Syntax

Literals	lit	$::= None \mid True \mid False \mid$ "a" $\mid \ldots \mid 1 \mid \ldots$
Expression	Exp	$::= lit@(\overline{A}) \mid Exp.id \mid f(\overline{Exp}) \mid Exp.f(\overline{Exp}) \mid C[\overline{A}](\overline{Exp})$
Typed Expression	$TExp$	$::= lit@(\overline{A}) : \tau \mid \ldots$
Assign Op.	$AsgOp$	$\in \{$`=, +=, -=, *=, /=, %=, //=`$\}$
Binary Op.	$BinOp$	$\in \{$`||, &&, |, &, ==, !=, <, >, <=, >=, +, -, *, /, %, **`$\}$
Statement	Stm	$::=$ **pass** $\mid$ **return** $Exp \mid Exp\,;Stm \mid id = Exp\,;Stm$
		$\mid Exp_1\ AsgOp\ Exp_2\,;Stm \mid$ **if** $Exp : Stm_1\,;$**else** $: Stm_2\,;Stm$
		$\mid$ **try** $: Stm$ **except** $:\ Exp\,;Stm \mid$ **raise** Exp

Projection To Python

$$(Exp)\quad (\!|lit@(\overline{B}) : \tau|\!)^A = \begin{cases} lit & \text{if } A \in \overline{B} \\ \texttt{Unit.id} & \text{otherwise} \end{cases}$$

$$(\!|Exp.id : \tau|\!)^A = \begin{cases} (\!|Exp|\!)^A.id & \text{if } A \in \text{rolesOf}(Exp.id) \\ \text{absent} & \text{otherwise} \end{cases}$$

$$(\!|f(\overline{Exp}) : \tau|\!)^A = \begin{cases} f(\overline{(\!|Exp|\!)^A}) & \text{if } A \in \text{rolesOf}(f(\overline{Exp})) \\ \texttt{Unit.id}(f(\overline{(\!|Exp|\!)^A})) & \text{if } A \in \text{rolesOf}(\overline{Exp}) \wedge A \notin \text{rolesOf}(f(\overline{Exp})) \\ \texttt{Unit.id}(\overline{(\!|Exp|\!)^A}) & \text{otherwise} \end{cases}$$

$$(\!|Exp.f(\overline{Exp}) : \tau|\!)^A = \begin{cases} (\!|Exp|\!)^A.f(\overline{(\!|Exp|\!)^A}) \\ \qquad \text{if } A \in \text{rolesOf}(Exp) \wedge A \in \text{rolesOf}(\overline{Exp}) \\ \qquad\qquad \wedge A \in \text{rolesOf}(Exp.f(\overline{Exp})) \\ \texttt{Unit.id}((\!|Exp|\!)^A.f(\overline{(\!|Exp|\!)^A})) \\ \qquad \text{if } A \in \text{rolesOf}(Exp) \wedge A \notin \text{rolesOf}(Exp.f(\overline{Exp})) \\ \texttt{Unit.id}((\!|Exp|\!)^A, \overline{(\!|Exp|\!)^A}) \quad \text{otherwise} \end{cases}$$

$$(\!|C[\overline{B}](\overline{Exp}) : \tau|\!)^A = \begin{cases} (\!|C[\overline{B}]|\!)^A(\overline{(\!|Exp|\!)^A}) & A \in \overline{B} \\ \texttt{Unit.id}(\overline{(\!|Exp|\!)^A}) & \text{otherwise} \end{cases}$$

$$\text{rolesOf}(\_ : \tau@(\overline{B})) = \overline{B}$$

$$\text{rolesOf}(\overline{Exp}) = \bigcup_i \text{rolesOf}(Exp_i)$$

$$(\!|\overline{Exp}|\!)^A = Exp'_1, Exp'_2, \cdots, Exp'_n \quad \text{where} \quad Exp'_i = (\!|Exp_i|\!)^A$$

$$
\begin{aligned}
(Stm)\quad & (\!|\textsf{pass}|\!)^A = \textsf{pass} \\
& (\!|\textsf{return}\ Exp;|\!)^A = \textsf{return}(\!|Exp|\!)^A \\
& (\!|Exp; Stm|\!)^A = \begin{cases} \textsf{match}\ (\!|Exp|\!)^A : \\ \quad \textsf{case}\ id : (\!|Stm|\!)^A; \\ (\!|Exp|\!)^A; (\!|Stm|\!)^A & \text{otherwise} \end{cases} \\
& (\!|id = Exp\ ; Stm|\!)^A = \begin{cases} id = (\!|Exp|\!)^A; (\!|Stm|\!)^A & \text{if}\ \ A \in \text{rolesOf}(id) \\ (\!|Exp|\!)^A; (\!|Stm|\!)^A & \text{otherwise} \end{cases} \\
& (\!|Exp_1\ AsgOp\ Exp_2\ ; Stm|\!)^A = \begin{cases} (\!|Exp_1|\!)^A\ AsgOp\ (\!|Exp_2|\!)^A\ ; (\!|Stm|\!)^A \\ \qquad\qquad \text{if}\ \ A \in \text{rolesOf}(Exp_1 \wedge Exp_2) \\ (\!|Stm|\!)^A \quad \text{otherwise} \end{cases} \\
& (\!|\textsf{if}\ Exp : Stm_1\ ; \textsf{else} : Stm_2\ ; Stm|\!)^A = \\
& \begin{cases} \textsf{if}\ (\!|Exp|\!)^A : (\!|Stm_1|\!)^A\ ; \textsf{else} : (\!|Stm_2|\!)^A\ ; (\!|Stm|\!)^A & \text{if}\ \ \text{typesOf}(Exp) = \texttt{boolean@}A \\ (\!|Exp|\!)^A\ ; [\![(\!|Stm_1|\!)^A]\!] \sqcup [\![(\!|Stm_2|\!)^A]\!]\ ; (\!|Stm|\!)^A & \text{otherwise} \end{cases} \\
& (\!|\textsf{try} : Stm\ \ \textsf{except} :\ \ Exp\ ; Stm|\!)^A = \\
& \begin{cases} \textsf{try} : (\!|Stm|\!)^A\ \ \textsf{except} :\ \ (\!|Exp|\!)^A\ ; (\!|Stm|\!)^A & \text{if}\ \ A \in \text{rolesOf}(Exp) \\ \textsf{try} : (\!|Stm|\!)^A\ \ ; (\!|Stm|\!)^A & \text{otherwise} \end{cases} \\
& (\!|\textsf{raise}\ \ Exp|\!)^A = \begin{cases} \textsf{raise}\ \ (\!|Exp|\!)^A & \text{if}\ \ A \in \text{rolesOf}(Exp) \\ absent & \text{otherwise} \end{cases}
\end{aligned}
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