Homework 2: Operational Semantics for WHILE

CS 252: Advanced Programming Languages
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1 Introduction

For this assignment, you will implement the semantics for a small imperative language, named WHILE.
$(e_1; e_2)$

2 Small-step semantics

Runtime Syntax:

$$\begin{array}{lcll} C & \in & \textit{Context} & ::= \quad C; e \mid C\ \textit{op}\ e \mid v\ \textit{op}\ C \mid x := C \mid \texttt{if}\ C\ \texttt{then}\ e_1\ \texttt{else}\ e_2 \mid \bullet \\ \sigma & \in & \textit{Store} & = \quad \textit{variable} \rightarrow v \end{array}$$

Evaluation Rules: $\boxed{e, \sigma \rightarrow e', \sigma'}$

[SS-VAR]
$$\frac{x \in \textit{domain}(\sigma) \qquad \sigma(x) = v}{C[x], \sigma \rightarrow C[v], \sigma}$$

[SS-ASSIGN]
$$\frac{}{C[x := v], \sigma \rightarrow C[v], \sigma[x := v]}$$

[SS-OP]
$$\frac{v = v_1\ \textit{op}\ v_2}{C[v_1\ \textit{op}\ v_2], \sigma \rightarrow C[v], \sigma}$$

[SS-SEQ]
$$\frac{}{C[v; e], \sigma \rightarrow C[e], \sigma}$$

[SS-IFTRUE]
$$\frac{}{C[\texttt{if true then}\ e_1\ \texttt{else}\ e_2], \sigma \rightarrow C[e_1], \sigma}$$

[SS-IFFALSE]
$$\frac{}{C[\texttt{if false then}\ e_1\ \texttt{else}\ e_2], \sigma \rightarrow C[e_2], \sigma}$$

[SS-WHILE]
$$\frac{}{C[\texttt{while}\ (e_1)\ e_2], \sigma \rightarrow C[\texttt{if}\ e_1\ \texttt{then}\ e_2; \texttt{while}\ (e_1)\ e_2\ \texttt{else false}], \sigma}$$

Figure 2: Small-step semantics for WHILE

e ::=		*Expressions*
	x	variables/addresses
	v	values
	$x := e$	assignment
	$e; e$	sequential expressions
	$e\ op\ e$	binary operations
	`if` e `then` e `else` e	conditional expressions
	`while` (e) e	while expressions
v ::=		*Values*
	i	integer values
	b	boolean values
op ::=	$+ \mid - \mid * \mid / \mid > \mid >= \mid < \mid <=$	*Binary operators*

Figure 1: The WHILE language