Typing Rules and Evaluation rules

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1 Fork

$$\frac{\Gamma|\mathbb{L} \vdash t : \ T}{fork\{\ t\ \} : \ Thread\ T} \quad \text{(T-Fork)}$$

$$\frac{t_1 \to t_1'}{fork\{\ t_1\ \} \to fork\{\ t_1'\ \}} \quad \text{(E-Fork)}$$

$$\frac{\Gamma|\mathbb{L} \vdash t : \ Thread\ T}{wait\{\ t\ \} : \ T} \quad \text{(T-Wait)}$$

$$\frac{t \to t'}{wait\{\ t\ \} \to wait\{\ t'\ \}} \quad \text{(E-Wait)}$$

$$\frac{\Gamma|\mathbb{L} \vdash t : \ Thread\ T}{wait\{\ fork\{\ t\ \}\ \} : \ T} \quad \text{(T-WaitFork)}$$

$$\frac{t_1 \to t_1'}{wait\{\ fork\{\ t_1\ \}\ \} \to wait\{\ fork\{\ t_1'\ \}\ \}} \quad \text{(E-Fork)}$$

$$wait\{\ fork\{\ v\ \}\ \} \to v \quad \text{(E-WaitFork)}$$

2 Mutex

$$\frac{}{\Gamma|\mathbb{L} \vdash mutex < X >:\ Mutex\ X} \quad \text{(T-Mutex)}$$

$$\frac{\Gamma|\mathbb{L} \vdash x:\ Mutex\ X \qquad \Gamma \vdash v : T}{ref < x > v:\ Ref < X > T} \quad \text{(T-RefMutex)}$$

$$\frac{t_1 \to t_1'}{ref < x > t_1 \to ref < x > t_1'} \quad \text{(E-RefMutex)}$$

$$\frac{\Gamma|\mathbb{L} \vdash t_1 : Ref < X > T \qquad X \in \mathbb{L}}{\Gamma|\mathbb{L} \vdash !t_1 : T} \quad \text{(T-DerefMutex)}$$

$$\frac{\Gamma|\mathbb{L} \vdash t_1 : Ref < X > T \qquad \Gamma \vdash t_2 : T \qquad X \in \mathbb{L}}{\Gamma|\mathbb{L} \vdash t_1 := t_2 : Unit} \quad \text{(T-AssignMutex)}$$

$$\frac{t_1|\mu \to t_1'|\mu'}{ref < x >\ t_1|\mu \to ref < x >\ t_1|\mu} \quad \text{(E-RefMutex)}$$

$$\frac{l \notin dom(\mu)}{ref < x >\ v|\mu \to l|\mu, l \mapsto v} \quad \text{(E-RefV)}$$

$$\frac{t_1|\mu \to t_1'|\mu'}{!t_1|\mu \to !t_1'|\mu} \quad \text{(E-Deref)}$$

$$\frac{\mu(l) = v}{!l|\mu \to v|\mu} \quad \text{(E-DerefLoc)}$$

$$\frac{t_1|\mu \to t_1'|\mu'}{t_1 := t_2|\mu \to t_1' := t_2|\mu} \quad \text{(E-Assign1)}$$

$$\frac{t_2|\mu \to t_2'|\mu'}{v := t_2|\mu \to v := t_2'|\mu} \quad \text{(E-Assign2)}$$

$$\frac{\mu(l) = v}{l := v|\mu \to unit|\mu, l \mapsto v} \quad \text{(E-AssignV)}$$

3 Lock

$$\frac{tail(\mathbb{L}) <_{lex} X \qquad \Gamma|\mathbb{L} \vdash t_1 : Mutex\ X \qquad \Gamma|(\mathbb{L}, X) \vdash t_2 : T}{lock\ t_1\ t_2 : T} \quad \text{(T-Lock)}$$

$$\frac{t_1 \to t_1'}{lock\ t_1\ t_2 \to lock\ t_1'\ t_2} \quad \text{(E-Lock1)}$$

$$\frac{t_2 \to t_2'}{lock\ v_1\ t_2 \to lock\ v_1\ t_2'} \quad \text{(E-Lock2)}$$

$$lock\ v_1\ v_2 \to v_2 \quad \text{(E-LockV)}$$