(IF-
TRUE)
$if TRUE then v_1 else v_2 \to$
v_1
(IF-
FALSE)
$if FALSE then v_1 else v_2 \to$
v_2
$M_2 \to$
M_2'
(THEN)
$if v_1 then M_2 else M_3 \to$
$if v_1 then M_2' else M_3$
$M_3 \to$
M_3'
(ELSE)
$if v_1 then v_2 else M_3 \to$
$if v_1 then v_2 else M_3'$
$M \to$
$M \to$
$\Rightarrow$
$\Rightarrow$
$\Rightarrow$
$\Rightarrow$
$\Rightarrow$
$M =$
M_1+
$M_2 \to$
M', M_1+
$M_2 \to$
$M_1 \to$
M_1'
$M_1 \to$
M_1''
$M_1' =$
M_1''
$M_2 \to$
M_2'
$M_2 \to$
M_2''
$M_2' =$
M_2''
$M_1 \to$
M_1'
(SUM-
LEFT)
M_1+
$M_2 \to$
$M_1'+$
$M_2 =$
M'
$M_1' =$
M_1''
$M' =$
M''
$M_2 \to$
M_2'
(SUM-
RIGHT)
v_1+
$M_2 \to$
v_1+
$M_2' =$
M'
$M_2' =$
M_2''
$M' =$
M''
n_1+
n_2
(SUM)
n_1+
$n_2 \to$
n'
$M =$
M_1-
$M_2 \to$
M', M_1-
$M_2 \to$
$M_1 \to$
M_1'
$M_1 \to$
M_1''
$M_1' =$
M_1''
$M_2 \to$
M_2'
$M_2 \to$
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$\emptyset \vdash$
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$\emptyset \vdash$
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$\emptyset \vdash$
(TRUE)
$\emptyset \quad \vdash$
(NAT)
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(IF-THEN-
ELSE)
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$\emptyset \vdash$
$\in$(VAR)
$\vdash$(FUN)
$\emptyset \vdash \rightarrow$

$\emptyset \vdash$
$\in$(VAR)
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$\emptyset \quad \vdash$
/rightarrow
(TRUE)
$\emptyset \quad \vdash$
(APP)
$\emptyset \vdash$

$\rightarrow$
$\vdash$
Γ
$\rightarrow \in \Gamma$(VAR)
$\Gamma \vdash \rightarrow$(FALSE)
$\Gamma \vdash$(TRUE)
$\Gamma \vdash$(FALSE)
$\Gamma \vdash$(IF-
THEN-
ELSE)
$\Gamma \vdash$(APP)
$\Gamma \vdash$

$\rightarrow$
$\vdash$
Γ
$\rightarrow \in \Gamma$(VAR)
$\Gamma \vdash \rightarrow$(FUN)
$\Gamma \vdash \ \rightarrow$
$\rightarrow \in \Gamma$(VAR)
$\Gamma \vdash$(TRUE)
$\Gamma \vdash$(FALSE)
$\Gamma \vdash$(IF-
THEN-
ELSE)
$\Gamma \vdash \rightarrow$(APP)
$\Gamma \vdash \rightarrow$

(PAIR-NOT-EVAL 1)
$\xrightarrow{1}_{2}$
(PAIR-NOT-EVAL 2)
$\xrightarrow{2}_{1}$
$\overline{*}$
$\overline{+}$
Termine 1: (4 − 1, if true then false else false).1
(MINUS)
$\rightarrow$
(EVAL PAIR 1)
$\rightarrow$
(PROJECT 1)
$\rightarrow$
(IF-TRUE)
$\rightarrow$
(EVAL PAIR 2)
$\rightarrow$
(PROJECT 2)
$\rightarrow$
(PAIR 1)
$\rightarrow$
Termine 2: (fn x : Nat ⇒ Nat.x.2) (4 − 2, 3 + 1)
(MINUS)
$\rightarrow$
(EVAL PAIR 1)
$\overline{+}\rightarrow$
$\overline{+}$
(APP2)
$\overline{*}\overline{+}\rightarrow$
$\overline{*}$
(SUM)
$\overline{+}\rightarrow$
(EVAL PAIR 1)
$\overline{+}\rightarrow$
(APP2)
$\overline{*}\overline{+}\rightarrow$
$\overline{*}$
(BETA)
$\overline{*}\rightarrow$
(PAIR

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passo **1**
(BETA)
→
(TRY)
→ **passo** **2**
(BETA)
→(IF)
→(TRY)
→ **passo** **3**
(IF-
FALSE)
→
(TRY)
→ **passo** **4**
(TRY
HAN-
DLE)
→ **passo** **5**
(BETA)
→ **passo** **6**
(SUM)
→ **passo** **1**
(BETA)
→
(APP
2)
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{}
(TRY)
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passo **2**
(BETA)
→
(IF)
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→
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2)
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{}
(TRY)
{}
→
{}
passo **3**
(IF-
FALSE)
{}
→
(APP
2)
{}
→
(TRY)
{}
→ **passo** **4**
(RAISE
APP
2)
→
(TRY)
→ **passo** **5**
(TRY
HAN-
DLE)
→ **passo** **6**
(BETA)
→ **passo** **7**
(BETA)
→ **passo** **1**
(RAISE
APP
2)
→
(APP

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A):
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b:Nat},
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{l:{a:Nat},
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DEPTH)
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B):
{l:{a:Nat,
b:Nat},
l':{m:Nat}}
i:
{l:{a:Nat},
l':{m:Nat}}
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C):
{l:{a:Nat,
b:Nat},
l':{m:Nat}}
i:
{l:{a:Nat}}
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Svolgimento

Class A extends B {A() {super()}}

Class B extends A {B() {super()}}

□

class A extends Object { A(){ super(); } }

class B extends Object { B(){ super(); } }

class Pair extends Object { {Object fst; Object snd; Pair(Object fst, Object snd){ super(); this.fst=fst; this.snd=snd }

Pair setfst(Object newfst) { return new Pair(newfst, this.snd); }}

Svolgimento

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