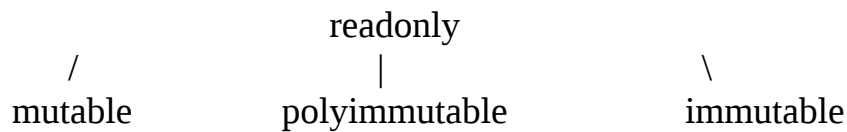


cd ::= class C { \overline{fd} ; kd \overline{md} }	class
fd ::= t f	field
kd ::= q C (t f) { this.f = \overline{f} ; }; // Doesn't support subclassing yet	constructor
md ::= t m (t this, t x) { t \overline{y} s; return y }	instance method
s ::= s;s x = new t() x = y x = y.f x.f = y x = y.m(z)	statement
t ::= q C	qualified type
q ::= readonly polyimmutable mutable immutable	qualifier

Type Hierarchy



Helper Functions

$q\ C\ f$

$\text{typeof}(f) = q$

m is annotated with @initialize

$\text{initializable}(m)$

$x = \text{"this" in constructor } \forall (x = \text{"this" in } m \wedge \text{initializable}(m))$

$\text{initializable}(x)$

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 and readonly on fields
- Forbid readonly on constructor return type
- In constructor, $q_{\text{this}} = q_{\text{ret}}$

Typing Rules

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

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

$$\frac{\begin{array}{l} \Gamma(x) = q_x \quad \Gamma(y) = q_y \quad \text{typeof}(f) = q_f \quad q_y <: q_x \triangleright q_f \\ q_x = \text{mutable} \vee (\text{initializable}(x) \wedge q_x = \{\text{immutable}, \text{polyimmutable}\}) \end{array}}{\Gamma \vdash x.f = y} \quad (\text{T-WRITE})$$

$$\frac{\begin{array}{l} \Gamma(x) = q_x \quad \Gamma(y) = q_y \quad \Gamma(z) = q_z \quad \text{typeof}(m) = q_{\text{this}}, q_p \rightarrow q_{\text{ret}} \\ q_y <: q_x \triangleright q_{\text{this}} \quad q_z <: q_x \triangleright q_p \quad q_x \triangleright q_{\text{ret}} <: q_x \\ ! \text{ inside constructor} \wedge !(\text{inside } m' \wedge \text{initializable}(m')) \rightarrow ! \text{initializable}(m) \end{array}}{\Gamma \vdash x = y.m(z)} \quad (\text{T-INVK})$$

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

Example