2004 Paper 5 Question 11

Semantics of Programming Languages

The language L has expression syntax

$$e ::= n \mid \textbf{skip} \mid \textbf{fn}\ x{:}T \Rightarrow e \mid e_1\ e_2 \mid x \mid e_1 := e_2 \mid !e \mid \mathsf{ref} e \mid \ell$$

with types

$$T ::= \mathsf{int} \mid \mathsf{unit} \mid T_1 \rightarrow T_2 \mid T\ \mathsf{ref}$$

It is intended to have a call-by-value semantics.

(a) Define the set of *values* for L. [2 marks]

(b) Give type rules and reduction rules for the store-related expressions $e_1 := e_2 \mid !e \mid \mathsf{ref} e \mid \ell$. Define clearly what the type environments and stores you are using are. [10 marks]

(c) Discuss possible alternative choices for the semantics of the operations in part (b), paying particular attention to: (i) what can be stored, (ii) store initialisation, and (iii) the results of assignments. Illustrate your answer with type rules and reduction rules as appropriate, and comment on any pragmatic advantages or disadvantages. [8 marks]