The semantics for statements:
c   : constant
str : string
r   : range
car : char array
v, w : vector
mat : matrix
x, y : variables
H   : heap for storage
ssep : statement separator

$$H(x)= \begin{cases} c \text{ if } H = H', x \to c \\ str \text{ if } H = H', x \to str \\ car \text{ if } H = H', x \to car \\ v \text{ if } H = H', x \to v \\ mat \text{ if } H = H', x \to mat \\ H'(x) \text{ if } H = H', y \to c' \text{ and } y <> x \\ H'(x) \text{ if } H = H', y \to str' \text{and } y <> x \\ H'(x) \text{ if } H = H', y \to car' \text{and } y <> x \\ H'(x) \text{ if } H = H', y \to vec' \text{and } y <> x \\ H'(x) \text{ if } H = H', y \to mat' \text{and } y <> x \\ 0 \text{ if } H = \cdot \end{cases}$$

$H; e \Downarrow c$

const

$$\frac{}{H; c \Downarrow c}$$

var1

$$\frac{}{H; x \Downarrow H(x)}$$

$L; H1; s1 \to L; H2; s2$

seq1

$$\frac{}{L; H; ssep\ s \to L; H; s}$$

seq2

$$\frac{L; H; s1 \to L; H'; s1'}{L; H; s1\ ssep\ s2 \to L; H'; s1'\ ssep\ s2}$$

assign1

$$\frac{L; H; e \Downarrow c}{L; H; x=e \to L; H; x \to c; ssep}$$

if1

$$\frac{L; H; e \Downarrow b \qquad b==1}{L; H; if\ e\ ssep\ s1\ end \to L; H; s1}$$

if2

$$\frac{L; H; e \Downarrow b \qquad b==0}{L; H; if\ e\ ssep\ s1\ end \to L; H; ssep}$$

if3

$$\frac{L; H; e \Downarrow b \qquad b==1}{L; H; if\ e\ ssep\ s1\ else\ s2\ end \to L; H; s1}$$

if4

$$\frac{L; H; e \Downarrow b \qquad b==0}{L; H; if\ e\ ssep\ s1\ else\ s2\ end \to L; H; s2}$$

if5

$$\frac{\texttt{L; H; e1} \Downarrow \texttt{b1} \quad \texttt{b1==0} \qquad \texttt{L; H; e2} \Downarrow \texttt{b2} \quad \texttt{b2==1}}{\texttt{L; H; if e1 ssep s1 elseif e2 ssep s2 end} \rightarrow \texttt{L; H; s2}}$$

if6

$$\frac{\texttt{L; H; e1} \Downarrow \texttt{b1} \quad \texttt{b1==0} \qquad \texttt{L; H; e2} \Downarrow \texttt{b2} \quad \texttt{b2==0}}{\texttt{L; H; if e1 ssep s1 elseif e2 ssep s2 end} \rightarrow \texttt{L; H; ssep}}$$

if7

$$\frac{\texttt{L; H; e1} \Downarrow \texttt{b1} \quad \texttt{b1==0} \qquad \texttt{L; H; e2} \Downarrow \texttt{b2} \quad \texttt{b2==0}}{\texttt{L; H; if e1 ssep s1 elseif e2 ssep s2 else s3 end} \rightarrow \texttt{L; H; s3}}$$

for

$$\frac{\texttt{L; H; e} \Downarrow \texttt{r}}{\texttt{L; H; for e ssep s end} \rightarrow \texttt{L; H; if e <= END ssep (s; for e' ssep s end) end}}$$

$v^e, w^e,$: vectors of expressions

(n, v^e) : vector of n expression $[v_1, v_2, \ldots, v_n]$

v^c, w^c : vectors of constants

(m, n, A) : matrix of size $m \times n$ $\begin{bmatrix} a_{1,1} & \cdots & a_{1,n} \\ \vdots & \ddots & \\ a_{m,1} & & a_{m,n} \end{bmatrix}$

Array access of an integer index

$$\frac{}{v(c) \rightarrow v_c}$$

Array access of an expression that evaluates to an integer

$$\frac{e \rightarrow c}{V(e) \rightarrow V_c}$$

Vector expression evaluation

$$\frac{v^e = [e_1, e_2, \ldots e_n]}{v^e \rightarrow [v_1^c, v_2^c, \ldots, v_n^c]}$$

Array acess of a range

$$\frac{RANGE \rightarrow (BEGIN, END)}{V(RANGE) \rightarrow [v_{begin}, v_{begin+1}, v_{begin+2}, \ldots V_{end}]}$$

scalar-vector multiplication

$$\frac{e \rightarrow c}{e * v \rightarrow [c * v_1, c * v_2, \ldots c * v_n]}$$

vector-vector addition

$$\frac{v^e \rightarrow v^c,\ w^e \rightarrow w^c}{v^e + w^e \rightarrow [v_1^c + w_1^c, v_2^c + w_2^c, \ldots, v_n^c + w_n^c]}$$