

MiniHaskell

Rekurzija in negibne točke.

$$f = \underbrace{\lambda x. f(x)}_f = \Phi(f)$$

$$f = \Phi(f)$$

let rec f = fun n → if n=0 then 1 else n * f(n-1)

let rec f = $\Phi(f)$?

$$\Phi(g) = \text{fun } n \rightarrow \text{if } n=0 \text{ then } 1 \text{ else } n * g(n-1)$$

$$\Phi : (\text{int} \rightarrow \text{int}) \rightarrow (\text{int} \rightarrow \text{int})$$

Rekurzivne definicije ne-funkcij

$$l = 1 :: (2 :: l)$$

l je seznam $1, 2, 1, 2, 1, 2, \dots$

$$\phi$$

$$x = \underset{\uparrow}{\phi(x)}$$

$$\Phi : \tau \rightarrow \tau$$

$$f = \text{fun } n \rightarrow \dots$$

rec x is e

$$\uparrow \\ \phi(x)$$

rec l is $1 :: (2 :: l)$

$$l = 1 :: (2 :: l)$$

rec $x : \tau$ is x

Evaluacija

$\underbrace{\text{rec } l : \text{int list is } 1 :: 2 :: l}_{\text{[1]}}$

$$x = \phi(x)$$

$1 :: 2 :: (\text{rec } l : \text{int list is } 1 :: 2 :: l)$

Parametrični polimorfizem

$$\text{map } f [x_1, \dots, x_n] = [f x_1, f x_2, \dots, f x_n]$$

$$\text{map} : \left. \begin{array}{l} (\text{int} \rightarrow \text{bool}) \rightarrow \text{int list} \rightarrow \text{bool list} \\ (\text{bool} \rightarrow \text{int}) \rightarrow \text{bool list} \rightarrow \text{int list} \\ (\text{int} * \text{int} \rightarrow \alpha) \rightarrow (\text{int} * \text{int}) \text{ list} \rightarrow \alpha \text{ list} \end{array} \right\} \text{polimorfna}$$

~~$$\forall \alpha, \beta \text{ type. } (\alpha \rightarrow \beta) \rightarrow \alpha \text{ list} \rightarrow \beta \text{ list}$$~~

$\begin{array}{ccc} 'a & 'b & \\ \uparrow & \uparrow & \\ \text{PARAMETER} & & \end{array}$

$$(\alpha * \delta \rightarrow \epsilon * \delta) \rightarrow (\alpha * \delta) \text{ list} \rightarrow (\epsilon * \delta) \text{ list}$$

Izpeljava tipov

$$\text{fun } x \rightarrow (X, x) \quad : \quad \alpha \rightarrow \alpha \times \alpha$$

1) izpeljemo tipe

2) izmed vseh možnih tipov izpeljemo najbolj splošnega (glavni tip).

"Unification"

Imamo sistem enačb z neznanhami.

1) $X = t$

rešimo za X : $X \rightarrow t$

pogoj X se ne pojavi v t !!!

Posled X zamenjamo s t

2) $t = X$ simetrična

3) $t = t$ vržemo stran

4) $t = t'$

$$\begin{array}{l}
 x^y \quad x^y \quad x^y \\
 t_1 \rightarrow t_2 = t_3 \text{ list} \\
 (t_1 \rightarrow t_2) \text{ list} = (x \rightarrow y) \text{ list} \Rightarrow \\
 t_1 \rightarrow t_2 = x \rightarrow y
 \end{array}$$

$$\begin{array}{l}
 x + x^2 + 3 = 0 \\
 x = \underline{-3 - x^2}
 \end{array}$$

$$\begin{array}{l}
 \cancel{A \rightarrow B = C \rightarrow D} \\
 \begin{array}{l}
 A = C \\
 B = D
 \end{array}
 \end{array}$$

NI REŠITVE

Occurs check

$$\boxed{\alpha = \alpha \rightarrow \text{int}}$$

$$\alpha = \text{rec } \beta \text{ is } \beta \rightarrow \text{int}$$

$$\alpha = \alpha_1 \rightarrow \alpha_2$$

$$(\alpha_1 \rightarrow \alpha_2) = (\alpha_1 \rightarrow \alpha_2) \rightarrow \text{int}$$

$$\alpha_1 = \alpha_1 \rightarrow \alpha_2$$

in

$$\boxed{\alpha_2 = \text{int}}$$

$$\alpha_1 = \alpha_1 \rightarrow \text{int}$$

$$\alpha = (\dots \rightarrow \text{int}) \rightarrow \text{int} \rightarrow \text{int}$$