The Rules

The Language

\[ L ::= \lambda x. L \quad \text{abstractions} \]
\[ L L \quad \text{applications} \]
\[ \text{let } x = L \text{ in } L \quad \text{Let expressions} \]
\[ \text{if } L \text{ then } L \text{ else } L \quad \text{If expressions} \]
\[ E \quad \text{expressions} \]
\[ E ::= x \quad \text{variables} \]
\[ n \quad \text{integers} \]
\[ b \quad \text{booleans} \]
\[ E \oplus E \quad \text{integer operations} \]
\[ E \sim E \quad \text{integer comparisons} \]
\[ E \&\& E \quad \text{boolean and} \]
\[ E \mid\mid E \quad \text{boolean or} \]

Reductions

Reduce the following programs according to the semantic rules given.

**Problem 1)**
\[ \{x:\text{Int},y:\text{Int}\} \vdash \text{if } x \ast y > 2 \text{ then } x \text{ else } y : \text{Int} \]

**Problem 2)**
\[ \{x:\text{Int},y:\text{Int}\} \vdash \text{let } m = x \ast y \text{ in } m - x : \text{Int} \]

**Problem 3)**
\[ \{\} \vdash (\lambda f.\lambda x. f \ x) \ (\lambda x. x) \ 10 : \text{Int} \]
Make your own rules!

Problem 4)
Try to write the type rules for Haskell’s head and tail functions.

Problem 5)
The logical rule for Modus Ponens looks like this:

\[
\begin{array}{c}
A \rightarrow B \\ A
\end{array} \Rightarrow B
\]

Is there a programming language equivalent to this? Talk to a neighbor and see if you can find a semantic rule that mirrors this.

Problem 6) What happens when you try to type check this code? Try to derive \( \alpha \).

\{y: \text{Int}, z: \text{String}\} \vdash (\lambda f. (fy, fz)) (\lambda x. x) : \alpha

\(^1\)Hint, the answer is “yes”.

Manager | Keeps team on track
Recorder | Records decisions
Reporter | Reports to Class
Reflector | Assesses team performance

1. What was a strength of your team's performance for this activity?

2. What could you do next time to increase your team's performance?

3. What insights did you have about the activity or your team's interaction today?

Type Semantics Activity (Monotype Version) --- Team's Assessment (SII)

Manager or Reflector: Consider the objectives of this activity and your team's experience with it, and then answer the following questions after consulting with your team.

1. What was a strength of this activity? List one aspect that helped it achieve its purpose.

2. What is one things we could do to improve this activity to make it more effective?

3. What insights did you have about the activity, either the content or at the meta level?