Syntax

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\begin{array}{lll}
\text{Type identifiers} & ::= & C, G, T, S, \ldots \\
\text{Types } \tau, \sigma & ::= & T \mid \textbf{dynamic} \mid \textbf{Object} \mid \textbf{Null} \mid \textbf{Type} \mid \textbf{num} \mid \textbf{bool} \\
 & & \mid \overrightarrow{\tau} \to \sigma \mid C{<}\overrightarrow{\tau}{>} \\
\text{Term identifiers} & ::= & a, b, x, y, m, n, \ldots \\
\text{Primops } (\phi) & ::= & +, - \ldots || \ldots \\
\text{lhs } (l) & ::= & x \mid e.m \\
\text{Expressions } e & ::= & x \mid i \mid \mathrm{tt} \mid \mathrm{ff} \mid \textbf{null} \mid \textbf{this} \mid \textbf{super} \mid (\overrightarrow{x : \tau}) \Rightarrow e \mid \textbf{new}\, C{<}\overrightarrow{\tau}{>}(\overrightarrow{e}) \\
 & & \mid \phi(\overrightarrow{e}) \mid e(\overrightarrow{e}) \mid e.m \mid l = e \\
 & & \mid e \textbf{ as } \tau \mid e \textbf{ is } \tau \\
\text{Declaration } (vd) & ::= & \textbf{var } x \ = \ e \mid \textbf{var } x : \tau \ = \ e \mid \tau\ f(\overrightarrow{x : \tau})\ b \\
\text{Statements } (s) & ::= & vd \mid e \mid \textbf{if } (E1) \textbf{ then } b_1 \textbf{ else } b_2 \mid \textbf{return } e \mid s; s \\
\text{Blocks } (b) & ::= & \{s;\} \\
\text{Class decl } (cd) & ::= & \textbf{class } C{<}\overrightarrow{T}{>} \textbf{ extends } G{<}\overrightarrow{S}{>}\ \{\overrightarrow{vd}\} \\
\text{Toplevel decl } (td) & ::= & vd \mid cd \\
\text{Program } (P) & ::= & \textbf{let } \overrightarrow{td} \textbf{ in } b
\end{array}
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\begin{array}{lll}
\text{Class signature } (Sig) & ::= & \textbf{class } C{<}\overrightarrow{T}{>} \textbf{ extends } G{<}\overrightarrow{S}{>}\ \{\overrightarrow{x : \tau}\} \\
\text{Type context } (\Delta) & ::= & \epsilon \mid \Delta, X <: \tau \\
\text{Class hierarchy } (\Phi) & ::= & \epsilon \mid \Phi, C \ : \ Sig
\end{array}
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Subtyping

$$
\frac{}{\Phi, \Delta \vdash \ \tau <: \ \textbf{dynamic}}
\qquad\qquad
\frac{}{\Phi, \Delta \vdash \ \tau <: \ \textbf{Object}}
$$

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\frac{}{\Phi, \Delta \vdash \ \textbf{bottom} <: \ \tau}
\qquad\qquad
\frac{}{\Phi, \Delta \vdash \ \tau <: \ \tau}
$$

$$
\frac{\Delta = \Delta'[S \ <: \ \sigma] \quad \Phi, \Delta \vdash \ \sigma <: \ \tau}{\Phi, \Delta \vdash \ S <: \ \tau}
$$

$$
\frac{\Phi, \Delta \vdash \ \sigma_i <: \ \tau_i \quad i \in 0, \ldots, n \quad \Phi, \Delta \vdash \ \tau_r <: \ \sigma_r}{\Phi, \Delta \vdash \ \tau_0, \ldots, \tau_n \to \tau_r <: \ \sigma_0, \ldots, \sigma_n \to \sigma_r}
$$

$$
\frac{\Phi, \Delta \vdash \ \tau_i <: \ \sigma_i \quad i \in 0, \ldots, n}{\Phi, \Delta \vdash \ C{<}\tau_0, \ldots, \tau_n{>} <: \ C{<}\sigma_0, \ldots, \sigma_n{>}}
$$

$$
\frac{\begin{array}{l}\Phi = \Phi'[C \ : \ \textbf{class } C{<}T_0, \ldots, T_n{>} \textbf{ extends } C'{<}\upsilon_0, \ldots, \upsilon_k{>}\ \{\ldots\}] \\ \Phi, \Delta \ \vdash \ \ [\tau_0, \ldots, \tau_n / T_0, \ldots, T_n] C'{<}\upsilon_0, \ldots, \upsilon_k{>} <: \ G{<}\sigma_0, \ldots, \sigma_m{>}\end{array}}{\Phi, \Delta \vdash \ C{<}\tau_0, \ldots, \tau_n{>} <: \ G{<}\sigma_0, \ldots, \sigma_m{>}}
$$