

$cd ::= \text{class } C \text{ extends } D \{ \overline{fd}; \overline{skd}; \overline{md} \}$ class

$fd ::= t f$ field

$kd ::= C(\overline{tf}) \{ \text{super}(\overline{f}); \text{this}.\overline{f} = \overline{f}; \}$

$md ::= tm(t \text{ this}, tx) \{ \overline{ty} s; \text{return } y \}$ method

$s ::= s; s \mid X = \text{new } t(c) \mid X = y \mid X = X.f \mid x.f = y \mid X = y.m(z)$ Mutable

$t ::= qc$

$q ::= \text{readonly} \mid \text{polyimmutable} \mid \text{mutable} \mid \text{immutable}$



PolyImmutable

ViewPoint Adaptation Rules:

- $\triangleright \text{mutable} = \text{mutable}$
- $\triangleright \text{readonly} = \text{readonly}$
- $\triangleright \text{immutable} = \text{immutable}$
- $q \triangleright \text{polyimmutable} = q$

Special Rules:

- Forbid mutable/readonly fields.
- Forbid readonly constructor return type.
- In constructor, $q_{\text{this}} = q_{\text{ret}}$.

$$\frac{\Gamma(x) = q_x \quad \Gamma(y) = q_y \quad q_y \leq q_x}{\Gamma \vdash x = y} \quad (\text{T-VAR})$$

$$\frac{\Gamma(x) = q_x \quad \Gamma(y) = q_y \quad \text{typeof}(f) = q_f \quad q_y \triangleright q_f \leq q_x}{\Gamma \vdash x = y.f} \quad (\text{T-READ})$$

$$\frac{\Gamma(x) = q_x \quad q_x = \text{mutable} \vee [x = \text{"this"} \text{ in constructor} \wedge q_x \in \{\text{mutable}, \text{immutable}, \text{polyimmutable}\}] \quad \Gamma(y) = q_y \quad \text{typeof}(f) = q_f \quad q_y \leq q_x \triangleright q_f}{\Gamma \vdash x.f = y} \quad (\text{T-WRITE})$$

$$\frac{\Gamma(x) = q_x \quad \Gamma(y) = q_y \quad \Gamma(z) = q_z \quad \text{typeof}(m) = q_{\text{this}}, q_p \rightarrow q_{\text{ret}} \quad q_y \leq q_x \triangleright q_{\text{this}} \quad q_z \leq q_x \triangleright q_p \quad q_x \triangleright q_{\text{ret}} \leq q_x}{\Gamma \vdash x = y.m(z)} \quad (\text{T-INVK})$$

$$\frac{\text{typeof}(C) = q_p \rightarrow q_{\text{ret}} \quad q \leq q \triangleright q_{\text{ret}} \quad q_y \leq q \triangleright q_p \quad q = \begin{cases} \text{mutable} \\ \text{immutable} \rightarrow q_p = \text{immutable} \vee \text{polyimmutable} \end{cases}}{\Gamma \vdash x = \text{new } q \ C(y)} \quad (\text{T-NEW})$$