Computer Language Processing

Exercise Sheet 07 Solutions

November 12, 2022

Exercise CYK Parsing and Chomsky Normal Form

2015 Ex 3

You can check your solution on http://grammar.epfl.ch.

Exercise Types rules, preservation and inferences

(2013 Ex 1)

a)

$$\frac{}{\Gamma \vdash \text{EmptyCol}[\alpha] \,:\, Collection[\alpha]}$$

$$\frac{\Gamma \vdash e_1 \,:\, Collection[T] \quad \Gamma \vdash e_2 \,:\, T}{\Gamma \vdash \text{add}(e_1, e_2) \,:\, Collection[T]}$$

$$\frac{\Gamma \vdash e_1 \,:\, Collection[T]}{\Gamma \vdash \text{permute}(e) \,:\, T \Rightarrow T}$$

$$\frac{\Gamma \vdash e \,:\, Collection[T]}{\Gamma \vdash \text{map}(e) \,:\, (T \Rightarrow U) \Rightarrow Collection[U]}$$

b)
x typechecks to $Collection[Int]$, z to $Collection[Int]$ and y to $Collection[Int \Rightarrow Int]$ Therefore map(x) typechecks to $(Int \Rightarrow Int) \Rightarrow Collection[Int]$ and flatMap(y)(map(x)) typechecks to $Collection[Int]$

Unification algorithm

1.
$$\tau_2 = (\tau_3 => \tau_4)$$
$$\tau_3 = (\tau, \tau_1)$$
$$\tau_5 = (\tau_1 => \tau_4)$$
$$\tau_6 = (\tau => \tau_5)$$

2. Elimination of τ_3 :
$$\tau_2 = ((\tau, \tau_1) => \tau_4)$$
$$\tau_3 = (\tau, \tau_1)$$
$$\tau_5 = (\tau_1 => \tau_4)$$
$$\tau_6 = (\tau => \tau_5)$$

3. Elimination of τ_5 :
$$\tau_2 = ((\tau, \tau_1) => \tau_4)$$
$$\tau_3 = (\tau, \tau_1)$$
$$\tau_5 = (\tau_1 => \tau_4)$$
$$\tau_6 = (\tau => (\tau_1 => \tau_4))$$

Write down an expression for the type of the argument (f) and of the result of curry in terms of types τ, τ_1, τ_4:

(argument)   f   : $((\tau, \tau_1) => \tau_4)$

(result)   curry(f)   : $(\tau => (\tau_1 => \tau_4))$