Definitive Semantic Descriptions

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Conventional semantic descriptions

Abstract syntax (fragment)

Expressions  $e \in \text{Exp}$
$$e ::= \text{con} \mid x \mid e_0 \text{bop} e_1 \mid \sim e \mid \ldots$$

Commands  $c \in \text{Com}$
$$c ::= x := e \mid c_0 ; c_1 \mid \text{if } e \text{ then } c \mid \ldots$$

\ldots
Conventional semantic descriptions

Auxiliary entities (fragment)

Environments \( \rho \in Env = Var \rightarrow BV \)
Stores \( \sigma \in S = Loc \rightarrow SV \ldots \)

\ldots
Conventional semantic descriptions

Semantics (SOS fragment)

Expressions

\[ \rho \vdash \langle e, \sigma \rangle \rightarrow \langle e', \sigma' \rangle \]

\[ \frac{\rho(x) = l, \quad \sigma(l) = v}{\rho \vdash \langle x, \sigma \rangle \rightarrow \langle v, \sigma \rangle} \]  

(1)
Conventional semantic descriptions

Semantics (SOS fragment)

Commands

\[ \rho \vdash \langle e, \sigma \rangle \longrightarrow \langle e', \sigma' \rangle \]  \hspace{1cm} (2)

\[ \rho \vdash \langle \text{if } e \text{ then } c, \sigma \rangle \longrightarrow \langle \text{if } e' \text{ then } c, \sigma' \rangle \]

\[ \rho \vdash \langle \text{if true then } c, \sigma \rangle \longrightarrow \langle c, \sigma \rangle \]  \hspace{1cm} (3)

\[ \rho \vdash \langle \text{if false then } c, \sigma \rangle \longrightarrow \langle \text{nil}, \sigma \rangle \]  \hspace{1cm} (4)
Possibility of reuse of parts of descriptions?

- usually cut-and-paste, edit, . . .
- explicit modules don’t help much . . .

Best chance for reuse with descriptions of individual constructs

(or of a few closely-related constructs)
Conventional descriptions of constructs

Commands

\( c \in Com \)

\( \rho \in Env, \sigma \in S, \ldots \)

\( \rho \vdash \langle c, \sigma \rangle \rightarrow \langle c', \sigma' \rangle \)
Conventional descriptions of constructs

Commands: Conditional

\[ c ::= \text{if } e \text{ then } c \]

\[ V \supseteq \{ \text{true, false} \} \]

\[
\rho \vdash \langle e, \sigma \rangle \rightarrow \langle e', \sigma' \rangle \\
\rho \vdash \langle \text{if } e \text{ then } c, \sigma \rangle \rightarrow \langle \text{if } e' \text{ then } c, \sigma' \rangle \\
\ldots
\]

(5)
Possibility of reuse of parts of descriptions!

- a language description is the collection of the descriptions of its individual constructs
- need to develop libraries of descriptions of individual constructs and auxiliary entities

Unfortunately, there’s a major problem:

combining constructs sometimes requires reformulation of their descriptions
We need **definitive descriptions of constructs!**

- conventional SOS and denotational semantics don’t support definitive descriptions
- modular SOS [see the proceedings] and action semantics definitely do
- does monadic denotational semantics?
Definitive descriptions of constructs

Commands

\[ c \in Com \]

\[ c \xrightarrow{X} c' \]

\[ \text{Final} \supseteq \{ \text{nil} \} \]
Definitive descriptions of constructs

Commands: Conditional

\[ c ::= \text{if } e \text{ then } c \]

\[ V \supseteq \{\text{true, false}\} \]

\[ e \xrightarrow{X} e' \]

\[ \text{if } e \text{ then } c \xrightarrow{X} \text{if } e' \text{ then } c \]

\[ \ldots \]
Definitive descriptions of constructs

Expressions

\[ e \in Exp \]

\[ e \overset{X}{\longrightarrow} e' \]

Final \supseteq Con
Definitive descriptions of constructs

Expressions: Constant Identifier

\[ e ::= x \]

\[ \rho : Env \]

\[ U = \{ \rho, \ldots \}, \quad \rho(x) = con \]

\[ \frac{\rho(x) = con}{x \xrightarrow{U} con} \]  

(7)
Status

- Libraries of definitive descriptions of constructs (and auxiliary entities) are being developed for MSOS and action semantics.
- A language-independent abstract syntax is being developed.
- Bisimulation proofs can be language-independent too, based on the definitive descriptions of the constructs involved.
Conclusion

• Describe individual constructs definitively
• Contribute to libraries
• Refer to libraries