1999 Paper 7 Question 12

Types

Contrast the advantages and disadvantages of explicit and implicit typing. [4 marks]

Consider an ML-style language with types and type schemes

$$\begin{aligned} \tau &::= \alpha \mid \texttt{bool} \mid \tau \to \tau \mid \tau\ \texttt{list} \\ \sigma &::= \forall A\,(\tau) \end{aligned}$$

Give the typing rules for variables, function abstraction, function application, and let-binding. Make the form of the typing judgement clear. [5 marks]

Give terms M_1 and M_2 such that N_1 is typable (in the empty context) and N_2 is not, where

$$\begin{aligned} N_1 &\stackrel{\text{def}}{=} \textbf{let val}\, f = M_1\, \textbf{in}\, M_2\, \textbf{end} \\ N_2 &\stackrel{\text{def}}{=} (\textbf{fn}\ f \Rightarrow M_2)\, M_1 \end{aligned}$$

Give all uses of $\sigma \succ \tau$ required in a typing derivation for N_1; prove that there does not exist a typing derivation for N_2. [7 marks]

What is a *principal type scheme*? Give the principal type scheme for N_1, or explain informally why it does not have one. [4 marks]