracket \langle a^2 \mid x := b \rangle :: \text{T} \rrbracket \rrbracket \rrbracket \rrbracket \rrbracket \rrbracket \\ &\llbracket \langle a \mid x := b \rangle \xrightarrow{\text{tex}} “ \\ &\backslash\text{langle } \#1. \\ &\backslash, \{\backslash\text{protect}\backslash\text{vert}\} \#2. \end{aligned}$$

$\{:=\}\backslash, \#3.$
 $\backslash\mathrm{rangle} \text{ ”}]$
 $\langle \mathbf{a} \mid \mathbf{x} := \mathbf{b} \rangle \xrightarrow{\mathrm{pyk}} \text{ “sub * set * to * end sub”}]$

$\langle * * \mid * := * \rangle$

$\langle * \mathbf{a} \mid \mathbf{x} := \mathbf{b} \rangle \xrightarrow{\mathrm{val}} \mathbf{x}! \text{ [} \mathbf{b}! \mathrm{If}(\mathbf{a}, \mathbf{T}, \langle \mathbf{a}^{\mathrm{h}} \mid \mathbf{x} := \mathbf{b} \rangle :: \langle * \mathbf{a}^{\mathrm{t}} \mid \mathbf{x} := \mathbf{b} \rangle) \text{]]}$
 $\langle * \mathbf{a} \mid \mathbf{x} := \mathbf{b} \rangle \xrightarrow{\mathrm{tex}} \text{ “}$
 $\backslash\mathrm{langle} \text{ }^{\wedge} \{ \backslash\mathrm{ast} \} \text{ } \#1.$
 $\backslash, \{ \backslash\mathrm{protect} \backslash\mathrm{vert} \} \#2.$
 $\{:=\}\backslash, \#3.$
 $\backslash\mathrm{rangle} \text{ ”}]$
 $\langle * \mathbf{a} \mid \mathbf{x} := \mathbf{b} \rangle \xrightarrow{\mathrm{pyk}} \text{ “sub star * set * to * end sub”}]$

$\emptyset$

$[\emptyset \xrightarrow{\mathrm{val}} \mathbf{T}]$
 $[\emptyset \xrightarrow{\mathrm{tex}} \text{ “}$
 $\backslash\mathrm{emptyset} \text{ ”}]$
 $[\emptyset \xrightarrow{\mathrm{pyk}} \text{ “the empty set”}]$

Remainder

$[\mathrm{Remainder} \xrightarrow{\mathrm{macro}} \lambda \mathbf{t}.\lambda \mathbf{s}.\lambda \mathbf{c}.\tilde{\mathcal{M}}_4(\mathbf{t}, \mathbf{s}, \mathbf{c}, \text{ [[Remainder} \doteq \mathrm{HeadPair}' \oplus \text{ [$
 $\mathrm{Transitivity}' \oplus \mathrm{Contra}' \text{]]}]]]$
 $[\mathrm{Remainder} \xrightarrow{\mathrm{tex}} \text{ “}$
 $\mathrm{Remainder} \text{”}]$
 $[\mathrm{Remainder} \xrightarrow{\mathrm{pyk}} \text{ “example remainder”}]$

$(*)^{\mathbf{v}}$

$[(\mathbf{x})^{\mathbf{v}} \xrightarrow{\mathrm{name}} \text{ “}$
 $(\text{ } \#1.$
 $)^{\wedge} \{ \backslash\mathrm{bf} \text{ v} \} \text{”}]$
 $[(\mathbf{x})^{\mathbf{v}} \xrightarrow{\mathrm{macro}} \lambda \mathbf{t}.\lambda \mathbf{s}.\lambda \mathbf{c}.\tilde{\mathcal{M}}_4(\mathbf{t}, \mathbf{s}, \mathbf{c}, \text{ [[}(\mathbf{x})^{\mathbf{v}} \doteq \mathbf{x} \text{]]}]]]$

$[(x)^v \xrightarrow{\text{tex}} \text{"\#1/tex name."}]$

$[(x)^v \xrightarrow{\text{pyk}} \text{"make visible * end visible"}]$

$\text{error}(*, *)$

$[\text{error}(\mathbf{m}, \mathbf{t}) \xrightarrow{\text{macro}} \lambda t. \lambda s. \lambda c. \tilde{\mathcal{M}}_4(\mathbf{t}, \mathbf{s}, \mathbf{c}, \llbracket [\text{error}(\mathbf{m}, \mathbf{t}) \doteq \text{error}_2(\llbracket \mathbf{m} \rrbracket, \mathbf{t}) \rrbracket])]$

$[\text{error}(\mathbf{m}, \mathbf{t}) \xrightarrow{\text{tex}} \text{"}$
 $\text{error}(\#1/\text{tex name.}$
 $, \#2.$
 $)]$

$[\text{error}(\mathbf{m}, \mathbf{t}) \xrightarrow{\text{pyk}} \text{"error * term * end error"}]$

$\text{error}_2(*, *)$

$[\text{error}_2(\mathbf{m}, \mathbf{t}) \xrightarrow{\text{val}} \mathbf{t}\text{-color}(\mathbf{m}^1 \llbracket \llbracket \text{"}$
 $\rrbracket^1 \mathbf{t} \rrbracket \rrbracket]$

$[\text{error}_2(\mathbf{m}, \mathbf{t}) \xrightarrow{\text{tex}} \text{"}$
 $\text{error}_{\{2\}}(\#1/\text{tex name.}$
 $, \#2.$
 $)]$

$[\text{error}_2(\mathbf{m}, \mathbf{t}) \xrightarrow{\text{pyk}} \text{"error two * term * end error"}]$

$\text{proof}(*, *, *)$

$[\text{proof}(\mathbf{p}, \mathbf{t}, \mathbf{c}) \xrightarrow{\text{val}} \text{proof}_2(\mathcal{S}(\mathbf{c}, \mathbf{p}), \mathbf{t})]$

$[\text{proof}(\mathbf{p}, \mathbf{t}, \mathbf{c}) \xrightarrow{\text{tex}} \text{"}$
 $\text{proof}(\#1.$
 $, \#2.$
 $, \#3.$
 $)]$

$[\text{proof}(\mathbf{p}, \mathbf{t}, \mathbf{c}) \xrightarrow{\text{pyk}} \text{"proof * term * cache * end proof"}]$

$\text{proof}_2(*, *)$

$[\text{proof}_2(q, t) \xrightarrow{\text{val}} t!$
 $\text{If}(q^E, q,$
 $\text{If}(\neg [q^0], \text{error}_2([\text{"Proof has at least one unresolved premise.}$
 $\text{Lemma; premise reads:"}], t; [q^{0h}]),$
 $\text{If}(\neg [q^1], \text{error}_2([\text{"Proof has at least one unresolved side condition.}$
 $\text{Lemma; condition reads:"}], t; [q^{1h}]),$
 $\text{If}(q^2 \doteq t, T,$
 $\text{error}_2([\text{"Lemma does not match conclusion. Lemma; conclusion reads:"}], t; [$
 $q^2])))))]$
 $[\text{proof}_2(q, t) \xrightarrow{\text{tex}} "$
 $\text{proof}_{-}\{2\}(\#1.$
 $, \#2.$
 $)"]$
 $[\text{proof}_2(q, t) \xrightarrow{\text{pyk}} \text{"proof two * term * end proof"}]$

$\mathcal{S}(*, *)$

$[\mathcal{S}(c, t) \xrightarrow{\text{val}} c!$
 $\text{If}(t^E, t,$
 $\text{If}(t \stackrel{r}{=} [*^I], \mathcal{S}^I(c, t),$
 $\text{If}(t \stackrel{r}{=} [*^\triangleright], \mathcal{S}^\triangleright(c, t),$
 $\text{If}(t \stackrel{r}{=} [*^V], \mathcal{S}^E(c, t),$
 $\text{If}(t \stackrel{r}{=} [*^+], \mathcal{S}^+(c, t),$
 $\text{If}(t \stackrel{r}{=} [*^-], \mathcal{S}^-(c, t),$
 $\text{If}(t \stackrel{r}{=} [*^*], \mathcal{S}^*(c, t),$
 $\text{If}(t \stackrel{r}{=} [* @ *], \mathcal{S}^@ (c, t),$
 $\text{If}(t \stackrel{r}{=} [* \vdash *], \mathcal{S}^\vdash (c, t),$
 $\text{If}(t \stackrel{r}{=} [* \Vdash *], \mathcal{S}^\Vdash (c, t),$
 $\text{If}(t \stackrel{r}{=} [* \text{ i.e. } *], \mathcal{S}^{\text{i.e.}} (c, t),$
 $\text{If}(t \stackrel{r}{=} [\forall *: *], \mathcal{S}^\forall (c, t),$
 $\text{If}(t \stackrel{r}{=} [*; *], \mathcal{S}^; (c, t),$
 $\text{error}_2([\text{"Unknown sequent operator:"}], t)))))))))))]$
 $[\mathcal{S}(x, y) \xrightarrow{\text{tex}} "$
 $\{\backslash \text{cal } S\}(\#1.$
 $, \#2.$
 $)"]$
 $[\mathcal{S}(x, y) \xrightarrow{\text{pyk}} \text{"sequent eval * term * end eval"}]$

$$\mathcal{S}^I(*, *)$$

$$[\mathcal{S}^I(c, t) \xrightarrow{\text{val}} c! [\emptyset :: [\emptyset :: [\text{t-color}(t^1 \vdash [\text{t}^1]) :: \text{T}]]]]$$

$$\begin{aligned} & [\mathcal{S}^I(x, y) \xrightarrow{\text{tex}} \text{“} \\ & \{\backslash \text{cal } S\}^{\wedge} \{I\}(\#1. \\ & , \#2. \\ & \text{”)”}] \end{aligned}$$

$$[\mathcal{S}^I(x, y) \xrightarrow{\text{pyk}} \text{“segeval init * term * end eval”}]$$

$$\mathcal{S}^{\triangleright}(*, *)$$

$$[\mathcal{S}^{\triangleright}(c, t) \xrightarrow{\text{val}} \mathcal{S}_1^{\triangleright}(c, t, \mathcal{S}(c, t^1))]$$

$$\begin{aligned} & [\mathcal{S}^{\triangleright}(x, y) \xrightarrow{\text{tex}} \text{“} \\ & \{\backslash \text{cal } S\}^{\wedge} \{\backslash \text{rhd}\}(\#1. \\ & , \#2. \\ & \text{”)”}] \end{aligned}$$

$$[\mathcal{S}^{\triangleright}(x, y) \xrightarrow{\text{pyk}} \text{“segeval modus * term * end eval”}]$$

$$\mathcal{S}_1^{\triangleright}(*, *, *)$$

$$\begin{aligned} & [\mathcal{S}_1^{\triangleright}(c, t, q) \xrightarrow{\text{val}} c! [\text{t!} \\ & \text{If}(q^E, q, \\ & \text{If}(q^2 \stackrel{r}{=} [* \vdash *], q^0 \cup \{q^{21}\} :: [\text{q}^1 :: [\text{q}^{22} :: \text{T}]] , \\ & \text{If}(q^2 \stackrel{r}{=} [* \Vdash *], q^0 :: [\text{q}^1 \cup \{q^{21}\} :: [\text{q}^{22} :: \text{T}]] , \\ & \text{error}_2([\text{“The modus operation requires the conclusion of its argument to be an} \\ & \text{inference or an endorsement”}], t)))]] \end{aligned}$$

$$\begin{aligned} & [\mathcal{S}_1^{\triangleright}(x, y, z) \xrightarrow{\text{tex}} \text{“} \\ & \{\backslash \text{cal } S\}^{\wedge} \{1\}^{\wedge} \{\backslash \text{rhd}\}(\#1. \\ & , \#2. \\ & , \#3. \\ & \text{”)”}] \end{aligned}$$

$$[\mathcal{S}_1^{\triangleright}(x, y, z) \xrightarrow{\text{pyk}} \text{“segeval modus one * term * sequent * end eval”}]$$

$$\mathcal{S}^E(*, *)$$

$$[\mathcal{S}^E(c, t) \xrightarrow{\text{val}} \mathcal{S}_1^E(c, t, \mathcal{S}(c, t^1))]$$

$$[\mathcal{S}^E(x, y) \xrightarrow{\text{tex}} \text{“} \{ \backslash \text{cal } S \}^{\wedge} \{ E \} (\#1. \\ , \#2. \\)”]$$

$$[\mathcal{S}^E(x, y) \xrightarrow{\text{pyk}} \text{“segeval verify * term * end eval”}]$$

$$\mathcal{S}_1^E(*, *, *)$$

$$[\mathcal{S}_1^E(c, t, q) \xrightarrow{\text{val}} c! [t! \\ \text{If}(q^E, q, \\ \text{If}(\neg [q^2 \stackrel{r}{=} [* \Vdash *]] , \text{error}_2(\lceil \text{“The verify operation requires the conclusion of} \\ \text{its argument to be an endorsement:”} \rceil, t), \\ \text{If}(\neg [q^{21c}] , \text{error}_2(\lceil \text{“The verify operation requires the side condition to} \\ \text{contain no metavariables. Term; condition:”} \rceil, t; [q^{21}]), \\ \text{If}(\mathcal{U}^M(\mathcal{U}^M(\mathcal{E}(q^{21}, T, c)) \text{ ‘ } c), q^0 :: [q^1 :: [q^{22} :: T]] , \\ \text{error}_2(\lceil \text{“False side condition:”} \rceil, t))))]]$$

$$[\mathcal{S}_1^E(x, y, z) \xrightarrow{\text{tex}} \text{“} \{ \backslash \text{cal } S \} _ \{ 1 \}^{\wedge} \{ E \} (\#1. \\ , \#2. \\ , \#3. \\)”]$$

$$[\mathcal{S}_1^E(x, y, z) \xrightarrow{\text{pyk}} \text{“segeval verify one * term * sequent * end eval”}]$$

$$\mathcal{S}^+(*, *)$$

$$[\mathcal{S}^+(c, t) \xrightarrow{\text{val}} \mathcal{S}_1^+(c, t, \mathcal{S}(c, t^1))]$$

$$[\mathcal{S}^+(x, y) \xrightarrow{\text{tex}} \text{“} \{ \backslash \text{cal } S \}^{\wedge} \{ + \} (\#1. \\ , \#2. \\)”]$$

$$[\mathcal{S}^+(x, y) \xrightarrow{\text{pyk}} \text{“sequent eval plus * term * end eval”}]$$

$$\mathcal{S}_1^+(*, *, *)$$

$$[\mathcal{S}_1^+(c, t, q) \xrightarrow{\text{val}} c! [t! \\ \text{If}(q^E, q, \\ \text{If}([q^2 \stackrel{r}{=} [* \vdash *]] \wedge [q^{22} \stackrel{r}{=} [* \vdash *]] ,$$

$$[q^0 :: [q^1 :: [t\text{-color}([q^{21} \oplus [q^{221}]) \vdash [q^{222}]) :: T]]], \\ \text{error}_2([\text{“Term; conclusion not fit for decurrying:”}, t; [q^2]])]$$

$$[\mathcal{S}_1^+(x, y, z) \xrightarrow{\text{tex}} “ \\ \{\backslash \text{cal } S\}_{- \{1\}}^{\{+\}}(\#1. \\ , \#2. \\ , \#3. \\)”]$$

$$[\mathcal{S}_1^+(x, y, z) \xrightarrow{\text{pyk}} \text{“sequeval plus one * term * sequent * end eval”}]$$

$$\mathcal{S}^-(*,*)$$

$$[\mathcal{S}^-(c, t) \xrightarrow{\text{val}} \mathcal{S}_1^-(c, t, \mathcal{S}(c, t^1))]$$

$$[\mathcal{S}^-(x, y) \xrightarrow{\text{tex}} “ \\ \{\backslash \text{cal } S\}^{\{-\}}(\#1. \\ , \#2. \\)”]$$

$$[\mathcal{S}^-(x, y) \xrightarrow{\text{pyk}} \text{“sequeval minus * term * end eval”}]$$

$$\mathcal{S}_1^-(*,*,*)$$

$$[\mathcal{S}_1^-(c, t, q) \xrightarrow{\text{val}} c! [t! \\ \text{If}(q^E, q, \\ \text{If}([q^2 \stackrel{r}{=} [* \vdash *]) \wedge [q^{21} \stackrel{r}{=} [* \oplus *]]) , \\ [q^0 :: [q^1 :: [t\text{-color}(q^{211} \vdash [q^{212} \vdash [q^{22}])]) :: T]]], \\ \text{error}_2([\text{“Term; conclusion not fit for decurrying:”}, t; [q^2]])]]$$

$$[\mathcal{S}_1^-(x, y, z) \xrightarrow{\text{tex}} “ \\ \{\backslash \text{cal } S\}_{- \{1\}}^{\{-\}}(\#1. \\ , \#2. \\ , \#3. \\)”]$$

$$[\mathcal{S}_1^-(x, y, z) \xrightarrow{\text{pyk}} \text{“sequeval minus one * term * sequent * end eval”}]$$

$$\mathcal{S}^*(*,*)$$

$$[\mathcal{S}^*(c, t) \xrightarrow{\text{val}} \mathcal{S}_1^*(c, t, \mathcal{S}(c, t^1))]$$

$$[\mathcal{S}^*(x, y) \xrightarrow{\text{tex}} “$$

$\{\backslash\text{cal S}\}^{\wedge}\{\backslash\text{ast}\}(\#1.$
 $, \#2.$
 $)"]$

$[\mathcal{S}^*(x, y) \xrightarrow{\text{pyk}} \text{"segeval deref * term * end eval"}]$

$\mathcal{S}_1^*(*, *, *)$

$[\mathcal{S}_1^*(c, t, q) \xrightarrow{\text{val}} c! \text{ [} t!$
 $\text{If}(q^E, q,$
 $\mathcal{S}_2^*(c, t, q, \text{aspect}(<\text{stmt}>, q^2, c))) \text{] }]$

$[\mathcal{S}_1^*(x, y, z) \xrightarrow{\text{tex}} \text{"}$
 $\{\backslash\text{cal S}\}_{-}\{1\}^{\wedge}\{\backslash\text{ast}\}(\#1.$
 $, \#2.$
 $, \#3.$
 $)"]$

$[\mathcal{S}_1^*(x, y, z) \xrightarrow{\text{pyk}} \text{"segeval deref one * term * sequent * end eval"}]$

$\mathcal{S}_2^*(*, *, *, *)$

$[\mathcal{S}_2^*(c, t, q, d) \xrightarrow{\text{val}} c! \text{ [} t! \text{ [} q!$
 $\text{If}(d, \text{error}_2(\text{"Dereferencing construct that has no statement def."}], t),$
 $\text{[} q^0 :: \text{ [} q^1 :: \text{ [} d^3 :: T \text{] } \text{] } \text{] } \text{] }]$

$[\mathcal{S}_2^*(c, t, q, d) \xrightarrow{\text{tex}} \text{"}$
 $\{\backslash\text{cal S}\}_{-}\{2\}^{\wedge}\{\backslash\text{ast}\}(\#1.$
 $, \#2.$
 $, \#3.$
 $, \#4.$
 $)"]$

$[\mathcal{S}_2^*(c, t, q, d) \xrightarrow{\text{pyk}} \text{"segeval deref two * term * sequent * def * end eval"}]$

$\mathcal{S}^{\textcircled{a}}(*, *)$

$[\mathcal{S}^{\textcircled{a}}(c, t) \xrightarrow{\text{val}} \mathcal{S}_1^{\textcircled{a}}(c, t, \mathcal{S}(c, t^1))]$

$[\mathcal{S}^{\textcircled{a}}(x, y) \xrightarrow{\text{tex}} \text{"}$
 $\{\backslash\text{cal S}\}^{\wedge}\{\backslash\text{char64}\}(\#1.$
 $, \#2.$
 $)"]$

$$[\mathcal{S}_1^+(x, y, z, u) \xrightarrow{\text{pyk}} \text{“segeval infer one * term * premise * sequent * end eval”}]$$

$$\mathcal{S}^\#(*, *)$$

$$[\mathcal{S}^\#(c, t) \xrightarrow{\text{val}} \mathcal{S}_1^\#(c, t, t^1, \mathcal{S}(c, t^2))]$$

$$[\mathcal{S}^\#(x, y) \xrightarrow{\text{tex}} \text{“} \{\cal S\}^{\wedge\{\makebox[0mm][l]{\scriptsize $\vdash$}}\}, \{\vdash\}\}(\#1. \\ , \#2. \\)”]$$

$$[\mathcal{S}^\#(x, y) \xrightarrow{\text{pyk}} \text{“segeval endorse * term * end eval”}]$$

$$\mathcal{S}_1^\#(*, *, *, *)$$

$$[\mathcal{S}_1^\#(c, t, p, q) \xrightarrow{\text{val}} c! \ [\ t! \ [\ p!$$

$$\text{If}(q^E, q,$$

$$[\ q^0 :: [\ q^1 \backslash \{p\} :: [\ t\text{-color}(p \Vdash [\ q^2 \]) :: \mathsf{T} \] \] \] \]$$

$$[\mathcal{S}_1^\#(x, y, z, u) \xrightarrow{\text{tex}} \text{“}$$

$$\{\cal S\}_{-1}^{\wedge\{\makebox[0mm][l]{\scriptsize $\vdash$}}\}, \{\vdash\}\}(\#1. \\ , \#2. \\ , \#3. \\ , \#4. \\)”]$$

$$[\mathcal{S}_1^\#(x, y, z, u) \xrightarrow{\text{pyk}} \text{“segeval endorse one * term * side * sequent * end eval”}]$$

$$\mathcal{S}^{\text{i.e.}}(*, *)$$

$$[\mathcal{S}^{\text{i.e.}}(c, t) \xrightarrow{\text{val}} \mathcal{S}_1^{\text{i.e.}}(c, t, t^2, \mathcal{S}(c, t^1))]$$

$$[\mathcal{S}^{\text{i.e.}}(x, y) \xrightarrow{\text{tex}} \text{“}$$

$$\{\cal S\}^{\wedge\{\text{i.e.}\}}(\#1. \\ , \#2. \\)”]$$

$$[\mathcal{S}^{\text{i.e.}}(x, y) \xrightarrow{\text{pyk}} \text{“segeval est * term * end eval”}]$$

$$\mathcal{S}_1^{\text{i.e.}}(*, *, *, *)$$

$$[\mathcal{S}_1^{\text{i.e.}}(c, t, a, q) \xrightarrow{\text{val}} c! [t! [a! \\ \text{If}(q^E, q, \mathcal{S}_2^{\text{i.e.}}(c, t, a, q, \text{aspect}(<\text{stmt}>, a, c)))]]]$$

$$[\mathcal{S}_1^{\text{i.e.}}(x, y, z, u) \xrightarrow{\text{tex}} “ \\ \{\backslash \text{cal } S\}_{- \{1\}}^{\{ \text{i.e.} \}}(\#1. \\ , \#2. \\ , \#3. \\ , \#4. \\)”]$$

$$[\mathcal{S}_1^{\text{i.e.}}(x, y, z, u) \xrightarrow{\text{pyk}} \text{“sequeval est one * term * name * sequent * end eval”}]$$

$$\mathcal{S}_2^{\text{i.e.}}(*, *, *, *, *)$$

$$[\mathcal{S}_2^{\text{i.e.}}(c, t, a, q, d) \xrightarrow{\text{val}} c! [t! [a! [q! \\ \text{If}(d, \text{error}_2(\lceil \text{“Referencing construct that has no statement def.”} \rceil, t), \\ \text{If}(\neg [d^3 \stackrel{t}{=} [q^2]], \text{error}_2(\lceil \text{“Reference; conclusion do not match.”} \rceil, a; [q^2]), \\ [q^0 :: [q^1 :: [a :: T]]]))]]]]]$$

$$[\mathcal{S}_2^{\text{i.e.}}(c, t, a, q, d) \xrightarrow{\text{tex}} “ \\ \{\backslash \text{cal } S\}_{- \{2\}}^{\{ \text{i.e.} \}}(\#1. \\ , \#2. \\ , \#3. \\ , \#4. \\ , \#5. \\)”]$$

$$[\mathcal{S}_2^{\text{i.e.}}(c, t, a, q, d) \xrightarrow{\text{pyk}} \text{“sequeval est two * term * name * sequent * def * end eval”}]$$

$$\mathcal{S}^\forall(*, *)$$

$$[\mathcal{S}^\forall(c, t) \xrightarrow{\text{val}} \mathcal{S}_1^\forall(c, t, t^1, \mathcal{S}(c, t^2))]$$

$$[\mathcal{S}^\forall(x, y) \xrightarrow{\text{tex}} “ \\ \{\backslash \text{cal } S\}^{\{ \backslash \text{forall} \}}(\#1. \\ , \#2. \\)”]$$

$$[\mathcal{S}^\forall(x, y) \xrightarrow{\text{pyk}} \text{“sequeval all * term * end eval”}]$$

$$\mathcal{S}_2^i(*, *, *, *)$$

$$[\mathcal{S}_2^i(c, t, p, q) \xrightarrow{\text{val}} c! \text{ } [t! \text{ } [p! \\ \text{If}(q^E, q, [p^0 \cup [q^0 \setminus \{p^2\}]] \text{ } :: [[p^1 \cup [q^1]] \text{ } :: [q^2 :: T]])]]]$$

$$[\mathcal{S}_2^i(c, t, p, q) \xrightarrow{\text{tex}} \text{“} \\ \{\backslash \text{cal } S\}_2^{\wedge} \{;\}(\#1. \\ , \#2. \\ , \#3. \\ , \#4. \\)”]$$

$$[\mathcal{S}_2^i(x, y, z, u) \xrightarrow{\text{pyk}} \text{“segeval cut two * term * forerunner * sequent * end eval”}]$$

$$\mathcal{T}(*)$$

$$[\mathcal{T}(x) \xrightarrow{\text{val}} x! \Lambda \lambda c. x]$$

$$[\mathcal{T}(x) \xrightarrow{\text{tex}} \text{“} \\ \{\backslash \text{cal } T\}(\#1. \\)”]$$

$$[\mathcal{T}(x) \xrightarrow{\text{pyk}} \text{“computably true * end true”}]$$

$$\text{claims}(*, *, *)$$

$$[\text{claims}(t, c, r) \xrightarrow{\text{val}} \\ \text{If}(\text{claims}_2(t, c, r), T, \text{claims}_2(t, c, c[r][\text{"bibliography"}]^1))]$$

$$[\text{claims}(t, c, r) \xrightarrow{\text{tex}} \text{“} \\ \text{claims}(\#1. \\ , \#2. \\ , \#3. \\)”]$$

$$[\text{claims}(t, c, r) \xrightarrow{\text{pyk}} \text{“claims * cache * ref * end claims”}]$$

$$\text{claims}_2(*, *, *)$$

$$[\text{claims}_2(t, c, r) \xrightarrow{\text{val}} \text{If}(\neg [r^c] , t! [c!F] , t \in_c [c[r][\text{"codex"}][r][0][0][\text{"claim"}]^3])] \\ [\text{claims}_2(t, c, r) \xrightarrow{\text{tex}} \text{“} \\ \text{claims_2}(\#1.$$

, #2.
 , #3.
)”]

[claims₂(t, c, r) $\xrightarrow{\text{pyk}}$ “claims two * cache * ref * end claims”]

<proof>

[<proof> $\xrightarrow{\text{val}}$ [<proof>]]

[<proof> $\xrightarrow{\text{tex}}$ “
 {<}proof{>}”]

[<proof> $\xrightarrow{\text{pyk}}$ “the proof aspect”]

proof

[proof $\xrightarrow{\text{msg}}$ <proof>]

[proof $\xrightarrow{\text{tex}}$ “
 proof”]

[proof $\xrightarrow{\text{pyk}}$ “proof”]

[**Lemma** *: *]

[[**Lemma** x: y] $\xrightarrow{\text{macro}}$ $\lambda t.\lambda s.\lambda c.\tilde{\mathcal{M}}_4(t, s, c, [[[\textbf{Lemma } x: y] \doteq [x \xrightarrow{\text{stmt}} y]]])$]

[[**Lemma** x: y] $\xrightarrow{\text{tex}}$ “
 [\mathbf{Lemma} \] #1.
 \colon #2.
]”]

[[**Lemma** x: y] $\xrightarrow{\text{pyk}}$ “lemma * says * end lemma”]

[**Proof of** *: *]

[[**Proof of** x: y] $\xrightarrow{\text{macro}}$ $\lambda t.\lambda s.\lambda c.\tilde{\mathcal{M}}_4(t, s, c, [[[\textbf{Proof of } x: y] \doteq [x \xrightarrow{\text{proof}} y]]])$]

[[**Proof of** x: y] $\xrightarrow{\text{tex}}$ “
 [\mathbf{Proof} \ of \] #1/tex name/tex.
 \colon #2.
]”]

$[[\mathbf{Proof\ of\ } x: y] \xrightarrow{\text{pyk}} \text{“proof of } * \text{ reads } * \text{ end proof”}]$

$[\ast \text{ lemma } \ast: \ast]$

$[[x \text{ lemma } y: z] \xrightarrow{\text{macro}} \lambda t. \lambda s. \lambda c. \tilde{\mathcal{M}}_4(t, s, c, [[[[x \text{ lemma } y: z] \doteq [y \stackrel{\text{stmt}}{=} x \vdash z]]]])]$

$[[x \text{ lemma } y: z] \xrightarrow{\text{tex}} \text{“}$
 $[\#1.$
 $\backslash \text{mathbf}\{\backslash \text{ lemma}\backslash \} \#2.$
 $\backslash \text{colon} \#3.$
 $]”]$

$[[x \text{ lemma } y: z] \xrightarrow{\text{pyk}} \text{“in theory } * \text{ lemma } * \text{ says } * \text{ end lemma”}]$

$[\ast \text{ antilemma } \ast: \ast]$

$[[x \text{ antilemma } y: z] \xrightarrow{\text{macro}} \lambda t. \lambda s. \lambda c. \tilde{\mathcal{M}}_4(t, s, c, [[[[x \text{ antilemma } y: z] \doteq [x \text{ lemma } y: z \vdash \perp]]]])]$

$[[x \text{ antilemma } y: z] \xrightarrow{\text{tex}} \text{“}$
 $[\#1.$
 $\backslash \text{mathbf}\{\backslash \text{ antilemma}\backslash \} \#2.$
 $\backslash \text{colon} \#3.$
 $]”]$

$[[x \text{ antilemma } y: z] \xrightarrow{\text{pyk}} \text{“in theory } * \text{ antilemma } * \text{ says } * \text{ end antilemma”}]$

$[\ast \text{ rule } \ast: \ast]$

$[[x \text{ rule } y: z] \xrightarrow{\text{macro}} \lambda t. \lambda s. \lambda c. \tilde{\mathcal{M}}_4(t, s, c, [[[[x \text{ rule } y: z] \doteq [x \text{ lemma } y: z][\mathbf{Proof\ of\ } y: \text{Rule tactic}]]]])]$

$[[x \text{ rule } y: z] \xrightarrow{\text{tex}} \text{“}$
 $[\#1.$
 $\backslash \text{mathbf}\{\backslash \text{ rule}\backslash \} \#2.$
 $\backslash \text{colon} \#3.$
 $]”]$

$[[x \text{ rule } y: z] \xrightarrow{\text{pyk}} \text{“in theory } * \text{ rule } * \text{ says } * \text{ end rule”}]$

[* **antirule** *: *]

$[[x \text{ **antirule** } y:z] \xrightarrow{\text{macro}} \lambda t. \lambda s. \lambda c. \tilde{\mathcal{M}}_4(t, s, c, [[[x \text{ **antirule** } y:z] \doteq [x \text{ **rule** } y:z \vdash \perp]]]]]]$

$[[[x \text{ **antirule** } y:z] \xrightarrow{\text{tex}} "$
 $[\#1.$
 $\backslash \text{mathbf{\{ \ antirule \ } \#2.}$
 $\backslash \text{colon \#3.}$
 $]"]]$

$[[x \text{ **antirule** } y:z] \xrightarrow{\text{pyk}} \text{"in theory * antirule * says * end antirule"}]$

verifier

$[\text{verifier} \xrightarrow{\text{val}} \lambda t. \lambda c. \mathcal{V}_1(c)]$

$[\text{verifier} \xrightarrow{\text{pyk}} \text{"verifier"}]$

$\mathcal{V}_1(*)$

$[\mathcal{V}_1(c) \xrightarrow{\text{val}}$
 $\text{let}_1(\lambda r.$
 $\text{let}_1(\lambda x.$
 $\text{let}_1(\lambda p.$
 $\text{let}_1(\lambda d.$
 $\text{If}(\neg d, d,$
 $\text{let}_1(\lambda i.$
 $\text{If}(\neg [i^c], T,$
 $\text{error}_2([\text{"Circular proof. Circle}$
 $\text{includes:"}], p[i]^{0h})), \mathcal{V}_5(c, r, p, p)), \mathcal{V}_3(c, r, p, T)), \mathcal{V}_2(c, x)), c[r][\text{"codex"}][r], c[0])]$

$[\mathcal{V}_1(c) \xrightarrow{\text{tex}} "$
 $\{\backslash \text{cal V}\}_1(\#1.$
 $)"]]$

$[\mathcal{V}_1(c) \xrightarrow{\text{pyk}} \text{"verify one * end verify"}]$

$\mathcal{V}_2(*, *)$

$[\mathcal{V}_2(c, p) \xrightarrow{\text{val}} c!$
 $\text{If}(p, T,$
 $\text{If}(\neg [p^{\text{hc}}], \mathcal{V}_2(c, p^{\text{h}}) :: \mathcal{V}_2(c, p^{\text{t}}), p^{\text{h}} ::$

$\text{let}_1(\lambda d.$
 $\text{If}(d, T,$
 $\text{let}_1(\lambda r.$
 $\text{If}(r^E, \text{error}_2(\lceil \text{"Error in proof of"} \rceil, d^2 \lceil \lceil \text{"}$
 $\text{"} \rceil^1 r \rceil \rceil), r), \mathcal{S}(c, \mathcal{U}^M(\lceil \mathcal{E}(d^3, T, c) \text{' } c \rceil \text{' } p))))), \mathbf{aspect}(<\text{proof}>, p^t))))]$
 $\lceil \mathcal{V}_2(c, p) \xrightarrow{\text{tex}} \text{"}$
 $\{\backslash \text{cal } V\}_{-2}(\#1.$
 $, \#2.$
 $\text{"})]$
 $\lceil \mathcal{V}_2(c, p) \xrightarrow{\text{pyk}} \text{"verify two * proofs * end verify"}]$

$\mathcal{V}_3(*, *, *, *)$

$\lceil \mathcal{V}_3(c, r, p, d) \xrightarrow{\text{val}} c! \lceil r! \lceil p!$
 $\text{If}(\neg d, d,$
 $\text{If}(p, T,$
 $\text{If}(\neg \lceil p^{\text{hc}} \rceil, \mathcal{V}_3(c, r, p^t, \mathcal{V}_3(c, r, p^h, T)),$
 $\text{let}_1(\lambda i.$
 $\text{let}_1(\lambda q.$
 $\text{If}(q, T,$
 $\text{If}(q^E, q,$
 $\text{If}(\neg \lceil q^1 \rceil, \text{error}_2(\lceil \text{"Unchecked sidecondition:"} \rceil, q^{1h}),$
 $\text{let}_1(\lambda d.$
 $\text{If}(d, \text{error}_2(\lceil \text{"Proof of non-existent lemma:"} \rceil, q^2),$
 $\text{If}(\neg \lceil q^2 \stackrel{t}{=} \lceil d^3 \rceil \rceil, \text{error}_2(\lceil \text{"Lemma/proof mismatch:"} \rceil, d^2; \lceil q^2 \rceil),$
 $\mathcal{V}_4(c, q^0))), \mathbf{aspect}(<\text{stmt}>, c[r][\text{"codex"}][r][i])))), p^t, p^h)))) \rceil \rceil]$
 $\lceil \mathcal{V}_3(c, r, p, d) \xrightarrow{\text{tex}} \text{"}$
 $\{\backslash \text{cal } V\}_{-3}(\#1.$
 $, \#2.$
 $, \#3.$
 $, \#4.$
 $\text{"})]$

$\lceil \mathcal{V}_3(c, r, p, d) \xrightarrow{\text{pyk}} \text{"verify three * ref * sequents * diagnose * end verify"}]$

$\mathcal{V}_4(*, *)$

$\lceil \mathcal{V}_4(c, p) \xrightarrow{\text{val}} c!$
 $\text{If}(p, T,$
 $\text{let}_1(\lambda d.$
 $\text{If}(\neg d, d,$

$\text{let}_1(\lambda p.$
 $\text{let}_1(\lambda r.$
 $\text{let}_1(\lambda i.$
 $\text{If}(\neg [c[r] ["diagnose"]] ,$
 $\text{error}_2([\text{"Reference to erroneous page"}], p),$
 $\text{If}(\neg \text{claims}([\text{verifier}], c, r),$
 $\text{error}_2([\text{"Reference to unchecked lemma"}], p),$
 $\text{If}(\mathbf{aspect}(<\text{proof}>, p, c),$
 $\text{error}_2([\text{"Reference to unproved lemma"}], p, T))) , p^i, p^r, p^h)), \mathcal{V}_4(c, p^t))]]$

$[\mathcal{V}_4(c, p) \xrightarrow{\text{tex}} "$
 $\{\backslash \text{cal V}\}_4(\#1.$
 $, \#2.$
 $)"]$

$[\mathcal{V}_4(c, p) \xrightarrow{\text{pyk}} \text{"verify four * premises * end verify"}]$

$\mathcal{V}_5(*, *, *, *)$

$[\mathcal{V}_5(c, r, a, q) \xrightarrow{\text{val}} c! [r! [a!$
 $\text{If}(q^c, q,$
 $\text{If}(a, q,$
 $\text{If}(\neg [a^{hc}], \mathcal{V}_5(c, r, a^t, \mathcal{V}_5(c, r, a^h, q)),$
 $\mathcal{V}_7(c, r, a^h, q)))]]]$

$[\mathcal{V}_5(c, r, a, q) \xrightarrow{\text{tex}} "$
 $\{\backslash \text{cal V}\}_5(\#1.$
 $, \#2.$
 $, \#3.$
 $, \#4.$
 $)"]$

$[\mathcal{V}_5(c, r, a, q) \xrightarrow{\text{pyk}} \text{"verify five * ref * array * sequents * end verify"}]$

$\mathcal{V}_6(*, *, *, *)$

$[\mathcal{V}_6(c, r, p, q) \xrightarrow{\text{val}} c! [r! [p!$
 $\text{If}(q^c, q,$
 $\text{If}(p, q,$
 $\text{let}_1(\lambda q.$
 $\text{If}(q^c, q,$
 $\text{If}(\neg [r \approx [p^{hr}]] , q,$
 $\mathcal{V}_7(c, r, p^{hi}, q)), \mathcal{V}_6(c, r, p^t, q)))]]]$

$\mathcal{V}_6(c, r, p, q) \xrightarrow{\text{tex}} “$
 $\{\backslash \text{cal V}\}_{-6}(\#1.$
 $, \#2.$
 $, \#3.$
 $, \#4.$
 $)”]$

$\mathcal{V}_6(c, r, p, q) \xrightarrow{\text{pyk}} “\text{verify six} * \text{ref} * \text{list} * \text{sequents} * \text{end verify}”]$

$\mathcal{V}_7(*, *, *, *)$

$[\mathcal{V}_7(c, r, i, q) \xrightarrow{\text{val}} c! \text{ [r!}$
 $\text{let}_1(\lambda v.$
 $\text{If}(v, q,$
 $\text{If}(v \approx 0, i,$
 $\text{If}(v \approx 1, q,$
 $\text{let}_1(\lambda q.$
 $\text{If}(q^c, q, q[i \rightarrow 1]), \mathcal{V}_6(c, r, v^0, q[i \rightarrow 0])))], q[i]) \text{ []}]$

$[\mathcal{V}_7(c, r, i, q) \xrightarrow{\text{tex}} “$
 $\{\backslash \text{cal V}\}_{-7}(\#1.$
 $, \#2.$
 $, \#3.$
 $, \#4.$
 $)”]$

$[\mathcal{V}_7(c, r, i, q) \xrightarrow{\text{pyk}} “\text{verify seven} * \text{ref} * \text{id} * \text{sequents} * \text{end verify}”]$

$\text{Cut}(*, *)$

$[\text{Cut}(a, b) \xrightarrow{\text{val}} \text{If}(b, a, a; b)]$

$[\text{Cut}(a, b) \xrightarrow{\text{tex}} “$
 $\text{Cut}(\#1.$
 $, \#2.$
 $)”]$

$[\text{Cut}(a, b) \xrightarrow{\text{pyk}} “\text{cut} * \text{and} * \text{end cut}”]$

$\text{Head}_{\oplus}(*)$

$[\text{Head}_{\oplus}(s) \xrightarrow{\text{val}} [\text{s}^1 \vdash [\text{s}^2 \vdash [\text{s}^{1I \triangleright}]]]^{+ \triangleright}]$

$[\text{Head}_{\oplus}(\mathbf{s}) \xrightarrow{\text{tex}} \text{“}$
 $\text{Head}_{\setminus\{\oplus\}} \ (\ \#1.$
 $\text{”)}]$

$[\text{Head}_{\oplus}(\mathbf{s}) \xrightarrow{\text{pyk}} \text{“head * end head”}]$

$\text{Tail}_{\oplus}(\ast)$

$[\text{Tail}_{\oplus}(\mathbf{s}) \xrightarrow{\text{val}} \ [\ \mathbf{s}^1 \vdash \ [\ \mathbf{s}^{2I} \] \] \ + \triangleright]$

$[\text{Tail}_{\oplus}(\mathbf{s}) \xrightarrow{\text{tex}} \text{“}$
 $\text{Tail}_{\setminus\{\oplus\}} \ (\ \#1.$
 $\text{”)}]$

$[\text{Tail}_{\oplus}(\mathbf{s}) \xrightarrow{\text{pyk}} \text{“tail * end tail”}]$

$\text{rule}_1(\ast, \ast)$

$[\text{rule}_1(\mathbf{s}, \mathbf{t}) \xrightarrow{\text{val}}$
 $\text{If}(\mathbf{s} \stackrel{\text{t}}{=} \mathbf{t}, \mathbf{T},$
 $\text{If}(\neg \ [\ \mathbf{t} \stackrel{\text{r}}{=} \ [\ \mathbf{x} \oplus \mathbf{y} \] \] \ , 0,$
 $\text{let}_1(\lambda \mathbf{p}.$
 $\text{If}(\neg \ [\ \mathbf{p}^c \] \ , \text{Cut}(\text{Head}_{\oplus}(\mathbf{t}), \mathbf{p}),$
 $\text{let}_1(\lambda \mathbf{p}.$
 $\text{If}(\neg \ [\ \mathbf{p}^c \] \ , \text{Cut}(\text{Tail}_{\oplus}(\mathbf{t}), \mathbf{p}), 0), \text{rule}_1(\mathbf{s}, \mathbf{t}^2)), \text{rule}_1(\mathbf{s}, \mathbf{t}^1)))]$

$[\text{rule}_1(\mathbf{s}, \mathbf{t}) \xrightarrow{\text{tex}} \text{“}$
 $\text{rule_1} \ (\ \#1.$
 $\ , \ \#2.$
 $\text{”)}]$

$[\text{rule}_1(\mathbf{s}, \mathbf{t}) \xrightarrow{\text{pyk}} \text{“rule one * theory * end rule”}]$

$\text{rule}(\ast, \ast)$

$[\text{rule}(\mathbf{c}, \mathbf{p}) \xrightarrow{\text{val}} \mathbf{c}!$
 $\text{let}_1(\lambda \mathbf{s}.$
 $\text{If}(\mathbf{s}, \lceil \text{“Rule has no statement aspect”} \rceil,$
 $\text{If}(\neg \ [\ \mathbf{s} \stackrel{\text{r}}{=} \ [\ \mathbf{x} \vdash \mathbf{y} \] \] \ , \text{error}_2(\lceil \text{“Rule has invalid statement aspect”} \rceil, \mathbf{s}),$
 $\text{let}_1(\lambda \mathbf{t}.$
 $\text{If}(\mathbf{t}, \lceil \text{“Theory has no statement aspect”} \rceil,$
 $\text{let}_1(\lambda \mathbf{r}.$

$\text{If}(\mathbf{r}^c, \text{error}_2(\lceil \text{“The theory does not assert the given rule”} \rceil, \mathbf{s}; \mathbf{t}),$
 $\lceil \mathbf{s}^1 \vdash \text{Cut}(\mathbf{s}^{11} \triangleright *, \mathbf{r}) \rceil$
 $\rangle, \text{rule}_1(\mathbf{s}^2, \mathbf{t})) \rangle, \mathbf{aspect}(\langle \text{stmt} \rangle, \mathbf{s}^1, \mathbf{c})^3 \rangle \rangle, \mathbf{aspect}(\langle \text{stmt} \rangle, \mathbf{p}^t)^3 \rangle]$
 $\lceil \text{rule}(\mathbf{c}, \mathbf{p}) \xrightarrow{\text{tex}} \text{“}$
 $\text{rule(\#1.}$
 $\text{, \#2.}$
 $\text{)”} \rceil$
 $\lceil \text{rule}(\mathbf{c}, \mathbf{p}) \xrightarrow{\text{pyk}} \text{“rule * subcodex * end rule”} \rceil]$

Rule tactic

$\lceil \text{Rule tactic} \xrightarrow{\text{val}} \lambda \mathbf{c}. \lambda \mathbf{p}. \text{rule}(\mathbf{c}, \mathbf{p}) \rceil$
 $\lceil \text{Rule tactic} \xrightarrow{\text{tex}} \text{“}$
 $\text{Rule \setminus tactic”} \rceil$
 $\lceil \text{Rule tactic} \xrightarrow{\text{pyk}} \text{“rule tactic”} \rceil]$

Plus(*, *)

$\lceil \text{Plus}(\mathbf{a}, \mathbf{b}) \xrightarrow{\text{val}} \text{If}(\mathbf{b}, \mathbf{a}, \mathbf{a} \oplus \mathbf{b}) \rceil$
 $\lceil \text{Plus}(\mathbf{a}, \mathbf{b}) \xrightarrow{\text{tex}} \text{“}$
 $\text{Plus(\#1.}$
 $\text{, \#2.}$
 $\text{)”} \rceil$
 $\lceil \text{Plus}(\mathbf{a}, \mathbf{b}) \xrightarrow{\text{pyk}} \text{“plus * and * end plus”} \rceil]$

[Theory *]

$\lceil [\text{Theory } \mathbf{n}] \xrightarrow{\text{macro}} \lambda \mathbf{t}. \lambda \mathbf{s}. \lambda \mathbf{c}. \text{theory}_2(\mathbf{t}, \mathbf{c}) \rceil$
 $\lceil [\text{Theory } \mathbf{n}] \xrightarrow{\text{tex}} \text{“}$
 $\lceil \backslash \text{mathbf{bf}}\{\text{Theory \setminus } \} \#1.$
 $\text{”} \rceil$
 $\lceil [\text{Theory } \mathbf{n}] \xrightarrow{\text{pyk}} \text{“theory * end theory”} \rceil]$

theory₂(*, *)

[theory₂(t, c) $\xrightarrow{\text{val}}$
 let₁(λn.
 let₁(λs.
 $\tilde{Q}(t, [[n \xrightarrow{\text{stmt}} x]], s), [[n] :: n] :: [[[x] :: \text{theory}_3(c, n)] :: T]), t^1)$
 [theory₂(t, c) $\xrightarrow{\text{tex}}$ “
 theory₂(#1.
 , #2.
)”]
 [theory₂(t, c) $\xrightarrow{\text{pyk}}$ “theory two * cache * end theory”]

theory₃(*, *)

[theory₃(c, n) $\xrightarrow{\text{val}}$ n!
 let₁(λr.
 theory₄(c[r[“codex”][r], n, T), c[0]])
 [theory₃(c, n) $\xrightarrow{\text{tex}}$ “
 theory₃(#1.
 , #2.
)”]
 [theory₃(c, n) $\xrightarrow{\text{pyk}}$ “theory three * name * end theory”]

theory₄(*, *, *)

[theory₄(c, n, s) $\xrightarrow{\text{val}}$ n!
 If(c, s,
 If($\neg [c^{\text{hc}}]$, theory₄(c^t, n, theory₄(c^h, n, s)),
 If($\neg [\text{aspect}(<\text{proof}>, c^t)^3 \stackrel{t}{=} [\text{Rule tactic}]]$, s,
 let₁(λd.
 If($\neg [d^1 \stackrel{t}{=} n]$, s,
 Plus(d², s)), **aspect**(<stmt>, c^t)³))))]
 [theory₄(c, n, s) $\xrightarrow{\text{tex}}$ “
 theory₄(#1.
 , #2.
 , #3.
)”]

[theory₄(c, n, s) $\xrightarrow{\text{pyk}}$ “theory four * name * sum * end theory”]

HeadNil''

[HeadNil'' $\xrightarrow{\text{proof}}$ Rule tactic]

[HeadNil'' $\xrightarrow{\text{stmt}}$ T'_E ⊢ [T^h = T]]

[HeadNil'' $\xrightarrow{\text{tex}}$ “
HeadNil''”]

[HeadNil'' $\xrightarrow{\text{pyk}}$ “example axiom lemma primed”]

HeadPair''

[HeadPair'' $\xrightarrow{\text{proof}}$ Rule tactic]

[HeadPair'' $\xrightarrow{\text{stmt}}$ T'_E ⊢ ∀a: ∀b: [[a :: b]^h = a]]

[HeadPair'' $\xrightarrow{\text{tex}}$ “
HeadPair''”]

[HeadPair'' $\xrightarrow{\text{pyk}}$ “example scheme lemma primed”]

Transitivity''

[Transitivity'' $\xrightarrow{\text{proof}}$ Rule tactic]

[Transitivity'' $\xrightarrow{\text{stmt}}$ T'_E ⊢ ∀a: ∀b: ∀c: [[a = b] ⊢ [a = c] ⊢ [b = c]]]

[Transitivity'' $\xrightarrow{\text{tex}}$ “
Transitivity''”]

[Transitivity'' $\xrightarrow{\text{pyk}}$ “example rule lemma primed”]

Contra''

[Contra'' $\xrightarrow{\text{proof}}$ Rule tactic]

[Contra'' $\xrightarrow{\text{stmt}}$ T'_E ⊢ [[[T :: T] = T] ⊢ ⊥]]

[Contra'' $\xrightarrow{\text{tex}}$ “
Contra''”]

[Contra'' $\xrightarrow{\text{pyk}}$ “contraexample lemma primed”]

HeadNil

[HeadNil $\xrightarrow{\text{proof}}$ Rule tactic]
[HeadNil $\xrightarrow{\text{stmt}}$ $T_E \vdash [\text{Th} = T]$]
[HeadNil $\xrightarrow{\text{tex}}$ “
HeadNil”]
[HeadNil $\xrightarrow{\text{pyk}}$ “example axiom lemma”]

HeadPair

[HeadPair $\xrightarrow{\text{proof}}$ Rule tactic]
[HeadPair $\xrightarrow{\text{stmt}}$ $T_E \vdash \forall \underline{a}: \forall \underline{b}: [[\underline{a} :: \underline{b}]^h = \underline{a}]$]
[HeadPair $\xrightarrow{\text{tex}}$ “
HeadPair”]
[HeadPair $\xrightarrow{\text{pyk}}$ “example scheme lemma”]

Transitivity

[Transitivity $\xrightarrow{\text{proof}}$ Rule tactic]
[Transitivity $\xrightarrow{\text{stmt}}$ $T_E \vdash \forall \underline{a}: \forall \underline{b}: \forall \underline{c}: [[\underline{a} = \underline{b}] \vdash [[\underline{a} = \underline{c}] \vdash [\underline{b} = \underline{c}]]]$]
[Transitivity $\xrightarrow{\text{tex}}$ “
Transitivity”]
[Transitivity $\xrightarrow{\text{pyk}}$ “example rule lemma”]

Contra

[Contra $\xrightarrow{\text{proof}}$ Rule tactic]
[Contra $\xrightarrow{\text{stmt}}$ $T_E \vdash [[[T :: T] = T] \vdash \perp]$]
[Contra $\xrightarrow{\text{tex}}$ “
Contra”]
[Contra $\xrightarrow{\text{pyk}}$ “contraexample lemma”]

T_E

$[T_E \xrightarrow{\text{stmt}} [\forall \underline{a}: \forall \underline{b}: [\underline{a} :: \underline{b}]^h = \underline{a}]] \oplus [[[\underline{T} :: \underline{T}] = \underline{T}] \vdash \perp] \oplus [[T^h = \underline{T}] \oplus \forall \underline{a}: \forall \underline{b}: \forall \underline{c}: [[\underline{a} = \underline{b}] \vdash [[\underline{a} = \underline{c}] \vdash [\underline{b} = \underline{c}]]]]]$

$[T_E \xrightarrow{\text{tex}} \text{“} T_E \text{”}]$

$[T_E \xrightarrow{\text{pyk}} \text{“example theory”}]$

ragged right

$[\text{ragged right} \xrightarrow{\text{name}} \text{“} \text{ragged\right} \text{”}]$

$[\text{ragged right} \xrightarrow{\text{tex}} \text{“} \backslash \text{raggedright} \text{”}]$

$[\text{ragged right} \xrightarrow{\text{pyk}} \text{“ragged right”}]$

ragged right expansion

$[\text{ragged right expansion} \xrightarrow{\text{name}} \text{“} \text{ragged\right expansion\right} \text{”}]$

$[\text{ragged right expansion} \xrightarrow{\text{macro}} \lambda t. \lambda s. \lambda c. \tilde{\mathcal{M}}_4(t, s, c, [[\text{ragged right expansion} \hat{=} \text{ragged right}]])]$

$[\text{ragged right expansion} \xrightarrow{\text{tex}} \text{“} \text{”}]$

$[\text{ragged right expansion} \xrightarrow{\text{pyk}} \text{“ragged right expansion”}]$

parm(*, *, *)

$[\text{parm}(t, s, n) \xrightarrow{\text{val}} n!]$
 $\text{If}(t \stackrel{r}{=} [\forall x: y], \forall n: \text{parm}(t^2, [t^1 :: n] :: s, T + 2 * n),$
 $\text{let}_1(\lambda m.$
 $\text{If}(\neg m, m, t^R :: \text{parm}^*(t^t, s, n)), \text{lookup}(t, s, T)))]$

$[\text{parm}(t, s, n) \xrightarrow{\text{tex}} \text{“} \text{parm}(\#1.$
 $, \#2.$
 $, \#3.$
 $\text{”})]$

$[\text{parm}(\mathbf{t}, \mathbf{s}, \mathbf{n}) \xrightarrow{\text{pyk}} \text{“parameter term * stack * seed * end parameter”}]$

$\text{parm}^*(\ast, \ast, \ast)$

$[\text{parm}^*(\mathbf{t}, \mathbf{s}, \mathbf{n}) \xrightarrow{\text{val}} \mathbf{s}! [\text{ n!If}(\mathbf{t}^{\mathbf{a}}, \mathbf{T}, \text{parm}(\mathbf{t}^{\mathbf{h}}, \mathbf{s}, \mathbf{n}) :: \text{parm}^*(\mathbf{t}^{\mathbf{t}}, \mathbf{s}, \mathbf{n}))]]$

$[\text{parm}^*(\mathbf{t}, \mathbf{s}, \mathbf{n}) \xrightarrow{\text{tex}} \text{“}$
 $\text{parm}^{\wedge}(\#1.$
 $, \#2.$
 $, \#3.$
 $\text{)”}]$

$[\text{parm}^*(\mathbf{t}, \mathbf{s}, \mathbf{n}) \xrightarrow{\text{pyk}} \text{“parameter term star * stack * seed * end parameter”}]$

$\text{inst}(\ast, \ast)$

$[\text{inst}(\mathbf{t}, \mathbf{s}) \xrightarrow{\text{val}} \text{If}(\mathbf{t}^{\mathbf{c}}, \text{inst}(\mathbf{s}[\mathbf{t}], \mathbf{s}), \mathbf{t}^{\mathbf{R}} :: \text{inst}^*(\mathbf{t}^{\mathbf{t}}, \mathbf{s}))]$

$[\text{inst}(\mathbf{t}, \mathbf{s}) \xrightarrow{\text{tex}} \text{“}$
 $\text{inst}(\#1.$
 $, \#2.$
 $\text{)”}]$

$[\text{inst}(\mathbf{t}, \mathbf{s}) \xrightarrow{\text{pyk}} \text{“instantiate * with * end instantiate”}]$

$\text{inst}^*(\ast, \ast)$

$[\text{inst}^*(\mathbf{t}, \mathbf{s}) \xrightarrow{\text{val}} \mathbf{s}!\text{If}(\mathbf{t}^{\mathbf{a}}, \mathbf{T}, \text{inst}(\mathbf{t}^{\mathbf{h}}, \mathbf{s}) :: \text{inst}^*(\mathbf{t}^{\mathbf{t}}, \mathbf{s}))]$

$[\text{inst}^*(\mathbf{t}, \mathbf{s}) \xrightarrow{\text{tex}} \text{“}$
 $\text{inst}^{\wedge}(\#1.$
 $, \#2.$
 $\text{)”}]$

$[\text{inst}^*(\mathbf{t}, \mathbf{s}) \xrightarrow{\text{pyk}} \text{“instantiate star * with * end instantiate”}]$

$\text{occur}(\ast, \ast, \ast)$

$[\text{occur}(\mathbf{t}, \mathbf{u}, \mathbf{s}) \xrightarrow{\text{val}} \mathbf{s}!\text{If}(\mathbf{u}^{\mathbf{c}}, \text{If}(\mathbf{t} \approx \mathbf{u}, \mathbf{T}, \text{occur}(\mathbf{t}, \mathbf{s}[\mathbf{u}], \mathbf{s})), \text{occur}^*(\mathbf{t}, \mathbf{u}^{\mathbf{t}}, \mathbf{s}))]$

$[\text{occur}(\mathbf{t}, \mathbf{u}, \mathbf{s}) \xrightarrow{\text{tex}} \text{“}$
 $\text{occur}(\#1.$

, #2.
 , #3.
)”]

$[\text{occur}(\mathbf{t}, \mathbf{u}, \mathbf{s}) \xrightarrow{\text{pyk}} \text{“occur * in * substitution * end occur”}]$

$\text{occur}^*(\ast, \ast, \ast)$

$[\text{occur}^*(\mathbf{t}, \mathbf{u}, \mathbf{s}) \xrightarrow{\text{val}} \mathbf{t}! [\text{s!If}(\mathbf{u}^{\mathbf{a}}, \mathbf{F}, \text{If}(\text{occur}(\mathbf{t}, \mathbf{u}^{\mathbf{h}}, \mathbf{s}), \mathbf{T}, \text{occur}^*(\mathbf{t}, \mathbf{u}^{\mathbf{t}}, \mathbf{s})))]]$

$[\text{occur}^*(\mathbf{t}, \mathbf{u}, \mathbf{s}) \xrightarrow{\text{tex}} \text{“}$
 $\text{occur}^{\wedge}(\#1.$
 , #2.
 , #3.
)”]

$[\text{occur}^*(\mathbf{t}, \mathbf{u}, \mathbf{s}) \xrightarrow{\text{pyk}} \text{“occur star * in * substitution * end occur”}]$

$\text{unify}(\ast = \ast, \ast)$

$[\text{unify}(\mathbf{t} = \mathbf{u}, \mathbf{s}) \xrightarrow{\text{val}} \mathbf{t}! [\mathbf{u}!$
 $\text{If}(\mathbf{s}^{\mathbf{c}}, \mathbf{s},$
 $\text{If}(\mathbf{t}^{\mathbf{c}}, \text{unify}_2(\mathbf{t} = \mathbf{u}, \mathbf{s}),$
 $\text{If}(\mathbf{u}^{\mathbf{c}}, \text{unify}_2(\mathbf{u} = \mathbf{t}, \mathbf{s}),$
 $\text{If}(\mathbf{t} \stackrel{\mathbf{r}}{=} \mathbf{u}, \text{unify}^*(\mathbf{t}^{\mathbf{t}} = \mathbf{u}^{\mathbf{t}}, \mathbf{s}, 0))))]]$

$[\text{unify}(\mathbf{t} = \mathbf{u}, \mathbf{s}) \xrightarrow{\text{tex}} \text{“}$
 $\text{unify}(\#1.$
 $=\#2.$
 , #3.
)”]

$[\text{unify}(\mathbf{t} = \mathbf{u}, \mathbf{s}) \xrightarrow{\text{pyk}} \text{“unify * with * substitution * end unify”}]$

$\text{unify}^*(\ast = \ast, \ast)$

$[\text{unify}^*(\mathbf{t} = \mathbf{u}, \mathbf{s}) \xrightarrow{\text{val}} \mathbf{u}!\text{If}(\mathbf{t}^{\mathbf{a}}, \mathbf{s}, \text{unify}^*(\mathbf{t}^{\mathbf{t}} = \mathbf{u}^{\mathbf{t}}, \text{unify}(\mathbf{t}^{\mathbf{h}} = \mathbf{u}^{\mathbf{h}}, \mathbf{s})))]$

$[\text{unify}^*(\mathbf{t} = \mathbf{u}, \mathbf{s}) \xrightarrow{\text{tex}} \text{“}$
 $\text{unify}^{\wedge}(\#1.$
 $=\#2.$
 , #3.
)”]

[unify*(t = u, s) $\xrightarrow{\text{pyk}}$ “unify star * with * substitution * end unify”]

unify₂(* = *, *)

[unify₂(t = u, s) $\xrightarrow{\text{val}}$
If(t ≈ u, s,
let₁(λt'.
If(¬ [t'], unify(t' = u, s),
If(occur(t, u, s), 0, s[t→u])), s[t]))]

[unify₂(t = u, s) $\xrightarrow{\text{tex}}$ “
unify_2(#1.
=#2.
, #3.
)”]

[unify₂(t = u, s) $\xrightarrow{\text{pyk}}$ “unify two * with * substitution * end unify”]

L_a

[L_a $\xrightarrow{\text{name}}$ “L_a”]
[L_a $\xrightarrow{\text{tex}}$ “
\if \relax \csname lgwprooflinep\endcsname L_a \else
\if \relax \csname lgwella\endcsname
\global \advance \lgwproofline by 1
\xdef \lgwella {L\ifnum \lgwproofline <10 0\fi \number \lgwproofline }
\fi \lgwella \fi ”]
[L_a $\xrightarrow{\text{pyk}}$ “ell a”]

L_b

[L_b $\xrightarrow{\text{name}}$ “L_b”]
[L_b $\xrightarrow{\text{tex}}$ “
\if \relax \csname lgwprooflinep\endcsname L_b \else
\if \relax \csname lgwellb\endcsname
\global \advance \lgwproofline by 1
\xdef \lgwellb {L\ifnum \lgwproofline <10 0\fi \number \lgwproofline }
\fi \lgwellb \fi ”]
[L_b $\xrightarrow{\text{pyk}}$ “ell b”]

L_c

```
[L_c  $\xrightarrow{\text{name}}$  "L_c"]  
  
[L_c  $\xrightarrow{\text{tex}}$  "  
\if \relax \csname lgwprooflinep\endcsname L_c \else  
\if \relax \csname lgwelld\endcsname  
\global \advance \lgwproofline by 1  
\xdef \lgwelld {L\ifnum \lgwproofline <10 0\fi \number \lgwproofline }  
\fi \lgwelld \fi }"]  
  
[L_c  $\xrightarrow{\text{pyk}}$  "ell c"]
```

L_d

```
[L_d  $\xrightarrow{\text{name}}$  "L_d"]  
  
[L_d  $\xrightarrow{\text{tex}}$  "  
\if \relax \csname lgwprooflinep\endcsname L_d \else  
\if \relax \csname lgwelld\endcsname  
\global \advance \lgwproofline by 1  
\xdef \lgwelld {L\ifnum \lgwproofline <10 0\fi \number \lgwproofline }  
\fi \lgwelld \fi }"]  
  
[L_d  $\xrightarrow{\text{pyk}}$  "ell d"]
```

L_e

```
[L_e  $\xrightarrow{\text{name}}$  "L_e"]  
  
[L_e  $\xrightarrow{\text{tex}}$  "  
\if \relax \csname lgwprooflinep\endcsname L_e \else  
\if \relax \csname lgwelle\endcsname  
\global \advance \lgwproofline by 1  
\xdef \lgwelle {L\ifnum \lgwproofline <10 0\fi \number \lgwproofline }  
\fi \lgwelle \fi }"]  
  
[L_e  $\xrightarrow{\text{pyk}}$  "ell e"]
```

L_f

```
[L_f  $\xrightarrow{\text{name}}$  "L_f"]  
  
[L_f  $\xrightarrow{\text{tex}}$  "
```

```

\if \relax \csname lgwprooflinep\endcsname L_f \else
\if \relax \csname lgwellf\endcsname
\global \advance \lgwproofline by 1
\xdef \lgwellf {L\ifnum \lgwproofline <10 0\fi \number \lgwproofline }
\fi \lgwellf \fi ”]

[L_f  $\xrightarrow{\text{pyk}}$  “ell f”]

```

L_g

```

[L_g  $\xrightarrow{\text{name}}$  “L_g”]

[L_g  $\xrightarrow{\text{tex}}$  “
\if \relax \csname lgwprooflinep\endcsname L_g \else
\if \relax \csname lgwellg\endcsname
\global \advance \lgwproofline by 1
\xdef \lgwellg {L\ifnum \lgwproofline <10 0\fi \number \lgwproofline }
\fi \lgwellg \fi ”]

[L_g  $\xrightarrow{\text{pyk}}$  “ell g”]

```

L_h

```

[L_h  $\xrightarrow{\text{name}}$  “L_h”]

[L_h  $\xrightarrow{\text{tex}}$  “
\if \relax \csname lgwprooflinep\endcsname L_h \else
\if \relax \csname lgwellh\endcsname
\global \advance \lgwproofline by 1
\xdef \lgwellh {L\ifnum \lgwproofline <10 0\fi \number \lgwproofline }
\fi \lgwellh \fi ”]

[L_h  $\xrightarrow{\text{pyk}}$  “ell h”]

```

L_i

```

[L_i  $\xrightarrow{\text{name}}$  “L_i”]

[L_i  $\xrightarrow{\text{tex}}$  “
\if \relax \csname lgwprooflinep\endcsname L_i \else
\if \relax \csname lgwelli\endcsname
\global \advance \lgwproofline by 1
\xdef \lgwelli {L\ifnum \lgwproofline <10 0\fi \number \lgwproofline }
\fi \lgwelli \fi ”]

```

[L_i $\xrightarrow{\text{pyk}}$ “ell i”]

L_j

[L_j $\xrightarrow{\text{name}}$ “L_j”]

[L_j $\xrightarrow{\text{tex}}$ “
\if \relax \cname lgwprooflinep\endcsname L_j \else
\if \relax \cname lgwellj\endcsname
\global \advance \lgwproofline by 1
\xdef \lgwellj {L\ifnum \lgwproofline <10 0\fi \number \lgwproofline }
\fi \lgwellj \fi ”]

[L_j $\xrightarrow{\text{pyk}}$ “ell j”]

L_k

[L_k $\xrightarrow{\text{name}}$ “L_k”]

[L_k $\xrightarrow{\text{tex}}$ “
\if \relax \cname lgwprooflinep\endcsname L_k \else
\if \relax \cname lgwellk\endcsname
\global \advance \lgwproofline by 1
\xdef \lgwellk {L\ifnum \lgwproofline <10 0\fi \number \lgwproofline }
\fi \lgwellk \fi ”]

[L_k $\xrightarrow{\text{pyk}}$ “ell k”]

L_l

[L_l $\xrightarrow{\text{name}}$ “L_l”]

[L_l $\xrightarrow{\text{tex}}$ “
\if \relax \cname lgwprooflinep\endcsname L_l \else
\if \relax \cname lgwelll\endcsname
\global \advance \lgwproofline by 1
\xdef \lgwelll {L\ifnum \lgwproofline <10 0\fi \number \lgwproofline }
\fi \lgwelll \fi ”]

[L_l $\xrightarrow{\text{pyk}}$ “ell l”]

L_m

```
[L_m  $\xrightarrow{\text{name}}$  "L_m"]  
[L_m  $\xrightarrow{\text{tex}}$  "  
\if \relax \csname lgwprooflinep\endcsname L_m \else  
\if \relax \csname lgwellm\endcsname  
\global \advance \lgwproofline by 1  
\xdef \lgwellm {L\ifnum \lgwproofline <10 0\fi \number \lgwproofline }  
\fi \lgwellm \fi }"]  
[L_m  $\xrightarrow{\text{pyk}}$  "ell m"]
```

L_n

```
[L_n  $\xrightarrow{\text{name}}$  "L_n"]  
[L_n  $\xrightarrow{\text{tex}}$  "  
\if \relax \csname lgwprooflinep\endcsname L_n \else  
\if \relax \csname lgwelln\endcsname  
\global \advance \lgwproofline by 1  
\xdef \lgwelln {L\ifnum \lgwproofline <10 0\fi \number \lgwproofline }  
\fi \lgwelln \fi }"]  
[L_n  $\xrightarrow{\text{pyk}}$  "ell n"]
```

L_o

```
[L_o  $\xrightarrow{\text{name}}$  "L_o"]  
[L_o  $\xrightarrow{\text{tex}}$  "  
\if \relax \csname lgwprooflinep\endcsname L_o \else  
\if \relax \csname lgwello\endcsname  
\global \advance \lgwproofline by 1  
\xdef \lgwello {L\ifnum \lgwproofline <10 0\fi \number \lgwproofline }  
\fi \lgwello \fi }"]  
[L_o  $\xrightarrow{\text{pyk}}$  "ell o"]
```

L_p

```
[L_p  $\xrightarrow{\text{name}}$  "L_p"]  
[L_p  $\xrightarrow{\text{tex}}$  "  

```

```
\if \relax \csname lgwprooflinep\endcsname L_p \else
\if \relax \csname lgwellp\endcsname
\global \advance \lgwproofline by 1
\xdef \lgwellp {L\ifnum \lgwproofline <10 0\fi \number \lgwproofline }
\fi \lgwellp \fi ”]

[L_p  $\xrightarrow{\text{pyk}}$  “ell p”]
```

L_q

```
[L_q  $\xrightarrow{\text{name}}$  “L_q”]

[L_q  $\xrightarrow{\text{tex}}$  “
\if \relax \csname lgwprooflinep\endcsname L_q \else
\if \relax \csname lgwellq\endcsname
\global \advance \lgwproofline by 1
\xdef \lgwellq {L\ifnum \lgwproofline <10 0\fi \number \lgwproofline }
\fi \lgwellq \fi ”]

[L_q  $\xrightarrow{\text{pyk}}$  “ell q”]
```

L_r

```
[L_r  $\xrightarrow{\text{name}}$  “L_r”]

[L_r  $\xrightarrow{\text{tex}}$  “
\if \relax \csname lgwprooflinep\endcsname L_r \else
\if \relax \csname lgwellr\endcsname
\global \advance \lgwproofline by 1
\xdef \lgwellr {L\ifnum \lgwproofline <10 0\fi \number \lgwproofline }
\fi \lgwellr \fi ”]

[L_r  $\xrightarrow{\text{pyk}}$  “ell r”]
```

L_s

```
[L_s  $\xrightarrow{\text{name}}$  “L_s”]

[L_s  $\xrightarrow{\text{tex}}$  “
\if \relax \csname lgwprooflinep\endcsname L_s \else
\if \relax \csname lgwells\endcsname
\global \advance \lgwproofline by 1
\xdef \lgwells {L\ifnum \lgwproofline <10 0\fi \number \lgwproofline }
\fi \lgwells \fi ”]
```

$$[L_s \xrightarrow{\text{pyk}} \text{“ell s”}]$$

L_t

$$[L_t \xrightarrow{\text{name}} \text{“L_t”}]$$

$$\begin{aligned}
& [L_t \xrightarrow{\text{tex}} \text{“} \\
& \quad \backslash \text{if } \backslash \text{relax } \backslash \text{csname lgwprooflinep} \backslash \text{endcsname } L_t \backslash \text{else} \\
& \quad \backslash \text{if } \backslash \text{relax } \backslash \text{csname lgwellt} \backslash \text{endcsname} \\
& \quad \backslash \text{global } \backslash \text{advance } \backslash \text{lgwproofline by 1} \\
& \quad \backslash \text{xdef } \backslash \text{lgwellt } \{ L \backslash \text{ifnum } \backslash \text{lgwproofline} < 10 0 \backslash \text{fi } \backslash \text{number } \backslash \text{lgwproofline} \} \\
& \quad \backslash \text{fi } \backslash \text{lgwellt } \backslash \text{fi ”}] \\
& [L_t \xrightarrow{\text{pyk}} \text{“ell t”}]
\end{aligned}$$

L_u

$$[L_u \xrightarrow{\text{name}} \text{“L_u”}]$$

$$\begin{aligned}
& [L_u \xrightarrow{\text{tex}} \text{“} \\
& \quad \backslash \text{if } \backslash \text{relax } \backslash \text{csname lgwprooflinep} \backslash \text{endcsname } L_u \backslash \text{else} \\
& \quad \backslash \text{if } \backslash \text{relax } \backslash \text{csname lgwellu} \backslash \text{endcsname} \\
& \quad \backslash \text{global } \backslash \text{advance } \backslash \text{lgwproofline by 1} \\
& \quad \backslash \text{xdef } \backslash \text{lgwellu } \{ L \backslash \text{ifnum } \backslash \text{lgwproofline} < 10 0 \backslash \text{fi } \backslash \text{number } \backslash \text{lgwproofline} \} \\
& \quad \backslash \text{fi } \backslash \text{lgwellu } \backslash \text{fi ”}] \\
& [L_u \xrightarrow{\text{pyk}} \text{“ell u”}]
\end{aligned}$$

L_v

$$[L_v \xrightarrow{\text{name}} \text{“L_v”}]$$

$$\begin{aligned}
& [L_v \xrightarrow{\text{tex}} \text{“} \\
& \quad \backslash \text{if } \backslash \text{relax } \backslash \text{csname lgwprooflinep} \backslash \text{endcsname } L_v \backslash \text{else} \\
& \quad \backslash \text{if } \backslash \text{relax } \backslash \text{csname lgwellv} \backslash \text{endcsname} \\
& \quad \backslash \text{global } \backslash \text{advance } \backslash \text{lgwproofline by 1} \\
& \quad \backslash \text{xdef } \backslash \text{lgwellv } \{ L \backslash \text{ifnum } \backslash \text{lgwproofline} < 10 0 \backslash \text{fi } \backslash \text{number } \backslash \text{lgwproofline} \} \\
& \quad \backslash \text{fi } \backslash \text{lgwellv } \backslash \text{fi ”}] \\
& [L_v \xrightarrow{\text{pyk}} \text{“ell v”}]
\end{aligned}$$

L_w

```
[L_w  $\xrightarrow{\text{name}}$  "L_w"]  
  
[L_w  $\xrightarrow{\text{tex}}$  "  
\if \relax \csname lgwprooflinep\endcsname L_w \else  
\if \relax \csname lgwellw\endcsname  
\global \advance \lgwproofline by 1  
\xdef \lgwellw {L\ifnum \lgwproofline <10 0\fi \number \lgwproofline }  
\fi \lgwellw \fi }"]  
  
[L_w  $\xrightarrow{\text{pyk}}$  "ell w"]
```

L_x

```
[L_x  $\xrightarrow{\text{name}}$  "L_x"]  
  
[L_x  $\xrightarrow{\text{tex}}$  "  
\if \relax \csname lgwprooflinep\endcsname L_x \else  
\if \relax \csname lgwellx\endcsname  
\global \advance \lgwproofline by 1  
\xdef \lgwellx {L\ifnum \lgwproofline <10 0\fi \number \lgwproofline }  
\fi \lgwellx \fi }"]  
  
[L_x  $\xrightarrow{\text{pyk}}$  "ell x"]
```

L_y

```
[L_y  $\xrightarrow{\text{name}}$  "L_y"]  
  
[L_y  $\xrightarrow{\text{tex}}$  "  
\if \relax \csname lgwprooflinep\endcsname L_y \else  
\if \relax \csname lgwelly\endcsname  
\global \advance \lgwproofline by 1  
\xdef \lgwelly {L\ifnum \lgwproofline <10 0\fi \number \lgwproofline }  
\fi \lgwelly \fi }"]  
  
[L_y  $\xrightarrow{\text{pyk}}$  "ell y"]
```

L_z

```
[L_z  $\xrightarrow{\text{name}}$  "L_z"]  
  
[L_z  $\xrightarrow{\text{tex}}$  "
```

```

\if \relax \csname lgwprooflinep\endcsname L.z \else
\if \relax \csname lgwellz\endcsname
\global \advance \lgwproofline by 1
\undef \lgwellz {L\ifnum \lgwproofline <10 0\fi \number \lgwproofline }
\fi \lgwellz \fi ”]

[Lz  $\xrightarrow{\text{pyk}}$  “ell z”]

```

L_A

```

[LA  $\xrightarrow{\text{name}}$  “LA”]

[LA  $\xrightarrow{\text{tex}}$  “
\if \relax \csname lgwprooflinep\endcsname L.A \else
\if \relax \csname lgwellbiga\endcsname
\global \advance \lgwproofline by 1
\undef \lgwellbiga {L\ifnum \lgwproofline <10 0\fi \number \lgwproofline }
\fi \lgwellbiga \fi ”]

[LA  $\xrightarrow{\text{pyk}}$  “ell big a”]

```

L_B

```

[LB  $\xrightarrow{\text{name}}$  “LB”]

[LB  $\xrightarrow{\text{tex}}$  “
\if \relax \csname lgwprooflinep\endcsname L.B \else
\if \relax \csname lgwellbigb\endcsname
\global \advance \lgwproofline by 1
\undef \lgwellbigb {L\ifnum \lgwproofline <10 0\fi \number \lgwproofline }
\fi \lgwellbigb \fi ”]

[LB  $\xrightarrow{\text{pyk}}$  “ell big b”]

```

L_C

```

[LC  $\xrightarrow{\text{name}}$  “LC”]

[LC  $\xrightarrow{\text{tex}}$  “
\if \relax \csname lgwprooflinep\endcsname L.C \else
\if \relax \csname lgwellbigc\endcsname
\global \advance \lgwproofline by 1
\undef \lgwellbigc {L\ifnum \lgwproofline <10 0\fi \number \lgwproofline }
\fi \lgwellbigc \fi ”]

```

[L_C $\xrightarrow{\text{pyk}}$ “ell big c”]

L_D

[L_D $\xrightarrow{\text{name}}$ “L_D”]

[L_D $\xrightarrow{\text{tex}}$ “
\if \relax \csname lgwprooflinep\endcsname L_D \else
\if \relax \csname lgwellbigd\endcsname
\global \advance \lgwproofline by 1
\xdef \lgwellbigd {L\ifnum \lgwproofline <10 0\fi \number \lgwproofline }
\fi \lgwellbigd \fi ”]
[L_D $\xrightarrow{\text{pyk}}$ “ell big d”]

L_E

[L_E $\xrightarrow{\text{name}}$ “L_E”]

[L_E $\xrightarrow{\text{tex}}$ “
\if \relax \csname lgwprooflinep\endcsname L_E \else
\if \relax \csname lgwellbige\endcsname
\global \advance \lgwproofline by 1
\xdef \lgwellbige {L\ifnum \lgwproofline <10 0\fi \number \lgwproofline }
\fi \lgwellbige \fi ”]
[L_E $\xrightarrow{\text{pyk}}$ “ell big e”]

L_F

[L_F $\xrightarrow{\text{name}}$ “L_F”]

[L_F $\xrightarrow{\text{tex}}$ “
\if \relax \csname lgwprooflinep\endcsname L_F \else
\if \relax \csname lgwellbigf\endcsname
\global \advance \lgwproofline by 1
\xdef \lgwellbigf {L\ifnum \lgwproofline <10 0\fi \number \lgwproofline }
\fi \lgwellbigf \fi ”]
[L_F $\xrightarrow{\text{pyk}}$ “ell big f”]

L_G

[L_G $\xrightarrow{\text{name}}$ “L_G”]

[L_G $\xrightarrow{\text{tex}}$ “

\if \relax \csname lgwprooflinep\endcsname L_G \else

\if \relax \csname lgwellbigg\endcsname

\global \advance \lgwproofline by 1

\xdef \lgwellbigg {L\ifnum \lgwproofline <10 0\fi \number \lgwproofline }

\fi \lgwellbigg \fi ”]

[L_G $\xrightarrow{\text{pyk}}$ “ell big g”]

L_H

[L_H $\xrightarrow{\text{name}}$ “L_H”]

[L_H $\xrightarrow{\text{tex}}$ “

\if \relax \csname lgwprooflinep\endcsname L_H \else

\if \relax \csname lgwellbigh\endcsname

\global \advance \lgwproofline by 1

\xdef \lgwellbigh {L\ifnum \lgwproofline <10 0\fi \number \lgwproofline }

\fi \lgwellbigh \fi ”]

[L_H $\xrightarrow{\text{pyk}}$ “ell big h”]

L_I

[L_I $\xrightarrow{\text{name}}$ “L_I”]

[L_I $\xrightarrow{\text{tex}}$ “

\if \relax \csname lgwprooflinep\endcsname L_I \else

\if \relax \csname lgwellbigi\endcsname

\global \advance \lgwproofline by 1

\xdef \lgwellbigi {L\ifnum \lgwproofline <10 0\fi \number \lgwproofline }

\fi \lgwellbigi \fi ”]

[L_I $\xrightarrow{\text{pyk}}$ “ell big i”]

L_J

[L_J $\xrightarrow{\text{name}}$ “L_J”]

[L_J $\xrightarrow{\text{tex}}$ “

```

\if \relax \csname lgwprooflinep\endcsname L_J \else
\if \relax \csname lgwellbigj\endcsname
\global \advance \lgwproofline by 1
\undef \lgwellbigj {L\ifnum \lgwproofline <10 0\fi \number \lgwproofline }
\fi \lgwellbigj \fi ”]

[L_J  $\xrightarrow{\text{pyk}}$  “ell big j”]

```

L_K

```

[L_K  $\xrightarrow{\text{name}}$  “L_K”]

[L_K  $\xrightarrow{\text{tex}}$  “
\if \relax \csname lgwprooflinep\endcsname L_K \else
\if \relax \csname lgwellbigk\endcsname
\global \advance \lgwproofline by 1
\undef \lgwellbigk {L\ifnum \lgwproofline <10 0\fi \number \lgwproofline }
\fi \lgwellbigk \fi ”]

[L_K  $\xrightarrow{\text{pyk}}$  “ell big k”]

```

L_L

```

[L_L  $\xrightarrow{\text{name}}$  “L_L”]

[L_L  $\xrightarrow{\text{tex}}$  “
\if \relax \csname lgwprooflinep\endcsname L_L \else
\if \relax \csname lgwellbigl\endcsname
\global \advance \lgwproofline by 1
\undef \lgwellbigl {L\ifnum \lgwproofline <10 0\fi \number \lgwproofline }
\fi \lgwellbigl \fi ”]

[L_L  $\xrightarrow{\text{pyk}}$  “ell big l”]

```

L_M

```

[L_M  $\xrightarrow{\text{name}}$  “L_M”]

[L_M  $\xrightarrow{\text{tex}}$  “
\if \relax \csname lgwprooflinep\endcsname L_M \else
\if \relax \csname lgwellbigm\endcsname
\global \advance \lgwproofline by 1
\undef \lgwellbigm {L\ifnum \lgwproofline <10 0\fi \number \lgwproofline }
\fi \lgwellbigm \fi ”]

```

[L_M $\xrightarrow{\text{pyk}}$ “ell big m”]

L_N

[L_N $\xrightarrow{\text{name}}$ “L_N”]

[L_N $\xrightarrow{\text{tex}}$ “
\if \relax \csname lgwprooflinep\endcsname L_N \else
\if \relax \csname lgwellbign\endcsname
\global \advance \lgwproofline by 1
\xdef \lgwellbign {L\ifnum \lgwproofline <10 0\fi \number \lgwproofline }
\fi \lgwellbign \fi ”]
[L_N $\xrightarrow{\text{pyk}}$ “ell big n”]

L_O

[L_O $\xrightarrow{\text{name}}$ “L_O”]

[L_O $\xrightarrow{\text{tex}}$ “
\if \relax \csname lgwprooflinep\endcsname L_O \else
\if \relax \csname lgwellbigo\endcsname
\global \advance \lgwproofline by 1
\xdef \lgwellbigo {L\ifnum \lgwproofline <10 0\fi \number \lgwproofline }
\fi \lgwellbigo \fi ”]
[L_O $\xrightarrow{\text{pyk}}$ “ell big o”]

L_P

[L_P $\xrightarrow{\text{name}}$ “L_P”]

[L_P $\xrightarrow{\text{tex}}$ “
\if \relax \csname lgwprooflinep\endcsname L_P \else
\if \relax \csname lgwellbigp\endcsname
\global \advance \lgwproofline by 1
\xdef \lgwellbigp {L\ifnum \lgwproofline <10 0\fi \number \lgwproofline }
\fi \lgwellbigp \fi ”]
[L_P $\xrightarrow{\text{pyk}}$ “ell big p”]

L_Q

$[L_Q \xrightarrow{\text{name}} \text{“}L_Q\text{”}]$

$[L_Q \xrightarrow{\text{tex}} \text{“}$
 $\backslash\text{if } \backslash\text{relax } \backslash\text{csname lgwprooflinep}\backslash\text{endcsname } L_Q \backslash\text{else}$
 $\backslash\text{if } \backslash\text{relax } \backslash\text{csname lgwellbigq}\backslash\text{endcsname}$
 $\backslash\text{global } \backslash\text{advance } \backslash\text{lgwproofline by 1}$
 $\backslash\text{xdef } \backslash\text{lgwellbigq } \{L\backslash\text{ifnum } \backslash\text{lgwproofline } <10\ 0\backslash\text{fi } \backslash\text{number } \backslash\text{lgwproofline } \}$
 $\backslash\text{fi } \backslash\text{lgwellbigq } \backslash\text{fi ”}]$
 $[L_Q \xrightarrow{\text{pyk}} \text{“ell big q”}]$

L_R

$[L_R \xrightarrow{\text{name}} \text{“}L_R\text{”}]$

$[L_R \xrightarrow{\text{tex}} \text{“}$
 $\backslash\text{if } \backslash\text{relax } \backslash\text{csname lgwprooflinep}\backslash\text{endcsname } L_R \backslash\text{else}$
 $\backslash\text{if } \backslash\text{relax } \backslash\text{csname lgwellbigr}\backslash\text{endcsname}$
 $\backslash\text{global } \backslash\text{advance } \backslash\text{lgwproofline by 1}$
 $\backslash\text{xdef } \backslash\text{lgwellbigr } \{L\backslash\text{ifnum } \backslash\text{lgwproofline } <10\ 0\backslash\text{fi } \backslash\text{number } \backslash\text{lgwproofline } \}$
 $\backslash\text{fi } \backslash\text{lgwellbigr } \backslash\text{fi ”}]$
 $[L_R \xrightarrow{\text{pyk}} \text{“ell big r”}]$

L_S

$[L_S \xrightarrow{\text{name}} \text{“}L_S\text{”}]$

$[L_S \xrightarrow{\text{tex}} \text{“}$
 $\backslash\text{if } \backslash\text{relax } \backslash\text{csname lgwprooflinep}\backslash\text{endcsname } L_S \backslash\text{else}$
 $\backslash\text{if } \backslash\text{relax } \backslash\text{csname lgwellbigs}\backslash\text{endcsname}$
 $\backslash\text{global } \backslash\text{advance } \backslash\text{lgwproofline by 1}$
 $\backslash\text{xdef } \backslash\text{lgwellbigs } \{L\backslash\text{ifnum } \backslash\text{lgwproofline } <10\ 0\backslash\text{fi } \backslash\text{number } \backslash\text{lgwproofline } \}$
 $\backslash\text{fi } \backslash\text{lgwellbigs } \backslash\text{fi ”}]$
 $[L_S \xrightarrow{\text{pyk}} \text{“ell big s”}]$

L_T

$[L_T \xrightarrow{\text{name}} \text{“}L_T\text{”}]$

$[L_T \xrightarrow{\text{tex}} \text{“}$

```

\if \relax \csname lgwprooflinep\endcsname L.T \else
\if \relax \csname lgwellbigt\endcsname
\global \advance \lgwproofline by 1
\undef \lgwellbigt {L\ifnum \lgwproofline <10 0\fi \number \lgwproofline }
\fi \lgwellbigt \fi ”]

[L_T  $\xrightarrow{\text{pyk}}$  “ell big t”]

```

L_U

```

[L_U  $\xrightarrow{\text{name}}$  “L_U”]

[L_U  $\xrightarrow{\text{tex}}$  “
\if \relax \csname lgwprooflinep\endcsname L.U \else
\if \relax \csname lgwellbigu\endcsname
\global \advance \lgwproofline by 1
\undef \lgwellbigu {L\ifnum \lgwproofline <10 0\fi \number \lgwproofline }
\fi \lgwellbigu \fi ”]

[L_U  $\xrightarrow{\text{pyk}}$  “ell big u”]

```

L_V

```

[L_V  $\xrightarrow{\text{name}}$  “L_V”]

[L_V  $\xrightarrow{\text{tex}}$  “
\if \relax \csname lgwprooflinep\endcsname L.V \else
\if \relax \csname lgwellbigv\endcsname
\global \advance \lgwproofline by 1
\undef \lgwellbigv {L\ifnum \lgwproofline <10 0\fi \number \lgwproofline }
\fi \lgwellbigv \fi ”]

[L_V  $\xrightarrow{\text{pyk}}$  “ell big v”]

```

L_W

```

[L_W  $\xrightarrow{\text{name}}$  “L_W”]

[L_W  $\xrightarrow{\text{tex}}$  “
\if \relax \csname lgwprooflinep\endcsname L.W \else
\if \relax \csname lgwellbigw\endcsname
\global \advance \lgwproofline by 1
\undef \lgwellbigw {L\ifnum \lgwproofline <10 0\fi \number \lgwproofline }
\fi \lgwellbigw \fi ”]

```


[L_W $\xrightarrow{\text{pyk}}$ “ell big w”]

L_X

[L_X $\xrightarrow{\text{name}}$ “L_X”]

[L_X $\xrightarrow{\text{tex}}$ “
\if \relax \csname lgwprooflinep\endcsname L_X \else
\if \relax \csname lgwellbigx\endcsname
\global \advance \lgwproofline by 1
\xdef \lgwellbigx {L\ifnum \lgwproofline <10 0\fi \number \lgwproofline }
\fi \lgwellbigx \fi ”]
[L_X $\xrightarrow{\text{pyk}}$ “ell big x”]

L_Y

[L_Y $\xrightarrow{\text{name}}$ “L_Y”]

[L_Y $\xrightarrow{\text{tex}}$ “
\if \relax \csname lgwprooflinep\endcsname L_Y \else
\if \relax \csname lgwellbigy\endcsname
\global \advance \lgwproofline by 1
\xdef \lgwellbigy {L\ifnum \lgwproofline <10 0\fi \number \lgwproofline }
\fi \lgwellbigy \fi ”]
[L_Y $\xrightarrow{\text{pyk}}$ “ell big y”]

L_Z

[L_Z $\xrightarrow{\text{name}}$ “L_Z”]

[L_Z $\xrightarrow{\text{tex}}$ “
\if \relax \csname lgwprooflinep\endcsname L_Z \else
\if \relax \csname lgwellbigz\endcsname
\global \advance \lgwproofline by 1
\xdef \lgwellbigz {L\ifnum \lgwproofline <10 0\fi \number \lgwproofline }
\fi \lgwellbigz \fi ”]
[L_Z $\xrightarrow{\text{pyk}}$ “ell big z”]

$L?$

$[L? \xrightarrow{\text{name}} \text{"L_?"}]$

$[L? \xrightarrow{\text{tex}} \text{"}$
 $\backslash\text{if } \backslash\text{relax } \backslash\text{csize lgwprooflinep}\backslash\text{endcsize L_? } \backslash\text{else}$
 $\backslash\text{global } \backslash\text{advance } \backslash\text{lgwproofline by 1}$
 $L\backslash\text{ifnum } \backslash\text{lgwproofline} < 10 0 \backslash\text{fi } \backslash\text{number } \backslash\text{lgwproofline}$
 $\backslash\text{fi "}]$

$[L? \xrightarrow{\text{pyk}} \text{"ell dummy"}]$

Reflexivity

$[\text{Reflexivity} \xrightarrow{\text{proof}} [\text{T}_E \vdash \forall \underline{a}: [[\text{HeadPair}^{I \triangleright * \triangleright} @ \underline{a}] @ \underline{a}] ; [[[[$
 $\text{Transitivity}^{I \triangleright * \triangleright} @ [[\underline{a} :: \underline{a}]^h]] @ \underline{a}] @ \underline{a}]^{\triangleright \triangleright}]]]]$

$[\text{Reflexivity} \xrightarrow{\text{stmt}} \text{T}_E \vdash \forall \underline{a}: [\underline{a} = \underline{a}]]$

$[\text{Reflexivity} \xrightarrow{\text{tex}} \text{"}$
 $\text{Reflexivity"}]$

$[\text{Reflexivity} \xrightarrow{\text{pyk}} \text{"sequent reflexivity"}]$

Reflexivity₁

$[\text{Reflexivity}_1 \xrightarrow{\text{proof}} \lambda c. \lambda x. \mathcal{P}([\text{T}_E \vdash \forall \underline{a}: [[\text{HeadPair} \gg [[\underline{a} :: \underline{a}]^h = \underline{a}]] ; [[$
 $[\text{Transitivity} \triangleright [[\underline{a} :: \underline{a}]^h = \underline{a}]] \triangleright [[\underline{a} :: \underline{a}]^h = \underline{a}]] \gg [\underline{a} = \underline{a}]]]$
 $], p_0, c)]$

$[\text{Reflexivity}_1 \xrightarrow{\text{stmt}} \text{T}_E \vdash \forall \underline{a}: [\underline{a} = \underline{a}]]$

$[\text{Reflexivity}_1 \xrightarrow{\text{tex}} \text{"}$
 $\text{Reflexivity}_1"]]$

$[\text{Reflexivity}_1 \xrightarrow{\text{pyk}} \text{"tactic reflexivity"}]$

Commutativity

$[\text{Commutativity} \xrightarrow{\text{proof}} [\text{T}_E \vdash \forall \underline{a}: \forall \underline{b}: [[\underline{a} = \underline{b}] \vdash [[\text{Reflexivity}^{I \triangleright * \triangleright} @ \underline{a}] ; [$
 $[[[\text{Transitivity}^{I \triangleright * \triangleright} @ \underline{a}] @ \underline{b}] @ \underline{a}]^{\triangleright \triangleright}]]]]$

$[\text{Commutativity} \xrightarrow{\text{stmt}} \text{T}_E \vdash \forall \underline{a}: \forall \underline{b}: [[\underline{a} = \underline{b}] \vdash [\underline{b} = \underline{a}]]]$

[Commutativity $\xrightarrow{\text{tex}}$ “
Commutativity”]

[Commutativity $\xrightarrow{\text{pyk}}$ “sequent commutativity”]

Commutativity₁

[Commutativity₁ $\xrightarrow{\text{proof}} \lambda c. \lambda x. \mathcal{P}(\lceil T_E \vdash \forall \underline{a}: \forall \underline{b}: [[\underline{a} = \underline{b}]] \vdash [[\text{Reflexivity}_1 \gg [\underline{a} = \underline{a}]] ; [[[\text{Transitivity} \triangleright [\underline{a} = \underline{b}]] \triangleright [\underline{a} = \underline{a}]] \gg [\underline{b} = \underline{a}]]] \rceil, p_0, c)$]

[Commutativity₁ $\xrightarrow{\text{stmt}} T_E \vdash \forall \underline{a}: \forall \underline{b}: [[\underline{a} = \underline{b}]] \vdash [\underline{b} = \underline{a}]]$]

[Commutativity₁ $\xrightarrow{\text{tex}}$ “
Commutativity₁”]

[Commutativity₁ $\xrightarrow{\text{pyk}}$ “tactic commutativity”]

<tactic>

[<tactic> $\xrightarrow{\text{val}}$ [<tactic>]]

[<tactic> $\xrightarrow{\text{tex}}$ “
{<}tactic{>}”]

[<tactic> $\xrightarrow{\text{pyk}}$ “the tactic aspect”]

tactic

[tactic $\xrightarrow{\text{msg}}$ <tactic>]

[tactic $\xrightarrow{\text{tex}}$ “
tactic”]

[tactic $\xrightarrow{\text{pyk}}$ “tactic”]

[* $\stackrel{\text{tactic}}{=}$ *]

[$x \stackrel{\text{tactic}}{=} y$] $\xrightarrow{\text{macro}} \lambda t. \lambda s. \lambda c. \tilde{\mathcal{M}}_4(t, s, c, \lceil [[x \stackrel{\text{tactic}}{=} y] \ddot{=} [(x)^{\mathbf{p}} \xrightarrow{\text{tactic}} y]] \rceil)$

[$x \stackrel{\text{tactic}}{=} y$] $\xrightarrow{\text{tex}}$ “
[#1/tex name/tex.

$\backslash\text{stackrel}{\text{tactic}}\{=\}\#2.$

]

$[[x \stackrel{\text{tactic}}{=} y] \stackrel{\text{pyk}}{\rightarrow} \text{“tactic define } * \text{ as } * \text{ end define”}]$

$\mathcal{P}(*, *, *)$

$[\mathcal{P}(t, s, c) \stackrel{\text{val}}{\rightarrow} s!$

$\text{let}_1(\lambda d.$

$\text{If}(d, t^h :: \mathcal{P}^*(t^t, s, c),$

$\mathcal{U}^M([[\mathcal{E}(d^3, T, c) ' t] ' s] ' c)), \text{aspect}(<\text{tactic}>, t, c))]$

$[\mathcal{P}(t, s, c) \stackrel{\text{tex}}{\rightarrow} “$

$\{\backslash\text{cal } P\}(\#1.$

$, \#2.$

$, \#3.$

$)”]$

$[\mathcal{P}(t, s, c) \stackrel{\text{pyk}}{\rightarrow} \text{“proof expand } * \text{ state } * \text{ cache } * \text{ end expand”}]$

$\mathcal{P}^*(*, *, *)$

$[\mathcal{P}^*(t, s, c) \stackrel{\text{val}}{\rightarrow} s! [\text{c!If}(t, T, \mathcal{P}(t^h, s, c) :: \mathcal{P}^*(t^t, s, c))]]$

$[\mathcal{P}^*(t, s, c) \stackrel{\text{tex}}{\rightarrow} “$

$\{\backslash\text{cal } P\}^*(\#1.$

$, \#2.$

$, \#3.$

$)”]$

$[\mathcal{P}^*(t, s, c) \stackrel{\text{pyk}}{\rightarrow} \text{“proof expand list } * \text{ state } * \text{ cache } * \text{ end expand”}]$

p_0

$[p_0 \stackrel{\text{val}}{\rightarrow} \mathcal{M}(\lambda t. \lambda s. \lambda c. \mathcal{P}(t, s, c)) :: T]$

$[p_0 \stackrel{\text{tex}}{\rightarrow} “$

$p_0”]$

$[p_0 \stackrel{\text{pyk}}{\rightarrow} \text{“proof state”}]$

$\text{conclude}_1(*, *)$

$[\text{conclude}_1(\mathbf{t}, \mathbf{c}) \xrightarrow{\text{val}}$
 $\text{let}_1(\lambda r.$
 $\text{If}(r^c, \text{error}_2([\text{“Unification failed”}], \mathbf{t}), r), \text{conclude}_2(\mathbf{t}^1, \mathbf{t}^2, \mathbf{c}))]$
 $[\text{conclude}_1(\mathbf{t}, \mathbf{c}) \xrightarrow{\text{tex}}$ “
 $\text{conclude_1} (\#1.$
 $, \#2.$
 $)”]$
 $[\text{conclude}_1(\mathbf{t}, \mathbf{c}) \xrightarrow{\text{pyk}}$ “conclude one * cache * end conclude”]

$\text{conclude}_2(*, *, *)$

$[\text{conclude}_2(\mathbf{a}, \mathbf{t}, \mathbf{c}) \xrightarrow{\text{val}}$ $\mathbf{t}!$
 $\text{If}(\mathbf{a} \stackrel{r}{=} [\mathbf{x} \triangleright \mathbf{y}], \text{conclude}_2(\mathbf{a}^1, \mathbf{a}\text{-color}(\mathbf{t} \triangleright [\mathbf{a}^2]), \mathbf{c}),$
 $\text{If}(\mathbf{a} \stackrel{r}{=} [\mathbf{x} \triangleright \mathbf{y}], \text{conclude}_2(\mathbf{a}^1, \mathbf{a}\text{-color}(\mathbf{t} \triangleright [\mathbf{a}^2]), \mathbf{c}),$
 $\text{If}(\mathbf{a} \stackrel{r}{=} [\mathbf{x} @ \mathbf{y}], \text{conclude}_2(\mathbf{a}^1, \mathbf{a}\text{-color}(\mathbf{t} @ [\mathbf{a}^2]), \mathbf{c}),$
 $\text{If}(\mathbf{aspect}(<\text{proof}>, \mathbf{a}, \mathbf{c}), \text{error}_2([\text{“Lemma expected”}], \mathbf{a}),$
 $\text{let}_1(\lambda d.$
 $\text{conclude}_3(\mathbf{a}^{I \triangleright * \triangleright}, \mathbf{t}, \text{parm}(\mathbf{d}^{32}, \mathbf{T}, 1), \mathbf{T}), \mathbf{aspect}(<\text{stmt}>, \mathbf{a}, \mathbf{c})))]$
 $[\text{conclude}_2(\mathbf{a}, \mathbf{t}, \mathbf{c}) \xrightarrow{\text{tex}}$ “
 $\text{conclude_2} (\#1.$
 $, \#2.$
 $, \#3.$
 $)”]$
 $[\text{conclude}_2(\mathbf{a}, \mathbf{t}, \mathbf{c}) \xrightarrow{\text{pyk}}$ “conclude two * proves * cache * end conclude”]

$\text{conclude}_3(*, *, *, *)$

$[\text{conclude}_3(\mathbf{a}, \mathbf{t}, \mathbf{l}, \mathbf{s}) \xrightarrow{\text{val}}$ $\mathbf{a}! [\mathbf{t}! [!! [\mathbf{s}!$
 $\text{If}(\mathbf{l} \stackrel{r}{=} [\mathbf{x} \vdash \mathbf{y}], [[$
 $\mathbf{t}] \stackrel{r}{=} [\mathbf{x} \triangleright \mathbf{y}]] \left\{ \begin{array}{l} \text{conclude}_3(\mathbf{a}^\triangleright, \mathbf{t}^1, \mathbf{l}^2, \text{unify}(\mathbf{l}^1 = \mathbf{t}^2, \mathbf{s})) \\ \text{conclude}_3(\mathbf{a}^\triangleright, \mathbf{t}, \mathbf{l}^2, \mathbf{s}) \end{array} \right. ,$
 $\text{If}(\mathbf{l} \stackrel{r}{=} [\mathbf{x} \Vdash \mathbf{y}], [[$
 $\mathbf{t}] \stackrel{r}{=} [\mathbf{x} \triangleright \mathbf{y}]] \left\{ \begin{array}{l} \text{conclude}_3(\mathbf{a}^\triangleright, \mathbf{t}^1, \mathbf{l}^2, \text{unify}(\mathbf{l}^1 = \mathbf{t}^2, \mathbf{s})) \\ \text{conclude}_3(\mathbf{a}^\triangleright, \mathbf{t}, \mathbf{l}^2, \mathbf{s}) \end{array} \right. ,$
 $\text{If}(\mathbf{l} \stackrel{r}{=} [\forall \mathbf{x}. \mathbf{y}], [[$
 $\mathbf{t}] \stackrel{r}{=} [\mathbf{x} @ \mathbf{y}]] \left\{ \begin{array}{l} \text{conclude}_3(\mathbf{a} @ [\mathbf{t}^2], \mathbf{t}^1, \mathbf{l}^2, \text{unify}(\mathbf{l}^1 = \mathbf{t}^2, \mathbf{s})) \\ \text{conclude}_3(\mathbf{a} @ [\mathbf{l}^1], \mathbf{t}, \mathbf{l}^2, \mathbf{s}) \end{array} \right. ,$

$\text{let}_1(\lambda s.$
 $\text{If}(s^c, s,$
 $\text{inst}(a, s), \text{unify}(l = t, s)))) \text{]]]]$
 $[\text{conclude}_3(a, t, l, s) \xrightarrow{\text{tex}} “$
 $\text{conclude_3 (\#1.}$
 $, \#2.$
 $, \#3.$
 $, \#4.$
 $)”]$
 $[\text{conclude}_3(a, t, l, s) \xrightarrow{\text{pyk}} “\text{conclude three * proves * lemma * substitution * end}$
 $\text{conclude}”]$

$*_{-}\{*\}$

$[*_{-}\{*\} \xrightarrow{\text{name}} “\#1.$
 $\backslash-\backslash\{\#2.$
 $\backslash\}”]$

$[*_{-}\{*\} \xrightarrow{\text{tex}} “\#1.$
 $-\{\#2.$
 $\}”]$

$[*_{-}\{*\} \xrightarrow{\text{pyk}} “* \text{ sub } * \text{ end sub}”]$

$*'$

$[x' \xrightarrow{\text{tex}} “\#1.”]$
 $[x' \xrightarrow{\text{pyk}} “* \text{ prime}”]$

$*[*]$

$[a[k] \xrightarrow{\text{val}} \text{assoc}_1(a, k, k)]$
 $[* [*] \xrightarrow{\text{tex}} “\#1.$
 $\{\} \#2.$
 $\{\} \}”]$
 $[* [*] \xrightarrow{\text{pyk}} “* \text{ assoc } * \text{ end assoc}”]$

$\ast[\ast\longrightarrow\ast]$

$\left[\mathbf{a}[\mathbf{i}\rightarrow\mathbf{v}]\overset{\text{val}}{\rightarrow}\mathbf{i}^{\mathbf{c}}\left\{\begin{array}{l}\mathbf{v}\left\{\begin{array}{l}\text{array-remove}(\mathbf{i},\mathbf{a},0)\\\text{array-put}(\mathbf{i},\mathbf{v},\mathbf{a},0)\end{array}\right.\\\mathbf{v}!\mathbf{a}\end{array}\right.\right]$

$\left[\mathbf{a}[\mathbf{i}\rightarrow\mathbf{v}]\overset{\text{tex}}{\rightarrow}\text{“}\#1.\right.$
 $\left[\text{ }\#2.\right.$
 $\left.\{\backslash\rightarrow\}\text{ }\#3.\right.$
 $\left.\right]”]$

$\left[\mathbf{a}[\mathbf{i}\rightarrow\mathbf{v}]\overset{\text{pyk}}{\rightarrow}\text{“}\ast\text{ set }\ast\text{ to }\ast\text{ end set”}\right]$

$\ast[\ast\Rightarrow\ast]$

$\left[\mathbf{a}[\mathbf{i}\Rightarrow\mathbf{v}]\overset{\text{val}}{\rightarrow}\mathbf{i}^{\mathbf{a}}\left\{\begin{array}{l}\mathbf{a}!\mathbf{v}\\\mathbf{a}[\mathbf{i}^{\mathbf{h}}\rightarrow\mathbf{a}[\mathbf{i}^{\mathbf{h}}][\mathbf{i}^{\mathbf{t}}\Rightarrow\mathbf{v}]]\end{array}\right.\right]$

$\left[\mathbf{a}[\mathbf{i}\Rightarrow\mathbf{v}]\overset{\text{tex}}{\rightarrow}\text{“}\#1.\right.$
 $\left[\text{ }\#2.\right.$
 $\left.\{\backslash\Rightarrow\}\text{ }\#3.\right.$
 $\left.\right]”]$

$\left[\mathbf{a}[\mathbf{i}\Rightarrow\mathbf{v}]\overset{\text{pyk}}{\rightarrow}\text{“}\ast\text{ set multi }\ast\text{ to }\ast\text{ end set”}\right]$

newline $\ast$

$\left[\text{newline x}\overset{\text{name}}{\rightarrow}\text{“}\right.$
 $\left.\text{newline}\backslash\text{ }\#1.”\right]$

$\left[\text{newline x}\overset{\text{val}}{\rightarrow}\mathbf{x}^{\mathbf{M}}\right]$

$\left[\text{newline x}\overset{\text{tex}}{\rightarrow}\text{“}\right.$
 $\left.\backslash\text{newline }\#1.”\right]$

$\left[\text{newline x}\overset{\text{pyk}}{\rightarrow}\text{“newline }\ast”\right]$

macro **newline** $\ast$

$\left[\text{macro newline x}\overset{\text{name}}{\rightarrow}\text{“}\right.$
 $\left.\text{macro}\backslash\text{ newline}\backslash\text{ }\#1.”\right]$

$\left[\text{macro newline x}\overset{\text{macro}}{\rightarrow}\lambda\mathbf{t}.\lambda\mathbf{s}.\lambda\mathbf{c}.\tilde{\mathcal{M}}_4(\mathbf{t},\mathbf{s},\mathbf{c},[[\text{macro newline x}\doteq\mathbf{x}]]))\right]$

[macro newline x $\xrightarrow{\text{tex}}$ “
\newline #1.”]
[macro newline x $\xrightarrow{\text{pyk}}$ “macro newline *”]

*0

[x0 $\xrightarrow{\text{val}}$ T +2* x]
[*0 $\xrightarrow{\text{tex}}$ “#1.
0”]
[*0 $\xrightarrow{\text{pyk}}$ “* bit nil”]

*1

[x1 $\xrightarrow{\text{val}}$ F +2* x]
[*1 $\xrightarrow{\text{tex}}$ “#1.
1”]
[*1 $\xrightarrow{\text{pyk}}$ “* bit one”]

0b

[0b $\xrightarrow{\text{val}}$ 0]
[0b $\xrightarrow{\text{tex}}$ “
0 \mathrm {b}”]
[0b $\xrightarrow{\text{pyk}}$ “binary”]

-color()

[a-color(t) $\xrightarrow{\text{val}}$ t^d { [t^r :: [tⁱ :: [a^d]]] :: [a-color*(t^t)] }
a!t
[x-color(y) $\xrightarrow{\text{tex}}$ “#1.
\mbox {-color}(#2.
)”]
[x-color(y) $\xrightarrow{\text{pyk}}$ “* color * end color”]

***-color**^{*}(*)

$$[a\text{-color}^*(t) \xrightarrow{\text{val}} t \left\{ \begin{array}{l} a!T \\ a\text{-color}(t^h) :: [a\text{-color}^*(t^t)] \end{array} \right.]$$

$$[x\text{-color}^*(y) \xrightarrow{\text{tex}} \text{“}\#1. \\ \backslash\mathbin{\text{mbox}} \{-\text{color}\}^{\{\backslash\ast\}}(\#2. \\ \text{)”}]$$

$$[x\text{-color}^*(y) \xrightarrow{\text{pyk}} \text{“}* \text{ color star } * \text{ end color”}]$$

***** ’ *****

Predef: apply

$$[* \text{ ’ } * \xrightarrow{\text{tex}} \text{“}\#1. \\ \backslash\mathbin{\text{mathbin}} \{\backslash\mathbin{\text{mbox}} \{\text{ ’ }\}\}\#2.”]$$

$$[* \text{ ’ } * \xrightarrow{\text{pyk}} \text{“}* \text{ apply } *”]$$

***** ‘ *****

$$[f \text{ ‘ } x \xrightarrow{\text{val}} \mathbf{apply}(f, x)]$$

$$[* \text{ ‘ } * \xrightarrow{\text{tex}} \text{“}\#1. \\ \backslash\mathbin{\text{mathbin}} \{\backslash\mathbin{\text{mbox}} \{\text{ ‘ }\}\}\#2.”]$$

$$[* \text{ ‘ } * \xrightarrow{\text{pyk}} \text{“}* \text{ tagged apply } *”]$$

*****^H

$$[x^H \xrightarrow{\text{val}} x \text{ ’ } T]$$

$$[*^H \xrightarrow{\text{tex}} \text{“}\#1. \\ \{\}^H”]$$

$$[*^H \xrightarrow{\text{pyk}} \text{“}* \text{ raw head”}]$$

*****^T

$$[x^T \xrightarrow{\text{val}} x \text{ ’ } F]$$

$$[*^T \xrightarrow{\text{tex}} \text{“}\#1. \\ \{\}^T”]$$

$$[*^T \xrightarrow{\text{pyk}} \text{"* raw tail"}]$$

$$*^U$$

$$[x^U \xrightarrow{\text{val}} \text{if}(x^H, x^T, T)]$$

$$[*^U \xrightarrow{\text{tex}} \text{"#1.} \\ \{\}^U"]$$

$$[*^U \xrightarrow{\text{pyk}} \text{"* cardinal untag"}]$$

$$*^h$$

$$[x^h \xRightarrow{\text{val}} x^{MTH}]$$

$$[*^h \xrightarrow{\text{tex}} \text{"#1.} \\ \{\}^h"]$$

$$[*^h \xrightarrow{\text{pyk}} \text{"* head"}]$$

$$*^t$$

$$[x^t \xRightarrow{\text{val}} \text{if}(x^d, \text{if}(x^c, T \dot{=} [x^{MTT}], x^{MTT}), T)]$$

$$[*^t \xrightarrow{\text{tex}} \text{"#1.} \\ \{\}^t"]$$

$$[*^t \xrightarrow{\text{pyk}} \text{"* tail"}]$$

$$*^s$$

$$[x^s \xRightarrow{\text{val}} x^{MTB}]$$

$$[*^s \xrightarrow{\text{tex}} \text{"#1.} \\ \{\}^s"]$$

$$[*^s \xrightarrow{\text{pyk}} \text{"* is singular"}]$$

$$*^c$$

$$[x^c \xRightarrow{\text{val}} \text{if}(x, F, x^{MHB})]$$

$$[*^c \overset{\text{tex}}{\rightarrow} "\#1. \\ \{\}^c"]$$

$$[*^c \overset{\text{pyk}}{\rightarrow} " * \text{ is cardinal}"]$$

$$*^d$$

$$[x^d \overset{\text{val}}{\Rightarrow} x^{\text{MHTHB}}]$$

$$[*^d \overset{\text{tex}}{\rightarrow} "\#1. \\ \{\}^d"]$$

$$[*^d \overset{\text{pyk}}{\rightarrow} " * \text{ is data}"]$$

$$*^a$$

$$[x^a \overset{\text{val}}{\rightarrow} [[\neg [x^d]] \vee [x^c]] \vee [x^s]]$$

$$[*^a \overset{\text{tex}}{\rightarrow} "\#1. \\ \{\}^a"]$$

$$[*^a \overset{\text{pyk}}{\rightarrow} " * \text{ is atomic}"]$$

$$*^C$$

$$[x^C \overset{\text{val}}{\rightarrow} \text{if}(x, T, x^{\text{HB}} \pm 2 * [x^{\text{TC}}])]$$

$$[*^C \overset{\text{tex}}{\rightarrow} "\#1. \\ \{\}^C"]$$

$$[*^C \overset{\text{pyk}}{\rightarrow} " * \text{ cardinal retract}"]$$

$$*^M$$

$$[x^M \overset{\text{val}}{\Rightarrow} \text{if}(x, T, \text{if}(x^H, T \dot{=} [x^{\text{TC}}] , \text{if}(x^{\text{HTH}}, x^{\text{THM}} \dot{=} [x^{\text{TTM}}] , \mathcal{M}(x^T))))]$$

$$[*^M \overset{\text{tex}}{\rightarrow} "\#1. \\ \{\}^M"]$$

$$[*^M \overset{\text{pyk}}{\rightarrow} " * \text{ tagged retract}"]$$

*B

[x^B $\xrightarrow{\text{val}}$ if(x, T, F)]

[*^B $\xrightarrow{\text{tex}}$ “#1.
{ } ^ B”]

[*^B $\xrightarrow{\text{pyk}}$ “* boolean retract”]

*^r

[x^r $\xrightarrow{\text{val}}$ x^{hh}]

[x^r $\xrightarrow{\text{tex}}$ “#1.
{ } ^ {r}”]

[x^r $\xrightarrow{\text{pyk}}$ “* ref”]

*ⁱ

[xⁱ $\xrightarrow{\text{val}}$ x^{hth}]

[xⁱ $\xrightarrow{\text{tex}}$ “#1.
{ } ^ {i}”]

[xⁱ $\xrightarrow{\text{pyk}}$ “* id”]

*^d

[x^d $\xrightarrow{\text{val}}$ x^{htt}]

[x^d $\xrightarrow{\text{tex}}$ “#1.
{ } ^ {d}”]

[x^d $\xrightarrow{\text{pyk}}$ “* debug”]

*^R

[x^R $\xrightarrow{\text{val}}$ x^r :: [xⁱ :: T]]

[x^R $\xrightarrow{\text{tex}}$ “#1.
{ } ^ {R}”]

[x^R $\xrightarrow{\text{pyk}}$ “* root”]

*⁰

[x⁰ $\xrightarrow{\text{val}}$ x^h]

[x⁰ $\xrightarrow{\text{tex}}$ “#1.
{ } ^ {0}”]

[x⁰ $\xrightarrow{\text{pyk}}$ “* zeroth”]

*¹

[x¹ $\xrightarrow{\text{val}}$ x^{t0}]

[x¹ $\xrightarrow{\text{tex}}$ “#1.
{ } ^ {1}”]

[x¹ $\xrightarrow{\text{pyk}}$ “* first”]

*²

[x² $\xrightarrow{\text{val}}$ x^{t1}]

[x² $\xrightarrow{\text{tex}}$ “#1.
{ } ^ {2}”]

[x² $\xrightarrow{\text{pyk}}$ “* second”]

*³

[x³ $\xrightarrow{\text{val}}$ x^{t2}]

[x³ $\xrightarrow{\text{tex}}$ “#1.
{ } ^ {3}”]

[x³ $\xrightarrow{\text{pyk}}$ “* third”]

*⁴

[x⁴ $\xrightarrow{\text{val}}$ x^{t3}]

[x⁴ $\xrightarrow{\text{tex}}$ “#1.
{ } ^ {4}”]

[x⁴ $\xrightarrow{\text{pyk}}$ “* fourth”]

$\ast^5$

$$[x^5 \overset{\text{val}}{\rightarrow} x^{t4}]$$

$$[x^5 \overset{\text{tex}}{\rightarrow} \text{“}\#1.\{\}^{\wedge}\{5\}\text{”}]$$

$$[x^5 \overset{\text{pyk}}{\rightarrow} \text{“}\ast \text{ fifth”}]$$

$\ast^6$

$$[x^6 \overset{\text{val}}{\rightarrow} x^{t5}]$$

$$[x^6 \overset{\text{tex}}{\rightarrow} \text{“}\#1.\{\}^{\wedge}\{6\}\text{”}]$$

$$[x^6 \overset{\text{pyk}}{\rightarrow} \text{“}\ast \text{ sixth”}]$$

$\ast^7$

$$[x^7 \overset{\text{val}}{\rightarrow} x^{t6}]$$

$$[x^7 \overset{\text{tex}}{\rightarrow} \text{“}\#1.\{\}^{\wedge}\{7\}\text{”}]$$

$$[x^7 \overset{\text{pyk}}{\rightarrow} \text{“}\ast \text{ seventh”}]$$

$\ast^8$

$$[x^8 \overset{\text{val}}{\rightarrow} x^{t7}]$$

$$[x^8 \overset{\text{tex}}{\rightarrow} \text{“}\#1.\{\}^{\wedge}\{8\}\text{”}]$$

$$[x^8 \overset{\text{pyk}}{\rightarrow} \text{“}\ast \text{ eighth”}]$$

$\ast^9$

$$[x^9 \overset{\text{val}}{\rightarrow} x^{t8}]$$

$$[x^9 \overset{\text{tex}}{\rightarrow} \text{“}\#1.\{\}^{\wedge}\{9\}\text{”}]$$

$$[x^9 \overset{\text{pyk}}{\rightarrow} \text{“}\ast \text{ ninth”}]$$

$\ast^E$

$$[x^E \xrightarrow{\text{val}} x \stackrel{r}{=} [xy]]$$

$$[x^E \xrightarrow{\text{tex}} "\#1. \\ \{\} \wedge \{ E \}"]$$

$$[x^E \xrightarrow{\text{pyk}} "\ast \text{ is error}"]$$

$\ast^V$

$$[t^V \xrightarrow{\text{val}} t \stackrel{r}{=} [\underline{a}]]$$

$$[t^V \xrightarrow{\text{tex}} "\#1. \\ \{\} \wedge \{\backslash\text{cal } V\}"]$$

$$[t^V \xrightarrow{\text{pyk}} "\ast \text{ is metavar}"]$$

$\ast^C$

$$[t^C \xrightarrow{\text{val}} \text{If}(t^V, F, t^{t^C\ast})]$$

$$[t^C \xrightarrow{\text{tex}} "\#1. \\ \{\} \wedge \{\backslash\text{cal } C\}"]$$

$$[t^C \xrightarrow{\text{pyk}} "\ast \text{ is metaclosed}"]$$

$\ast^{C\ast}$

$$[t^{C\ast} \xrightarrow{\text{val}} \text{If}(t, T, \text{If}(t^{hC}, t^{t^{C\ast}}, F))]$$

$$[t^{C\ast} \xrightarrow{\text{tex}} "\#1. \\ \{\} \wedge \{\{\backslash\text{cal } C\} \wedge \{\backslash\text{ast}\}\}"]$$

$$[t^{C\ast} \xrightarrow{\text{pyk}} "\ast \text{ is metaclosed star}"]$$

$\ast \cdot \ast$

$$[x \cdot y \xrightarrow{\text{val}} \text{If}(x^c \wedge [\textcolor{blue}{y^c}], x \cdot_0 y, T)]$$

$$[x \cdot y \xrightarrow{\text{tex}} "\#1. \\ \backslash\text{cdot } \#2."]$$

$$[x \cdot y \xrightarrow{\text{pyk}} "\ast \text{ times } \ast"]$$

$$* \cdot_0 *$$

$$[x \cdot_0 y \overset{\text{val}}{\rightarrow} y^s \left\{ \begin{array}{l} x^!0 \\ y^h \left\{ \begin{array}{l} T + 2* \left[\begin{array}{l} x \cdot_0 \left[\begin{array}{l} y^t \end{array} \right] \end{array} \right] \\ (T + 2* \left[\begin{array}{l} x \cdot_0 \left[\begin{array}{l} y^t \end{array} \right] \end{array} \right])^M +_0 x \end{array} \right\} \end{array} \right\}]$$

$$[x \cdot_0 y \overset{\text{tex}}{\rightarrow} \text{"\#1. \\ \backslash cdot_0 \#2."}]$$

$$[x \cdot_0 y \overset{\text{pyk}}{\rightarrow} \text{"* times zero *"}]$$

$$* \vdash *$$

$$[x + y \overset{\text{val}}{\rightarrow} \text{If}(x^c \wedge \left[\begin{array}{l} y^c \end{array} \right], x+_0 y, T)]$$

$$[x + y \overset{\text{tex}}{\rightarrow} \text{"\#1. \\ + \#2."}]$$

$$[x + y \overset{\text{pyk}}{\rightarrow} \text{"* plus *"}]$$

$$* \vdash_0 *$$

$$[x+_0 y \overset{\text{val}}{\rightarrow} x^s \left\{ \begin{array}{l} y \\ y^s \left\{ \begin{array}{l} x \\ x^h \left\{ \begin{array}{l} y^h \left\{ \begin{array}{l} T + 2* \left[\begin{array}{l} x^t+_0 \left[\begin{array}{l} y^t \end{array} \right] \end{array} \right] \\ F + 2* \left[\begin{array}{l} x^t+_0 \left[\begin{array}{l} y^t \end{array} \right] \end{array} \right] \\ F + 2* \left[\begin{array}{l} x^t+_0 \left[\begin{array}{l} y^t \end{array} \right] \end{array} \right] \\ T + 2* \left[\begin{array}{l} x^t+_1 \left[\begin{array}{l} y^t \end{array} \right] \end{array} \right] \end{array} \right\} \end{array} \right\} \end{array} \right\} \end{array} \right\}]$$

$$[x+_0 y \overset{\text{tex}}{\rightarrow} \text{"\#1. \\ \backslash mathop\{+_0\} \#2."}]$$

$$[x+_0 y \overset{\text{pyk}}{\rightarrow} \text{"* plus zero *"}]$$

$$* \vdash_1 *$$

$$[x+_1 y \overset{\text{val}}{\rightarrow} x^s \left\{ \begin{array}{l} y+_0^1 \\ y^s \left\{ \begin{array}{l} x+_0^1 \\ x^h \left\{ \begin{array}{l} y^h \left\{ \begin{array}{l} F + 2* \left[\begin{array}{l} x^t+_0 \left[\begin{array}{l} y^t \end{array} \right] \end{array} \right] \\ T + 2* \left[\begin{array}{l} x^t+_1 \left[\begin{array}{l} y^t \end{array} \right] \end{array} \right] \\ T + 2* \left[\begin{array}{l} x^t+_1 \left[\begin{array}{l} y^t \end{array} \right] \end{array} \right] \\ F + 2* \left[\begin{array}{l} x^t+_1 \left[\begin{array}{l} y^t \end{array} \right] \end{array} \right] \end{array} \right\} \end{array} \right\} \end{array} \right\} \end{array} \right\}]$$

$$[x+_1 y \overset{\text{tex}}{\rightarrow} \text{"\#1. \\ \backslash mathop\{+_1\} \#2."}]$$

$$\backslash\mathop{\mathrm{+}}\nolimits_1\} \#2.”]$$

$$[\mathop{\mathrm{x}}\nolimits_{+1}y\overset{\mathrm{pyk}}{\rightarrow} “* \text{ plus one } *”]$$

$$* \mathop{-}\nolimits *$$

$$[\mathop{\mathrm{x}}\nolimits-\mathop{\mathrm{y}}\nolimits\overset{\mathrm{val}}{\rightarrow}\mathrm{If}(\mathop{\mathrm{x}}\nolimits^{\mathrm{c}}\wedge\left[\mathop{\mathrm{y}}\nolimits^{\mathrm{c}}\right],\mathrm{If}(\mathop{\mathrm{x}}\nolimits<\mathop{\mathrm{y}}\nolimits,0,\mathop{\mathrm{x}}\nolimits-\mathop{\mathrm{y}}\nolimits),\mathrm{T})]$$

$$[\mathop{\mathrm{x}}\nolimits-\mathop{\mathrm{y}}\nolimits\overset{\mathrm{tex}}{\rightarrow} “\#1.\\-\#2.”]$$

$$[\mathop{\mathrm{x}}\nolimits-\mathop{\mathrm{y}}\nolimits\overset{\mathrm{pyk}}{\rightarrow} “* \text{ minus } *”]$$

$$*\mathop{-}_0*$$

$$[\mathop{\mathrm{x}}\nolimits-\mathop{\mathrm{y}}\nolimits\overset{\mathrm{val}}{\rightarrow}\mathop{\mathrm{y}}\nolimits^{\mathrm{s}}\left\{\begin{array}{l}\mathop{\mathrm{x}}\nolimits\\ \mathop{\mathrm{x}}\nolimits^{\mathrm{h}}\left\{\begin{array}{l}\mathop{\mathrm{y}}\nolimits^{\mathrm{h}}\left\{\begin{array}{l}\mathrm{T}+2* \left[\begin{array}{l}\mathop{\mathrm{x}}\nolimits^{\mathrm{t}}-\mathop{\mathrm{y}}\nolimits^{\mathrm{t}}\end{array}\right]\left[\begin{array}{l}\mathop{\mathrm{y}}\nolimits^{\mathrm{t}}\end{array}\right]\end{array}\right\}\\ \mathrm{F}+2* \left[\begin{array}{l}\mathop{\mathrm{x}}\nolimits^{\mathrm{t}}-\mathop{\mathrm{y}}\nolimits^{\mathrm{t}}\end{array}\right]\left[\begin{array}{l}\mathop{\mathrm{y}}\nolimits^{\mathrm{t}}\end{array}\right]\end{array}\right\}\\ \mathop{\mathrm{y}}\nolimits^{\mathrm{h}}\left\{\begin{array}{l}\mathrm{F}+2* \left[\begin{array}{l}\mathop{\mathrm{x}}\nolimits^{\mathrm{t}}-\mathop{\mathrm{y}}\nolimits^{\mathrm{t}}\end{array}\right]\left[\begin{array}{l}\mathop{\mathrm{y}}\nolimits^{\mathrm{t}}\end{array}\right]\end{array}\right\}\\ \mathrm{T}+2* \left[\begin{array}{l}\mathop{\mathrm{x}}\nolimits^{\mathrm{t}}-\mathop{\mathrm{y}}\nolimits^{\mathrm{t}}\end{array}\right]\left[\begin{array}{l}\mathop{\mathrm{y}}\nolimits^{\mathrm{t}}\end{array}\right]\end{array}\right\}\end{array}\right\}\end{array}\right]$$

$$[\mathop{\mathrm{x}}\nolimits-\mathop{\mathrm{y}}\nolimits\overset{\mathrm{tex}}{\rightarrow} “\#1.\\ \backslash\mathop{\mathrm{mathop{-}}\nolimits}_0\} \#2.”]$$

$$[\mathop{\mathrm{x}}\nolimits-\mathop{\mathrm{y}}\nolimits\overset{\mathrm{pyk}}{\rightarrow} “* \text{ minus zero } *”]$$

$$*\mathop{-}_1*$$

$$[\mathop{\mathrm{x}}\nolimits-\mathop{\mathrm{y}}\nolimits\overset{\mathrm{val}}{\rightarrow}\mathop{\mathrm{y}}\nolimits^{\mathrm{s}}\left\{\begin{array}{l}\mathop{\mathrm{x}}\nolimits-\mathop{\mathrm{y}}\nolimits^{\mathrm{t}}1\\ \mathop{\mathrm{x}}\nolimits^{\mathrm{h}}\left\{\begin{array}{l}\mathop{\mathrm{y}}\nolimits^{\mathrm{h}}\left\{\begin{array}{l}\mathrm{F}+2* \left[\begin{array}{l}\mathop{\mathrm{x}}\nolimits^{\mathrm{t}}-\mathop{\mathrm{y}}\nolimits^{\mathrm{t}}\end{array}\right]\left[\begin{array}{l}\mathop{\mathrm{y}}\nolimits^{\mathrm{t}}\end{array}\right]\end{array}\right\}\\ \mathrm{T}+2* \left[\begin{array}{l}\mathop{\mathrm{x}}\nolimits^{\mathrm{t}}-\mathop{\mathrm{y}}\nolimits^{\mathrm{t}}\end{array}\right]\left[\begin{array}{l}\mathop{\mathrm{y}}\nolimits^{\mathrm{t}}\end{array}\right]\end{array}\right\}\\ \mathop{\mathrm{y}}\nolimits^{\mathrm{h}}\left\{\begin{array}{l}\mathrm{T}+2* \left[\begin{array}{l}\mathop{\mathrm{x}}\nolimits^{\mathrm{t}}-\mathop{\mathrm{y}}\nolimits^{\mathrm{t}}\end{array}\right]\left[\begin{array}{l}\mathop{\mathrm{y}}\nolimits^{\mathrm{t}}\end{array}\right]\end{array}\right\}\\ \mathrm{F}+2* \left[\begin{array}{l}\mathop{\mathrm{x}}\nolimits^{\mathrm{t}}-\mathop{\mathrm{y}}\nolimits^{\mathrm{t}}\end{array}\right]\left[\begin{array}{l}\mathop{\mathrm{y}}\nolimits^{\mathrm{t}}\end{array}\right]\end{array}\right\}\end{array}\right\}\end{array}\right]$$

$$[\mathop{\mathrm{x}}\nolimits-\mathop{\mathrm{y}}\nolimits\overset{\mathrm{tex}}{\rightarrow} “\#1.\\ \backslash\mathop{\mathrm{mathop{-}}\nolimits}_1\} \#2.”]$$

$$[\mathop{\mathrm{x}}\nolimits-\mathop{\mathrm{y}}\nolimits\overset{\mathrm{pyk}}{\rightarrow} “* \text{ minus one } *”]$$

$$*\cup\left\{*\right\}$$

$$[\mathop{\mathrm{x}}\nolimits\cup\left\{\mathop{\mathrm{y}}\nolimits\right\}\overset{\mathrm{val}}{\rightarrow}\mathrm{If}(\mathop{\mathrm{y}}\nolimits\in_{\mathrm{t}}\mathop{\mathrm{x}}\nolimits,\mathop{\mathrm{x}}\nolimits,\mathop{\mathrm{y}}\nolimits::\mathop{\mathrm{x}}\nolimits)]$$

[x ∪ {y} $\xrightarrow{\text{tex}}$ “#1.
\cup \{ #2.
\}”]

[x ∪ {y} $\xrightarrow{\text{pyk}}$ “* term plus * end plus”]

* ∪ *

[x ∪ y $\xrightarrow{\text{val}}$ If(x^a, y, [x^t ∪ y] ∪ {x^h})]

[x ∪ y $\xrightarrow{\text{tex}}$ “#1.
\cup #2.”]

[x ∪ y $\xrightarrow{\text{pyk}}$ “* term union *”]

* \{ * }

[x \{ y } $\xrightarrow{\text{val}}$ If(x^a, y!∅, If(y $\stackrel{t}{=}$ [x^h], x^t, x^h :: [x^t \{ y }]))]

[x \{ y } $\xrightarrow{\text{tex}}$ “#1.
\backslash \{ #2.
\}”]

[x \{ y } $\xrightarrow{\text{pyk}}$ “* term minus * end minus”]

* ∴ *

[y ∴ z $\xrightarrow{\text{val}}$ λx.if(x, y, z)]

[* ∴ * $\xrightarrow{\text{tex}}$ “#1.
\mathrel { \dot { . \, \, . } } #2.”]

[* ∴ * $\xrightarrow{\text{pyk}}$ “* raw pair *”]

* ∴ *

[x ∴ y $\xrightarrow{\text{val}}$ x : [y : [x ∴ y]]]

[* ∴ * $\xrightarrow{\text{tex}}$ “#1.
\mathrel { \underline { \dot { . \, \, . } } } #2.”]

[* ∴ * $\xrightarrow{\text{pyk}}$ “* eager pair *”]

* :: *

[x :: y $\xrightarrow{\text{val}}$ (0 :: [0 :: T])^I :: [x :: y]]
[* :: * $\xrightarrow{\text{tex}}$ “#1.
\mathrel { \underline { : \, \, , : } } \#2.”]
[* :: * $\xrightarrow{\text{pyk}}$ “* tagged pair *”]

* +2* *

[x +2* y $\xrightarrow{\text{val}}$ if(x, if(y, T, x :: y), x :: y)]
[* +2* * $\xrightarrow{\text{tex}}$ “#1.
\mathrel { \underline { \{ + \} 2 \, \ast } } \#2.”]
[* +2* * $\xrightarrow{\text{pyk}}$ “* untagged double *”]

* :: *

[x :: y $\xRightarrow{\text{val}}$ x^M :: [y^M]]
[x :: y $\xrightarrow{\text{tex}}$ “#1.
\mathrel { : \, \, , : } \#2.”]
[* :: * $\xrightarrow{\text{pyk}}$ “* pair *”]

* +2* *

[x +2* y $\xRightarrow{\text{val}}$ T :: [x^B :: [y^{UC}]]]
[* +2* * $\xrightarrow{\text{tex}}$ “#1.
\mathrel { \{ + \} 2 \, \ast } \#2.”]
[* +2* * $\xrightarrow{\text{pyk}}$ “* double *”]

*, *

[x, y $\xrightarrow{\text{tex}}$ “#1.
, \linebreak [0] #2.”]
[x, y $\xrightarrow{\text{pyk}}$ “* comma *”]

$$* \stackrel{\text{B}}{\approx} *$$

$$[x \stackrel{\text{B}}{\approx} y \xrightarrow{\text{val}} x \left\{ \begin{array}{l} \text{If}(y, T, F) \\ \text{If}(y, F, T) \end{array} \right.]$$

$$[* \stackrel{\text{B}}{\approx} * \xrightarrow{\text{tex}} \text{"\#1.} \\ \backslash\text{stackrelrel}\{B\}\{\backslash\text{approx}\}\#2.\text{"}]$$

$$[* \stackrel{\text{B}}{\approx} * \xrightarrow{\text{pyk}} \text{"* boolean equal *"}]$$

$$* \stackrel{\text{D}}{\approx} *$$

$$[x \stackrel{\text{D}}{\approx} y \xrightarrow{\text{val}} x^c \left\{ \begin{array}{l} \text{If}(y^c, x \stackrel{\text{C}}{\approx} y, F) \\ \text{If}(y^c, F, x \stackrel{\text{P}}{\approx} y) \end{array} \right.]$$

$$[* \stackrel{\text{D}}{\approx} * \xrightarrow{\text{tex}} \text{"\#1.} \\ \backslash\text{stackrelrel}\{D\}\{\backslash\text{approx}\}\#2.\text{"}]$$

$$[* \stackrel{\text{D}}{\approx} * \xrightarrow{\text{pyk}} \text{"* data equal *"}]$$

$$* \stackrel{\text{C}}{\approx} *$$

$$[x \stackrel{\text{C}}{\approx} y \xrightarrow{\text{val}} x^s \left\{ \begin{array}{l} \text{If}(y^s, T, F) \\ \text{If}(y^s, F, [x^h \stackrel{\text{B}}{\approx} [y^h]] \wedge [x^t \stackrel{\text{C}}{\approx} [y^t]]) \end{array} \right.]$$

$$[* \stackrel{\text{C}}{\approx} * \xrightarrow{\text{tex}} \text{"\#1.} \\ \backslash\text{stackrelrel}\{C\}\{\backslash\text{approx}\}\#2.\text{"}]$$

$$[* \stackrel{\text{C}}{\approx} * \xrightarrow{\text{pyk}} \text{"* cardinal equal *"}]$$

$$* \stackrel{\text{P}}{\approx} *$$

$$[x \stackrel{\text{P}}{\approx} y \xrightarrow{\text{val}} x^s \left\{ \begin{array}{l} \text{If}(y^s, T, F) \\ \text{If}(y^s, F, [x^h \approx [y^h]] \wedge [x^t \approx [y^t]]) \end{array} \right.]$$

$$[* \stackrel{\text{P}}{\approx} * \xrightarrow{\text{tex}} \text{"\#1.} \\ \backslash\text{stackrelrel}\{P\}\{\backslash\text{approx}\}\#2.\text{"}]$$

$$[* \stackrel{\text{P}}{\approx} * \xrightarrow{\text{pyk}} \text{"* peano equal *"}]$$

$$* \approx *$$

$$[x \approx y \xRightarrow{\text{val}} x^d \left\{ \begin{array}{l} \text{If}(y^d, x \overset{D}{\approx} y, F) \\ \text{If}(y^d, F, T) \end{array} \right\}]$$

$$[* \approx * \xrightarrow{\text{tex}} \text{"\#1.} \\ \backslash \text{approx \#2."}]$$

$$[* \approx * \xrightarrow{\text{pyk}} \text{"* tagged equal *"}]$$

$$* = *$$

$$[* = * \xrightarrow{\text{tex}} \text{"\#1.} \\ = \text{\#2."}]$$

$$[* = * \xrightarrow{\text{pyk}} \text{"* math equal *"}]$$

$$* \xrightarrow{+} *$$

$$[* \xrightarrow{+} * \xrightarrow{\text{tex}} \text{"\#1.} \\ \backslash \text{stackrelrel \{+\}\{\rightarrow\} \#2."}]$$

$$[* \xrightarrow{+} * \xrightarrow{\text{pyk}} \text{"* reduce to *"}]$$

$$* \overset{t}{=} *$$

$$[x \overset{t}{=} y \xRightarrow{\text{val}} \text{If}(x \overset{r}{=} y, x^t \overset{t^*}{=} [y^t], F)]$$

$$[* \overset{t}{=} * \xrightarrow{\text{tex}} \text{"\#1.} \\ \backslash \text{stackrelrel \{t\}\{=\} \#2."}]$$

$$[* \overset{t}{=} * \xrightarrow{\text{pyk}} \text{"* term equal *"}]$$

$$* \overset{t^*}{=} *$$

$$[x \overset{t^*}{=} y \xRightarrow{\text{val}} x^a \left\{ \begin{array}{l} \text{If}(y^a, T, F) \\ \text{If}(y^a, F, \text{If}(x^h \overset{t}{=} [y^h], x^t \overset{t^*}{=} [y^t], F)) \end{array} \right\}]$$

$$[* \overset{t^*}{=} * \xrightarrow{\text{tex}} \text{"\#1.} \\ \backslash \text{stackrelrel \{t^*\}\{=\} \#2."}]$$

$$[* \overset{t^*}{=} * \xrightarrow{\text{pyk}} \text{"* term list equal *"}]$$

$$* \stackrel{r}{=} *$$

$$[x \stackrel{r}{=} y \stackrel{\text{val}}{\rightarrow} \text{If}(x^r \approx [y^r], x^i \approx [y^i], F)]$$

$$[x \stackrel{r}{=} y \stackrel{\text{tex}}{\rightarrow} \text{"\#1.} \\ \backslash\text{stackrel{r}{rel}\{r\}\{=\} \#2."}]$$

$$[x \stackrel{r}{=} y \stackrel{\text{pyk}}{\rightarrow} \text{"* term root equal *"}]$$

$$* \in_t *$$

$$[x \in_t y \stackrel{\text{val}}{\rightarrow} \text{If}(y^a, x!F, \text{If}(x \stackrel{t}{=} [y^h], T, x \in_t [y^t]))]$$

$$[x \in_t y \stackrel{\text{tex}}{\rightarrow} \text{"\#1.} \\ \backslash\text{in_t \#2."}]$$

$$[x \in_t y \stackrel{\text{pyk}}{\rightarrow} \text{"* term in *"}]$$

$$* \subseteq_T *$$

$$[x \subseteq_T y \stackrel{\text{val}}{\rightarrow} \text{If}(x^a, y!T, \text{If}(x^h \in_t y, x^t \subseteq_T y, F))]$$

$$[x \subseteq_T y \stackrel{\text{tex}}{\rightarrow} \text{"\#1.} \\ \backslash\text{subseteq_T \#2."}]$$

$$[x \subseteq_T y \stackrel{\text{pyk}}{\rightarrow} \text{"* term subset *"}]$$

$$* \stackrel{T}{=} *$$

$$[x \stackrel{T}{=} y \stackrel{\text{val}}{\rightarrow} \text{If}(x \subseteq_T y, y \subseteq_T x, F)]$$

$$[x \stackrel{T}{=} y \stackrel{\text{tex}}{\rightarrow} \text{"\#1.} \\ \backslash\text{stackrel{T}{rel}\{T\}\{=\} \#2."}]$$

$$[x \stackrel{T}{=} y \stackrel{\text{pyk}}{\rightarrow} \text{"* term set equal *"}]$$

$$* \stackrel{s}{=} *$$

$$[x \stackrel{s}{=} y \stackrel{\text{val}}{\rightarrow} \text{If}(\neg [x^2 \stackrel{t}{=} [y^2]], F, \text{If}(x^0 \stackrel{T}{=} [y^0], x^1 \stackrel{T}{=} [y^1], F))]$$

$$[x \stackrel{s}{=} y \stackrel{\text{tex}}{\rightarrow} \text{"\#1.} \\ \backslash\text{stackrel{s}{rel}\{s\}\{=\} \#2."}]$$

$$[x \stackrel{s}{=} y \stackrel{\text{pyk}}{\rightarrow} \text{"* sequent equal *"}]$$

* free in *

[v free in t $\xrightarrow{\text{val}}$
 If(v $\stackrel{t}{=} \text{t}$, T,
 If($\neg$ [t $\stackrel{r}{=} [\forall *: *]$], v free in* [t^t] ,
 If(v $\stackrel{t}{=} [\text{t}^1]$, F, v free in [t²])))]
 [x free in y $\xrightarrow{\text{tex}}$ “#1.
 \mathrel {free\ in} #2.”]
 [v free in t $\xrightarrow{\text{pyk}}$ “* free in *”]

* free in* *

[v free in* t $\xrightarrow{\text{val}}$ If(t, v!F, If(v free in [t^h] , T, v free in* [t^t]))]
 [x free in* y $\xrightarrow{\text{tex}}$ “#1.
 \mathrel {free\ in}^{\{\backslash ast\}} #2.”]
 [v free in* t $\xrightarrow{\text{pyk}}$ “* free in star *”]

* free for * in *

[a free for x in b $\xrightarrow{\text{val}}$ a! [x!
 If(b^v, T,
 If($\neg$ [b $\stackrel{r}{=} [\forall *: *]$] , a free for* x in [b^t] ,
 If(x $\stackrel{t}{=} [\text{b}^1]$, T,
 If($\neg$ [x free in [b²]] , T,
 If(b¹ free in a, F, [a] free for x in [b²])))))]]
 [a free for x in b $\xrightarrow{\text{tex}}$ “#1.
 \mathrel {free\ for} #2.
 \mathrel {in} #3.”]
 [a free for x in b $\xrightarrow{\text{pyk}}$ “* free for * in *”]

* free for* * in *

[a free for* x in b $\xrightarrow{\text{val}}$
 If(b, a! [x!T] ,
 If(a free for x in [b^h] , a free for* x in [b^t] , F))]

$$\begin{aligned} & [\text{a free for}^* \text{x in b} \xrightarrow{\text{tex}} \text{"\#1.} \\ & \backslash \text{mathrel} \{ \text{free} \backslash \text{for} \}^{\wedge} \{ \backslash \text{ast} \} \text{ \#2.} \\ & \backslash \text{mathrel} \{ \text{in} \} \text{ \#3.}"] \end{aligned}$$

$$[\text{a free for}^* * \text{ in b} \xrightarrow{\text{pyk}} \text{"* free for star * in *"}]$$

$$* \in_c *$$

$$[\text{x} \in_c \text{y} \xrightarrow{\text{val}} [\text{y} \stackrel{\text{r}}{=} [\text{x} \wedge_c \text{y}]] \left\{ \begin{array}{l} \text{If}(\text{x} \in_c [\text{y}^1], \text{T}, \text{x} \in_c [\text{y}^2]) \\ \text{x} \stackrel{\text{t}}{=} \text{y} \end{array} \right\}]$$

$$\begin{aligned} & [\text{x} \in_c \text{y} \xrightarrow{\text{tex}} \text{"\#1.} \\ & \backslash \text{in.c} \text{ \#2.}"] \end{aligned}$$

$$[\text{x} \in_c \text{y} \xrightarrow{\text{pyk}} \text{"* claim in *"}]$$

$$* < *$$

$$[\text{x} < \text{y} \xrightarrow{\text{val}} \text{If}(\text{x}^c \wedge [\text{y}^c], \text{x} <' \text{y}, \text{F})]$$

$$\begin{aligned} & [\text{x} < \text{y} \xrightarrow{\text{tex}} \text{"\#1.} \\ & < \text{ \#2.}"] \end{aligned}$$

$$[\text{x} < \text{y} \xrightarrow{\text{pyk}} \text{"* less *"}]$$

$$* <' *$$

$$[\text{x} <' \text{y} \xrightarrow{\text{val}} \text{y}^s \left\{ \begin{array}{l} \text{x}^! \text{F} \\ \text{x}^s \left\{ \begin{array}{l} \text{T} \\ \text{x}^h \left\{ \begin{array}{l} \text{y}^h \left\{ \begin{array}{l} \text{x}^t < \\ \text{x}^t \leq' \\ \text{x}^t <' \\ \text{x}^t <' \end{array} \right. \left[\begin{array}{l} \text{y}^t \\ \text{y}^t \\ \text{y}^t \\ \text{y}^t \end{array} \right] \end{array} \right. \end{array} \right. \end{array} \right. \end{array} \right\}]$$

$$\begin{aligned} & [\text{x} <' \text{y} \xrightarrow{\text{tex}} \text{"\#1.} \\ & <' \text{ \#2.}"] \end{aligned}$$

$$[\text{x} <' \text{y} \xrightarrow{\text{pyk}} \text{"* less zero *"}]$$

$$* \leq' *$$

$$[x \leq' y \overset{\text{val}}{\rightarrow} x^s \left\{ \begin{array}{l} y^!T \\ y^s \end{array} \right\} \overset{F}{\left\{ \begin{array}{l} x^h \\ y^h \end{array} \right\}} \left\{ \begin{array}{l} y^h \\ y^h \end{array} \right\} \left\{ \begin{array}{l} x^t \\ x^t \\ x^t \\ x^t \end{array} \right\} \leq' \left[\begin{array}{l} y^t \\ y^t \\ y^t \\ y^t \end{array} \right] \quad]$$

$$[x \leq' y \overset{\text{tex}}{\rightarrow} \text{"\#1.} \\ \backslash \text{le' \#2."}]$$

$$[x \leq' y \overset{\text{pyk}}{\rightarrow} \text{"* less one *"}]$$

$$\neg *$$

$$[\neg x \overset{\text{val}}{\rightarrow} \text{If}(x, F, T)]$$

$$[\neg * \overset{\text{tex}}{\rightarrow} \text{"} \\ \{\backslash \text{neg } \} \text{\#1."}]$$

$$[\neg * \overset{\text{pyk}}{\rightarrow} \text{"not *"}]$$

$$* \wedge *$$

$$[x \wedge y \overset{\text{val}}{\rightarrow} x \left\{ \begin{array}{l} \text{If}(y, T, F) \\ \text{If}(y, F, F) \end{array} \right\} \quad]$$

$$[* \wedge * \overset{\text{tex}}{\rightarrow} \text{"\#1.} \\ \backslash \text{wedge \#2."}]$$

$$[* \wedge * \overset{\text{pyk}}{\rightarrow} \text{"* and *"}]$$

$$* \ddot{\wedge} *$$

$$[x \ddot{\wedge} y \overset{\text{macro}}{\rightarrow} \lambda t. \lambda s. \lambda c. \tilde{\mathcal{M}}_4(t, s, c, [[x \ddot{\wedge} y \doteq \text{If}(x, y, F)])]$$

$$[x \ddot{\wedge} y \overset{\text{tex}}{\rightarrow} \text{"\#1.} \\ \backslash \text{mathrel}\{\backslash \ddot{\wedge}\} \text{\#2."}]$$

$$[x \ddot{\wedge} y \overset{\text{pyk}}{\rightarrow} \text{"* macro and *"}]$$

$$* \tilde{\wedge} *$$

$$[x \tilde{\wedge} y \xrightarrow{\text{val}} \text{if}(x, y, x)]$$

$$[x \tilde{\wedge} y \xrightarrow{\text{tex}} \text{"\#1.} \\ \backslash\mathrel{\{\tilde{\wedge}\}} \text{\#2."}]$$

$$[x \tilde{\wedge} y \xrightarrow{\text{pyk}} \text{"* simple and *"}]$$

$$* \wedge_c *$$

$$[x \wedge_c y \xrightarrow{\text{val}} \lambda t. \lambda c. [[[x ' t] ' c] \tilde{\wedge} [[y ' t] ' c]]]$$

$$[x \wedge_c y \xrightarrow{\text{tex}} \text{"\#1.} \\ \backslash\text{wedge_c} \text{\#2."}]$$

$$[x \wedge_c y \xrightarrow{\text{pyk}} \text{"* claim and *"}]$$

$$* \vee *$$

$$[x \vee y \xrightarrow{\text{val}} x \left\{ \begin{array}{l} \text{If}(y, T, T) \\ \text{If}(y, T, F) \end{array} \right.]$$

$$[* \vee * \xrightarrow{\text{tex}} \text{"\#1.} \\ \backslash\text{vee} \text{\#2."}]$$

$$[* \vee * \xrightarrow{\text{pyk}} \text{"* or *"}]$$

$$* \parallel *$$

$$[* \parallel * \xrightarrow{\text{tex}} \text{"\#1.} \\ \backslash\text{parallel} \text{\#2."}]$$

$$[* \parallel * \xrightarrow{\text{pyk}} \text{"* parallel *"}]$$

$$* \ddot{\vee} *$$

$$[x \ddot{\vee} y \xrightarrow{\text{macro}} \lambda t. \lambda s. \lambda c. \tilde{\mathcal{M}}_4(t, s, c, \llbracket x \ddot{\vee} y \doteq \text{If}(x, T, y) \rrbracket)]$$

$$[x \ddot{\vee} y \xrightarrow{\text{tex}} \text{"\#1.} \\ \backslash\mathrel{\{\ddot{\vee}\}} \text{\#2."}]$$

$$[x \ddot{\vee} y \xrightarrow{\text{pyk}} \text{"* macro or *"}]$$

$$* \Rightarrow *$$

$$[x \Rightarrow y \xrightarrow{\text{macro}} \lambda t.\lambda s.\lambda c.\tilde{\mathcal{M}}_4(t,s,c, \llbracket [x \Rightarrow y \doteq \text{If}(x,y,T)] \rrbracket)]$$

$$[x \Rightarrow y \xrightarrow{\text{tex}} \text{“}\#1.\backslash\mathrel{\{\ddot{\hspace{.05em}\rightarrow}\}} \text{ }\#2.\text{”}]$$

$$[x \Rightarrow y \xrightarrow{\text{pyk}} \text{“} * \text{ macro imply } * \text{”}]$$

$$* : *$$

$$[x : y \xrightarrow{\text{val}} \text{if}(x,y,y)]$$

$$[* : * \xrightarrow{\text{tex}} \text{“}\#1.\text{:}\#2.\text{”}]$$

$$[* : * \xrightarrow{\text{pyk}} \text{“} * \text{ guard } * \text{”}]$$

$$*!*$$

$$[x!y \xRightarrow{\text{val}} \text{If}(x,y,y)]$$

$$[*!* \xrightarrow{\text{tex}} \text{“}\#1.\text{!}\#2.\text{”}]$$

$$[*!* \xrightarrow{\text{pyk}} \text{“} * \text{ tagged guard } * \text{”}]$$

$$*\left\{\begin{array}{c} * \\ * \end{array}\right.$$

$$[x \left\{ \begin{array}{c} y \\ z \end{array} \right. \xRightarrow{\text{val}} \text{If}(x,y,z)]$$

$$[* \left\{ \begin{array}{c} * \\ * \end{array} \right. \xrightarrow{\text{tex}} \text{“}\#1.\backslash\left\{\backslash\protect \begin {array}\{1\}\#2.\backslash\backslash\#3.\backslash\protect \end {array}\backslash\right.\text{”}]$$

$$[* \left\{ \begin{array}{c} * \\ * \end{array} \right. \xrightarrow{\text{pyk}} \text{“} * \text{ select } * \text{ else } * \text{ end select”}]$$

$\lambda * .*$

Predef: lambda

$[\lambda * .* \xrightarrow{\text{tex}} “$
 $\backslash\text{lambda} \#1.$
 $\#2.”]$

$[\lambda * .* \xrightarrow{\text{pyk}} “\text{lambda} * \text{dot} *”]$

$\Lambda*$

$[\Lambda x \xRightarrow{\text{val}} \mathcal{M}(\lambda u. \mathcal{U}(x \text{ ' } \mathcal{M}(u)))]$

$[\Lambda* \xrightarrow{\text{tex}} “$
 $\backslash\text{Lambda} \#1.”]$

$[\Lambda* \xrightarrow{\text{pyk}} “\text{tagging} *”]$

if * then * else *

$[\text{if } x \text{ then } y \text{ else } z \xrightarrow{\text{macro}} \lambda t. \lambda s. \lambda c. \tilde{\mathcal{M}}_4(t, s, c, \llbracket [\text{if } x \text{ then } y \text{ else } z \doteq \text{If}(x, y, z)] \rrbracket)]$

$[\text{if } x \text{ then } y \text{ else } z \xrightarrow{\text{tex}} “$
 $\{\backslash\text{bf if}\} \backslash \#1.$
 $\backslash \{\backslash\text{bf then}\} \backslash \#2.$
 $\backslash \{\backslash\text{bf else}\} \backslash \#3.”]$

$[\text{if } x \text{ then } y \text{ else } z \xrightarrow{\text{pyk}} “\text{open if } * \text{ then } * \text{ else } *”]$

let * = * in *

$[\text{let } x = y \text{ in } z \xrightarrow{\text{macro}} \lambda t. \lambda s. \lambda c. \tilde{\mathcal{M}}_4(t, s, c, \llbracket [\text{let } x = y \text{ in } z \doteq \text{let}_1(\lambda x. z, y)] \rrbracket)]$

$[\text{let } x = y \text{ in } z \xrightarrow{\text{tex}} “$
 $\backslash\text{mathbf}\{\text{let} \backslash \} \#1.$
 $\#2.$
 $\backslash\text{mathbf}\{\backslash \text{ in } \backslash \} \#3.”]$

$[\text{let } x = y \text{ in } z \xrightarrow{\text{pyk}} “\text{let } * \text{ be } * \text{ in } *”]$

$[x^+ \xrightarrow{\text{tex}} \text{"\#1.} \\ \{\} \wedge \{ + \} \text{"}]$

$[x^+ \xrightarrow{\text{pyk}} \text{"* curry plus"}]$

$*^-$

$[x^- \xrightarrow{\text{val}} [x^-]^R :: [x :: T]]$

$[x^- \xrightarrow{\text{tex}} \text{"\#1.} \\ \{\} \wedge \{ - \} \text{"}]$

$[x^- \xrightarrow{\text{pyk}} \text{"* curry minus"}]$

$*^*$

$[x^* \xrightarrow{\text{val}} [x^*]^R :: [x :: T]]$

$[x^* \xrightarrow{\text{tex}} \text{"\#1.} \\ \{\} \wedge \{ \backslash\text{ast} \} \text{"}]$

$[x^* \xrightarrow{\text{pyk}} \text{"* dereference"}]$

$* @ *$

$[x @ y \xrightarrow{\text{val}} [x @ y]^R :: [x :: [y :: T]]]$

$[x @ y \xrightarrow{\text{tex}} \text{"\#1.} \\ \backslash\text{mathop} \{ \backslash\text{char64} \} \#2.\text{"}]$

$[x @ y \xrightarrow{\text{pyk}} \text{"* at *"}]$

$* \triangleright *$

$[x \triangleright y \xrightarrow{\text{val}} [x \triangleright y]^R :: [x :: [y :: T]]]$

$[x \triangleright y \xrightarrow{\text{tex}} \text{"\#1.} \\ \backslash\text{rhd} \#2.\text{"}]$

$[x \triangleright y \xrightarrow{\text{pyk}} \text{"* modus ponens *"}]$

* $\rhd$ *

$[x \rhd y \xrightarrow{\text{val}} [x \rhd y]^R :: [x :: [y :: T]]]$

$[x \rhd y \xrightarrow{\text{tex}} \text{"\#1.} \\ \backslash\mathrm{mathrel} \{\backslash\makebox [0mm][l]{\$\rhd \$}\backslash, \{\backslashrhd \}\} \text{\#2."}]$

$[x \rhd y \xrightarrow{\text{pyk}} \text{"* modus probans *"}]$

* $\gg$ *

$[x \gg y \xrightarrow{\text{tactic}} \lambda t. \lambda s. \lambda c. \text{conclude}_1(t, c)]$

$[x \gg y \xrightarrow{\text{tex}} \text{"\#1.} \\ \backslash\mathrm{gg} \text{\#2."}]$

$[x \gg y \xrightarrow{\text{pyk}} \text{"* conclude *"}]$

* $\vdash$ *

$[x \vdash y \xrightarrow{\text{val}} [x \vdash y]^R :: [x :: [y :: T]]]$

$[x \vdash y \xrightarrow{\text{tex}} \text{"\#1.} \\ \backslash\mathrm{vdash} \text{\#2."}]$

$[x \vdash y \xrightarrow{\text{pyk}} \text{"* infer *"}]$

* $\Vdash$ *

$[x \Vdash y \xrightarrow{\text{val}} [x \Vdash y]^R :: [x :: [y :: T]]]$

$[x \Vdash y \xrightarrow{\text{tex}} \text{"\#1.} \\ \backslash\mathrm{mathrel} \{\backslash\makebox [0mm][l]{\$\vdash \$}\backslash, \{\backslashvdash \}\} \text{\#2."}]$

$[x \Vdash y \xrightarrow{\text{pyk}} \text{"* endorse *"}]$

* $\dot{\text{i.e.}}$ *

$[x \dot{\text{i.e.}} y \xrightarrow{\text{val}} [x \dot{\text{i.e.}} y]^R :: [x :: [y :: T]]]$

$[x \dot{\text{i.e.}} y \xrightarrow{\text{tex}} \text{"\#1.} \\ \backslash\mathrm{mathrel} \{\dot{\text{i.e.}}\} \text{\#2."}]$

$[x \dot{\text{i.e.}} y \xrightarrow{\text{pyk}} \text{"* id est *"}]$

$\forall *: *$

$[\forall x: y \xrightarrow{\text{val}} [\forall x: y]^R :: [x :: [y :: T]]]$

$[\forall x: y \xrightarrow{\text{tex}} “$
 $\backslash \text{forall} \#1.$
 $\backslash \text{colon} \#2.”]$

$[\forall x: y \xrightarrow{\text{pyk}} “\text{all } * \text{ indeed } *”]$

$* \oplus *$

$[x \oplus y \xrightarrow{\text{val}} [x \oplus y]^R :: [x :: [y :: T]]]$

$[x \oplus y \xrightarrow{\text{tex}} “\#1.$
 $\backslash \text{mathrel} \{ \backslash \text{oplus} \} \#2.”]$

$[x \oplus y \xrightarrow{\text{pyk}} “* \text{ rule plus } *”]$

$*; *$

$[x; y \xrightarrow{\text{val}} [x; y]^R :: [x :: [y :: T]]]$

$[x; y \xrightarrow{\text{tex}} “\#1.$
 $; \#2.”]$

$[x; y \xrightarrow{\text{pyk}} “* \text{ cut } *”]$

$* \text{ proves } *$

$[p \text{ proves } t \xrightarrow{\text{macro}} \lambda t. \lambda s. \lambda c. \tilde{\mathcal{M}}_4(t, s, c, [[p \text{ proves } t \doteq \text{proof}([p], [t], \text{self})]])]$

$[p \text{ proves } t \xrightarrow{\text{tex}} “\#1.$
 $\backslash \text{proves} \backslash \#2.”]$

$[x \text{ proves } y \xrightarrow{\text{pyk}} “* \text{ proves } *”]$

$* \text{ proof of } * : *$

$[t \text{ proof of } s : p \xrightarrow{\text{name}} “\#1.$
 $\backslash \text{mathbf} \{ \backslash \text{proof} \backslash \text{of} \} \#2.$
 $: \#3.”]$

[**t proof of s : p** $\xrightarrow{\text{macro}}$ $\lambda t.\lambda s.\lambda c.\tilde{\mathcal{M}}_4(t, s, c, \llbracket \text{t proof of s : p} \equiv$
Proof of s : $\lambda c.\lambda x.\mathcal{P}(\llbracket t \vdash p \rrbracket, p_0, c) \rrbracket \rrbracket$)]

[**t proof of s : p** $\xrightarrow{\text{tex}}$ “
 $\backslash$ if $\backslash$ relax $\backslash$ csname lgwproofline $\backslash$ endcsname
 $\backslash$ def $\backslash$ lgwproofline{x}
 $\backslash$ newcount $\backslash$ lgwproofline
 $\backslash$ fi
 $\backslash$ begingroup
 $\backslash$ def $\backslash$ insideproof{x}
 $\backslash$ lgwproofline=0 #1.
 $\backslash$ mathbf { $\backslash$ proof $\backslash$ of $\backslash$ } #2.
 $\backslash$ colon #3.
 $\backslash$ gdef $\backslash$ lgwella{ $\backslash$ relax}
 $\backslash$ gdef $\backslash$ lgwellb{ $\backslash$ relax}
 $\backslash$ gdef $\backslash$ lgwellc{ $\backslash$ relax}
 $\backslash$ gdef $\backslash$ lgwelld{ $\backslash$ relax}
 $\backslash$ gdef $\backslash$ lgwelle{ $\backslash$ relax}
 $\backslash$ gdef $\backslash$ lgwellf{ $\backslash$ relax}
 $\backslash$ gdef $\backslash$ lgwellg{ $\backslash$ relax}
 $\backslash$ gdef $\backslash$ lgwellh{ $\backslash$ relax}
 $\backslash$ gdef $\backslash$ lgwelli{ $\backslash$ relax}
 $\backslash$ gdef $\backslash$ lgwellj{ $\backslash$ relax}
 $\backslash$ gdef $\backslash$ lgwellk{ $\backslash$ relax}
 $\backslash$ gdef $\backslash$ lgwelll{ $\backslash$ relax}
 $\backslash$ gdef $\backslash$ lgwellm{ $\backslash$ relax}
 $\backslash$ gdef $\backslash$ lgwelln{ $\backslash$ relax}
 $\backslash$ gdef $\backslash$ lgwello{ $\backslash$ relax}
 $\backslash$ gdef $\backslash$ lgwellp{ $\backslash$ relax}
 $\backslash$ gdef $\backslash$ lgwellq{ $\backslash$ relax}
 $\backslash$ gdef $\backslash$ lgwellr{ $\backslash$ relax}
 $\backslash$ gdef $\backslash$ lgwells{ $\backslash$ relax}
 $\backslash$ gdef $\backslash$ lgwellt{ $\backslash$ relax}
 $\backslash$ gdef $\backslash$ lgwellu{ $\backslash$ relax}
 $\backslash$ gdef $\backslash$ lgwellv{ $\backslash$ relax}
 $\backslash$ gdef $\backslash$ lgwellw{ $\backslash$ relax}
 $\backslash$ gdef $\backslash$ lgwellx{ $\backslash$ relax}
 $\backslash$ gdef $\backslash$ lgwelly{ $\backslash$ relax}
 $\backslash$ gdef $\backslash$ lgwellz{ $\backslash$ relax}
 $\backslash$ gdef $\backslash$ lgwellbiga{ $\backslash$ relax}
 $\backslash$ gdef $\backslash$ lgwellbigb{ $\backslash$ relax}
 $\backslash$ gdef $\backslash$ lgwellbigc{ $\backslash$ relax}
 $\backslash$ gdef $\backslash$ lgwellbigd{ $\backslash$ relax}
 $\backslash$ gdef $\backslash$ lgwellbige{ $\backslash$ relax}
 $\backslash$ gdef $\backslash$ lgwellbigf{ $\backslash$ relax}
 $\backslash$ gdef $\backslash$ lgwellbigg{ $\backslash$ relax}

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\gdef\lgwellbigh{\relax}
\gdef\lgwellbigi{\relax}
\gdef\lgwellbigj{\relax}
\gdef\lgwellbigk{\relax}
\gdef\lgwellbigl{\relax}
\gdef\lgwellbigm{\relax}
\gdef\lgwellbign{\relax}
\gdef\lgwellbigo{\relax}
\gdef\lgwellbigp{\relax}
\gdef\lgwellbigq{\relax}
\gdef\lgwellbigr{\relax}
\gdef\lgwellbigs{\relax}
\gdef\lgwellbigt{\relax}
\gdef\lgwellbigu{\relax}
\gdef\lgwellbigv{\relax}
\gdef\lgwellbigw{\relax}
\gdef\lgwellbigx{\relax}
\gdef\lgwellbigy{\relax}
\gdef\lgwellbigz{\relax}
\endgroup ”]
```

```
[t proof of l : p  $\xrightarrow{\text{pyk}}$  “* proof of * reads *”]
```

```
Line * : *  $\gg$  * ; *
```

```
[Line l : a  $\gg$  i ; p  $\xrightarrow{\text{name}}$  “
Line \, #1.
: #2.
\gg #3.
; #4.”]

[Line l : a  $\gg$  i ; p  $\xrightarrow{\text{macro}}$   $\lambda t.\lambda s.\lambda c.\tilde{\mathcal{M}}_4(t,s,c,[ [ \text{Line l : a } \gg i ; p \doteq ( [ a \gg i ]$ 
; let l  $\doteq$  i in p) ] ) ] ]

[Line l : a  $\gg$  i ; p  $\xrightarrow{\text{tex}}$  “
\newline \makebox [0.1\textwidth] {\}%
\parbox [b]{0.4\textwidth} {\raggedright
\setlength {\parindent} {-0.1\textwidth} }%
\makebox [0.1\textwidth ] [l] {\$#1.
\$;} \$#2.
{\}\gg {\}$}\quad
\parbox [t]{0.4\textwidth} {\$#3.
\$ \hfill \makebox [0mm] [l] {\quad ; }} \$#4.”]

[Line l : a  $\gg$  i ; p  $\xrightarrow{\text{pyk}}$  “line * because * indeed * cut *”]
```

Last line * $\gg$ * $\square$

```
[Last line a  $\gg$  i  $\square \xrightarrow{\text{name}}$  “
Last\ line \, #1.
\gg #2.
\,\Box”]

[Last line a  $\gg$  i  $\square \xrightarrow{\text{macro}} \lambda t.\lambda s.\lambda c.\tilde{\mathcal{M}}_4(t, s, c, [[\text{Last line a} \gg i \square \doteq (a \gg i)])]$ ]

[Last line a  $\gg$  i  $\square \xrightarrow{\text{tex}}$  “
\newline \makebox [0.1\textwidth]{}%
\parbox [b]{0.4\textwidth}{\raggedright
\setlength {\parindent}{-0.1\textwidth}}%
\makebox [0.1\textwidth][l]{\$
\if \relax \csname lgwproofline\endcsname L_? \else
\global \advance \lgwproofline by 1
\Ifnum \lgwproofline <10 0\fi \number \lgwproofline
\fi
\:$\#1.
\}\gg \{\}\}\quad
\parbox [t]{0.4\textwidth}{\$\#2.
\$\hfill \makebox [0mm][l]{\quad \makebox[0mm]{\$\Box$\}}”]

[Last line a  $\gg$  i  $\square \xrightarrow{\text{pyk}}$  “because * indeed * qed”]
```

Line * : Premise $\gg$ *; *

```
[Line l : Premise  $\gg$  i; p  $\xrightarrow{\text{name}}$  “
Line \, #1.
: Premise \gg #2.
; #3.”]

[Line l : Premise  $\gg$  i; p  $\xrightarrow{\text{macro}} \lambda t.\lambda s.\lambda c.\tilde{\mathcal{M}}_4(t, s, c, [[\text{Line l : Premise} \gg i; p \doteq (i \vdash \text{let l} \doteq i \text{ in p})]])]$ ]

[Line l : Premise  $\gg$  i; p  $\xrightarrow{\text{tex}}$  “
\newline \makebox [0.1\textwidth][l]{\$\#1.
\:$\makebox [0.4\textwidth][l]{\$Premise\}\gg\{\}\}\quad
\parbox [t]{0.4\textwidth}{\$\#2.
\$\hfill \makebox [0mm][l]{\quad ; }\#3.”]

[Line l : Premise  $\gg$  i; p  $\xrightarrow{\text{pyk}}$  “line * premise * cut *”]
```

Line * : Side-condition $\gg$ *; *

```
[Line l : Side-condition  $\gg$  i; p  $\xrightarrow{\text{name}}$  “
Line \, #1.
: \mbox{Side-condition} \gg #2.
; #3.”]

[Line l : Side-condition  $\gg$  i; p  $\xrightarrow{\text{macro}} \lambda t. \lambda s. \lambda c. \tilde{\mathcal{M}}_4(t, s, c, [[\text{Line l} :
\text{Side-condition} \gg i; p \doteq (i \vdash \text{let l} \doteq i \text{ in p} )]])]$ 

[Line l : Side-condition  $\gg$  i; p  $\xrightarrow{\text{tex}}$  “
\newline \makebox [0.1\textwidth ]{l}{\$#1.
\makebox [0.4\textwidth ]{l}{
\mbox{Side-condition}}\gg\{ \$}\quad
\parbox [t]{0.4\textwidth }{\$#2.
\hfill \makebox [0mm]{l}{\quad ; }}#3.”]

[Line l : Side-condition  $\gg$  i; p  $\xrightarrow{\text{pyk}}$  “line * side condition * cut *”]
```

Arbitrary $\gg$ *; *

```
[Arbitrary  $\gg$  i; p  $\xrightarrow{\text{name}}$  “
Arbitrary \gg #1.
; #2.”]

[Arbitrary  $\gg$  i; p  $\xrightarrow{\text{macro}} \lambda t. \lambda s. \lambda c. \tilde{\mathcal{M}}_4(t, s, c, [[\text{Arbitrary} \gg i; p \doteq (\forall i: p)])]$ 

[Arbitrary  $\gg$  i; p  $\xrightarrow{\text{tex}}$  “
\newline \makebox [0.1\textwidth ]{l}{\$
\if \relax \csname lgwproofline\endcsname L_? \else
\global \advance \lgwproofline by 1
L\ifnum \lgwproofline < 10 0\fi \number \lgwproofline
\fi
\makebox [0.4\textwidth ]{l}{\$Arbitrary}\gg\{ \$}\quad
\parbox [t]{0.4\textwidth }{\$#1.
\hfill \makebox [0mm]{l}{\quad ; }}#2.”]

[Arbitrary  $\gg$  i; p  $\xrightarrow{\text{pyk}}$  “arbitrary * cut *”]
```

Local $\gg$ * = *; *

```
[Local  $\gg$  a = i; p  $\xrightarrow{\text{name}}$  “
Local \gg #1.
= #2.
; #3.”]
```

[Local $\gg a = i; p \xrightarrow{\text{macro}} \lambda t. \lambda s. \lambda c. \tilde{\mathcal{M}}_4(t, s, c, [[\text{Local} \gg a = i; p \doteq (\text{let } a \doteq i \text{ in } p)])])]$

[Local $\gg a = i; p \xrightarrow{\text{tex}}$ “
\newline\makebox[0.1\textwidth]{\$
\if \relax \csname lgwprooflinep\endcsname L_? \else
\global \advance \lgwproofline by 1
L\ifnum \lgwproofline <10 0\fi \number \lgwproofline
\fi
\$:\}%
\makebox[0.4\textwidth]{\$Local\}\gg\{\}\$}%
\quad%
\parbox[t]{0.4\textwidth}{\$\#1.
= \#2.
\$\hfill\makebox[0mm][l]{\quad ; }\}\#3.”]

[Local $\gg u = v; p \xrightarrow{\text{pyk}}$ “locally define * as * cut *”]

&

[*&* $\xrightarrow{\text{name}}$ “#1.
\& #2.”]

[*&* $\xrightarrow{\text{tex}}$ “#1.
.”]

[*&* $\xrightarrow{\text{pyk}}$ “* tab *”]

**

[** $\xrightarrow{\text{name}}$ “#1.
\backslash\backslash #2.”]

[** $\xrightarrow{\text{tex}}$ “#1.
\ \ #2.”]

[** $\xrightarrow{\text{pyk}}$ “* row

*”]

The pyk compiler, version 0.grue.20050502+ by Klaus Grue
GRD-2005-06-02.UTC:08:38:28.861822 = MJD-53523.TAI:08:39:00.861822 =
LGT-4624418340861822e-6