

# CS 456 Fall 2022 Project 1 Inference Rules

Your name: Aniket Gupta, Shivam Bairoliya

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The full list of inference rules for Heapy Imp in addition to the big step semantics already defined is below. Assume S stands for the set of statements. Assume  $y \in \text{Id}$ .

$$\frac{\Gamma(x) = \top}{\Gamma \vdash x : \top} \quad (\text{T-VAR})$$

$$\frac{}{\Gamma \vdash \text{true} : \text{bool}} \quad (\text{T-TRUE})$$

$$\frac{}{\Gamma \vdash \text{false} : \text{bool}} \quad (\text{T-FALSE})$$

$$\frac{}{\Gamma \vdash n : \text{nat}} \quad (\text{T-NAT})$$

$$\frac{\Gamma \vdash e_1 : \text{nat} \quad \Gamma \vdash e_2 : \text{nat}}{\Gamma \vdash e_1 + e_2 : \text{nat}} \quad (\text{E-ADD})$$

$$\frac{\Gamma \vdash e_1 : \text{bool}}{\Gamma \vdash \neg e_1 : \text{bool}} \quad (\text{E-NEG})$$

$$\frac{\Gamma \vdash e_1 : \text{bool} \quad \Gamma \vdash e_2 : \text{bool}}{\Gamma \vdash e_1 \wedge e_2 : \text{bool}} \quad (\text{E-AND})$$

$$\frac{\Gamma \vdash e_1 : \text{nat} \quad \Gamma \vdash e_2 : \text{nat}}{\Gamma \vdash e_1 \leq e_2 : \text{bool}} \quad (\text{E-LESSEQ})$$

$$\frac{\Gamma \vdash x : \text{ptrnat}}{\Gamma \vdash !x : \text{nat}} \quad (\text{E-HEAPREADNAT})$$

$$\frac{\Gamma \vdash e : \text{bool} \quad \Gamma \vdash s_1 : S; \Gamma_2 \quad \Gamma \vdash s_2 : S; \Gamma_2}{\Gamma \vdash \text{if } e \text{ then } s_1 \text{ else } s_2 : \Gamma_2} \quad (\text{S-IFELSE})$$

$$\begin{array}{c}
\frac{\Gamma \vdash e : \text{bool} \quad \Gamma \vdash s : S; \Gamma_2}{\Gamma \vdash \text{while } e \text{ do } s : \Gamma_2} \quad (\text{S-LOOP}) \\
\\
\frac{\Gamma \vdash s_1 : S; \Gamma_2 \quad \Gamma_2 \vdash s_2 : S; \Gamma_3}{\Gamma \vdash s_1; s_2 : \Gamma_3} \quad (\text{S-SEQ}) \\
\\
\frac{\Gamma \vdash x : \text{nat} \quad \Gamma \vdash e : \text{nat}}{\Gamma \vdash x := e : \Gamma} \quad (\text{S-ASSIGNNATEXISTINGVAR}) \\
\\
\frac{x \notin \Gamma \quad \Gamma \vdash e : \text{nat}}{\Gamma \vdash x := e : \Gamma[x \mapsto \text{nat}]} \quad (\text{S-ASSIGNNATNEWVAR}) \\
\\
\frac{\Gamma \vdash x : \text{bool} \quad \Gamma \vdash e : \text{bool}}{\Gamma \vdash x := e : \Gamma} \quad (\text{S-ASSIGNBOOLEXISTINGVAR}) \\
\\
\frac{x \notin \Gamma \quad \Gamma \vdash e : \text{bool}}{\Gamma \vdash x := e : \Gamma[x \mapsto \text{bool}]} \quad (\text{S-ASSIGNBOOLNEWVAR}) \\
\\
\frac{\Gamma \vdash x : \text{ptrnat} \quad \Gamma \vdash e : \text{nat}}{\Gamma \vdash !x := e : \Gamma} \quad (\text{S-UPDATEPTRNAT}) \\
\\
\frac{x \notin \Gamma \quad \Gamma \vdash y : \text{ptrnat}}{\Gamma \vdash x = y : \Gamma[x \mapsto \text{ptrnat}]} \quad (\text{S-NEWALIASPTRNAT}) \\
\\
\frac{\Gamma \vdash x : \text{ptrnat} \quad \Gamma \vdash y : \text{ptrnat}}{\Gamma \vdash x = y : \Gamma} \quad (\text{S-EXISTINGALIASPTRNAT}) \\
\\
\frac{\Gamma \vdash x : \text{ptrnat} \quad \Gamma \vdash e : \text{nat}}{\Gamma \vdash x := \text{new}(e) : \Gamma} \quad (\text{S-EXISTINGPTRNAT}) \\
\\
\frac{x \notin \Gamma \quad \Gamma \vdash e : \text{nat}}{\Gamma \vdash x := \text{new}(e) : \Gamma[x \mapsto \text{ptrnat}]} \quad (\text{S-NEWPTRNAT}) \\
\\
\frac{}{\Gamma \vdash \text{skip} : \Gamma} \quad (\text{S-SKIP})
\end{array}$$