# Type System for Heavy Imp

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$$\frac{}{\Gamma \vdash \text{n: Nat}} \ (\text{T-Num}) \qquad\qquad \frac{}{\Gamma \vdash \text{b: Bool}} \ (\text{T-Bool})$$

$$\frac{\Gamma(x) = \text{Nat}}{\Gamma \vdash \text{x: Nat}} \ (\text{T-StoreR}) \qquad \frac{\Gamma(x) = \text{Loc}}{\Gamma \vdash \text{!x: Nat}} \ (\text{T-HeapR}) \qquad \frac{\Gamma \vdash t_1 : \text{Bool}}{\Gamma \vdash \neg t_1 : \text{Bool}} \ (\text{T-Neg})$$

$$\frac{\Gamma \vdash t_1 : \text{Nat} \qquad \Gamma \vdash t_2 : \text{Nat}}{\Gamma \vdash t_1 + t_2 : \text{Nat}} \ (\text{T-Add})$$

$$\frac{\Gamma \vdash t_1 : \text{Bool} \qquad \Gamma \vdash t_2 : \text{Bool}}{\Gamma \vdash t_1 \wedge t_2 : \text{Bool}} \ (\text{T-And}) \qquad \frac{\Gamma \vdash t_1 : \text{Nat} \qquad \Gamma \vdash t_2 : \text{Nat}}{\Gamma \vdash t_1 \leq t_2 : \text{Bool}} \ (\text{T-Leq})$$

$$\frac{\Gamma \vdash \text{e} : \text{Nat}}{\Gamma, \text{x} := \text{e} \Downarrow [\text{x} \mapsto \text{Nat}]\Gamma} \ (\text{T-StoreAss}) \qquad \frac{\Gamma \vdash \text{e} : \text{Nat}}{\Gamma, \text{x} := \text{new(e)} \Downarrow [\text{x} \mapsto \text{Loc}]\Gamma} \ (\text{T-HeapNew})$$

$$\frac{\Gamma \vdash \text{e} : \text{Loc}}{\Gamma, \text{x} = \text{e} \Downarrow [\text{x} \mapsto \text{Loc}]\Gamma} \ (\text{T-HeapAlias}) \qquad \frac{\Gamma \vdash \text{x} : \text{Loc} \qquad \Gamma \vdash \text{e} : \text{Nat}}{\Gamma, *\text{x} = \text{e} \Downarrow \Gamma} \ (\text{T-HeapAssign})$$

$$\frac{}{\Gamma, \textbf{skip} \Downarrow \Gamma} \ (\text{T-Skip}) \qquad \frac{\Gamma \vdash c : \text{Bool}}{\Gamma, \textbf{while } \text{b } \textbf{do } \text{c} \Downarrow \Gamma} \ (\text{T-While})$$

$$\frac{\Gamma \vdash c : \text{Bool} \qquad \Gamma \vdash e_1 :\Downarrow \Gamma_1 \qquad \Gamma \vdash e_2 :\Downarrow \Gamma_2}{\Gamma, \text{if } b \text{ then } e_1 \text{ else } e_2 \Downarrow \Gamma_1 \cap \Gamma_2} \ (\text{T-Conditional})$$

$$\frac{\Gamma \vdash e_1 :\Downarrow \Gamma_1 \qquad \Gamma_1 \vdash e_2 :\Downarrow \Gamma_2}{\Gamma, e_1; \ e_2 \Downarrow \Gamma_2} \ (\text{T-Sequence})$$