1 Transition Rules

1.1 Abstract Syntax

$$
\begin{aligned}
S &::= x := a \mid r[a_1] := a_2 \mid S_1;\ S_2 \mid \text{if } b \text{ do } S \mid \text{if } b \text{ do } S_1 \text{ else do } S_2 \mid \text{while } b \text{ do } S \\
&\quad \mid \text{from } x := a_1 \text{ to } a_2 \text{ step } a_3 \text{ do } S \mid \text{call } p(\vec{x}) \mid \text{begin } D_V\ D_P\ S \text{ end} \\
a &::= n \mid x \mid a_1 + a_2 \mid a_1 - a_2 \mid a_1 * a_2 \mid a_1 / a_2 \mid (a) \\
b &::= a_1 = a_2 \mid a_1 > a_2 \mid a_1 < a_2 \mid \neg b \mid b_1 \wedge b_2 \mid b_1 \vee b_2 \mid (b) \\
D_V &::= \text{var } x := a;\ D_V \mid \varepsilon \\
D_P &::= \text{proc } p \text{ is } S;\ D_P \mid \varepsilon \\
D_A &::= \text{array } r[a_1] := a_2;\ D_A \mid \varepsilon
\end{aligned}
$$

Transitioner er på formen: $env_V, env_P \vdash \langle S, sto\rangle \to sto'$

[VAR-ASS] $env_V, env_P \vdash \langle x <-- a, sto\rangle \to sto[l \mapsto v]$

where $env_V, sto \vdash a \to_a v$
and $env_V\ x = l$

[ARR-ASS] $env_V, env_P \vdash \langle r[a_1] <-- a_2, sto\rangle \to sto[l \mapsto v_2]$

where $env_V, sto \vdash a_1 \to_a v_1$
and $env_V, sto \vdash a_2 \to_a v_2$
and $???[r[v_1] = l$

[COMP]
$$\frac{\begin{array}{c} env_V, env_P \vdash \langle S_1, sto\rangle \to sto'' \\ env_V, env_P \vdash \langle S_2, sto''\rangle \to sto' \end{array}}{env_V, env_P \vdash \langle S_1; S_2, sto\rangle \to sto'}$$

[IF-TRUE]
$$\frac{env_V, env_P \vdash \langle S, sto\rangle \to sto'}{env_V, env_P \vdash \langle \text{if } b \text{ begin } S \text{ end}, sto\rangle \to sto'}$$

if $env_V, sto \vdash b \to_b \text{TRUE}$

[IF-FALSE] $env_V, env_P \vdash \langle \text{if } b \text{ begin } S \text{ end}, sto\rangle \to sto$

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if $env_V, sto \vdash b \rightarrow_b$ FALSE

[IF-ELSE-TRUE] $$\frac{env_V, env_P \vdash \langle S_1, sto\rangle \rightarrow sto'}{env_V, env_P \vdash \langle \text{if } b \text{ begin } S_1 \text{ end else begin } S_2 \text{ end}, sto\rangle \rightarrow sto'}$$

if $env_V, sto \vdash b \rightarrow_b$ TRUE

[IF-ELSE-FALSE] $$\frac{env_V, env_P \vdash \langle S_2, sto\rangle \rightarrow sto'}{env_V, env_P \vdash \langle \text{if } b \text{ begin } S_1 \text{ end else begin } S_2 \text{ end}, sto\rangle \rightarrow sto'}$$

if $env_V, sto \vdash b \rightarrow_b$ FALSE

[WHILE-TRUE] $$\frac{\begin{array}{c} env_V, env_P \vdash \langle S, sto\rangle \rightarrow sto'' \\ env_V, env_P \vdash \langle \text{while } b \text{ begin } S \text{ end}, sto''\rangle \rightarrow sto' \end{array}}{env_V, env_P \vdash \langle \text{while } b \text{ begin } S \text{ end}, sto\rangle \rightarrow sto'}$$

if $env_V, sto \vdash b \rightarrow_b$ TRUE

[WHILE-FALSE] $$env_V, env_P \vdash \langle \text{while } b \text{ begin } S \text{ end}, sto\rangle \rightarrow sto$$

if $env_V, sto \vdash b \rightarrow_b$ FALSE

[FROM-TRUE] $$\frac{}{env_V, env_P \vdash \langle \text{from } x < -- a_1 \text{ to } a_2 \text{ step } a_3 \text{ begin } S \text{ end}\rangle \rightarrow sto'}$$

where $env_V, sto \vdash a_1 \rightarrow_a v_1$
and $env_V, sto \vdash a_2 \rightarrow_a v_2$
and $env_V, sto \vdash a_3 \rightarrow_a v_3$
and $v_1 \leq v_2$

[FROM-FALSE] $$\frac{}{env_V, env_P \vdash \langle \text{from } x < -- a_1 \text{ to } a_2 \text{ step } a_3 \text{ begin } S \text{ end}\rangle \rightarrow sto'}$$

where $env_V, sto \vdash a_1 \rightarrow_a v_1$
and $env_V, sto \vdash a_2 \rightarrow_a v_2$
and $env_V, sto \vdash a_3 \rightarrow_a v_3$
and $v_1 > v_2$

[CALL] $$\frac{}{env_V, env_P \vdash \langle \text{call } p(\vec{x}), sto\rangle \rightarrow sto'}$$

[BLOK] $$\frac{\begin{array}{c} \langle D_V, env_V, sto\rangle \rightarrow_{DV} (env'_V, sto'') \\ env'_V \vdash \langle D_P, env_P\rangle \rightarrow_{DP} env'_P \\ env'_V env'_P \vdash \langle S, sto''\rangle \rightarrow sto' \end{array}}{env_V, env_P \vdash \langle \text{begin } D_V\ D_P\ S \text{ end}, sto\rangle \rightarrow sto'}$$

Table 1.1: Statements

Transitioner er på formen: $env_V, sto \vdash a \rightarrow_a v$

[NUM] $env_V, sto \vdash n \rightarrow_a v$

if $\mathcal{N}[[n]] = v$

[VAR] $env_V, sto \vdash x \rightarrow_a v$

if $env_V\ x = l$
and $sto\ l = v$

[ADD] $$\frac{env_V, sto \vdash a_1 \rightarrow_a v_1 \quad env_V, sto \vdash a_2 \rightarrow_a v_2}{env_V, sto \vdash a_1 + a_2 \rightarrow_a v}$$

where $v = v_1 + v_2$

[SUB] $$\frac{env_V, sto \vdash a_1 \rightarrow_a v_1 \quad env_V, sto \vdash a_2 \rightarrow_a v_2}{env_V, sto \vdash a_1 - a_2 \rightarrow_a v}$$

where $v = v_1 - v_2$

[MULT] $$\frac{env_V, sto \vdash a_1 \rightarrow_a v_1 \quad env_V, sto \vdash a_2 \rightarrow_a v_2}{env_V, sto \vdash a_1 \cdot a_2 \rightarrow_a v}$$

where $v = v_1 \cdot v_2$

[DIV] $$\frac{env_V, sto \vdash a_1 \rightarrow_a v_1 \quad env_V, sto \vdash a_2 \rightarrow_a v_2}{env_V, sto \vdash a_1 / a_2 \rightarrow_a v}$$

where $v = v_1 / v_2$

[PAR] $$\frac{env_V, sto \vdash a_1 \rightarrow_a v_1}{env_V, sto \vdash (a_1) \rightarrow_a v_1}$$

Table 1.2: Arithmetic expressions

Transitioner på formen: $env_V, sto \vdash b \rightarrow_b t$

[EQUAL-TRUE] $$\frac{env_V, sto \vdash a_1 \rightarrow_a v_1 \quad env_V, sto \vdash a_2 \rightarrow_a v_2}{env_V, sto \vdash a_1 = a_2 \rightarrow_b \text{TRUE}}$$

if $v_1 = v_2$

[EQUAL-FALSE] $$\frac{env_V, sto \vdash a_1 \rightarrow_a v_1 \quad env_V, sto \vdash a_2 \rightarrow_a v_2}{env_V, sto \vdash a_1 = a_2 \rightarrow_b \text{FALSE}}$$

if $v_1 \neq v_2$

[GRT-TRUE] $$\frac{env_V, sto \vdash a_1 \rightarrow_a v_1 \quad env_V, sto \vdash a_2 \rightarrow_a v_2}{env_V, sto \vdash a_1 > a_2 \rightarrow_b \text{TRUE}}$$

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if $v_1 > v_2$

[GRT-FALSE] $$\frac{env_V, sto \vdash a_1 \rightarrow_a v_1 \quad env_V, sto \vdash a_2 \rightarrow_a v_2}{env_V, sto \vdash a_1 > a_2 \rightarrow_b \text{FALSE}}$$

if $v_1 \not> v_2$

[LES-TRUE] $$\frac{env_V, sto \vdash a_1 \rightarrow_a v_1 \quad env_V, sto \vdash a_2 \rightarrow_a v_2}{env_V, sto \vdash a_1 < a_2 \rightarrow_b \text{TRUE}}$$

if $v_1 < v_2$

[LES-FALSE] $$\frac{env_V, sto \vdash a_1 \rightarrow_a v_1 \quad env_V, sto \vdash a_2 \rightarrow_a v_2}{env_V, sto \vdash a_1 < a_2 \rightarrow_b \text{FALSE}}$$

if $v_1 \not< v_2$

[NOT-1] $$\frac{env_V, sto \vdash b \rightarrow_b \text{TRUE}}{env_V, sto \vdash !b \rightarrow_b \text{FALSE}}$$

[NOT-2] $$\frac{env_V, sto \vdash b \rightarrow_b \text{TRUE}}{env_V, sto \vdash !b \rightarrow_b \text{FALSE}}$$

[AND-TRUE] $$\frac{env_V, sto \vdash b_1 \rightarrow_b \text{TRUE} \quad env_V, sto \vdash b_2 \rightarrow_b \text{TRUE}}{env_V, sto \vdash b_1 \wedge b_2 \rightarrow_b \text{TRUE}}$$

[AND-FALSE] $$\frac{env_V, sto \vdash b_i \rightarrow_b \text{FALSE}}{env_V, sto \vdash b_1 \wedge b_2 \rightarrow_b \text{FALSE}}$$

where $i \in 1, 2$

[OR-TRUE] $$\frac{env_V, sto \vdash b_i \rightarrow_b \text{TRUE}}{env_V, sto \vdash b_1 \vee b_2 \rightarrow_b \text{TRUE}}$$

where $i \in 1, 2$

[OR-FALSE] $$\frac{env_V, sto \vdash b_1 \rightarrow_b \text{FALSE} \quad env_V, sto \vdash b_2 \rightarrow_b \text{FALSE}}{env_V, sto \vdash b_1 \vee b_2 \rightarrow_b \text{FALSE}}$$

[PAR-BOOL] $$\frac{env_V, sto \vdash b \rightarrow_b v}{env_V, sto \vdash (b) \rightarrow_b v}$$

Table 1.3: Boolean expressions

Transitioner på formen: $\langle D_V, env_V, sto\rangle \rightarrow_{DV} (env'_V, sto')$

[VAR-DECL] $$\frac{\langle D_V, env''_V, sto[l \mapsto v]\rangle \rightarrow_{DV} (env'_V, sto'}{\text{var } x <-- a; D_V, env_V, sto\rangle \rightarrow_{DV} (env'_V, sto')}$$

where $env_V, sto \vdash a \rightarrow_a v$

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and $l = env_V$ next
and $env''_V = env_V[x \mapsto l][\text{next} \mapsto \text{new } l]$

[EMPTY-VAR]	$\langle \varepsilon, env_V, sto \rangle \rightarrow_{DV} (env_V, sto)$
[PROC-DECL]	Transitioner på formen: $env_V \vdash \langle D_P, env_P \rangle \rightarrow_{DP} env'_P$ $\dfrac{env_V \vdash \langle D_P, env_P[p \mapsto (S, env_V, env_P)] \rangle \rightarrow_{DP} env'_P}{env_V \vdash \langle \text{proc } p \text{ is } S; D_P, env_P \rangle \rightarrow_{DP} env'_P}$
[EMPTY-PROC]	$env_V \vdash \langle \varepsilon, env_P \rangle \rightarrow_{DP} env'_P$
[ARRAY-DECL]	
[EMPTY-ARRAY]	

Table 1.4: Declarations