Optimising Compilers 2002

p8q7
AM

Solution Notes y2002p8.tex

$$\text{(VAR)}\frac{}{\Gamma[x:t]\vdash x:t,\emptyset}$$

$$\text{(LAM)}\frac{\Gamma[x:t]\vdash e:t',F}{\Gamma\vdash \lambda x.e:t\xrightarrow{F}t',\emptyset}$$

$$\text{(APP)}\frac{\Gamma\vdash e_1:t\xrightarrow{F''}t',F \qquad \Gamma\vdash e_2:t,F'}{\Gamma\vdash e_1e_2:t',F\cup F'\cup F''}$$

$$\text{(REF)}\frac{\Gamma\vdash e:\mathit{int},F}{\Gamma\vdash \mathit{ref}\ e:\mathit{intref},F\cup\{A\}}$$

$$\text{(DEREF)}\frac{\Gamma\vdash e:\mathit{intref},F}{\Gamma\vdash\ !e:\mathit{int},F\cup\{R\}}$$

$$\text{(ASS)}\frac{\Gamma\vdash e_1:\mathit{intref},F \qquad \Gamma\vdash e_2:\mathit{int},F'}{\Gamma\vdash e_1:=e_2:\mathit{int},F\cup F'\cup\{W\}}$$

$$\text{(COND)}\frac{\Gamma\vdash e_1:\mathit{int},F \qquad \Gamma\vdash e_2:t,F' \qquad \Gamma\vdash e_3:t,F''}{\Gamma\vdash \mathit{if}\ e_1\ \mathit{then}\ e_2\ \mathit{else}\ e_3:t,F\cup F'\cup F''}$$

Types and effects, also issues and problems arising:

- $e_1 \equiv \mathit{if}\ !g\ \mathit{then}\ \mathit{ref}\ 1\ \mathit{else}\ g$
  This typechecks simply and enables one to deduce $\vdash e_1 : \mathit{intref}, \{A, R\}$. No problems, note the union in if-then-else.
- $e_2 \equiv \lambda x.\mathit{if}\ !g\ \mathit{then}\ \mathit{ref}\ x\ \mathit{else}\ g$
  This also typechecks simply and enables one to deduce $\vdash e_2 : \mathit{int} \xrightarrow{\{A,R\}} \mathit{intref}, \emptyset$. No problems, note the latent side effects, and no immediate ones.
- $e_3 \equiv \mathit{if}\ !g\ \mathit{then}\ \lambda x.\mathit{ref}\ x\ \mathit{else}\ \lambda x.g$
  This is problematic, unless one adds a clause

  $$\text{(SUB)}\frac{\Gamma\vdash e:t\xrightarrow{F'}t',F}{\Gamma\vdash e:t\xrightarrow{F''}t',F}\ \text{(provided } F'\subseteq F''\text{)}$$

  in which case we can deduce $\vdash e_3 : \mathit{int} \xrightarrow{\{A\}} \mathit{intref}, \{R\}$. The issue is that the system given above requires the *same* t for the if-then-else consequents and the t here are functions which differ in latent effect ($\mathit{int} \xrightarrow{\{A\}} \mathit{intref}$ versus $\mathit{int} \xrightarrow{\{\}} \mathit{intref}$).