

### Syntax

Literals	$lit$	$::= None \mid True \mid False \mid "a" \mid \dots \mid 1 \mid \dots$
Expression	$Exp$	$::= lit@(\overline{A}) \mid Exp.id \mid id_{Fun}(\overline{Exp})$ $\mid Exp.id_{Fun}(\overline{Exp}) \mid id_{Cls}@\overline{A}.\overline{Exp}$
Expression	$TExp$	$::= lit@(\overline{A}) : \tau \mid \dots$
	$id_{Fun}$	$::= f \mid g \mid \dots$
	$id_{Cls}$	$::= C \mid D \mid \dots$
Assign Op.	$AsgOp$	$\in \{=, +=, -=, *=, /=, \%=, //=\}$
Binary Op.	$BinOp$	$\in \{  , \&\&,  , \&, ==, !=, <, >, <=, >=, +, -, *, /, \%, **\}$

### Projection To Python

$$\begin{aligned}
(Exp) \quad \llbracket lit@(\overline{B}) : \tau \rrbracket^A &= \begin{cases} lit & \text{if } A \in \overline{B} \\ \text{Unit.id} & \text{otherwise} \end{cases} \\
\llbracket Exp.id : \tau \rrbracket^A &= \begin{cases} \llbracket Exp \rrbracket^A.id & \text{if } A \in \text{rolesOf}(Exp.id) \\ \text{absent} & \text{otherwise} \end{cases} \\
\llbracket id_{Fun}(\overline{Exp}) : \tau \rrbracket^A &= \begin{cases} id_{Fun}(\llbracket \overline{Exp} \rrbracket^A) & \text{if } A \in \text{rolesOf}(\overline{Exp}) \\ id_{Fun}(\llbracket \text{Unit.id} \rrbracket^A) & \\ \text{if } A \notin \text{rolesOf}(\overline{Exp}) \wedge A \in \text{rolesOf}(id_{Fun}(\overline{Exp})) & \\ \text{Unit.id}_{Fun}(\llbracket \overline{Exp} \rrbracket^A) & \text{otherwise} \end{cases} \\
\llbracket Exp.id_{Fun}(\overline{Exp}) : \tau \rrbracket^A &= \begin{cases} \llbracket Exp \rrbracket^A.id_{Fun}(\llbracket \overline{Exp} \rrbracket^A) & \\ \text{if } A \in \text{rolesOf}(Exp) \wedge A \in \text{rolesOf}(\overline{Exp}) & \\ \llbracket Exp \rrbracket^A.id_{Fun}(\llbracket \text{Unit.id} \rrbracket^A) & \\ \text{if } A \in \text{rolesOf}(Exp) \wedge A \notin \text{rolesOf}(\overline{Exp}) & \\ \text{Unit.id}_{Fun}(\llbracket \overline{Exp} \rrbracket^A, \llbracket \overline{Exp} \rrbracket^A) & \text{otherwise} \end{cases} \\
\llbracket id_{Cls}@\overline{B}(\overline{Exp}) : \tau \rrbracket^A &= \begin{cases} \llbracket id_{Cls}@\overline{B} \rrbracket^A(\llbracket \overline{Exp} \rrbracket^A) & A \in \overline{B} \\ \text{Unit.id}_{Cls}(\llbracket \overline{Exp} \rrbracket^A) & \text{otherwise} \end{cases} \\
\text{rolesOf}(\_ : \tau@(\overline{B})) &= \overline{B} \\
\text{rolesOf}(Exp.id : \tau) &= \overline{B} \quad \text{if } \text{rolesOf}(Exp) = \overline{B} \\
\text{rolesOf}(id_{Fun}(\overline{Exp}) : \tau) &= \overline{B} \quad \text{if } \text{rolesOf}(\overline{Exp}) = \overline{B} \\
\text{rolesOf}(Exp.id_{Fun}(\overline{Exp}) : \tau) &= \overline{B} \quad \text{if } \text{rolesOf}(Exp) = \overline{B}
\end{aligned}$$