

$$[\text{variable}] \frac{\text{get}(\sigma \ R) \triangleright Z}{\langle \text{deref}(R), \sigma \rangle \rightarrow \langle Z, \sigma \rangle}$$

$$[\text{divInt}] \frac{n_1 \triangleright \text{int32}(-) \quad n_2 \triangleright \text{int32}(-)}{\langle \text{div}(n_1 \ n_2), \sigma \rangle \rightarrow \langle \text{div}(n_1 \ n_2), \sigma \rangle}$$

$$[\text{divReal}] \frac{n_1 \triangleright \text{real64}(-) \quad n_2 \triangleright \text{real64}(-)}{\langle \text{div}(n_1 \ n_2), \sigma \rangle \rightarrow \langle \text{div}(n_1 \ n_2), \sigma \rangle}$$

$$[\text{divRightInt}] \frac{n \triangleright \text{int32}(-) \quad \langle E_2, \sigma \rangle \rightarrow \langle I_2, \sigma' \rangle}{\langle \text{div}(n \ E_2), \sigma \rangle \rightarrow \langle \text{div}(n \ I_2), \sigma' \rangle}$$

$$[\text{divRightReal}] \frac{n \triangleright \text{real64}(-) \quad \langle E_2, \sigma \rangle \rightarrow \langle I_2, \sigma' \rangle}{\langle \text{div}(n \ E_2), \sigma \rangle \rightarrow \langle \text{div}(n \ I_2), \sigma' \rangle}$$

$$[\text{divLeft}] \frac{\langle E_1, \sigma \rangle \rightarrow \langle I_1, \sigma' \rangle}{\langle \text{div}(E_1 \ E_2), \sigma \rangle \rightarrow \langle \text{div}(I_1 \ E_2), \sigma' \rangle}$$

$$[\text{sequenceDone}] \langle \text{seq}(\text{done } C), \sigma \rangle \rightarrow \langle C, \sigma \rangle$$

$$[\text{sequence}] \frac{\langle C_1, \sigma \rangle \rightarrow \langle C_1', \sigma' \rangle}{\langle \text{seq}(C_1 \ C_2), \sigma \rangle \rightarrow \langle \text{seq}(C_1' \ C_2), \sigma' \rangle}$$

$$[\text{gt}] \frac{n_1 \triangleright \text{int32}(-) \quad n_2 \triangleright \text{int32}(-)}{\langle \text{gt}(n_1 \ n_2), \sigma \rangle \rightarrow \langle \text{gt}(n_1 \ n_2), \sigma \rangle}$$

$$[\text{gt}] \frac{n_1 \triangleright \text{real64}(-) \quad n_2 \triangleright \text{real64}(-)}{\langle \text{gt}(n_1 \ n_2), \sigma \rangle \rightarrow \langle \text{gt}(n_1 \ n_2), \sigma \rangle}$$

$$[\text{gtRight}] \frac{n \triangleright \text{int32}(-) \quad \langle E_2, \sigma \rangle \rightarrow \langle I_2, \sigma' \rangle}{\langle \text{gt}(n \ E_2), \sigma \rangle \rightarrow \langle \text{gt}(n \ I_2), \sigma' \rangle}$$

$$[\text{gtRight}] \frac{n \triangleright \text{real64}(-) \quad \langle E_2, \sigma \rangle \rightarrow \langle I_2, \sigma' \rangle}{\langle \text{gt}(n \ E_2), \sigma \rangle \rightarrow \langle \text{gt}(n \ I_2), \sigma' \rangle}$$

$$[\text{gtLeft}] \frac{\langle E_1, \sigma \rangle \rightarrow \langle I_1, \sigma' \rangle}{\langle \text{gt}(E_1 \ E_2), \sigma \rangle \rightarrow \langle \text{gt}(I_1 \ E_2), \sigma' \rangle}$$

$$[\text{box}] \frac{x \triangleright \text{real64}(-) \quad y \triangleright \text{real64}(-) \quad z \triangleright \text{real64}(-)}{\langle \text{box}(x \ y \ z), \sigma \rangle \rightarrow \langle \text{user}(\text{string}(\text{box}) \ x \ y \ z), \sigma \rangle}$$

$$[\text{rotate}] \frac{Z \triangleright \text{int32}(-) \quad x \triangleright \text{real64}(-) \quad y \triangleright \text{real64}(-) \quad z \triangleright \text{real64}(-)}{\langle \text{rotate}(Z \ x \ y \ z), \sigma \rangle \rightarrow \langle \text{user}(\text{string}(\text{rotate}) \ Z \ x \ y \ z), \sigma \rangle}$$

$$[\text{rotateResolve}] \frac{\langle E_1, \sigma \rangle \rightarrow \langle V_1, \sigma \rangle \quad \langle E_2, \sigma \rangle \rightarrow \langle V_2, \sigma \rangle \quad \langle E_3, \sigma \rangle \rightarrow \langle V_3, \sigma \rangle \quad \langle E_4, \sigma \rangle \rightarrow \langle V_4, \sigma \rangle}{\langle \text{rotate}(E_1 \ E_2 \ E_3 \ E_4), \sigma \rangle \rightarrow \langle \text{rotate}(V_1 \ V_2 \ V_3 \ V_4), \sigma \rangle}$$

$$[\text{scale}] \frac{Z \triangleright \text{int32}(-) \quad x \triangleright \text{real64}(-) \quad y \triangleright \text{real64}(-) \quad z \triangleright \text{real64}(-)}{\langle \text{scale}(Z \ x \ y \ z), \sigma \rangle \rightarrow \langle \text{user}(\text{string}(\text{scale}) \ Z \ x \ y \ z), \sigma \rangle}$$

$$[\text{scaleResolve}] \frac{\langle E_1, \sigma \rangle \rightarrow \langle V_1, \sigma \rangle \quad \langle E_2, \sigma \rangle \rightarrow \langle V_2, \sigma \rangle \quad \langle E_3, \sigma \rangle \rightarrow \langle V_3, \sigma \rangle \quad \langle E_4, \sigma \rangle \rightarrow \langle V_4, \sigma \rangle}{\langle \text{scale}(E_1 \ E_2 \ E_3 \ E_4), \sigma \rangle \rightarrow \langle \text{scale}(V_1 \ V_2 \ V_3 \ V_4), \sigma \rangle}$$

$$[\text{ne}] \frac{n_1 \triangleright \text{int32}(-) \quad n_2 \triangleright \text{int32}(-)}{\langle \text{ne}(n_1 \ n_2), \sigma \rangle \rightarrow \langle \text{ne}(n_1 \ n_2), \sigma \rangle}$$

$$[\text{neRight}] \frac{n \triangleright \text{int32}(-) \quad \langle E_2, \sigma \rangle \rightarrow \langle I_2, \sigma' \rangle}{\langle \text{ne}(n \ E_2), \sigma \rangle \rightarrow \langle \text{ne}(n \ I_2), \sigma' \rangle}$$

$$[\text{neLeft}] \frac{\langle E_1, \sigma \rangle \rightarrow \langle I_1, \sigma' \rangle}{\langle \text{ne}(E_1 \ E_2), \sigma \rangle \rightarrow \langle \text{ne}(I_1 \ E_2), \sigma' \rangle}$$

$$[\text{cube}] \frac{e \triangleright \text{real64}(-)}{\langle \text{cube}(e), \sigma \rangle \rightarrow \langle \text{user}(\text{string}(\text{cube}) \ e), \sigma \rangle}$$

$$[\text{cubeResolve}] \frac{\langle E, \sigma \rangle \rightarrow \langle I, \sigma' \rangle}{\langle \text{cube}(E), \sigma \rangle \rightarrow \langle \text{cube}(I), \sigma' \rangle}$$

$$[\text{ifTrue}] \langle \text{if}(\text{bool}(\text{True}) \ C_1 \ C_2), \sigma \rangle \rightarrow \langle C_1, \sigma \rangle$$

$$[\text{ifFalse}] \langle \text{if}(\text{bool}(\text{False}) \ C_1 \ C_2), \sigma \rangle \rightarrow \langle C_2, \sigma \rangle$$

$$[\text{ifResolve}] \frac{\langle E, \sigma \rangle \rightarrow \langle E', \sigma' \rangle}{\langle \text{if}(E \ C_1 \ C_2), \sigma \rangle \rightarrow \langle \text{if}(E' \ C_1 \ C_2), \sigma' \rangle}$$

$$[\text{init}] \frac{w \triangleright \text{int32}(-) \quad h \triangleright \text{int32}(-)}{\langle \text{init}(w \ h), \sigma \rangle \rightarrow \langle \text{user}(\text{string}(\text{init}) \ w \ h), \sigma \rangle}$$

$$[\text{subInt}] \frac{n_1 \triangleright \text{int32}(-) \quad n_2 \triangleright \text{int32}(-)}{\langle \text{sub}(n_1 \ n_2), \sigma \rangle \rightarrow \langle \text{sub}(n_1 \ n_2), \sigma \rangle}$$

$$[\text{subReal}] \frac{n_1 \triangleright \text{real64}(-) \quad n_2 \triangleright \text{real64}(-)}{\langle \text{sub}(n_1 \ n_2), \sigma \rangle \rightarrow \langle \text{sub}(n_1 \ n_2), \sigma \rangle}$$

$$[\text{subRightInt}] \frac{n \triangleright \text{int32}(-) \quad \langle E_2, \sigma \rangle \rightarrow \langle I_2, \sigma' \rangle}{\langle \text{sub}(n \ E_2), \sigma \rangle \rightarrow \langle \text{sub}(n \ I_2), \sigma' \rangle}$$

$$[\text{subRightReal}] \frac{n \triangleright \text{real64}(-) \quad \langle E_2, \sigma \rangle \rightarrow \langle I_2, \sigma' \rangle}{\langle \text{sub}(n \ E_2), \sigma \rangle \rightarrow \langle \text{sub}(n \ I_2), \sigma' \rangle}$$

$$[\text{subLeft}] \frac{\langle E_1, \sigma \rangle \rightarrow \langle I_1, \sigma' \rangle}{\langle \text{sub}(E_1 \ E_2), \sigma \rangle \rightarrow \langle \text{sub}(I_1 \ E_2), \sigma' \rangle}$$

$$[\text{sphere}] \frac{r \triangleright \text{real64}(-)}{\langle \text{sphere}(r), \sigma \rangle \rightarrow \langle \text{user}(\text{string}(\text{sphere}) \ r), \sigma \rangle}$$

$$[\text{paint}] \langle \text{paint}, \sigma \rangle \rightarrow \langle \text{user}(\text{string}(\text{paint})), \sigma \rangle$$

$$[\text{while}] \quad \langle \text{while}(E \ C), \sigma \rangle \rightarrow \langle \text{if}(E \ \text{seq}(C \ \text{while}(E \ C)) \ \text{done}), \sigma \rangle$$

$$[\text{cylinder}] \quad \frac{r \triangleright \text{real64}(-) \quad h \triangleright \text{real64}(-)}{\langle \text{cylinder}(r \ h), \sigma \rangle \rightarrow \langle \text{user}(\text{string}(\text{cylinder}) \ r \ h), \sigma \rangle}$$

$$[\text{addInt}] \quad \frac{n_1 \triangleright \text{int32}(-) \quad n_2 \triangleright \text{int32}(-)}{\langle \text{add}(n_1 \ n_2), \sigma \rangle \rightarrow \langle \text{add}(n_1 \ n_2), \sigma \rangle}$$

$$[\text{addReal}] \quad \frac{n_1 \triangleright \text{real64}(-) \quad n_2 \triangleright \text{real64}(-)}{\langle \text{add}(n_1 \ n_2), \sigma \rangle \rightarrow \langle \text{add}(n_1 \ n_2), \sigma \rangle}$$

$$[\text{addRightInt}] \quad \frac{n \triangleright \text{int32}(-) \quad \langle E_2, \sigma \rangle \rightarrow \langle I_2, \sigma' \rangle}{\langle \text{add}(n \ E_2), \sigma \rangle \rightarrow \langle \text{add}(n \ I_2), \sigma' \rangle}$$

$$[\text{addRightReal}] \quad \frac{n \triangleright \text{real64}(-) \quad \langle E_2, \sigma \rangle \rightarrow \langle I_2, \sigma' \rangle}{\langle \text{add}(n \ E_2), \sigma \rangle \rightarrow \langle \text{add}(n \ I_2), \sigma' \rangle}$$

$$[\text{addLeft}] \quad \frac{\langle E_1, \sigma \rangle \rightarrow \langle I_1, \sigma' \rangle}{\langle \text{add}(E_1 \ E_2), \sigma \rangle \rightarrow \langle \text{add}(I_1 \ E_2), \sigma' \rangle}$$

$$[\text{cone}] \quad \frac{r \triangleright \text{real64}(-) \quad h \triangleright \text{real64}(-)}{\langle \text{cone}(r \ h), \sigma \rangle \rightarrow \langle \text{user}(\text{string}(\text{cone}) \ r \ h), \sigma \rangle}$$

$$[\text{assignInt}] \quad \frac{n \triangleright \text{int32}(-)}{\langle \text{assign}(X \ n), \sigma \rangle \rightarrow \langle \text{done}, \text{put}(\sigma \ X \ n) \rangle}$$

$$[\text{assignReal}] \quad \frac{n \triangleright \text{real64}(-)}{\langle \text{assign}(X \ n), \sigma \rangle \rightarrow \langle \text{done}, \text{put}(\sigma \ X \ n) \rangle}$$

$$[\text{assignStr}] \quad \frac{s \triangleright \text{string}(-)}{\langle \text{assign}(X \ s), \sigma \rangle \rightarrow \langle \text{done}, \text{put}(\sigma \ X \ s) \rangle}$$

$$[\text{assignBool}] \quad \frac{b \triangleright \text{bool}(-)}{\langle \text{assign}(X \ b), \sigma \rangle \rightarrow \langle \text{done}, \text{put}(\sigma \ X \ b) \rangle}$$

$$[\text{assignResolve}] \quad \frac{\langle E, \sigma \rangle \rightarrow \langle I, \sigma' \rangle}{\langle \text{assign}(X \ E), \sigma \rangle \rightarrow \langle \text{assign}(X \ I), \sigma' \rangle}$$

$$[\text{torus}] \quad \frac{r \triangleright \text{real64}(-) \quad R \triangleright \text{real64}(-)}{\langle \text{torus}(r \ R), \sigma \rangle \rightarrow \langle \text{user}(\text{string}(\text{torus}) \ r \ R), \sigma \rangle}$$

$$[\text{tetrahedron}] \quad \frac{e \triangleright \text{real64}(-)}{\langle \text{tetrahedron}(e), \sigma \rangle \rightarrow \langle \text{user}(\text{string}(\text{tetrahedron}) \ e), \sigma \rangle}$$

$$[\text{mulInt}] \quad \frac{n_1 \triangleright \text{int32}(-) \quad n_2 \triangleright \text{int32}(-)}{\langle \text{mul}(n_1 \ n_2), \sigma \rangle \rightarrow \langle \text{mul}(n_1 \ n_2), \sigma \rangle}$$

$$[\text{mulReal}] \quad \frac{n_1 \triangleright \text{real64}(-) \quad n_2 \triangleright \text{real64}(-)}{\langle \text{mul}(n_1 \ n_2), \sigma \rangle \rightarrow \langle \text{mul}(n_1 \ n_2), \sigma \rangle}$$

$$[\text{mulRightInt}] \frac{n \triangleright \text{int32}(-) \quad \langle E_2, \sigma \rangle \rightarrow \langle I_2, \sigma' \rangle}{\langle \text{mul}(n \ E_2), \sigma \rangle \rightarrow \langle \text{mul}(n \ I_2), \sigma' \rangle}$$

$$[\text{mulRightReal}] \frac{n \triangleright \text{real64}(-) \quad \langle E_2, \sigma \rangle \rightarrow \langle I_2, \sigma' \rangle}{\langle \text{mul}(n \ E_2), \sigma \rangle \rightarrow \langle \text{mul}(n \ I_2), \sigma' \rangle}$$

$$[\text{mulLeft}] \frac{\langle E_1, \sigma \rangle \rightarrow \langle I_1, \sigma' \rangle}{\langle \text{mul}(E_1 \ E_2), \sigma \rangle \rightarrow \langle \text{mul}(I_1 \ E_2), \sigma' \rangle}$$

$$[\text{pyramid}] \frac{e \triangleright \text{real64}(-) \quad h \triangleright \text{real64}(-)}{\langle \text{pyramid}(e \ h), \sigma \rangle \rightarrow \langle \text{user}(\text{string}(\text{pyramid}) \ e \ h), \sigma \rangle}$$

$$[\text{translate}] \frac{Z \triangleright \text{int32}(-) \quad x \triangleright \text{real64}(-) \quad y \triangleright \text{real64}(-) \quad z \triangleright \text{real64}(-)}{\langle \text{translate}(Z \ x \ y \ z), \sigma \rangle \rightarrow \langle \text{user}(\text{string}(\text{translate}) \ Z \ x \ y \ z), \sigma \rangle}$$

$$[\text{translateResolve}] \frac{\langle E_1, \sigma \rangle \rightarrow \langle V_1, \sigma \rangle \quad \langle E_2, \sigma \rangle \rightarrow \langle V_2, \sigma \rangle \quad \langle E_3, \sigma \rangle \rightarrow \langle V_3, \sigma \rangle \quad \langle E_4, \sigma \rangle \rightarrow \langle V_4, \sigma \rangle}{\langle \text{translate}(E_1 \ E_2 \ E_3 \ E_4), \sigma \rangle \rightarrow \langle \text{translate}(V_1 \ V_2 \ V_3 \ V_4), \sigma \rangle}$$
