

# Logiweb codex of check

## Up Help

$\mathcal{X}$ , check,  $[* \overset{\circ}{*}]$ , RootVisible(\*), A, R, C, T, L, {\*},  $\bar{*}$ , 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,  $\langle * \equiv * \mid * := * \rangle$ ,  $\langle * \equiv^0 * \mid * := * \rangle$ ,  $\langle * \equiv^1 * \mid * := * \rangle$ ,  $\langle * \equiv^* * \mid * := * \rangle$ , Ded(\*, \*), Ded<sub>0</sub>(\*, \*), Ded<sub>1</sub>(\*, \*, \*), Ded<sub>2</sub>(\*, \*, \*), Ded<sub>3</sub>(\*, \*, \*, \*), Ded<sub>4</sub>(\*, \*, \*, \*), Ded<sub>4</sub><sup>\*</sup>(\*, \*, \*, \*), Ded<sub>5</sub>(\*, \*, \*), Ded<sub>6</sub>(\*, \*, \*, \*), Ded<sub>6</sub><sup>\*</sup>(\*, \*, \*, \*), Ded<sub>7</sub>(\*), Ded<sub>8</sub>(\*, \*), Ded<sub>8</sub><sup>\*</sup>(\*, \*), S, Neg, MP, Gen, Ded, S1, S2, S3, S4, S5, S6, S7, S8, S9, Repetition, A1', A2', A4', A5', Prop 3.2a, Prop 3.2b, Prop 3.2c, Prop 3.2d, Prop 3.2e<sub>1</sub>, Prop 3.2e<sub>2</sub>, Prop 3.2e, Prop 3.2f<sub>1</sub>, Prop 3.2f<sub>2</sub>, Prop 3.2f, Prop 3.2g<sub>1</sub>, Prop 3.2g<sub>2</sub>, Prop 3.2g, Prop 3.2h<sub>1</sub>, Prop 3.2h<sub>2</sub>, Prop 3.2h, Block<sub>1</sub>(\*, \*, \*), Block<sub>2</sub>(\*), \*<sup>hide</sup>, MacroIndent(\*), \*', \* = \*, \* ≠ \*, \*<sup>var</sup>, \*#<sup>0</sup>\*, \*#<sup>1</sup>\*, \*#<sup>\*</sup>\*, ∃\*:\*, ∀\*:\*, ∇<sub>obj</sub>\*:\*, \* ⇒ \*, \* ⇔ \*, \*#\*, \*⊇\*, Π\*:\*, Begin\*:\*, End\*:\*, Last block line\* ≫ \*;\*, Arbitrary ≫ \*;\*, \* | \*, →, \* \ \\*,

$\mathcal{X}$

$[\mathcal{X} \xrightarrow{\text{stmt}} \mathcal{X}]$

## check

$[\text{check} \xrightarrow{\text{prio}}$

### Preassociative

[check], [base], [bracket \* end bracket], [big bracket \* end bracket], [ \$ \* \$ ], [flush left [\*], [x], [y], [z], [[\* ⋈ \*], [[\* <sup>\*</sup> \*], [pyk], [tex], [name], [prio], [\*], [T], [if(\*, \*, \*)], [[\*  $\overset{*}{\Rightarrow}$  \*], [val], [claim], [ $\perp$ ], [f(\*)], [(\*)<sup>l</sup>], [F], [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], [(\*)<sup>M</sup>], [If(\*, \*, \*)], [array{\*} \* end array], [l], [c], [r], [empty], [( \* | \* := \* )], [ $\mathcal{M}$ (\*)], [ $\tilde{\mathcal{U}}$ (\*)], [ $\mathcal{U}$ (\*)], [ $\mathcal{U}^M$ (\*)], [apply(\*, \*)], [apply<sub>1</sub>(\*, \*)], [identifier(\*)], [identifier<sub>1</sub>(\*, \*)], [array-plus(\*, \*)], [array-remove(\*, \*, \*)], [array-put(\*, \*, \*, \*)], [array-add(\*, \*, \*, \*, \*)], [bit(\*, \*)], [bit<sub>1</sub>(\*, \*)], [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],

$[so]$ ,  $[zip(*, *)]$ ,  $[assoc_1(*, *, *)]$ ,  $[(*)^P]$ ,  $[self]$ ,  $[[* \doteq *]]$ ,  $[[* \dot{=} *]]$ ,  $[[* \dot{=} *]]$ ,  
 $[[* \stackrel{pyk}{=} *]]$ ,  $[[* \stackrel{tex}{=} *]]$ ,  $[[* \stackrel{name}{=} *]]$ ,  $[Priority\ table[*]]$ ,  $[\tilde{\mathcal{M}}_1]$ ,  $[\tilde{\mathcal{M}}_2(*)]$ ,  $[\tilde{\mathcal{M}}_3(*)]$ ,  
 $[\tilde{\mathcal{M}}_4(*, *, *, *)]$ ,  $[\mathcal{M}(*, *, *)]$ ,  $[\tilde{\mathcal{Q}}(*, *, *)]$ ,  $[\tilde{\mathcal{Q}}_2(*, *, *)]$ ,  $[\tilde{\mathcal{Q}}_3(*, *, *, *)]$ ,  $[\tilde{\mathcal{Q}}^*(*, *, *)]$ ,  
 $[(*)]$ ,  $[(*)]$ ,  $[display(*)]$ ,  $[statement(*)]$ ,  $[[*]]$ ,  $[[*]^-]$ ,  $[aspect(*, *)]$ ,  
 $[aspect(*, *, *)]$ ,  $[(*)]$ ,  $[tuple_1(*)]$ ,  $[tuple_2(*)]$ ,  $[let_2(*, *)]$ ,  $[let_1(*, *)]$ ,  
 $[[* \stackrel{claim}{=} *]]$ ,  $[checker]$ ,  $[check(*, *)]$ ,  $[check_2(*, *, *)]$ ,  $[check_3(*, *, *)]$ ,  
 $[check^*(*, *)]$ ,  $[check_2^*(*, *, *)]$ ,  $[[*]]$ ,  $[[*]^-]$ ,  $[[*]^\circ]$ ,  $[msg]$ ,  $[[* \stackrel{msg}{=} *]]$ ,  $[<stmt>]$ ,  
 $[stmt]$ ,  $[[* \stackrel{stmt}{=} *]]$ ,  $[HeadNil']$ ,  $[HeadPair']$ ,  $[Transitivity']$ ,  $[⊥]$ ,  $[Contra']$ ,  $[T'_E]$ ,  
 $[L_1]$ ,  $[*]$ ,  $[A]$ ,  $[B]$ ,  $[C]$ ,  $[D]$ ,  $[E]$ ,  $[F]$ ,  $[G]$ ,  $[H]$ ,  $[I]$ ,  $[J]$ ,  $[K]$ ,  $[L]$ ,  $[M]$ ,  $[N]$ ,  $[O]$ ,  $[P]$ ,  $[Q]$ ,  
 $[R]$ ,  $[S]$ ,  $[T]$ ,  $[U]$ ,  $[V]$ ,  $[W]$ ,  $[X]$ ,  $[Y]$ ,  $[Z]$ ,  $[[* \mid * := *]]$ ,  $[[* \mid * := *]]$ ,  $[\emptyset]$ ,  $[Remainder]$ ,  
 $[(*)^\vee]$ ,  $[intro(*, *, *, *)]$ ,  $[intro(*, *, *)]$ ,  $[error(*, *)]$ ,  $[error_2(*, *)]$ ,  $[proof(*, *, *)]$ ,  
 $[proof_2(*, *)]$ ,  $[S(*, *)]$ ,  $[S^1(*, *)]$ ,  $[S^\triangleright(*, *)]$ ,  $[S_1^\triangleright(*, *, *)]$ ,  $[S^E(*, *)]$ ,  $[S_1^E(*, *, *)]$ ,  
 $[S^+(*, *)]$ ,  $[S_1^+(*, *, *)]$ ,  $[S^-(*, *)]$ ,  $[S_1^-(*, *, *)]$ ,  $[S^*(*, *)]$ ,  $[S_1^*(*, *, *)]$ ,  
 $[S_2^*(*, *, *, *)]$ ,  $[S^\circ(*, *)]$ ,  $[S_1^\circ(*, *, *)]$ ,  $[S^+(*, *)]$ ,  $[S_1^+(*, *, *, *)]$ ,  $[S^{\#}(*, *)]$ ,  
 $[S_1^{\#}(*, *, *, *)]$ ,  $[S^{i.e.}(*, *)]$ ,  $[S_1^{i.e.}(*, *, *, *)]$ ,  $[S_2^{i.e.}(*, *, *, *, *)]$ ,  $[S^\vee(*, *)]$ ,  
 $[S_1^\vee(*, *, *, *)]$ ,  $[S^i(*, *)]$ ,  $[S_1^i(*, *, *, *)]$ ,  $[S_2^i(*, *, *, *, *)]$ ,  $[T(*)]$ ,  $[claims(*, *, *)]$ ,  
 $[claims_2(*, *, *)]$ ,  $[<proof>]$ ,  $[proof]$ ,  $[Lemma\ * : *]$ ,  $[Proof\ of\ * : *]$ ,  
 $[* \text{ lemma } * : *]$ ,  $[* \text{ antilemma } * : *]$ ,  $[* \text{ rule } * : *]$ ,  $[* \text{ antirule } * : *]$ ,  
 $[verifier]$ ,  $[\mathcal{V}_1(*)]$ ,  $[\mathcal{V}_2(*, *)]$ ,  $[\mathcal{V}_3(*, *, *, *)]$ ,  $[\mathcal{V}_4(*, *)]$ ,  $[\mathcal{V}_5(*, *, *, *)]$ ,  $[\mathcal{V}_6(*, *, *, *)]$ ,  
 $[\mathcal{V}_7(*, *, *, *)]$ ,  $[Cut(*, *)]$ ,  $[Head_\oplus(*)]$ ,  $[Tail_\oplus(*)]$ ,  $[rule_1(*, *)]$ ,  $[rule(*, *)]$ ,  
 $[Rule\ tactic]$ ,  $[Plus(*, *)]$ ,  $[Theory\ *]$ ,  $[theory_2(*, *)]$ ,  $[theory_3(*, *)]$ ,  
 $[theory_4(*, *, *)]$ ,  $[HeadNil'']$ ,  $[HeadPair'']$ ,  $[Transitivity'']$ ,  $[Contra'']$ ,  $[HeadNil]$ ,  
 $[HeadPair]$ ,  $[Transitivity]$ ,  $[Contra]$ ,  $[T_E]$ ,  $[ragged\ right]$ ,  
 $[ragged\ right\ expansion]$ ,  $[parm(*, *, *)]$ ,  $[parm^*(*, *, *)]$ ,  $[inst(*, *)]$ ,  
 $[inst^*(*, *)]$ ,  $[occur(*, *, *)]$ ,  $[occur^*(*, *, *)]$ ,  $[unify(* = *, *)]$ ,  $[unify^*(*) = *, *)]$ ,  
 $[unify_2(* = *, *)]$ ,  $[L_a]$ ,  $[L_b]$ ,  $[L_c]$ ,  $[L_d]$ ,  $[L_e]$ ,  $[L_f]$ ,  $[L_g]$ ,  $[L_h]$ ,  $[L_i]$ ,  $[L_j]$ ,  $[L_k]$ ,  $[L_l]$ ,  $[L_m]$ ,  
 $[L_n]$ ,  $[L_o]$ ,  $[L_p]$ ,  $[L_q]$ ,  $[L_r]$ ,  $[L_s]$ ,  $[L_t]$ ,  $[L_u]$ ,  $[L_v]$ ,  $[L_w]$ ,  $[L_x]$ ,  $[L_y]$ ,  $[L_z]$ ,  $[L_A]$ ,  $[L_B]$ ,  $[L_C]$ ,  
 $[L_D]$ ,  $[L_E]$ ,  $[L_F]$ ,  $[L_G]$ ,  $[L_H]$ ,  $[L_I]$ ,  $[L_J]$ ,  $[L_K]$ ,  $[L_L]$ ,  $[L_M]$ ,  $[L_N]$ ,  $[L_O]$ ,  $[L_P]$ ,  $[L_Q]$ ,  $[L_R]$ ,  
 $[L_S]$ ,  $[L_T]$ ,  $[L_U]$ ,  $[L_V]$ ,  $[L_W]$ ,  $[L_X]$ ,  $[L_Y]$ ,  $[L_Z]$ ,  $[L_?]$ ,  $[Reflexivity]$ ,  $[Reflexivity_1]$ ,  
 $[Commutativity]$ ,  $[Commutativity_1]$ ,  $[<tactic>]$ ,  $[tactic]$ ,  $[[* \stackrel{tactic}{=} *]]$ ,  $[P(*, *, *)]$ ,  
 $[P^*(*, *, *)]$ ,  $[p_0]$ ,  $[conclude_1(*, *)]$ ,  $[conclude_2(*, *, *)]$ ,  $[conclude_3(*, *, *, *)]$ ,  
 $[conclude_4(*, *)]$ ,  $[[* \stackrel{\circ}{=} *]]$ ,  $[RootVisible(*)]$ ,  $[A]$ ,  $[R]$ ,  $[C]$ ,  $[T]$ ,  $[L]$ ,  $[*]$ ,  $[a]$ ,  $[b]$ ,  
 $[c]$ ,  $[d]$ ,  $[e]$ ,  $[f]$ ,  $[g]$ ,  $[h]$ ,  $[i]$ ,  $[j]$ ,  $[k]$ ,  $[l]$ ,  $[m]$ ,  $[n]$ ,  $[o]$ ,  $[p]$ ,  $[q]$ ,  $[r]$ ,  $[s]$ ,  $[t]$ ,  $[u]$ ,  $[v]$ ,  $[w]$ ,  $[x]$ ,  
 $[y]$ ,  $[z]$ ,  $[[* \equiv * \mid * := *]]$ ,  $[[* \equiv 0 \mid * := *]]$ ,  $[[* \equiv 1 \mid * := *]]$ ,  $[[* \equiv * \mid * := *]]$ ,  
 $[Ded(*, *)]$ ,  $[Ded_0(*, *)]$ ,  $[Ded_1(*, *, *)]$ ,  $[Ded_2(*, *, *)]$ ,  $[Ded_3(*, *, *, *)]$ ,  
 $[Ded_4(*, *, *, *)]$ ,  $[Ded_4^*(*, *, *, *)]$ ,  $[Ded_5(*, *, *)]$ ,  $[Ded_6(*, *, *, *)]$ ,  
 $[Ded_6^*(*, *, *, *)]$ ,  $[Ded_7(*)]$ ,  $[Ded_8(*, *)]$ ,  $[Ded_8^*(*, *)]$ ,  $[S]$ ,  $[Neg]$ ,  $[MP]$ ,  $[Gen]$ ,  
 $[Ded]$ ,  $[S1]$ ,  $[S2]$ ,  $[S3]$ ,  $[S4]$ ,  $[S5]$ ,  $[S6]$ ,  $[S7]$ ,  $[S8]$ ,  $[S9]$ ,  $[Repetition]$ ,  $[A1']$ ,  $[A2']$ ,  $[A4']$ ,  
 $[A5']$ ,  $[Prop\ 3.2a]$ ,  $[Prop\ 3.2b]$ ,  $[Prop\ 3.2c]$ ,  $[Prop\ 3.2d]$ ,  $[Prop\ 3.2e_1]$ ,  $[Prop\ 3.2e_2]$ ,  
 $[Prop\ 3.2e]$ ,  $[Prop\ 3.2f_1]$ ,  $[Prop\ 3.2f_2]$ ,  $[Prop\ 3.2f]$ ,  $[Prop\ 3.2g_1]$ ,  $[Prop\ 3.2g_2]$ ,  
 $[Prop\ 3.2g]$ ,  $[Prop\ 3.2h_1]$ ,  $[Prop\ 3.2h_2]$ ,  $[Prop\ 3.2h]$ ,  $[Block_1(*, *, *)]$ ,  $[Block_2(*)]$ ;  
**Preassociative**  
 $[* \{ * \}]$ ,  $[*/indexintro(*, *, *, *)]$ ,  $[*/intro(*, *, *)]$ ,  $[*/bothintro(*, *, *, *, *)]$ ,  
 $[*/nameintro(*, *, *, *)]$ ,  $[*']$ ,  $[[* \ *]]$ ,  $[[* \rightarrow *]]$ ,  $[[* \Rightarrow *]]$ ,  $[*0]$ ,  $[*1]$ ,  $[0b]$ ,  $[* \text{-color} (*)]$ ,

[\*-color\* (\*), [\*H], [\*T], [\*U], [\*h], [\*t], [\*s], [\*c], [\*d], [\*a], [\*C], [\*M], [\*B], [\*F], [\*i], [\*d], [\*R], [\*0], [\*1], [\*2], [\*3], [\*4], [\*5], [\*6], [\*7], [\*8], [\*9], [\*E], [\*V], [\*C], [\*C<sup>#</sup>], [\*hide];

### Preassociative

[“ \* ”], [], [(\*)<sup>t</sup>], [string(\*) + \*], [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 \*], [[\*], [\ \*], [ ] \*], [^ \*], [\_ \*], [‘ \*], [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 \*], [{ \*}, [ | \*}, [ } \*}, [ ~ \*}, [Preassociative \*; \*], [Postassociative \*; \*], [[\*], [\*], [priority \* end], [newline \*], [macro newline \*], [MacroIndent(\*)];

### Preassociative

[\* ’ \*], [\* ‘ \*];

### Preassociative

[\*’];

### Preassociative

[\* · \*], [\* · 0 \*];

### Preassociative

[\* + \*], [\* + 0 \*], [\* + 1 \*], [\* - \*], [\* - 0 \*], [\* - 1 \*];

### Preassociative

[\* ∪ { \* }, [\* ∪ \*], [\* \ { \* }];

### Postassociative

[\* . : \*], [\* . : \*], [\* : : \*], [\* + 2 \* \*], [\* : : \*], [\* + 2 \* \*];

### Postassociative

[\* , \*];

### Preassociative

[\* <sup>B</sup> ≈ \*], [\* <sup>D</sup> ≈ \*], [\* <sup>C</sup> ≈ \*], [\* <sup>P</sup> ≈ \*], [\* ≈ \*], [\* = \*], [\* → \*], [\* <sup>t</sup> = \*], [\* <sup>t\*</sup> = \*], [\* <sup>r</sup> = \*], [\* ∈<sub>T</sub> \*], [\* ⊆<sub>T</sub> \*], [\* <sup>T</sup> = \*], [\* <sup>s</sup> = \*], [\* free in \*], [\* free in\* \*], [\* free for \* in \*], [\* free for\* \* in \*], [\* ∈<sub>C</sub> \*], [\* < \*], [\* <’ \*], [\* ≤’ \*], [\* = \*], [\* ≠ \*], [\*<sup>var</sup>], [\*#<sup>0</sup> \*], [\*#<sup>1</sup> \*], [\*#\* \*];

### Preassociative

[¬\*];

### Preassociative

[\* ∧ \*], [\* <sup>λ</sup> \*], [\* <sup>λ</sup> \*], [\* ∧<sub>C</sub> \*];

### Preassociative

[\* ∨ \*], [\* || \*], [\* <sup>∨</sup> \*];

### Preassociative

[∃\* : \*], [∀\* : \*], [∀<sub>obj</sub>\* : \*];

### Postassociative

[\* <sup>⇒</sup> \*], [\* ⇒ \*], [\* ⇔ \*];

### Postassociative

[\* : \*], [\* spy \*], [\*! \*];

### Preassociative

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

**Preassociative**

[ $\lambda$  \* .\*], [ $\Lambda$  \* .\*], [ $\Lambda$  \*], [if \* then \* else \*], [let \* = \* in \*], [let \*  $\doteq$  \* in \*];

**Preassociative**

[\*#\*];

**Preassociative**

[\*<sup>I</sup>], [\*<sup>▷</sup>], [\*<sup>V</sup>], [\*<sup>+</sup>], [\*<sup>-</sup>], [\*<sup>\*</sup>];

**Preassociative**

[\* @ \*], [\* ▷ \*], [\* ▷ \*], [\* ≫ \*], [\* ≧ \*];

**Postassociative**

[\* ⊢ \*], [\* ⊢ \*], [\* i.e. \*];

**Preassociative**

[ $\forall$ \*: \*], [ $\prod$ \*: \*];

**Postassociative**

[\* ⊕ \*];

**Postassociative**

[\*; \*];

**Preassociative**

[\* proves \*];

**Preassociative**

[\* **proof of** \* : \*], [Line \* : \* ≫ \*; \*], [Last line \* ≫ \* □],  
[Line \* : Premise ≫ \*; \*], [Line \* : Side-condition ≫ \*; \*], [Arbitrary ≫ \*; \*],  
[Local ≫ \* = \*; \*], [Begin \*; \* : End; \*], [Last block line \* ≫ \*; \*],  
[Arbitrary ≫ \*; \*];

**Postassociative**

[\* | \*];

**Postassociative**

[\* , \*], [\* [\* \*]];

**Preassociative**

[\*&\*], [→];

**Preassociative**

[\* \\ \*], [\* linebreak[4] \*], [\* \\ \*];

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

[\*  $\overset{\circ}{=}$  \*]

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

[ $[x \overset{\circ}{=} y] \xrightarrow{\text{tex}}$  “

[#1/tex name/tex.

\stackrel{\circ}{=} {=} #2.

]”]

$[[* \overset{\circ}{=} *] \xrightarrow{\text{pyk}} \text{"general macro define " as " end define"}]$

## RootVisible(\*)

$[\text{RootVisible}(x) \xrightarrow{\text{name}} \text{"RootVisible(\#1.} \\ \text{)}"]]$

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

$[\text{RootVisible}(*) \xrightarrow{\text{pyk}} \text{"make root visible " end visible"}]$

## A

$[A \xrightarrow{\text{tex}} \text{"A"}]$

$[A \xrightarrow{\text{pyk}} \text{"sequent example axiom"}]$

## R

$[R \xrightarrow{\text{tex}} \text{"R"}]$

$[R \xrightarrow{\text{pyk}} \text{"sequent example rule"}]$

## C

$[C \xrightarrow{\text{tex}} \text{"C"}]$

$[C \xrightarrow{\text{pyk}} \text{"sequent example contradiction"}]$

## T

$[T \xrightarrow{\text{tex}} \text{"T"}]$

$[T \xrightarrow{\text{pyk}} \text{"sequent example theory"}]$

**L**

[ $\mathbf{L} \xrightarrow{\text{tex}}$  “  
 $\mathbf{L}$ ”]

[ $\mathbf{L} \xrightarrow{\text{pyk}}$  “sequent example lemma”]

{\*}

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

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

$\overline{*}$

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

[ $\overline{*} \xrightarrow{\text{pyk}}$  “object var " end var”]

*a*

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

[ $a \xrightarrow{\text{tex}}$  “  
 $\mathit{a}$ ”]

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

*b*

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

[ $b \xrightarrow{\text{tex}}$  “  
 $\mathit{b}$ ”]

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

*c*

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

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

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

*d*

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

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

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

*e*

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

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

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

*f*

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

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

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

*g*

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

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

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

*h*

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

[ $h \xrightarrow{\text{tex}}$  “  
`\mathit{h}`”]

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

*i*

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

[ $i \xrightarrow{\text{tex}}$  “  
`\mathit{i}`”]

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

*j*

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

[ $j \xrightarrow{\text{tex}}$  “  
`\mathit{j}`”]

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

*k*

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

[ $k \xrightarrow{\text{tex}}$  “  
`\mathit{k}`”]

[ $k \xrightarrow{\text{pyk}}$  “object k”]

*l*

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

[ $l \xrightarrow{\text{tex}}$  “  
`\mathit{l}`”]

[ $l \xrightarrow{\text{pyk}}$  “object l”]

*m*

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

[ $m \xrightarrow{\text{tex}} \text{“}\backslash\text{mathit}\{m\}\text{”}$ ]

[ $m \xrightarrow{\text{pyk}} \text{“object } m\text{”}$ ]

*n*

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

[ $n \xrightarrow{\text{tex}} \text{“}\backslash\text{mathit}\{n\}\text{”}$ ]

[ $n \xrightarrow{\text{pyk}} \text{“object } n\text{”}$ ]

*o*

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

[ $o \xrightarrow{\text{tex}} \text{“}\backslash\text{mathit}\{o\}\text{”}$ ]

[ $o \xrightarrow{\text{pyk}} \text{“object } o\text{”}$ ]

*p*

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

[ $p \xrightarrow{\text{tex}} \text{“}\backslash\text{mathit}\{p\}\text{”}$ ]

[ $p \xrightarrow{\text{pyk}} \text{“object } p\text{”}$ ]

*q*

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

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

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

*r*

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

$[r \xrightarrow{\text{tex}} \text{"\mathit{r}"}]$

$[r \xrightarrow{\text{pyk}} \text{"object r"}]$

*s*

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

$[s \xrightarrow{\text{tex}} \text{"\mathit{s}"}]$

$[s \xrightarrow{\text{pyk}} \text{"object s"}]$

*t*

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

$[t \xrightarrow{\text{tex}} \text{"\mathit{t}"}]$

$[t \xrightarrow{\text{pyk}} \text{"object t"}]$

*u*

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

$[u \xrightarrow{\text{tex}} \text{"\mathit{u}"}]$

$[u \xrightarrow{\text{pyk}} \text{"object u"}]$

*v*

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

$[v \xrightarrow{\text{tex}} \text{"\mathit{v}"}]$

$[v \xrightarrow{\text{pyk}} \text{"object v"}]$

*w*

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

$[w \xrightarrow{\text{tex}} “$   
 $\backslash\text{mathit}\{w\}”]$

$[w \xrightarrow{\text{pyk}} “\text{object } w”]$

*x*

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

$[x \xrightarrow{\text{tex}} “$   
 $\backslash\text{mathit}\{x\}”]$

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

*y*

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

$[y \xrightarrow{\text{tex}} “$   
 $\backslash\text{mathit}\{y\}”]$

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

*z*

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

$[z \xrightarrow{\text{tex}} “$   
 $\backslash\text{mathit}\{z\}”]$

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

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

$[\langle a \equiv b \mid x := t \rangle \xrightarrow{\text{macro}} \lambda t. \lambda s. \lambda c. \tilde{\mathcal{M}}_4(t, s, c, [[\langle a \equiv b \mid x := t \rangle \doteq \langle [a] \equiv^0 [b] \mid [x] := [t] \rangle]])]$

$[\langle x \equiv y \mid z := u \rangle \xrightarrow{\text{tex}} “$   
 $\backslash\text{langle } \#1.$

$\{\backslash\text{equiv}\} \#2.$

$\mid \#3.$

{:=} #4.  
 \rangle ”]

[⟨\*≡\* | \* :=\*⟩<sup>pyk</sup> “sub " is " where " is " end sub”]

⟨\*≡<sup>0</sup>\* | \* :=\*⟩

[⟨a≡<sup>0</sup>b|x:=t⟩<sup>val</sup> λc.x<sup>var</sup> ∧ ⟨a≡<sup>1</sup>b|x:=t⟩]

[⟨x≡<sup>0</sup>y|z:=u⟩<sup>tex</sup> “

\rangle #1.

{\equiv}^0 #2.

| #3.

{:=} #4.

\rangle ”]

[⟨\*≡<sup>0</sup>\* | \* :=\*⟩<sup>pyk</sup> “sub zero " is " where " is " end sub”]

⟨\*≡<sup>1</sup>\* | \* :=\*⟩

[⟨a≡<sup>1</sup>b|x:=t⟩<sup>val</sup> a!x!t!

If(If(b <sup>r</sup> [∇<sub>obj</sub>u:v], b<sup>1</sup> <sup>t</sup> x, F), a <sup>t</sup> b,

If(b<sup>var</sup> ∧ b <sup>t</sup> x, a <sup>t</sup> t, If(

a <sup>r</sup> b, ⟨a<sup>t</sup>≡\*b<sup>t</sup>|x:=t⟩, F)))]

[⟨x≡<sup>1</sup>y|z:=u⟩<sup>tex</sup> “

\rangle #1.

{\equiv}^1 #2.

| #3.

{:=} #4.

\rangle ”]

[⟨\*≡<sup>1</sup>\* | \* :=\*⟩<sup>pyk</sup> “sub one " is " where " is " end sub”]

⟨\*≡\* | \* :=\*⟩

[⟨a≡\*b|x:=t⟩<sup>val</sup> b!x!t!If(a, T, If(⟨a<sup>h</sup>≡<sup>1</sup>b<sup>h</sup>|x:=t⟩, ⟨a<sup>t</sup>≡\*b<sup>t</sup>|x:=t⟩, F)))]

[⟨x≡\*y|z:=u⟩<sup>tex</sup> “

\rangle #1.

{\equiv}^\* #2.

| #3.

{:=} #4.  
\rangle ”]

[(<\*≡\* \* | \* :=\*)<sup>pyk</sup> “sub star " is " where " is " end sub”]

Ded(\*, \*)

[Ded(p, c)<sup>macro</sup> λt.λs.λc.λ $\tilde{M}_4$ (t, s, c, [[Ded(p, c) ≐ λx.Ded<sub>0</sub>([p], [c])]])]

[Ded(x, y)<sup>tex</sup> “  
Ded(#1.  
, #2.  
)”]

[Ded(\*, \*)<sup>pyk</sup> “deduction " conclude " end deduction”]

Ded<sub>0</sub>(\*, \*)

[Ded<sub>0</sub>(p, c)<sup>val</sup> c!If(Ded<sub>8</sub>(p, T), Ded<sub>1</sub>(Ded<sub>7</sub>(p), c, T), F)]

[Ded<sub>0</sub>(x, y)<sup>tex</sup> “  
Ded<sub>0</sub>(#1.  
, #2.  
)”]

[Ded<sub>0</sub>(\*, \*)<sup>pyk</sup> “deduction zero " conclude " end deduction”]

Ded<sub>1</sub>(\*, \*, \*)

[Ded<sub>1</sub>(p, c, s)<sup>val</sup> If(c  $\stackrel{r}{=} [x \vdash y]$ , Ded<sub>1</sub>(p, c<sup>2</sup>, c<sup>1</sup> :: s), Ded<sub>2</sub>(p, c, s))]

[Ded<sub>1</sub>(x, y, z)<sup>tex</sup> “  
Ded<sub>1</sub>(#1.  
, #2.  
, #3.  
)”]

[Ded<sub>1</sub>(\*, \*, \*)<sup>pyk</sup> “deduction one " conclude " condition " end deduction”]

Ded<sub>2</sub>(\* , \* , \* )

[Ded<sub>2</sub>(p, c, s)  $\xrightarrow{\text{val}}$  s!p  $\stackrel{r}{\equiv}$  [x  $\vdash$  y]  $\wedge$  c  $\stackrel{r}{\equiv}$  [x  $\Rightarrow$   
y] { Ded<sub>3</sub>(p<sup>1</sup>, c<sup>1</sup>, s, T)  $\wedge$  Ded<sub>2</sub>(p<sup>2</sup>, c<sup>2</sup>, s) }  
Ded<sub>4</sub>(p, c, s, Ded<sub>6</sub>(p, c, T, T)) ]

[Ded<sub>2</sub>(x, y, z)  $\xrightarrow{\text{tex}}$  "  
Ded\_2(#1.  
, #2.  
, #3.  
)"]

[Ded<sub>2</sub>(\* , \* , \* )  $\xrightarrow{\text{pyk}}$  "deduction two " conclude " condition " end deduction"]

Ded<sub>3</sub>(\* , \* , \* , \* )

[Ded<sub>3</sub>(p, c, s, b)  $\xrightarrow{\text{val}}$  If( $\neg$ c  $\stackrel{r}{\equiv}$  [ $\forall_{\text{obj}x}$ : y], Ded<sub>4</sub>(p, c, s, b), If(p  $\stackrel{r}{\equiv}$  [ $\forall_{\text{obj}x}$ : y]  $\wedge$  p<sup>1</sup>  $\stackrel{t}{\equiv}$  c<sup>1</sup>,  
Ded<sub>4</sub>(p, c, s, b), Ded<sub>3</sub>(p, c<sup>2</sup>, s, c<sup>1</sup> :: c<sup>1</sup> :: b)))]

[Ded<sub>3</sub>(x, y, z, u)  $\xrightarrow{\text{tex}}$  "  
Ded\_3(#1.  
, #2.  
, #3.  
, #4.  
)"]

[Ded<sub>3</sub>(\* , \* , \* , \* )  $\xrightarrow{\text{pyk}}$  "deduction three " conclude " condition " bound " end  
deduction"]

Ded<sub>4</sub>(\* , \* , \* , \* )

[Ded<sub>4</sub>(p, c, s, b)  $\xrightarrow{\text{val}}$  s!b!If(p  $\stackrel{r}{\equiv}$  [ $\bar{x}$ ], **lookup**(p, b, T)  $\stackrel{t}{\equiv}$  c, If( $\neg$ p  $\stackrel{r}{\equiv}$  c, F,  
If(p  $\stackrel{r}{\equiv}$  [ $\forall_{\text{obj}x}$ : y], p<sup>1</sup>  $\stackrel{t}{\equiv}$  c<sup>1</sup>  $\wedge$  Ded<sub>4</sub>(p<sup>2</sup>, c<sup>2</sup>, s, p<sup>1</sup> :: p<sup>1</sup> :: b), If( $\neg$ p  $\stackrel{r}{\equiv}$  [ $\underline{x}$ ],  
Ded<sub>4</sub><sup>\*</sup>(p<sup>t</sup>, c<sup>t</sup>, s, b), p<sup>1</sup>  $\stackrel{t}{\equiv}$  c<sup>1</sup>  $\wedge$  Ded<sub>5</sub>(p, s, b)))]

[Ded<sub>4</sub>(x, y, z, u)  $\xrightarrow{\text{tex}}$  "  
Ded\_4(#1.  
, #2.  
, #3.  
, #4.  
)"]

[Ded<sub>4</sub>(\* , \* , \* , \* )  $\xrightarrow{\text{pyk}}$  "deduction four " conclude " condition " bound " end  
deduction"]

$\text{Ded}_4^*(*, *, *, *)$

$[\text{Ded}_4^*(p, c, s, b) \xrightarrow{\text{val}} \text{c!s!b!If}(p, T, \text{Ded}_4(p^h, c^h, s, b) \wedge \text{Ded}_4^*(p^t, c^t, s, b))]$

$[\text{Ded}_4^*(x, y, z, u) \xrightarrow{\text{tex}} \text{“$

$\text{Ded}_4^*(\#1.$

$, \#2.$

$, \#3.$

$, \#4.$

$\text{”)”]$

$[\text{Ded}_4^*(*, *, *, *) \xrightarrow{\text{pyk}} \text{“deduction four star " conclude " condition " bound " end deduction”}]$

$\text{Ded}_5(*, *, *)$

$[\text{Ded}_5(p, s, b) \xrightarrow{\text{val}} \text{p!s!If}(b, T, \text{[[x]}\#^0\text{[y]}\text{]}^h :: \text{[[*]}\text{]}^h :: b^{hh} :: T :: \text{[[x]}\text{]}^h :: p :: T :: T \in_t s \wedge \text{Ded}_5(p, s, b^t))]$

$[\text{Ded}_5(x, y, z) \xrightarrow{\text{tex}} \text{“$

$\text{Ded}_5(\#1.$

$, \#2.$

$, \#3.$

$\text{”)”]$

$[\text{Ded}_5(*, *, *) \xrightarrow{\text{pyk}} \text{“deduction five " condition " bound " end deduction”}]$

$\text{Ded}_6(*, *, *, *)$

$[\text{Ded}_6(p, c, e, b) \xrightarrow{\text{val}} \text{p!c!b!e!If}(p \stackrel{r}{=} [\bar{x}], p \in_t e \left\{ \begin{array}{l} b \\ p :: c :: b \end{array} \right., \text{If}(\neg p \stackrel{r}{=} c, T, \text{If}(p \stackrel{r}{=} [\underline{a}], b, \text{If}(p \stackrel{r}{=} [\forall_{\text{obj}x}: y], \text{Ded}_6(p^2, c^2, c^1 :: e, b), \text{Ded}_6^*(p^t, c^t, e, b)))))]$

$[\text{Ded}_6(p, c, e, b) \xrightarrow{\text{tex}} \text{“$

$\text{Ded}_6(\#1.$

$, \#2.$

$, \#3.$

$, \#4.$

$\text{”)”]$

$[\text{Ded}_6(*, *, *, *) \xrightarrow{\text{pyk}} \text{“deduction six " conclude " exception " bound " end deduction”}]$

$\text{Ded}_6^*(*, *, *, *)$

$[\text{Ded}_6^*(p, c, e, b) \xrightarrow{\text{val}} p!c!b!e!If(p, b, \text{Ded}_6^*(p^t, c^t, e, \text{Ded}_6(p^h, c^h, e, b)))]$

$[\text{Ded}_6^*(p, c, e, b) \xrightarrow{\text{tex}} "$

$\text{Ded}_6^*(\#1.$

$, \#2.$

$, \#3.$

$, \#4.$

$)"]$

$[\text{Ded}_6^*(*, *, *, *) \xrightarrow{\text{pyk}} \text{"deduction six star " conclude " exception " bound " end deduction"}]$

$\text{Ded}_7(*)$

$[\text{Ded}_7(p) \xrightarrow{\text{val}} p \stackrel{r}{=} [\forall x: y] \left\{ \begin{array}{l} \text{Ded}_7(p^2) \\ p \end{array} \right\} ]$

$[\text{Ded}_7(p) \xrightarrow{\text{tex}} "$

$\text{Ded}_7(\#1.$

$)"]$

$[\text{Ded}_7(*) \xrightarrow{\text{pyk}} \text{"deduction seven " end deduction"}]$

$\text{Ded}_8(*, *)$

$[\text{Ded}_8(p, b) \xrightarrow{\text{val}} If(p \stackrel{r}{=} [\forall x: y], \text{Ded}_8(p^2, p^1 :: b), If(p \stackrel{r}{=} [a], p \in_t b, \text{Ded}_8^*(p^t, b)))]$

$[\text{Ded}_8(p, b) \xrightarrow{\text{tex}} "$

$\text{Ded}_8(\#1.$

$, \#2.$

$)"]$

$[\text{Ded}_8(*, *) \xrightarrow{\text{pyk}} \text{"deduction eight " bound " end deduction"}]$

$\text{Ded}_8^*(*, *)$

$[\text{Ded}_8^*(p, b) \xrightarrow{\text{val}} b!If(p, \top, If(\text{Ded}_8(p^h, b), \text{Ded}_8^*(p^t, b), F))]$

$[\text{Ded}_8^*(p, b) \xrightarrow{\text{tex}} "$

$\text{Ded}_8^*(\#1.$

, #2.  
)”]

[Ded<sub>8</sub><sup>\*</sup>(\*, \*)  $\xrightarrow{\text{pyk}}$  “deduction eight star ” bound ” end deduction”]

## S

[S  $\xrightarrow{\text{stmt}}$   $\forall \underline{a}: \forall \underline{b}: \underline{a} + \underline{b}' = \underline{a} + \underline{b}' \oplus \forall \underline{a}: \forall \underline{b}: \underline{a} \Rightarrow \underline{b} \vdash \underline{a} \vdash \underline{b} \oplus \forall \underline{a}: \forall \underline{b}: \underline{a} = \underline{b} \vdash \underline{a}' = \underline{b}' \oplus$   
 $\forall \underline{a}: \forall \underline{b}: \underline{a}' = \underline{b}' \vdash \underline{a} = \underline{b} \oplus \forall \underline{a}: \forall \underline{b}: \lambda x. \text{Ded}_0([\underline{a}], [\underline{b}]) \Vdash \underline{a} \vdash \underline{b} \oplus \forall \underline{a}: \forall \underline{b}: \underline{a} \cdot \underline{b}' =$   
 $\underline{a} \cdot \underline{b} + \underline{a} \oplus \forall \underline{a}: \underline{a} + 0 = \underline{a} \oplus \forall \underline{a}: \forall \underline{b}: \neg \underline{b} \Rightarrow \neg \underline{a} \vdash \neg \underline{b} \Rightarrow \underline{a} \vdash \underline{b} \oplus \forall \underline{a}: \forall \underline{b}: \forall \underline{c}: \underline{a} = \underline{b} \vdash$   
 $\underline{a} = \underline{c} \vdash \underline{b} = \underline{c} \oplus \forall \underline{x}: \forall \underline{a}: \forall \underline{b}: \forall \underline{c}: \langle [\underline{b}] \equiv^0 [\underline{a}] \mid [\underline{x}] := [0] \rangle \Vdash \langle [\underline{c}] \equiv^0 [\underline{a}] \mid [\underline{x}] := [\underline{x}'] \rangle \Vdash$   
 $\underline{b} \vdash \underline{a} \Rightarrow \underline{c} \vdash \underline{a} \oplus \forall \underline{a}: \neg 0 = \underline{a}' \oplus \forall \underline{x}: \forall \underline{a}: \underline{a} \vdash \forall_{\text{obj } \underline{x}}: \underline{a} \oplus \forall \underline{a}: \underline{a} \cdot 0 = 0]$

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

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

## Neg

[Neg  $\xrightarrow{\text{proof}}$  Rule tactic]

[Neg  $\xrightarrow{\text{stmt}}$  S  $\vdash \forall \underline{a}: \forall \underline{b}: \neg \underline{b} \Rightarrow \neg \underline{a} \vdash \neg \underline{b} \Rightarrow \underline{a} \vdash \underline{b}$ ]

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

[Neg  $\xrightarrow{\text{pyk}}$  “double negation”]

## MP

[MP  $\xrightarrow{\text{proof}}$  Rule tactic]

[MP  $\xrightarrow{\text{stmt}}$  S  $\vdash \forall \underline{a}: \forall \underline{b}: \underline{a} \Rightarrow \underline{b} \vdash \underline{a} \vdash \underline{b}$ ]

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

[MP  $\xrightarrow{\text{pyk}}$  “rule mp”]

## Gen

[Gen  $\xrightarrow{\text{proof}}$  Rule tactic]

[Gen  $\xrightarrow{\text{stmt}}$   $S \vdash \forall \underline{x}: \forall \underline{a}: \underline{a} \vdash \forall_{\text{obj}} \underline{x}: \underline{a}$ ]

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

[Gen  $\xrightarrow{\text{pyk}}$  “rule gen”]

## Ded

[Ded  $\xrightarrow{\text{proof}}$  Rule tactic]

[Ded  $\xrightarrow{\text{stmt}}$   $S \vdash \forall \underline{a}: \forall \underline{b}: \lambda x. \text{Ded}_0([\underline{a}], [\underline{b}]) \Vdash \underline{a} \vdash \underline{b}$ ]

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

[Ded  $\xrightarrow{\text{pyk}}$  “deduction”]

## S1

[S1  $\xrightarrow{\text{proof}}$  Rule tactic]

[S1  $\xrightarrow{\text{stmt}}$   $S \vdash \forall \underline{a}: \forall \underline{b}: \forall \underline{c}: \underline{a} = \underline{b} \vdash \underline{a} = \underline{c} \vdash \underline{b} = \underline{c}$ ]

[S1  $\xrightarrow{\text{tex}}$  “  
S1”]

[S1  $\xrightarrow{\text{pyk}}$  “axiom s one”]

## S2

[S2  $\xrightarrow{\text{proof}}$  Rule tactic]

[S2  $\xrightarrow{\text{stmt}}$   $S \vdash \forall \underline{a}: \forall \underline{b}: \underline{a} = \underline{b} \vdash \underline{a}' = \underline{b}'$ ]

[S2  $\xrightarrow{\text{tex}}$  “  
S2”]

[S2  $\xrightarrow{\text{pyk}}$  “axiom s two”]

## S3

[S3  $\xrightarrow{\text{proof}}$  Rule tactic]

[S3  $\xrightarrow{\text{stmt}}$   $S \vdash \forall \underline{a}: \neg 0 = \underline{a}'$ ]

[S3  $\xrightarrow{\text{tex}}$  “  
S3”]

[S3  $\xrightarrow{\text{pyk}}$  “axiom s three”]

S4

[S4  $\xrightarrow{\text{proof}}$  Rule tactic]

[S4  $\xrightarrow{\text{stmt}}$   $S \vdash \forall \underline{a}: \forall \underline{b}: \underline{a}' = \underline{b}' \vdash \underline{a} = \underline{b}$ ]

[S4  $\xrightarrow{\text{tex}}$  “  
S4”]

[S4  $\xrightarrow{\text{pyk}}$  “axiom s four”]

S5

[S5  $\xrightarrow{\text{proof}}$  Rule tactic]

[S5  $\xrightarrow{\text{stmt}}$   $S \vdash \forall \underline{a}: \underline{a} + 0 = \underline{a}$ ]

[S5  $\xrightarrow{\text{tex}}$  “  
S5”]

[S5  $\xrightarrow{\text{pyk}}$  “axiom s five”]

S6

[S6  $\xrightarrow{\text{proof}}$  Rule tactic]

[S6  $\xrightarrow{\text{stmt}}$   $S \vdash \forall \underline{a}: \forall \underline{b}: \underline{a} + \underline{b}' = \underline{a} + \underline{b}'$ ]

[S6  $\xrightarrow{\text{tex}}$  “  
S6”]

[S6  $\xrightarrow{\text{pyk}}$  “axiom s six”]

S7

[S7  $\xrightarrow{\text{proof}}$  Rule tactic]

[S7  $\xrightarrow{\text{stmt}}$   $S \vdash \forall \underline{a}: \underline{a} \cdot 0 = 0$ ]

[S7  $\xrightarrow{\text{tex}}$  “  
S7”]

[S7  $\xrightarrow{\text{pyk}}$  “axiom s seven”]

S8

[S8  $\xrightarrow{\text{proof}}$  Rule tactic]

[S8  $\xrightarrow{\text{stmt}}$   $S \vdash \forall \underline{a}: \forall \underline{b}: \underline{a} \cdot \underline{b}' = \underline{a} \cdot \underline{b} + \underline{a}$ ]

[S8  $\xrightarrow{\text{tex}}$  “  
S8”]

[S8  $\xrightarrow{\text{pyk}}$  “axiom s eight”]

S9

[S9  $\xrightarrow{\text{proof}}$  Rule tactic]

[S9  $\xrightarrow{\text{stmt}}$   $S \vdash \forall \underline{x}: \forall \underline{a}: \forall \underline{b}: \forall \underline{c}: \langle [\underline{b}] \equiv^0 [\underline{a}] \mid [\underline{x}] := [0] \rangle \Vdash \langle [\underline{c}] \equiv^0 [\underline{a}] \mid [\underline{x}] := [\underline{x}'] \rangle \Vdash \underline{b} \vdash \underline{a} \Rightarrow \underline{c} \vdash \underline{a}$ ]

[S9  $\xrightarrow{\text{tex}}$  “  
S9”]

[S9  $\xrightarrow{\text{pyk}}$  “axiom s nine”]

Repetition

[Repetition  $\xrightarrow{\text{proof}}$   $\lambda \underline{c}. \lambda \underline{x}. [S \vdash \forall \underline{a}: \underline{a}^I]$ ]

[Repetition  $\xrightarrow{\text{stmt}}$   $S \vdash \forall \underline{a}: \underline{a} \vdash \underline{a}$ ]

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

[Repetition  $\xrightarrow{\text{pyk}}$  “repetition”]

A1'

[A1'  $\xrightarrow{\text{proof}}$   $\lambda \underline{c}. \lambda \underline{x}. \mathcal{P}([S \vdash \forall \underline{a}: \forall \underline{b}: \forall \underline{a}: \forall \underline{b}: \underline{a} \vdash \underline{b} \vdash \text{Repetition} \triangleright \underline{a} \gg \underline{a}; \text{Ded} \triangleright \forall \underline{a}: \forall \underline{b}: \underline{a} \vdash \underline{b} \vdash \underline{a} \gg \underline{a} \Rightarrow \underline{b} \Rightarrow \underline{a}], \rho_0, \underline{c})$ ]

[A1'  $\xrightarrow{\text{stmt}}$  S  $\vdash \forall \underline{a}: \forall \underline{b}: \underline{a} \Rightarrow \underline{b} \Rightarrow \underline{a}$ ]

[A1'  $\xrightarrow{\text{tex}}$  “  
A1”]

[A1'  $\xrightarrow{\text{pyk}}$  “lemma a one”]

A2'

[A2'  $\xrightarrow{\text{proof}}$   $\lambda c. \lambda x. \mathcal{P}([S \vdash \forall \underline{a}: \forall \underline{b}: \forall \underline{c}: \underline{a} \Rightarrow \underline{b} \Rightarrow \underline{c} \vdash \underline{a} \Rightarrow \underline{b} \vdash \underline{a} \vdash \text{MP} \triangleright \underline{a} \Rightarrow \underline{b} \triangleright \underline{a} \gg \underline{b}; \text{MP} \triangleright \underline{a} \Rightarrow \underline{b} \Rightarrow \underline{c} \triangleright \underline{a} \gg \underline{b} \Rightarrow \underline{c}; \text{MP} \triangleright \underline{b} \Rightarrow \underline{c} \triangleright \underline{b} \gg \underline{c}; \text{Ded} \triangleright \forall \underline{a}: \forall \underline{b}: \forall \underline{c}: \underline{a} \Rightarrow \underline{b} \Rightarrow \underline{c} \vdash \underline{a} \Rightarrow \underline{b} \vdash \underline{a} \vdash \underline{c} \gg \underline{a} \Rightarrow \underline{b} \Rightarrow \underline{c} \Rightarrow \underline{a} \Rightarrow \underline{b} \Rightarrow \underline{a} \Rightarrow \underline{c}]$ , p0, c)]

[A2'  $\xrightarrow{\text{stmt}}$  S  $\vdash \forall \underline{a}: \forall \underline{b}: \forall \underline{c}: \underline{a} \Rightarrow \underline{b} \Rightarrow \underline{c} \Rightarrow \underline{a} \Rightarrow \underline{b} \Rightarrow \underline{a} \Rightarrow \underline{c}$ ]

[A2'  $\xrightarrow{\text{tex}}$  “  
A2”]

[A2'  $\xrightarrow{\text{pyk}}$  “lemma a two”]

A4'

[A4'  $\xrightarrow{\text{proof}}$   $\lambda c. \lambda x. \mathcal{P}([S \vdash \bar{x} + \bar{y} = \bar{y} + \bar{x} \vdash \text{Repetition} \triangleright \bar{x} + \bar{y} = \bar{y} + \bar{x} \gg \bar{x} + \bar{y} = \bar{y} + \bar{x}; \text{Ded} \triangleright \bar{x} + \bar{y} = \bar{y} + \bar{x} \vdash \bar{x} + \bar{y} = \bar{y} + \bar{x} \gg \forall_{\text{obj}} \bar{x}: \forall_{\text{obj}} \bar{y}: \bar{x} + \bar{y} = \bar{y} + \bar{x} \Rightarrow 2 + 3 = 3 + 2]$ , p0, c)]

[A4'  $\xrightarrow{\text{stmt}}$  S  $\vdash \forall_{\text{obj}} \bar{x}: \forall_{\text{obj}} \bar{y}: \bar{x} + \bar{y} = \bar{y} + \bar{x} \Rightarrow 2 + 3 = 3 + 2]$

[A4'  $\xrightarrow{\text{tex}}$  “  
A4”]

[A4'  $\xrightarrow{\text{pyk}}$  “lemma a four”]

A5'

[A5'  $\xrightarrow{\text{proof}}$   $\lambda c. \lambda x. \mathcal{P}([S \vdash 2 + 3 = 5 \Rightarrow 2 + 3 + \bar{x} = 5 + \bar{x} \vdash 2 + 3 = 5 \vdash \text{MP} \triangleright 2 + 3 = 5 \Rightarrow 2 + 3 + \bar{x} = 5 + \bar{x} \triangleright 2 + 3 = 5 \gg 2 + 3 + \bar{x} = 5 + \bar{x}; \text{Gen} \triangleright 2 + 3 + \bar{x} = 5 + \bar{x} \gg \forall_{\text{obj}} \bar{x}: 2 + 3 + \bar{x} = 5 + \bar{x}; \text{Ded} \triangleright 2 + 3 = 5 \Rightarrow 2 + 3 + \bar{x} = 5 + \bar{x} \vdash 2 + 3 = 5 \vdash \forall_{\text{obj}} \bar{x}: 2 + 3 + \bar{x} = 5 + \bar{x} \gg \forall_{\text{obj}} \bar{x}: 2 + 3 = 5 \Rightarrow 2 + 3 + \bar{x} = 5 + \bar{x} \Rightarrow 2 + 3 = 5 \Rightarrow \forall_{\text{obj}} \bar{x}: 2 + 3 + \bar{x} = 5 + \bar{x}]$ , p0, c)]

[A5'  $\xrightarrow{\text{stmt}}$  S  $\vdash \forall_{\text{obj}} \bar{x}: 2 + 3 = 5 \Rightarrow 2 + 3 + \bar{x} = 5 + \bar{x} \Rightarrow 2 + 3 = 5 \Rightarrow \forall_{\text{obj}} \bar{x}: 2 + 3 + \bar{x} = 5 + \bar{x}]$

[A5'  $\xrightarrow{\text{tex}}$  “

A5”]

[A5'  $\xrightarrow{\text{pyk}}$  “lemma a five”]

## Prop 3.2a

[Prop 3.2a  $\xrightarrow{\text{proof}}$   $\lambda c. \lambda x. \mathcal{P}([S \vdash \forall \underline{a}: S5 \gg \underline{a} + 0 = \underline{a}; S1 \triangleright \underline{a} + 0 = \underline{a} \triangleright \underline{a} + 0 = \underline{a} \gg \underline{a} = \underline{a}], p_0, c)$ ]

[Prop 3.2a  $\xrightarrow{\text{stmt}}$   $S \vdash \forall \underline{a}: \underline{a} = \underline{a}$ ]

[Prop 3.2a  $\xrightarrow{\text{tex}}$  “  
Prop\ 3.2a”]

[Prop 3.2a  $\xrightarrow{\text{pyk}}$  “prop three two a”]

## Prop 3.2b

[Prop 3.2b  $\xrightarrow{\text{proof}}$   $\lambda c. \lambda x. \mathcal{P}([S \vdash \forall \underline{a}: \forall \underline{b}: \underline{a} = \underline{b} \vdash \text{Prop 3.2a} \gg \underline{a} = \underline{a}; S1 \triangleright \underline{a} = \underline{b} \triangleright \underline{a} = \underline{a} \gg \underline{b} = \underline{a}], p_0, c)$ ]

[Prop 3.2b  $\xrightarrow{\text{stmt}}$   $S \vdash \forall \underline{a}: \forall \underline{b}: \underline{a} = \underline{b} \vdash \underline{b} = \underline{a}$ ]

[Prop 3.2b  $\xrightarrow{\text{tex}}$  “  
Prop\ 3.2b”]

[Prop 3.2b  $\xrightarrow{\text{pyk}}$  “prop three two b”]

## Prop 3.2c

[Prop 3.2c  $\xrightarrow{\text{proof}}$   $\lambda c. \lambda x. \mathcal{P}([S \vdash \forall \underline{a}: \forall \underline{b}: \forall \underline{c}: \underline{a} = \underline{b} \vdash \underline{b} = \underline{c} \vdash \text{Prop 3.2b} \triangleright \underline{a} = \underline{b} \gg \underline{b} = \underline{a}; S1 \triangleright \underline{b} = \underline{a} \triangleright \underline{b} = \underline{c} \gg \underline{a} = \underline{c}], p_0, c)$ ]

[Prop 3.2c  $\xrightarrow{\text{stmt}}$   $S \vdash \forall \underline{a}: \forall \underline{b}: \forall \underline{c}: \underline{a} = \underline{b} \vdash \underline{b} = \underline{c} \vdash \underline{a} = \underline{c}$ ]

[Prop 3.2c  $\xrightarrow{\text{tex}}$  “  
Prop\ 3.2c”]

[Prop 3.2c  $\xrightarrow{\text{pyk}}$  “prop three two c”]

## Prop 3.2d

[Prop 3.2d  $\xrightarrow{\text{proof}}$   $\lambda c. \lambda x. \mathcal{P}([S \vdash \forall \underline{a}: \forall \underline{b}: \forall \underline{c}: \underline{a} = \underline{c} \vdash \underline{b} = \underline{c} \vdash \text{Prop 3.2b} \triangleright \underline{b} = \underline{c} \gg \underline{c} = \underline{b}; \text{Prop 3.2c} \triangleright \underline{a} = \underline{c} \triangleright \underline{c} = \underline{b} \gg \underline{a} = \underline{b}], p_0, c)$ ]

[Prop 3.2d  $\xrightarrow{\text{stmt}}$   $S \vdash \forall \underline{a}: \forall \underline{b}: \forall \underline{c}: \underline{a} = \underline{c} \vdash \underline{b} = \underline{c} \vdash \underline{a} = \underline{b}$ ]

[Prop 3.2d  $\xrightarrow{\text{tex}}$  “  
Prop\ 3.2d”]

[Prop 3.2d  $\xrightarrow{\text{pyk}}$  “prop three two d”]

## Prop 3.2e<sub>1</sub>

[Prop 3.2e<sub>1</sub>  $\xrightarrow{\text{proof}}$   $\lambda c. \lambda x. \mathcal{P}([S \vdash \forall \underline{a}: \forall \underline{b}: \forall \underline{a}': \forall \underline{b}': \underline{a} = \underline{b} \vdash S5 \gg \underline{a} + 0 = \underline{a}; \text{Prop 3.2c} \triangleright \underline{a} + 0 = \underline{a} \triangleright \underline{a} = \underline{b} \gg \underline{a} + 0 = \underline{b}; S5 \gg \underline{b} + 0 = \underline{b}; \text{Prop 3.2d} \triangleright \underline{a} + 0 = \underline{b} \triangleright \underline{b} + 0 = \underline{b} \gg \underline{a} + 0 = \underline{b} + 0; \text{Ded} \triangleright \forall \underline{a}: \forall \underline{b}: \underline{a} = \underline{b} \vdash \underline{a} + 0 = \underline{b} + 0 \gg \underline{a} = \underline{b} \Rightarrow \underline{a} + 0 = \underline{b} + 0], p_0, c)$ ]

[Prop 3.2e<sub>1</sub>  $\xrightarrow{\text{stmt}}$   $S \vdash \forall \underline{a}: \forall \underline{b}: \underline{a} = \underline{b} \Rightarrow \underline{a} + 0 = \underline{b} + 0$ ]

[Prop 3.2e<sub>1</sub>  $\xrightarrow{\text{tex}}$  “  
Prop\ 3.2e.1”]

[Prop 3.2e<sub>1</sub>  $\xrightarrow{\text{pyk}}$  “prop three two e one”]

## Prop 3.2e<sub>2</sub>

[Prop 3.2e<sub>2</sub>  $\xrightarrow{\text{proof}}$   $\lambda c. \lambda x. \mathcal{P}([S \vdash \forall \underline{a}: \forall \underline{b}: \forall \underline{c}: \forall \underline{a}': \forall \underline{b}': \forall \underline{c}': \underline{a} = \underline{b} \Rightarrow \underline{a} + \underline{c} = \underline{b} + \underline{c} \vdash \underline{a} = \underline{b} \vdash \text{MP} \triangleright \underline{a} = \underline{b} \Rightarrow \underline{a} + \underline{c} = \underline{b} + \underline{c} \triangleright \underline{a} = \underline{b} \gg \underline{a} + \underline{c} = \underline{b} + \underline{c}; S2 \triangleright \underline{a} + \underline{c} = \underline{b} + \underline{c} \gg \underline{a} + \underline{c}' = \underline{b} + \underline{c}'; S6 \gg \underline{a} + \underline{c}' = \underline{a} + \underline{c}'; \text{Prop 3.2c} \triangleright \underline{a} + \underline{c}' = \underline{a} + \underline{c}' \triangleright \underline{a} + \underline{c}' = \underline{b} + \underline{c}' \gg \underline{a} + \underline{c}' = \underline{b} + \underline{c}'; S6 \gg \underline{b} + \underline{c}' = \underline{b} + \underline{c}'; \text{Prop 3.2d} \triangleright \underline{a} + \underline{c}' = \underline{b} + \underline{c}' \triangleright \underline{b} + \underline{c}' = \underline{b} + \underline{c}' \gg \underline{a} + \underline{c}' = \underline{b} + \underline{c}'; \text{Ded} \triangleright \forall \underline{a}: \forall \underline{b}: \forall \underline{c}: \underline{a} = \underline{b} \Rightarrow \underline{a} + \underline{c} = \underline{b} + \underline{c} \vdash \underline{a} = \underline{b} \vdash \underline{a} + \underline{c}' = \underline{b} + \underline{c}' \gg \underline{a} = \underline{b} \Rightarrow \underline{a} + \underline{c} = \underline{b} + \underline{c} \Rightarrow \underline{a} = \underline{b} \Rightarrow \underline{a} + \underline{c}' = \underline{b} + \underline{c}'], p_0, c)$ ]

[Prop 3.2e<sub>2</sub>  $\xrightarrow{\text{stmt}}$   $S \vdash \forall \underline{a}: \forall \underline{b}: \forall \underline{c}: \underline{a} = \underline{b} \Rightarrow \underline{a} + \underline{c} = \underline{b} + \underline{c} \Rightarrow \underline{a} = \underline{b} \Rightarrow \underline{a} + \underline{c}' = \underline{b} + \underline{c}'$ ]

[Prop 3.2e<sub>2</sub>  $\xrightarrow{\text{tex}}$  “  
Prop\ 3.2e.2”]

[Prop 3.2e<sub>2</sub>  $\xrightarrow{\text{pyk}}$  “prop three two e two”]

## Prop 3.2e

[Prop 3.2e  $\xrightarrow{\text{proof}}$   $\lambda c. \lambda x. \mathcal{P}(\lceil S \vdash \forall \underline{a}: \forall \underline{b}: \forall \underline{c}: \underline{a} = \underline{b} \vdash \text{Prop 3.2e}_1 \gg \bar{x} = \bar{y} \Rightarrow \bar{x} + 0 = \bar{y} + 0; \text{Prop 3.2e}_2 \gg \bar{x} = \bar{y} \Rightarrow \bar{x} + \bar{z} = \bar{y} + \bar{z} \Rightarrow \bar{x} = \bar{y} \Rightarrow \bar{x} + \bar{z}' = \bar{y} + \bar{z}'; \text{S9} @ \bar{z} \triangleright \bar{x} = \bar{y} \Rightarrow \bar{x} + 0 = \bar{y} + 0 \triangleright \bar{x} = \bar{y} \Rightarrow \bar{x} + \bar{z} = \bar{y} + \bar{z} \Rightarrow \bar{x} = \bar{y} \Rightarrow \bar{x} + \bar{z}' = \bar{y} + \bar{z}' \gg \bar{x} = \bar{y} \Rightarrow \bar{x} + \bar{z} = \bar{y} + \bar{z}; \text{Ded} \triangleright \bar{x} = \bar{y} \Rightarrow \bar{x} + \bar{z} = \bar{y} + \bar{z} \gg \underline{a} = \underline{b} \Rightarrow \underline{a} + \underline{c} = \underline{b} + \underline{c}; \text{MP} \triangleright \underline{a} = \underline{b} \Rightarrow \underline{a} + \underline{c} = \underline{b} + \underline{c} \triangleright \underline{a} = \underline{b} \gg \underline{a} + \underline{c} = \underline{b} + \underline{c} \rceil, p_0, c)$ ]

[Prop 3.2e  $\xrightarrow{\text{stmt}}$   $S \vdash \forall \underline{a}: \forall \underline{b}: \forall \underline{c}: \underline{a} = \underline{b} \vdash \underline{a} + \underline{c} = \underline{b} + \underline{c}$ ]

[Prop 3.2e  $\xrightarrow{\text{tex}}$  “  
Prop\ 3.2e”]

[Prop 3.2e  $\xrightarrow{\text{pyk}}$  “prop three two e”]

## Prop 3.2f<sub>1</sub>

[Prop 3.2f<sub>1</sub>  $\xrightarrow{\text{proof}}$   $\lambda c. \lambda x. \mathcal{P}(\lceil S \vdash \text{S5} \gg 0 + 0 = 0; \text{Prop 3.2b} \triangleright 0 + 0 = 0 \gg 0 = 0 + 0 \rceil, p_0, c)$ ]

[Prop 3.2f<sub>1</sub>  $\xrightarrow{\text{stmt}}$   $S \vdash 0 = 0 + 0$ ]

[Prop 3.2f<sub>1</sub>  $\xrightarrow{\text{tex}}$  “  
Prop\ 3.2f\_1”]

[Prop 3.2f<sub>1</sub>  $\xrightarrow{\text{pyk}}$  “prop three two f one”]

## Prop 3.2f<sub>2</sub>

[Prop 3.2f<sub>2</sub>  $\xrightarrow{\text{proof}}$   $\lambda c. \lambda x. \mathcal{P}(\lceil S \vdash \forall \underline{a}: \forall \underline{a}': \underline{a} = 0 + \underline{a} \vdash \text{S2} \triangleright \underline{a} = 0 + \underline{a} \gg \underline{a}' = 0 + \underline{a}'; \text{S6} \gg 0 + \underline{a}' = 0 + \underline{a}'; \text{Prop 3.2d} \triangleright \underline{a}' = 0 + \underline{a}' \triangleright 0 + \underline{a}' = 0 + \underline{a}' \gg \underline{a}' = 0 + \underline{a}'; \text{Ded} \triangleright \forall \underline{a}: \underline{a} = 0 + \underline{a} \vdash \underline{a}' = 0 + \underline{a}' \gg \underline{a} = 0 + \underline{a} \Rightarrow \underline{a}' = 0 + \underline{a}' \rceil, p_0, c)$ ]

[Prop 3.2f<sub>2</sub>  $\xrightarrow{\text{stmt}}$   $S \vdash \forall \underline{a}: \underline{a} = 0 + \underline{a} \Rightarrow \underline{a}' = 0 + \underline{a}'$ ]

[Prop 3.2f<sub>2</sub>  $\xrightarrow{\text{tex}}$  “  
Prop\ 3.2f\_2”]

[Prop 3.2f<sub>2</sub>  $\xrightarrow{\text{pyk}}$  “prop three two f two”]

## Prop 3.2f

[Prop 3.2f  $\xrightarrow{\text{proof}}$   $\lambda c. \lambda x. \mathcal{P}(\lceil S \vdash \forall \underline{a}: \text{Prop 3.2f}_1 \gg 0 = 0 + 0; \text{Prop 3.2f}_2 \gg \bar{x} = 0 + \bar{x} \Rightarrow \bar{x}' = 0 + \bar{x}'; \text{S9} @ \bar{x} \triangleright 0 = 0 + 0 \triangleright \bar{x} = 0 + \bar{x} \Rightarrow \bar{x}' = 0 + \bar{x}' \gg \bar{x} =$

$0 + \bar{x}; \text{Ded} \triangleright \bar{x} = 0 + \bar{x} \gg \underline{a} = 0 + \underline{a}], p_0, c)]$

$[\text{Prop } 3.2f \xrightarrow{\text{stmt}} S \vdash \forall \underline{a}: \underline{a} = 0 + \underline{a}]$

$[\text{Prop } 3.2f \xrightarrow{\text{tex}} \text{“}$   
 $\text{Prop} \setminus 3.2f\text{”}]$

$[\text{Prop } 3.2f \xrightarrow{\text{pyk}} \text{“prop three two f”}]$

## Prop 3.2g<sub>1</sub>

$[\text{Prop } 3.2g_1 \xrightarrow{\text{proof}} \lambda c. \lambda x. \mathcal{P}([S \vdash \forall \underline{a}: S5 \gg \underline{a}' + 0 = \underline{a}'; S5 \gg \underline{a} + 0 = \underline{a}; S2 \triangleright \underline{a} + 0 = \underline{a} \gg \underline{a} + 0' = \underline{a}'; \text{Prop } 3.2d \triangleright \underline{a}' + 0 = \underline{a}' \triangleright \underline{a} + 0' = \underline{a}' \gg \underline{a}' + 0 = \underline{a} + 0'], p_0, c)]$

$[\text{Prop } 3.2g_1 \xrightarrow{\text{stmt}} S \vdash \forall \underline{a}: \underline{a}' + 0 = \underline{a} + 0']$

$[\text{Prop } 3.2g_1 \xrightarrow{\text{tex}} \text{“}$   
 $\text{Prop} \setminus 3.2g_1\text{”}]$

$[\text{Prop } 3.2g_1 \xrightarrow{\text{pyk}} \text{“prop three two g one”}]$

## Prop 3.2g<sub>2</sub>

$[\text{Prop } 3.2g_2 \xrightarrow{\text{proof}} \lambda c. \lambda x. \mathcal{P}([S \vdash \forall \underline{a}: \forall \underline{b}: \forall \underline{a}': \forall \underline{b}': \underline{a}' + \underline{b} = \underline{a} + \underline{b}' \vdash S2 \triangleright \underline{a}' + \underline{b} = \underline{a} + \underline{b}' \gg \underline{a}' + \underline{b}' = \underline{a} + \underline{b}''; S6 \gg \underline{a}' + \underline{b}' = \underline{a}' + \underline{b}''; \text{Prop } 3.2c \triangleright \underline{a}' + \underline{b}' = \underline{a}' + \underline{b}' \triangleright \underline{a}' + \underline{b}' = \underline{a} + \underline{b}'' \gg \underline{a}' + \underline{b}' = \underline{a} + \underline{b}''; S6 \gg \underline{a} + \underline{b}' = \underline{a} + \underline{b}''; S2 \triangleright \underline{a} + \underline{b}' = \underline{a} + \underline{b}' \gg \underline{a} + \underline{b}'' = \underline{a} + \underline{b}''; \text{Prop } 3.2d \triangleright \underline{a}' + \underline{b}' = \underline{a} + \underline{b}'' \triangleright \underline{a} + \underline{b}'' = \underline{a} + \underline{b}'' \gg \underline{a}' + \underline{b}' = \underline{a} + \underline{b}''; \text{Ded} \triangleright \forall \underline{a}: \forall \underline{b}: \underline{a}' + \underline{b} = \underline{a} + \underline{b}' \vdash \underline{a}' + \underline{b}' = \underline{a} + \underline{b}'' \gg \underline{a}' + \underline{b} = \underline{a} + \underline{b}' \Rightarrow \underline{a}' + \underline{b}' = \underline{a} + \underline{b}''], p_0, c)]$

$[\text{Prop } 3.2g_2 \xrightarrow{\text{stmt}} S \vdash \forall \underline{a}: \forall \underline{b}: \underline{a}' + \underline{b} = \underline{a} + \underline{b}' \Rightarrow \underline{a}' + \underline{b}' = \underline{a} + \underline{b}'']$

$[\text{Prop } 3.2g_2 \xrightarrow{\text{tex}} \text{“}$   
 $\text{Prop} \setminus 3.2g_2\text{”}]$

$[\text{Prop } 3.2g_2 \xrightarrow{\text{pyk}} \text{“prop three two g two”}]$

## Prop 3.2g

$[\text{Prop } 3.2g \xrightarrow{\text{proof}} \lambda c. \lambda x. \mathcal{P}([S \vdash \forall \underline{a}: \forall \underline{b}: \text{Prop } 3.2g_1 \gg \bar{x}' + 0 = \bar{x} + 0'; \text{Prop } 3.2g_2 \gg \bar{x}' + \bar{y} = \bar{x} + \bar{y}' \Rightarrow \bar{x}' + \bar{y}' = \bar{x} + \bar{y}''; S9 @ \bar{y} \triangleright \bar{x}' + 0 = \bar{x} + 0' \triangleright \bar{x}' + \bar{y} = \bar{x} + \bar{y}' \Rightarrow \bar{x}' + \bar{y}' = \bar{x} + \bar{y}'' \gg \bar{x}' + \bar{y} = \bar{x} + \bar{y}''; \text{Ded} \triangleright \bar{x}' + \bar{y} = \bar{x} + \bar{y}' \gg \underline{a}' + \underline{b} = \underline{a} + \underline{b}'], p_0, c)]$

$[\text{Prop } 3.2g \xrightarrow{\text{stmt}} S \vdash \forall \underline{a}: \forall \underline{b}: \underline{a}' + \underline{b} = \underline{a} + \underline{b}']$

[Prop 3.2g  $\xrightarrow{\text{tex}}$  “  
Prop\ 3.2g”]

[Prop 3.2g  $\xrightarrow{\text{pyk}}$  “prop three two g”]

## Prop 3.2h<sub>1</sub>

[Prop 3.2h<sub>1</sub>  $\xrightarrow{\text{proof}}$   $\lambda c. \lambda x. \mathcal{P}([S \vdash \forall \underline{a}: S5 \gg \underline{a} + 0 = \underline{a}; \text{Prop 3.2f} \gg \underline{a} = 0 + \underline{a}; \text{Prop 3.2c} \triangleright \underline{a} + 0 = \underline{a} \triangleright \underline{a} = 0 + \underline{a} \gg \underline{a} + 0 = 0 + \underline{a}], p_0, c)$ ]

[Prop 3.2h<sub>1</sub>  $\xrightarrow{\text{stmt}}$   $S \vdash \forall \underline{a}: \underline{a} + 0 = 0 + \underline{a}$ ]

[Prop 3.2h<sub>1</sub>  $\xrightarrow{\text{tex}}$  “  
Prop\ 3.2h.1”]

[Prop 3.2h<sub>1</sub>  $\xrightarrow{\text{pyk}}$  “prop three two h one”]

## Prop 3.2h<sub>2</sub>

[Prop 3.2h<sub>2</sub>  $\xrightarrow{\text{proof}}$   $\lambda c. \lambda x. \mathcal{P}([S \vdash \forall \underline{a}: \forall \underline{b}: \forall \underline{a}: \forall \underline{b}: \underline{a} + \underline{b} = \underline{b} + \underline{a} \vdash S2 \triangleright \underline{a} + \underline{b} = \underline{b} + \underline{a} \gg \underline{a} + \underline{b}' = \underline{b} + \underline{a}'; S6 \gg \underline{a} + \underline{b}' = \underline{a} + \underline{b}'; \text{Prop 3.2c} \triangleright \underline{a} + \underline{b}' = \underline{a} + \underline{b}' \triangleright \underline{a} + \underline{b}' = \underline{b} + \underline{a}' \gg \underline{a} + \underline{b}' = \underline{b} + \underline{a}'; \text{Prop 3.2g} \gg \underline{b}' + \underline{a} = \underline{b} + \underline{a}'; \text{Prop 3.2d} \triangleright \underline{a} + \underline{b}' = \underline{b} + \underline{a}' \triangleright \underline{b}' + \underline{a} = \underline{b} + \underline{a}' \gg \underline{a} + \underline{b}' = \underline{b}' + \underline{a}; \text{Ded} \triangleright \forall \underline{a}: \forall \underline{b}: \underline{a} + \underline{b} = \underline{b} + \underline{a} \vdash \underline{a} + \underline{b}' = \underline{b}' + \underline{a} \gg \underline{a} + \underline{b} = \underline{b} + \underline{a} \Rightarrow \underline{a} + \underline{b}' = \underline{b}' + \underline{a}], p_0, c)$ ]

[Prop 3.2h<sub>2</sub>  $\xrightarrow{\text{stmt}}$   $S \vdash \forall \underline{a}: \forall \underline{b}: \underline{a} + \underline{b} = \underline{b} + \underline{a} \Rightarrow \underline{a} + \underline{b}' = \underline{b}' + \underline{a}$ ]

[Prop 3.2h<sub>2</sub>  $\xrightarrow{\text{tex}}$  “  
Prop\ 3.2h.2”]

[Prop 3.2h<sub>2</sub>  $\xrightarrow{\text{pyk}}$  “prop three two h two”]

## Prop 3.2h

[Prop 3.2h  $\xrightarrow{\text{proof}}$   $\lambda c. \lambda x. \mathcal{P}([S \vdash \forall \underline{a}: \forall \underline{b}: \text{Prop 3.2h}_1 \gg \bar{x} + 0 = 0 + \bar{x}; \text{Prop 3.2h}_2 \gg \bar{x} + \bar{y} = \bar{y} + \bar{x} \Rightarrow \bar{x} + \bar{y}' = \bar{y}' + \bar{x}; S9 @ \bar{y} \triangleright \bar{x} + 0 = 0 + \bar{x} \triangleright \bar{x} + \bar{y} = \bar{y} + \bar{x} \Rightarrow \bar{x} + \bar{y}' = \bar{y}' + \bar{x} \gg \bar{x} + \bar{y} = \bar{y} + \bar{x}; \text{Ded} \triangleright \bar{x} + \bar{y} = \bar{y} + \bar{x} \gg \underline{a} + \underline{b} = \underline{b} + \underline{a}], p_0, c)$ ]

[Prop 3.2h  $\xrightarrow{\text{stmt}}$   $S \vdash \forall \underline{a}: \forall \underline{b}: \underline{a} + \underline{b} = \underline{b} + \underline{a}$ ]

[Prop 3.2h  $\xrightarrow{\text{tex}}$  “  
Prop\ 3.2h”]

[Prop 3.2h  $\xrightarrow{\text{pyk}}$  “prop three two h”]

## Block<sub>1</sub>(\* , \* , \*)

[Block<sub>1</sub>(t, s, c)  $\xrightarrow{\text{val}}$  t!s!c!let<sub>1</sub>(λb.let<sub>1</sub>(λx.let<sub>1</sub>(λq.let<sub>1</sub>(λq.  $\tilde{Q}$ (t, [b; q], [b] :: b :: [q] :: q :: T),  $\tilde{M}$ (q, s, c)),  $\tilde{Q}$ (t, [let l ≐ x in p], [l] :: t<sup>2</sup> :: [p] :: t<sup>3</sup> :: [x] :: x :: T)), Block<sub>2</sub>(b)),  $\mathcal{M}$ (t<sup>1</sup>, s, c)]

[Block<sub>1</sub>(t, s, c)  $\xrightarrow{\text{tex}}$  “  
Block\_1(#1.  
, #2.  
, #3.  
)”]

[Block<sub>1</sub>(\* , \* , \*)  $\xrightarrow{\text{pyk}}$  “block one " state " cache " end block”]

## Block<sub>2</sub>(\* )

[Block<sub>2</sub>(b)  $\xrightarrow{\text{val}}$  If(b  $\stackrel{r}{=} [x \vdash y]$ ,  $\tilde{Q}$ (b, [x ⊢ y], [x] :: b<sup>1</sup> :: [y] :: Block<sub>2</sub>(b<sup>2</sup>) :: T),  
If(b  $\stackrel{r}{=} [x \Vdash y]$ ,  $\tilde{Q}$ (b, [x ⊢ y], [x] :: b<sup>1</sup> :: [y] :: Block<sub>2</sub>(b<sup>2</sup>) :: T), If(b  $\stackrel{r}{=} [\forall x: y]$ ,  
 $\tilde{Q}$ (b, [∀x: y], [x] :: b<sup>1</sup> :: [y] :: Block<sub>2</sub>(b<sup>2</sup>) :: T), If(b  $\stackrel{r}{=} [x; y]$ , Block<sub>2</sub>(b<sup>2</sup>),  
If(b  $\stackrel{r}{=} [x \gg y]$ , b<sup>2</sup>, ⊥)))]

[Block<sub>2</sub>(b)  $\xrightarrow{\text{tex}}$  “  
Block\_2(#1.  
)”]

[Block<sub>2</sub>(\* )  $\xrightarrow{\text{pyk}}$  “block two " end block”]

\*hide

Predef: hide

[x<sup>hide</sup>  $\xrightarrow{\text{tex}}$  “#1.  
{ } ^ {hide}”]

[\*<sup>hide</sup>  $\xrightarrow{\text{pyk}}$  “" hide”]

## MacroIndent(\* )

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

[MacroIndent(x)  $\xrightarrow{\text{macro}}$  λt.λs.λc.  $\tilde{M}_4$ (t, s, c, [[MacroIndent(x) ≐ x]])]

$[\text{MacroIndent}(x) \xrightarrow{\text{tex}} “$   
 $\$%$   
 $\backslash\text{leftskip}=1em%$   
 $\$#1.”]$

$[\text{MacroIndent}(*) \xrightarrow{\text{pyk}} “\text{macro indent } ”]$

$*'$

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

$[*' \xrightarrow{\text{pyk}} “\text{ suc}”]$

$* = *$

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

$[* = * \xrightarrow{\text{pyk}} “\text{ equal } ”]$

$* \neq *$

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

$[* \neq * \xrightarrow{\text{pyk}} “\text{ unequal } ”]$

$*\text{var}$

$[x^{\text{var}} \xrightarrow{\text{val}} x \stackrel{r}{=} [\bar{x}]$

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

$[*^{\text{var}} \xrightarrow{\text{pyk}} “\text{ is object var}”]$

$*\#^0*$

$[x\#^0y \xrightarrow{\text{val}} \lambda c. x^{\text{var}} \wedge y^c \wedge x\#^1y]$

[x#<sup>0</sup>y  $\xrightarrow{\text{tex}}$  “#1.  
\#. ^0#2.”]

[\*#<sup>0</sup>\*  $\xrightarrow{\text{pyk}}$  “" avoid zero ""]

\*#<sup>1</sup>\*

[x#<sup>1</sup>y  $\xrightarrow{\text{val}}$  If(y<sup>var</sup>,  $\neg x \stackrel{t}{=} y$ ,  
If( $\neg y \stackrel{r}{=} [\forall_{\text{obj}} x: y]$ , x#\*y<sup>t</sup>,  
If(x  $\stackrel{t}{=} y^1$ , T, x#<sup>1</sup>y<sup>2</sup>)))]

[x#<sup>1</sup>y  $\xrightarrow{\text{tex}}$  “#1.  
\#. ^1#2.”]

[\*#<sup>1</sup>\*  $\xrightarrow{\text{pyk}}$  “" avoid one ""]

\*#\*<sup>\*</sup>\*

[x#\*y  $\xrightarrow{\text{val}}$  x!If(y, T, If(x#<sup>1</sup>y<sup>h</sup>, x#\*y<sup>t</sup>, F))]

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

[\*#\*<sup>\*</sup>\*  $\xrightarrow{\text{pyk}}$  “" avoid star ""]

∃\*: \*

[∃x: y  $\xrightarrow{\text{tex}}$  “  
\exists exists #1.  
\colon #2.”]

[∃\*: \*  $\xrightarrow{\text{pyk}}$  “exist " indeed ""]

∀\*: \*

[∀x: y  $\xrightarrow{\text{macro}}$  lt.ls.lc.  $\tilde{\mathcal{M}}$ (If( $\neg t^1 \stackrel{r}{=} [x, y]$ ,  $\tilde{\mathcal{Q}}(t, [\forall_{\text{obj}} x: y], [x] :: t^1 :: [y] :: t^2 :: T)$ ,  
 $\tilde{\mathcal{Q}}(t, [\forall_{\text{obj}} x: \forall y: z], [x] :: t^{11} :: [y] :: t^{12} :: [z] :: t^2 :: T)$ ), s, c)]

[∀x: y  $\xrightarrow{\text{tex}}$  “  
\forall forall #1.  
\colon #2.”]

[∀\*: \*  $\xrightarrow{\text{pyk}}$  “for all " indeed ""]

$\forall_{\text{obj}} * : *$

$[\forall_{\text{obj}} x : y \xrightarrow{\text{tex}} \text{"\#1.} \\ \backslash \text{forall\_}\{\text{obj}\} \text{\#1.} \\ \backslash \text{colon \#2.}"]$

$[\forall_{\text{obj}} * : * \xrightarrow{\text{pyk}} \text{"for all objects " indeed "}]$

$* \Rightarrow *$

$[x \Rightarrow y \xrightarrow{\text{tex}} \text{"\#1.} \\ \backslash \text{Rightarrow \#2.}"]$

$[* \Rightarrow * \xrightarrow{\text{pyk}} \text{" imply "}]$

$* \Leftrightarrow *$

$[x \Leftrightarrow y \xrightarrow{\text{tex}} \text{"\#1.} \\ \backslash \text{Leftrightarrow \#2.}"]$

$[* \Leftrightarrow * \xrightarrow{\text{pyk}} \text{" if and only if "}]$

$* \# *$

$[x \# y \xrightarrow{\text{macro}} \lambda t. \lambda s. \lambda c. \tilde{\mathcal{M}}_4(t, s, c, [[x \# y \doteq [x] \#^0 [y]])]]$

$[x \# y \xrightarrow{\text{tex}} \text{"\#1.} \\ \backslash \text{\#.\#2.}"]$

$[* \# * \xrightarrow{\text{pyk}} \text{" avoid "}]$

$* \triangleright *$

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

$[x \triangleright y \xrightarrow{\text{tex}} \text{"\#1.} \\ \backslash \text{unrhd \#2.}"]$

$[* \triangleright * \xrightarrow{\text{pyk}} \text{" object modus ponens "}]$

$\Pi * : *$

$[\Pi x: y \xrightarrow{\text{macro}} \lambda t. \lambda s. \lambda c. \tilde{M}(\text{If}(\neg t^1 \stackrel{r}{=} [x, y], \tilde{Q}(t, [\forall x: y], [x] :: t^1 :: [y] :: t^2 :: T), \tilde{Q}(t, [\forall x: \Pi y: z], [x] :: t^{11} :: [y] :: t^{12} :: [z] :: t^2 :: T)), s, c)]$

$[\Pi x: y \xrightarrow{\text{tex}} “$   
 $\backslash \text{Pi} \#1.$   
 $\backslash \text{colon} \#2.”]$

$[\Pi * : * \xrightarrow{\text{pyk}} “\text{for all terms " indeed " ”]$

**Begin \* ; \* : End ; \***

$[\text{Begin } b; l : \text{End}; p \xrightarrow{\text{name}} “$   
 $\text{Begin } \backslash, \#1.$   
 $; \#2.$   
 $: \text{End}; \#3.”]$

$[\text{Begin } b; l : \text{End}; p \xrightarrow{\text{macro}} \lambda t. \lambda s. \lambda c. \text{Block}_1(t, s, c)]$

$[\text{Begin } b; l : \text{End}; p \xrightarrow{\text{tex}} “$   
 $\backslash \text{newline} \backslash \text{makebox} [0.1 \backslash \text{textwidth}] \{ \} \%$   
 $\backslash \text{parbox} [b] \{ 0.4 \backslash \text{textwidth} \} \{ \backslash \text{raggedright}$   
 $\backslash \text{setlength} \{ \backslash \text{parindent} \} \{ -0.1 \backslash \text{textwidth} \} \%$   
 $\backslash \text{makebox} [0.1 \backslash \text{textwidth} ] [l] \{ \$$   
 $\backslash \text{if} \backslash \text{relax} \backslash \text{csname} \text{lgwproofline} \backslash \text{endcsname} L_? \backslash \text{else}$   
 $\backslash \text{global} \backslash \text{advance} \backslash \text{lgwproofline} \text{ by } 1$   
 $L \backslash \text{ifnum} \backslash \text{lgwproofline} < 10 0 \backslash \text{fi} \backslash \text{number} \backslash \text{lgwproofline}$   
 $\backslash \text{fi}$   
 $\$: \} \$ \text{Block} \{ \} \backslash \text{gg} \{ \} \$ \} \backslash \text{quad}$   
 $\backslash \text{parbox} [t] \{ 0.4 \backslash \text{textwidth} \} \{ \$ \text{Begin}$   
 $\$ \backslash \text{hfill} \backslash \text{makebox} [0 \text{mm}] [l] \{ \backslash \text{quad} ; \} \} \#1.$   
 $\backslash \text{newline} \backslash \text{makebox} [0.1 \backslash \text{textwidth}] \{ \} \%$   
 $\backslash \text{parbox} [b] \{ 0.4 \backslash \text{textwidth} \} \{ \backslash \text{raggedright}$   
 $\backslash \text{setlength} \{ \backslash \text{parindent} \} \{ -0.1 \backslash \text{textwidth} \} \%$   
 $\backslash \text{makebox} [0.1 \backslash \text{textwidth} ] [l] \{ \$ \#2.$   
 $\$: \} \$ \text{Block} \{ \} \backslash \text{gg} \{ \} \$ \} \backslash \text{quad}$   
 $\backslash \text{parbox} [t] \{ 0.4 \backslash \text{textwidth} \} \{ \$ \text{End}$   
 $\$ \backslash \text{hfill} \backslash \text{makebox} [0 \text{mm}] [l] \{ \backslash \text{quad} ; \} \} \#3.”]$   
 $[\text{Begin } * ; * : \text{End}; * \xrightarrow{\text{pyk}} “\text{block " line " end block " ”]$

Last block line \*  $\gg$  \* ;

```
[Last block line a  $\gg$  i ;  $\xrightarrow{\text{name}}$  “  
Last\ block\ line \, #1.  
\gg #2.  
\,;”]
```

```
[Last block line a  $\gg$  i ;  $\xrightarrow{\text{macro}}$  \t.\s.\c.\tilde{\mathcal{M}}_4(t,s,c, [[Last block line a  $\gg$  i ;  $\doteq$  (a  $\gg$   
i)])]
```

```
[Last block line a  $\gg$  i ;  $\xrightarrow{\text{tex}}$  “  
\newline \makebox [0.1\textwidth]{}%  
\parbox [b]{0.4\textwidth }{\raggedright  
\setlength {\parindent }{-0.1\textwidth }%  
\makebox [0.1\textwidth ][l]{$  
\if \relax \csname lgwprooflinep\endcsname L_? \else  
\global \advance \lgwproofline by 1  
L\ifnum \lgwproofline <10 0\fi \number \lgwproofline  
\fi  
$:}$#1.  
{ }\gg { }$}\quad  
\parbox [t]{0.4\textwidth }{ $#2.  
$\hfill \makebox [0mm][l]{\quad ; }”]
```

```
[Last block line *  $\gg$  * ;  $\xrightarrow{\text{pyk}}$  “because " indeed " end line”]
```

Arbitrary  $\gg$  \* ; \*

```
[Arbitrary  $\gg$  i ; p  $\xrightarrow{\text{name}}$  “  
Arbitrary \gg #1.  
; #2.”]
```

```
[Arbitrary  $\gg$  i ; p  $\xrightarrow{\text{macro}}$  \t.\s.\c.\tilde{\mathcal{M}}_4(t,s,c, [[Arbitrary  $\gg$  i ; p  $\doteq$   $\Pi$ i: p]])]
```

```
[Arbitrary  $\gg$  i ; p  $\xrightarrow{\text{tex}}$  “  
\newline \makebox [0.1\textwidth ][l]{$  
\if \relax \csname lgwprooflinep\endcsname L_? \else  
\global \advance \lgwproofline by 1  
L\ifnum \lgwproofline <10 0\fi \number \lgwproofline  
\fi  
$:}\makebox [0.4\textwidth ][l]{$Arbitrary}\gg{ }$}\quad  
\parbox [t]{0.4\textwidth }{ $#1.  
$\hfill \makebox [0mm][l]{\quad ; }#2.”]
```

```
[Arbitrary  $\gg$  * ; *  $\xrightarrow{\text{pyk}}$  “any term " end line ”]
```

\* | \*

[x | y  $\xrightarrow{\text{tex}}$  "#1.  
\mathrel{} #2.]

[\* | \*  $\xrightarrow{\text{pyk}}$  "# alternative "]

→

[→  $\xrightarrow{\text{tex}}$  "  
\rightarrow "]

[→  $\xrightarrow{\text{pyk}}$  "evaluates to"]

\* \ \ \*

[x \ \ y  $\xrightarrow{\text{name}}$  "#1.  
\backslash \backslash #2.]

[x \ \ y  $\xrightarrow{\text{tex}}$  "#1.  
\{\} #2.]

[\* \ \ \*  $\xrightarrow{\text{pyk}}$  "# safe row "]

*The pyk compiler, version 0.grue.20060417+ by Klaus Grue  
GRD-2006-06-16.UTC:14:58:03.474266 = MJD-53902.TAI:14:58:36.474266 =  
LGT-4657186716474266e-6*