Arrays 1

We assume that the set of locations to be the natural numbers, i.e. $\mathbf{Loc} = \mathbb{N}$, and we can then find the location k positions from the location l as the location $l + k$

1.1   Abstract syntax

$$S ::= \ldots \mid x[a] := a \mid \text{begin } D_V \ D_A \ D_P \ S \text{ end}$$
$$a ::= \ldots \mid x[a]$$
$$D_A ::= \text{array } x \text{ of } [1..n];\ D_A \mid \varepsilon$$

1.2   Statements

The transition system for the statements are as follows: $(\Gamma_{\mathbf{Stm}}, \rightarrow, \mathrm{T}_{\mathbf{Stm}})$, where the configurations are: $\Gamma_{\mathbf{Stm}} = \mathbf{Stm} \times \mathbf{Sto} \cup \mathbf{Sto}$ and the end configurations are: $\mathrm{T}_{\mathbf{Stm}} = \mathbf{Sto}$. The transition rules are on the form: $env_V, env_P \vdash \langle S, sto \rangle \rightarrow sto'$

$$[\text{ARR-ASS}] \quad env_V, env_P \vdash \langle x[a_1] := a_2, sto \rangle \rightarrow sto[l_2 \mapsto v_2]$$

where $env_V, sto \vdash a_1 \rightarrow_a v_1$
and $env_V, sto \vdash a_2 \rightarrow_a v_2$
and $env_V \ r = l_1$
and $l_2 = l_1 + v_1$
and $v_3 = sto \ l_1$
and $1 \leq v_1 \leq v_3$

$$[\text{BLOCK}] \quad \frac{\left| \begin{array}{c} \langle D_V, env_V, sto \rangle \rightarrow_{DV} (env_V', sto'') \\ \langle D_A, env_V', sto'' \rangle \rightarrow_{DA} (env_V'', sto^3) \\ env_V'' \vdash \langle D_P, env_P \rangle \rightarrow_{DP} env_P' \\ env_V'', env_P' \vdash \langle S, sto^3 \rangle \rightarrow sto' \end{array} \right|}{env_v, env_P \vdash \langle \text{begin } D_V \ D_A \ D_P \ S \text{ end}, sto \rangle \rightarrow sto'}$$

1.3   Arithmetic Expressions

The transition system for the arithmetic expressions are as follows: $(\Gamma_{\textbf{Aexp}}, \rightarrow_a, T_{\textbf{Aexp}})$, where the configurations are: $\Gamma_{\textbf{Aexp}} = \textbf{Aexp} \cup \mathbb{Z}$ and the end configurations are: $T_{\textbf{Aexp}} = \mathbb{Z}$. The transition rules are on the form: $env_V, sto \vdash a \rightarrow_a v$.

$$[\text{ARR}] \quad env_V, sto \vdash x[a_1] \rightarrow_a a_2$$

where $env_V, sto \vdash a_1 \rightarrow_a v_1$
and $env_V, sto \vdash a_2 \rightarrow_a v_2$
and $env_V \; x = l$
and $sto \; l = v_3$
and $0 < v_1 \leq v_3$
and $sto(l + v_1) = v_2$

1.4   Array Declaration

The transition system for the array declaration are as follows: $(\Gamma_{\textbf{ErkA}}, \rightarrow_{DA}, T_{\textbf{ErkA}})$, where the configurations are: $\Gamma_{DV} = (\textbf{ErkA} \times \textbf{EnvV} \times \textbf{Sto}) \cup (\textbf{EnvV} \times \textbf{Sto}), T_{DV} = \textbf{EnvV} \times \textbf{Sto}$ and the end configurations are: $T_{\textbf{ErkV}} = \textbf{EnvV} \times \textbf{Sto}$. The transition rules are on the form: $\langle D_A, env_V, sto \rangle \rightarrow_{DA} (env_V', sto')$.

$$[\text{ARRAY-DEC}] \quad \frac{\langle D_A, env_V[x \mapsto l, \; \text{next} \mapsto l + v + 1], sto[l \mapsto v] \rangle \rightarrow_{DA} (env_V', sto')}{\langle \text{array } x \text{ of } [1..n], D_A, env_V, sto \rangle \rightarrow_{DA} (env_V', sto'}$$

where $env_V, sto \vdash n \rightarrow_a v$
and $l = env_V \; \text{next}$
and $n > 0$

$$[\text{EMPTY-ARRAY}] \quad \langle \varepsilon, env_V, sto \rangle \rightarrow_{DA} (env_V, sto)$$