

## Syntax

Literals	$lit$	$::= None \mid True \mid False \mid \dots \mid 1 \mid \dots$
Expression	$Exp$	$::= lit@(\overline{A}) \mid Exp.id \mid Exp_1 \text{ BinOp } Exp_2$ $\mid id_{Fun}(\overline{Exp}) \mid Exp.id_{Fun}(\overline{Exp}) \mid id_{Cls}@(\overline{A}).(\overline{Exp})$
	$id_{Fun}$	$::= f \mid g \mid \dots$
	$id_{Cls}$	$::= C \mid D \mid \dots$
Assign Op.	$AsgOp$	$\in \{=, +=, -=, *=, /=, \%=, /\} \}$
Binary Op.	$BinOp$	$\in \{  , \&\&,  , \&, ==, !=, <, >, <=, >=, +, -, *, /, \%, **\}$

## Projection To Python

$$\begin{aligned}
(Exp) \quad \langle lit@(\overline{B}) \rangle^A &= \begin{cases} lit & \text{if } A \in \overline{B} \\ \text{Unit.id} & \text{otherwise} \end{cases} \\
\langle Exp.id \rangle^A &= \begin{cases} \langle Exp \rangle^A.id & \text{if } A \in \text{rolesOf}(Exp.id) \\ \text{absent} & \text{otherwise} \end{cases} \\
\langle id_{Fun}(\overline{Exp}) \rangle^A &= \begin{cases} id_{Fun}(\langle Exp \rangle^A) & \text{if } A \in \text{rolesOf}(id_{Fun}(\overline{Exp})) \\ \text{Unit.id}_{Fun}(\langle Exp \rangle^A) & \text{otherwise} \end{cases} \\
\langle Exp.id_{Fun}(\overline{Exp}) \rangle^A &= \begin{cases} \langle Exp \rangle^A.id_{Fun}(\langle Exp \rangle^A) & \text{if } A \in \text{rolesOf}(Exp) \\ \text{Unit.id}_{Fun}(\langle Exp \rangle^A, \langle Exp \rangle^A) & \text{otherwise} \end{cases} \\
\langle id_{Cls}@(\overline{B})(\overline{Exp}) \rangle^A &= \begin{cases} \langle id_{Cls}@(\overline{B}) \rangle^A(\langle Exp \rangle^A) & A \in \overline{B} \\ \text{Unit.id}_{Cls}(\langle Exp \rangle^A) & \text{otherwise} \end{cases} \\
\langle Exp_1 \text{ BinOp } Exp_2 \rangle^A &= \begin{cases} \langle Exp_1 \rangle^A \text{ BinOp } \langle Exp_2 \rangle^A & \text{if } \text{roleOf}(Exp_1) = \text{roleOf}(Exp_2) = \{A\} \\ \text{Unit.id}(\langle Exp_1 \rangle^A, \langle Exp_2 \rangle^A) & \text{otherwise} \end{cases} \\
\text{rolesOf}(lit@(\overline{B})) &= \overline{B} \\
\text{rolesOf}(Exp.id) &= \overline{B} \quad \text{if } \exists T. \text{typeOf}(Exp.id) = T@(\overline{B}) \\
\text{typeOf} : Exp &\rightarrow Type \\
\text{rolesOf}(id_{Fun}(\overline{Exp})) &= \overline{B} \quad \text{if } \exists T. \text{typeOf}(id_{Fun}(\overline{Exp})) = T@(\overline{B}) \\
\text{rolesOf}(Exp.id_{Fun}(\overline{Exp})) &= \overline{B} \quad \text{if } \exists T. \text{typeOf}(Exp.id_{Fun}(\overline{Exp})) = T@(\overline{B})
\end{aligned}$$