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 $Exp \mid Exp \cdot Stm \mid id = Exp \cdot Stm$
		$\mid Exp_1\ AsgOp\ Exp_2 \cdot Stm \mid$ if $Exp : Stm$ else $: Stm$
		$\mid$ try $: Stm$ except $:$ raise Exp ; Stm

Projection To Python

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

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

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

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

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

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

$$\text{rolesOf}(Exp.id : \tau) = \overline{B} \quad \text{if} \quad \text{rolesOf}(Exp) = \overline{B}$$

$$\text{rolesOf}(f(\overline{Exp}) : \tau) = \overline{B} \quad \text{if} \quad \text{rolesOf}(\overline{Exp}) = \overline{B}$$

$$\text{rolesOf}(Exp.f(\overline{Exp}) : \tau) = \overline{B} \quad \text{if} \quad \text{rolesOf}(Exp) = \overline{B}$$

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

$$(\!|\overline{Exp}|\!)^A = Exp'_1, Exp'_2, \cdots, Exp'_n \quad \text{where} \quad Exp'_i = \begin{cases} (\!|Exp_i|\!)^A & \text{if rolesOf}(Exp_i) = A \\ \texttt{Unit.id} & \end{cases}$$