Reference: Theorems and Lemmata

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Figure 1: Key Theorems

Type Safety:

1. (Preservation) If $\vdash e : \tau$ and $e \longmapsto e'$ then $\vdash e' : \tau$.
2. (Progress) If $\vdash e : \tau$ then either e val or $e \longmapsto e'$ for some e'.

Termination: For every $\vdash e : \tau$ there exists a v val such that $e \longmapsto^* v$.

Figure 2: Key Lemmata

Inversion: Suppose $\Gamma \vdash e : \tau$.

1. If $e = \mathsf{plus}(e_1; e_2)$ then it must be that
   - $\tau = \mathsf{Num}$
   - $\Gamma \vdash e_1 : \mathsf{Num}$
   - $\Gamma \vdash e_2 : \mathsf{Num}$
2. ...

Weakening: If $\Gamma \vdash e : \tau$ and x is fresh then $\Gamma, x : \sigma \vdash e : \tau$.

Substitution: If $\Gamma \vdash e : \tau$ and $\Gamma, x : \tau \vdash u : \sigma$, then $\Gamma \vdash u[e/x] : \sigma$.

Canonical forms: Suppose e val.

1. If $\vdash e : \mathsf{Num}$ then $e = \mathsf{num}[n]$ for some $n \in \mathbb{N}$.
2. If $\vdash e : \mathsf{Str}$ then $e = \mathsf{str}[s]$ for some $s \in \Sigma^*$.