

```

let
  f = proc(? x, int y) if x then +(y,1) else -(y,1)
in
  let
    g = proc(? m, int n) (m true n)
  in
    let
      h = (g f 5)
    in
      g

```

$t_f, t_x, t_y, t_g, t_m, t_n, t_h$
 x, x, x, x, x, x, x

$$\begin{cases} t_f = t_x * t_y \rightarrow t_1 \\ t_g = t_m * t_n \rightarrow t_2 \end{cases}$$

Procedimento

declares proc

$$\begin{cases} t_f = t_x * \text{int} \rightarrow t_1 \\ t_g = t_m * \text{int} \rightarrow t_2 \end{cases}$$

$$\text{if } x \text{ then } +(y,1) \text{ else } -(y,1) \quad t_1$$

$t_x = \text{bool}$

$$t_f = \text{bool} * \text{int} \rightarrow \text{int}$$

$$t_m = \text{bool} * t_n \rightarrow t_2$$

$$t_m = \text{bool} * \text{int} \rightarrow t_2$$

$$t_h = t_2$$

$$t_g = t_f * \text{int} \rightarrow t_2$$

$$t_m = t_f$$

$$t_g = (\text{bool} * \text{int} \rightarrow \text{int}) * \text{int} \rightarrow \text{int}$$

$$t_y = \text{int}$$

$$t_n = \text{int}$$

$$t_x = \text{bool}$$

$$t_f = \text{bool} * \text{int} \rightarrow \text{int}$$

$$t_m = \text{bool} * \text{int} \rightarrow \text{int}$$

regla if

$$t_2 = \text{int}$$

$$t_h = \text{int}$$

$$t = t_g$$

```

let
  f = proc(? x, ? y, ? z)
    ① → if (x y) then *(z, 2) else ②
in
  let
    g = proc(? m)
      if m then true else false
    k = 5 ③
  in
    (f g true k) ④

```

$t_f \leq (bool \rightarrow bool) * bool * int \rightarrow int$
 $t_x \leq bool \rightarrow bool$
 $t_y \leq bool$
 $t_z \leq int$
 $t_g \leq bool \rightarrow bool$
 $t_m \leq bool$
 $t_k \leq int$

$t_f = t_x * t_y * t_z \rightarrow t_1$
 $t_g = t_m \rightarrow t_2$

} declarations

① $t_x \leq t_y \rightarrow bool$

$int * int \rightarrow int$

② $t_z \leq int \rightarrow int$
 $int = t_z$

③ $t_m \leq bool$

$t_2 \leq bool$

④ $t_f = t_g * bool * t_k \rightarrow t_1$

$t_g = t_x$

$t_y = bool$

$t_k = t_z$

$t_f = (bool \rightarrow bool) * bool * int \rightarrow int$

$t_j = int * int \rightarrow int$

$t_x = int$

$t_y = int$

$t_t \leq (int * int \rightarrow int) * int * int \rightarrow int$

$t_k \leq int * int \rightarrow int$

$t_a \leq int$

$t_b \leq int$

$t_1 = int$

$t_2 = int$

$t_b = t_k * t_a * t_b \rightarrow t_2$

$t_b = t_k * int * t_b \rightarrow t_2$

② $t_k = t_a * t_b \rightarrow t_2$

$t_j = t_k$

③ $t_t = t_j * int * int \rightarrow t_2$

$t_j = int * int \rightarrow int$
 $t_k = t_a * t_b \rightarrow t_2$

$t_t = (int * int \rightarrow int) * int * int \rightarrow int$

```

let
  j = proc(int x, ? y)
    ① + (x, y)
  t = proc(? k, int a, ? b)
    ② (k a b)
in
  ③ (t j 2 3)

```

$t_j = t_x * t_y \rightarrow t_1$

$t_j = int * t_y \rightarrow t_1$

① $int * int \rightarrow int$
 $t_x * t_y \rightarrow t_1$

③ $t_t = t_j * int * int \rightarrow t_2$

$t_j = int * int \rightarrow int$
 $t_k = t_a * t_b \rightarrow t_2$

$t_t = (int * int \rightarrow int) * int * int \rightarrow int$

```

let
{
  j = proc(int x, ? y)
    {
      if (y 2) then +(x,2) else -(x,3)
    }
  t = proc(? k, int a, ? b, ? c)
    {
      (k +(a,b) c)
    }
  s = proc(? a) zero?(a)
}
in
let
{
  p = proc(? m, ? n)
    {
      (m n 5 14 s)
    }
}
in
(p t j)

```

$$t_j = \text{int} \times t_y \rightarrow t_1$$

$$t_y = \text{int} \rightarrow \text{bool} \quad t_1 = \text{int}$$

$$t_x = \text{int}$$

$$t_c = t_x \times t_a \times t_b \times t_c \rightarrow t_2$$

$$t_k \in \text{int} \times t_c \rightarrow t_2$$

$$t_a \times t_b \rightarrow \text{int}$$

$$t_a = \text{int} \quad t_b = \text{int}$$

$$t_s = t_{q_2} \rightarrow t_3$$

$$t_{q_2} \rightarrow t_3$$

$$\text{int} \rightarrow \text{bool}$$

$$t_s = \text{int} \rightarrow \text{bool}$$

$$t_m = \text{int} \times (\text{int} \rightarrow \text{bool}) \rightarrow \text{int} \times \text{int} \times \text{int} \times (\text{int} \rightarrow \text{bool}) \rightarrow \text{int}$$

$$t_m = t_c \quad t_y = t_2$$

$$t_n = t_k$$

$$t_2 = \text{int}$$

$$t_p = (\text{int} \times (\text{int} \rightarrow \text{bool}) \rightarrow \text{int} \times \text{int} \times \text{int} \times (\text{int} \rightarrow \text{bool}) \rightarrow \text{int}) \times (\text{int} \times (\text{int} \rightarrow \text{bool}) \rightarrow \text{int}) \rightarrow \text{int}$$

Expression int

$$t_j =$$

$$t_x = \text{int}$$

$$t_y = \text{int} \rightarrow \text{bool}$$

$$t_c = \text{int} \times (\text{int} \rightarrow \text{bool}) \rightarrow \text{int} \times \text{int} \times \text{int} \times (\text{int} \rightarrow \text{bool}) \rightarrow \text{int}$$

$$t_s = \text{int} \times (\text{int} \rightarrow \text{bool}) \rightarrow \text{int}$$

$$t_g = \text{int}$$

$$t_b = \text{int}$$

$$t_c = \text{int}$$

$$t_s = \text{int} \rightarrow \text{bool}$$

$$t_{q_2} = \text{int}$$

$$t_m = \text{int} \times (\text{int} \rightarrow \text{bool}) \rightarrow \text{int} \times \text{int} \times \text{int} \times (\text{int} \rightarrow \text{bool}) \rightarrow \text{int}$$

$$t_n = \text{int} \times (\text{int} \rightarrow \text{bool}) \rightarrow \text{int}$$

$$t_p = t_m \times t_n \rightarrow t_4$$

$$t_m = t_n \times \text{int} \times \text{int} \times t_s \rightarrow t_4$$

$$t_m = t_n \times \text{int} \times \text{int} \times (\text{int} \rightarrow \text{bool}) \rightarrow t_4$$

$$t_p = t_c \times t_j \rightarrow t_4$$

$$t_m = t_c$$

$$t_n = t_j = t_k$$

```

let
  x = 3
  y = 4

  f1 = proc(a) b c d)
    if b then (a c d)
    else proc(t w) *(t,w)

  f2 = proc(n m)
    proc(g h) +(*(g,m), *(h,n))

  f3 = proc(i j) >(i,j)

in
  ((f1 (f2 (f3 x y) + (y,3) *(x,2))) x + (y,3))

```

es: int

$\vdash x = \text{int}$
 $\vdash y = \text{int}$
 $\vdash f_1 \checkmark$
 $\vdash f_2 : \text{int} \times \text{int} \rightarrow \text{int} \times \text{int} \rightarrow \text{int}$
 $\vdash f_3 : \text{int} \times \text{int} \rightarrow \text{bool}$

$\vdash f_1 = \vdash a \times \vdash b \times \vdash c \times \vdash d \rightarrow \vdash t_1$
 $\vdash a = \vdash c \times \vdash d \rightarrow \vdash t_1$
 $\vdash \text{proc} = \vdash t \times \vdash w \rightarrow \vdash t_1$
 $\text{int} \times \text{int} \rightarrow \text{int}$

$\vdash f_3 : \vdash i \times \vdash j \rightarrow \vdash t_4$

$\text{int} \times \text{int} \rightarrow \text{bool}$
 $\vdash f_3 = \vdash x \times \vdash y \rightarrow \vdash t_4$

$\vdash f_2 = \vdash n \times \vdash m \rightarrow \vdash t_2$
 $\vdash t_2 = \vdash g \times \vdash h \rightarrow \vdash t_3$

$\vdash f_2 = \vdash f_2 \times \text{bool} \times \text{int} \times \text{int} \rightarrow \vdash t_1$
 $\vdash a = \vdash f_2$

$\vdash f_2 : \text{int} \times \text{int} \rightarrow (\text{int} \times \text{int} \rightarrow \text{int})$

$\vdash f_1 : (\text{int} \times \text{int} \rightarrow (\text{int} \times \text{int} \rightarrow \text{int})) \times \text{bool} \times \text{int} \times \text{int} \rightarrow (\text{int} \times \text{int} \rightarrow \text{int})$
 $\text{int} \times \text{int} \rightarrow \text{int}$
 int

```

let x = 3 y = 4
f = proc(? a, ? b, ? c, ? d)
  if b then (a c d) else proc(? t, ? w) *(t,w)
f2 = proc(? n, ? m) proc(? g, ? h) +(*(g,m),*(h,n))
f3 = proc(? i, ? j) >(i,j)
in let
  z = ((f f2 (f3 x y) + (y,3) *(x,2)) x + (y,3))
  in (f f2 (f3 x y) + (y,3) *(x,2))

```

\uparrow probor $\pi / \vdash p_0$