Pony

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Text of abstract . . . .

1 SYNTAX

$$
\begin{aligned}
\mathtt{P} &::= \overline{\mathtt{CT}}\ \overline{\mathtt{AT}} \\
\mathtt{CT} &::= \mathtt{class}\ \mathtt{C}\ \overline{\mathtt{F}} \\
\mathtt{AT} &::= \mathtt{actor}\ \mathtt{A}\ \overline{\mathtt{F}}\ \overline{\mathtt{B}} \\
\mathtt{F} &::= \mathtt{var}\ f : \mathtt{S}\ \kappa \\
\mathtt{B} &::= \mathtt{be}\ b(\overline{x : \mathtt{S}\ \kappa}) \Rightarrow e \\
e &::= x \\
&\mid x = e \\
&\mid e.f \\
&\mid e.f = e \\
&\mid e.b(\overline{e}) \\
&\mid e; e \\
&\mid \mathtt{new}\ \mathtt{S}
\end{aligned}
$$

2 CAPABILITIES

$$
\begin{aligned}
\kappa &::= \mathtt{iso} \mid \mathtt{trn} \mid \mathtt{ref} \mid \mathtt{val} \mid \mathtt{box} \mid \mathtt{tag} \\
\lambda &::= \kappa \mid \mathtt{iso}- \mid \mathtt{trn}-
\end{aligned}
$$

$$
\mathtt{iso}- \leq \{\mathtt{iso}, \mathtt{trn}-\} \qquad \mathtt{trn}- \leq \{\mathtt{trn}, \mathtt{ref}, \mathtt{val}\} \leq \mathtt{box} \qquad \{\mathtt{iso}, \mathtt{box}\} \leq \mathtt{tag} \qquad \lambda \leq \lambda
$$

$$
\frac{\lambda \leq \lambda'' \qquad \lambda'' \leq \lambda'}{\lambda \leq \lambda'}
$$

3 TYPING RULES

$$\frac{x \in \Gamma}{\Gamma \vdash x : \Gamma(x)}\ \textsc{T-Local} \qquad \frac{\Gamma(x) = \mathtt{S}\ \kappa \qquad \Gamma \vdash_{\mathcal{A}} e : \mathtt{S}\ \kappa}{\Gamma \vdash x = e : \mathcal{U}(\mathtt{S}\ \kappa)}\ \textsc{T-AsnLocal}$$

$$\frac{\Gamma \vdash e : \mathtt{S}\ \lambda \qquad \mathit{Field}(\mathtt{S}, f) = \mathtt{S}'\kappa}{\Gamma \vdash e.f : \mathtt{S}'\ (\lambda \rhd \kappa)}\ \textsc{T-Fld}$$

$$\frac{\Gamma \vdash e : \mathtt{S}\ \lambda \qquad \mathit{Field}(\mathtt{S}, f) = \mathtt{S}'\kappa \qquad \Gamma \vdash_{\mathcal{A}} e' : \mathtt{S}'\ \kappa \qquad \Gamma \vdash e : \mathtt{S}'\ \lambda' \qquad \lambda \lhd \mathcal{A}(\lambda')}{\Gamma \vdash e.f = e' : \mathtt{S}'\ (\lambda \blacktriangleright \kappa)}\ \textsc{T-AsnFld} \qquad \frac{\mathtt{C} \in \mathtt{P}}{\mathtt{new\ C} : \mathtt{C\ iso}-}\ \textsc{T-Ctor}$$

$$\frac{\Gamma \vdash e : \mathtt{A}\ \lambda \qquad \overline{\Gamma \vdash_{\mathcal{A}} e : \mathtt{S}\ \lambda} \qquad \mathit{Behv}(A, b) = \overline{\mathtt{S}\ \lambda}}{\Gamma \vdash e.b(\overline{e}) : \mathtt{A}\ \lambda}\ \textsc{T-Behv} \qquad \frac{\Gamma \vdash e : \mathtt{S}\ \lambda \qquad \Gamma \vdash e' : \mathtt{S}'\ \lambda'}{\Gamma \vdash e; e' : \mathtt{S}'\ \lambda'}\ \textsc{T-Seq}$$

4 RUNTIME

4.1 Active and Passive Temporaries

4.2 Visibility

$$\begin{aligned} p &::= \mathtt{this} \mid x \mid t_a.f \mid p.f \\ pg &::= p \mid t_a \end{aligned}$$

$$\frac{\iota \in \chi}{\Delta, \chi, \iota \vdash \iota : \{\mathtt{ref}\}, \mathtt{this}}\ \textsc{V-This} \qquad \frac{\Delta, \chi, \iota \vdash \iota' : \lambda s, pg \qquad \chi(\iota', f) = \iota'' \qquad \mathit{Field}(\chi(\iota)\downarrow_1, f) = \mathtt{S}\ \kappa}{\Delta, \chi, \iota \vdash \iota'' : \lambda s \circ \kappa, pg.f}\ \textsc{V-Fld}$$

$$\frac{\chi(\alpha, x) = \iota \qquad \Delta(\alpha, x) = \mathtt{S}\ \kappa}{\Delta, \chi, \alpha \vdash \iota : \{\kappa, \mathcal{U}(\kappa)\}, x}\ \textsc{V-Local} \qquad \frac{\chi(\alpha, t_a) = \iota \qquad \Delta(\alpha, t_a) = \mathtt{S}\ \lambda}{\Delta, \chi, \alpha \vdash \iota : \{\lambda\}, t_a}\ \textsc{V-Active}$$

4.3 Well-formed visibility

$\mathit{WFV}(\Delta, \chi)$ iff $\forall \alpha, \alpha', \iota, p, p', \lambda s, \lambda s', \iota_0, p_0, \lambda_0$

(1) If $\alpha \neq \alpha'$ and $\Delta, \chi, \alpha \vdash \iota : \lambda s, p$ and $\Delta, \chi, \alpha' \vdash \iota : \lambda s', p'$ then $\lambda s \sim_g \lambda s'$

(2) If $\Delta, \chi, \alpha \vdash \iota_0 : \lambda s_0, p_0$ and $\mathit{Writable}(\lambda s_0)$ and $\Delta, \chi, \iota_0 \vdash \iota : \lambda s, p$ and $\Delta, \chi, \iota_0 \vdash \iota : \lambda s', p'$ then either
  - (a) $\lambda s \sim_l \lambda s'$ or
  - (b) $\chi, \alpha \vdash p \sim p'$

(3) If $\Delta, \chi, \alpha \vdash \iota : \lambda s, p$ and $\Delta, \chi, \alpha \vdash \iota : \{\lambda\}, t_a$ then $\lambda s \sim_l \mathcal{A}(\lambda)$

5 RECOVERY

5.1 Regioned capabilities

$$\begin{aligned} \lambda ::=\ & \mathtt{iso}- \mid \mathtt{iso} \mid \mathtt{val} \mid \mathtt{tag} \\ & \mid (\mathtt{trn}-, r_{id}) \mid (\mathtt{trn}, r_{id}) \mid (\mathtt{ref}, r_{id}) \mid (\mathtt{box}, r_{id}) \end{aligned}$$

5.2 Well-formed regions

$\mathit{WFR}(\Delta, \chi)$ iff $\forall \alpha, \mathtt{S}, z, z', \lambda, \lambda'$,
If $\chi(\alpha, z) = \chi(\alpha, z')$ and $\Delta(\alpha, z) = \mathtt{S}\ \lambda$ and $\Delta(\alpha, z') = \mathtt{S}\ \lambda'$ then either

(1) $\mathit{Region}(\lambda) = \mathit{Region}(\lambda')$ or
(2) $\lambda \sim_g \lambda'$