

$$l, \sigma \Rightarrow \sigma(l) \quad (\text{LOCAL-LOOKUP})$$

$$l, \lambda \Rightarrow \lambda(l) \quad (\text{GLOBAL-LOOKUP})$$

$$\text{Apply}(\mathbf{I}, \langle e, f_m, f_r, l \rangle) \Rightarrow_g \mathbf{I} e f_m f_r l \quad (\text{APPLY-ITER})$$

$$\frac{\text{while}(\text{cond}_g) \mathbf{G} \text{ cond}_l f_m f_r l_g, \lambda \Rightarrow_g l_g', \lambda'}{\mathbf{I} \text{ cond}_g f_m f_r l_g, \lambda \Rightarrow_g l_g', \lambda'} \quad (\text{ITER-MAPRED})$$

$$\frac{\text{whilecond map} (\mathbf{L} f_m f_r) \bar{l}_l, \sigma \Rightarrow_l \bar{l}_l', \sigma' \text{ agg } \bar{l}_l', \sigma, \lambda \equiv l_g', \sigma, \lambda' \text{ fold } f_r l_g', \lambda \Rightarrow_g l_g'', \lambda'}{\mathbf{G} \text{ cond } f_m f_r l_g, \lambda, \sigma \Rightarrow_g l_g'', \lambda', \sigma'} \quad (\text{MAPRED-GLOBAL})$$

$$\frac{\text{map } f_m l_l, \sigma \Rightarrow_l l_l'', \sigma'' \quad \text{fold } f_r l_l'', \sigma \Rightarrow_l l_l', \sigma'}{\mathbf{L} f_m f_r l_l, \sigma \Rightarrow_l l_l', \sigma'} \quad (\text{MAPRED-LOCAL})$$

$$\text{ch } l_g \equiv \bar{l}_l \equiv \{l_l \mid l_l \subset l_g \ \& \ \cap_{l_l, l_i \in \bar{l}_l} l_l = \phi\}; \forall l_i, \sigma_i [l_i \mapsto \lambda(l)] \quad (\text{CHUNKIFY})$$

$$\text{agg } \bar{l}_l \equiv l_g \equiv \cup_{l_l \in \bar{l}_l} l_l; \forall l_i, \lambda [l \mapsto l_i] \quad (\text{AGGREGATE})$$