Rules

Arithmetic expressions (E):

$$\begin{aligned}
\langle n\boldsymbol{c}, \boldsymbol{s}, \boldsymbol{m}\rangle &\to \langle \boldsymbol{c}, n\boldsymbol{s}, \boldsymbol{m}\rangle \\
\langle v\boldsymbol{c}, \boldsymbol{s}, \boldsymbol{m}\rangle &\to \langle \boldsymbol{c}, m(v), \boldsymbol{s}, \boldsymbol{m}\rangle \\
\langle (E_1\ iop\ E_2)\boldsymbol{c}, \boldsymbol{s}, \boldsymbol{m}\rangle &\to \langle E_1\ E_2\ iop\ \boldsymbol{c}, \boldsymbol{s}, \boldsymbol{m}\rangle \\
\langle iop\ \boldsymbol{c}, n_2 n_1 \boldsymbol{s}, \boldsymbol{m}\rangle &\to \langle \boldsymbol{c}, n\boldsymbol{s}, \boldsymbol{m}\rangle \text{ where } n = n_1\ \underline{iop}\ n_2
\end{aligned}$$

Boolean conditions (C):

$$\begin{aligned}
\langle b\boldsymbol{c}, \boldsymbol{s}, \boldsymbol{m}\rangle &\to \langle b, n\boldsymbol{s}, \boldsymbol{m}\rangle \\
\langle (E_1\ bop\ E_2)\boldsymbol{c}, \boldsymbol{s}, \boldsymbol{m}\rangle &\to \langle E_1\ E_2\ bop\ \boldsymbol{c}, \boldsymbol{s}, \boldsymbol{m}\rangle \\
\langle bop\ \boldsymbol{c}, n_2 n_1 \boldsymbol{s}, \boldsymbol{m}\rangle &\to \langle \boldsymbol{c}, b\boldsymbol{s}, \boldsymbol{m}\rangle \text{ where } b = n_1\ \underline{bop}\ n_2
\end{aligned}$$

Statements (S):

$$\begin{aligned}
\langle ()\boldsymbol{c}, \boldsymbol{s}, \boldsymbol{m}\rangle &\to \langle \boldsymbol{c}, \boldsymbol{s}, \boldsymbol{m}\rangle \\
\langle (S_1; S_2)\boldsymbol{c}, \boldsymbol{s}, \boldsymbol{m}\rangle &\to \langle S_1 S_2 \boldsymbol{c}, \boldsymbol{s}, \boldsymbol{m}\rangle \\
\langle v = E\boldsymbol{c}, \boldsymbol{s}, \boldsymbol{m}\rangle &\to \langle E\ save\ \boldsymbol{c}, v\boldsymbol{s}, \boldsymbol{m}\rangle \\
\langle save\ \boldsymbol{c}, nv\boldsymbol{s}, \boldsymbol{m}\rangle &\to \langle \boldsymbol{c}, \boldsymbol{s}, \boldsymbol{m}[v = n]\rangle \\
\langle continue\ \boldsymbol{c}, \boldsymbol{s}, \boldsymbol{m}\rangle &\to \langle \boldsymbol{c'}, \boldsymbol{s}, \boldsymbol{m}\rangle \\
\langle break\ \boldsymbol{c}, \boldsymbol{s}, \boldsymbol{m}\rangle &\to \langle \boldsymbol{c''}, \boldsymbol{s}, \boldsymbol{m}\rangle
\end{aligned}$$

where $\boldsymbol{c'}$ are the commands up to the first *while*
and $\boldsymbol{c''}$ are the commands up to the first *while* (inclusive)

Branching (if):

$$\begin{aligned}
\langle (if\ C\ then\ S_t\ else\ S_f)\boldsymbol{c}, \boldsymbol{s}, \boldsymbol{m}\rangle &\to \langle C\ branch\ \boldsymbol{c}, S_t S_f \boldsymbol{s}, \boldsymbol{m}\rangle \\
\langle branch\ \boldsymbol{c}, true\ S_t S_f \boldsymbol{s}, \boldsymbol{m}\rangle &\to \langle S_t \boldsymbol{c}, \boldsymbol{s}, \boldsymbol{m}\rangle \\
\langle branch\ \boldsymbol{c}, false\ S_t S_f \boldsymbol{s}, \boldsymbol{m}\rangle &\to \langle S_f \boldsymbol{c}, \boldsymbol{s}, \boldsymbol{m}\rangle
\end{aligned}$$

Looping ($while$):

$$\begin{aligned}
\langle (while\ C\ do\ S)\boldsymbol{c}, \boldsymbol{s}, \boldsymbol{m}\rangle &\to \langle C\ loop\ \boldsymbol{c}, CS\boldsymbol{s}, \boldsymbol{m}\rangle \\
\langle loop\ \boldsymbol{c}, false\ CS\boldsymbol{s}, \boldsymbol{m}\rangle &\to \langle \boldsymbol{c}, \boldsymbol{s}, \boldsymbol{m}\rangle \\
\langle loop\ \boldsymbol{c}, true\ CS\boldsymbol{s}, \boldsymbol{m}\rangle &\to \langle S(while\ C\ do\ S)\boldsymbol{c}, \boldsymbol{s}, \boldsymbol{m}\rangle
\end{aligned}$$