CS 456: Assignment 5

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1 Chapter 6 Question 5

Imagine you want to add lists to Typed Impcore using the same techniques we use for arrays. Devise new abstract syntax to support lists, and write appropriate typeformation, type-introduction, and type-elimination rules. The rules should look similar to the rules shown in Section 6.4, and to make it obvious which rules are formation rules, which rules are introduction rules, and which rules are elimination rules, the rules should be divided into three groups.

Your abstract syntax should cover all the list primitives defined in Chapter 3: the empty list, test to see if a list is empty, cons, car, and cdr. Your abstract syntax may differ from the abstract syntax used in JLScheme.

Be sure your rules are deterministic: it should be possible to compute the type of an expression given only the syntax of the expression and the current type environment.

1.1 Abstract Syntax

```
datatype exp = LGET    of exp * exp
    | LSET    of exp * exp * exp
    | LMAKE   of exp * exp
    | LLEN    of exp
```

1.2 Formation Rules

$$\frac{\tau \text{ IS A TYPE}}{\text{LIST}(\tau) \text{ IS A TYPE}} \ (\text{LISTFORMATION})$$

1.3 Introduction Rules

$$\frac{\Gamma_\xi, \Gamma_\varphi, \Gamma_\rho \vdash e_1 : \text{INT} \qquad \Gamma_\xi, \Gamma_\varphi, \Gamma_\rho \vdash e_2 : \tau}{\Gamma_\xi, \Gamma_\varphi, \Gamma_\rho \vdash \text{LIST-MAKE}(e_1, e_2) \ : \text{LIST}(\tau)} \ (\text{LISTMAKE})$$

1.4 Elimination Rules

$$\frac{\Gamma_\xi, \Gamma_\varphi, \Gamma_\rho \vdash e_1 : \mathrm{LIST}(\tau) \qquad \Gamma_\xi, \Gamma_\varphi, \Gamma_\rho \vdash e_2 : \mathrm{INT}}{\Gamma_\xi, \Gamma_\varphi, \Gamma_\rho \vdash \mathrm{LIST\text{-}MAKE}(e_1, e_2) \ : \tau} \ (\textsc{ListGet})$$

$$\frac{\Gamma_\xi, \Gamma_\varphi, \Gamma_\rho \vdash e_1 : \mathrm{LIST}(\tau) \qquad \Gamma_\xi, \Gamma_\varphi, \Gamma_\rho \vdash e_2 : \mathrm{INT} \qquad \Gamma_\xi, \Gamma_\varphi, \Gamma_\rho \vdash e_3 : \tau}{\Gamma_\xi, \Gamma_\varphi, \Gamma_\rho \vdash \mathrm{LIST\text{-}SET}(e_1, e_2, e_3) \ : \tau} \ (\textsc{ListSet})$$

$$\frac{\Gamma_\xi, \Gamma_\varphi, \Gamma_\rho \vdash e : \mathrm{LIST}(\tau)}{\Gamma_\xi, \Gamma_\varphi, \Gamma_\rho \vdash \mathrm{LIST\text{-}LENGTH}(e) \ : \mathrm{INT}} \ (\textsc{ListLength})$$