

Algorithm for finding *non-ndg* locations

Non-ndg locations

Let X be the smallest set such that:

//defined symbols on the left

- $\left\{ (\alpha, L, \tau) \mid \alpha = l \rightarrow r \in \mathfrak{R}, \tau \in \text{pos}(l) \setminus \{\varepsilon\}, \text{root}(l|_{\tau}) \in D \right\} \subseteq X$

//duplicated variables on the right

- $\left\{ (\alpha, R, \tau) \mid \alpha = l \rightarrow r \in \mathfrak{R}, \tau, \pi \in \text{pos}(r), \tau \neq \pi, r|_{\tau} = r|_{\pi} \in V \right\} \subseteq X$

//data flows in the same rules

- $\left\{ (\alpha, L, \tau) \mid \alpha = l \rightarrow r \in \mathfrak{R}, \tau \in \text{pos}(l), \pi \in \text{pos}(r), l|_{\tau} = r|_{\pi} \in V \right\} \subseteq X, \text{ if } (\alpha, R, \pi) \in X$

//data flows in (separate) rules

- $\left\{ (\alpha, R, \tau) \mid \alpha = l \rightarrow r \in \mathfrak{R}, \tau \in \text{pos}(r), \tau = \pi.v, \right. \quad \left. \beta = s \rightarrow t \in \mathfrak{R}, \exists \text{ MGU for } r|_{\pi} \text{ and } s, \omega \in \text{pos}(s), v \# \omega \right\} \subseteq X, \text{ if } (\beta, L, \omega) \in X$

//return positions of marked defined symbols

- $\left\{ (\alpha, R, \tau) \mid \alpha = l \rightarrow r \in \mathfrak{R}, \right. \quad \left. \beta = s \rightarrow t \in \mathfrak{R}, \text{root}(l) = \text{root}(t|_{\pi}) \in D, \tau \in \text{pos}(r) \right\} \subseteq X, \text{ if } (\beta, R, \pi) \in X$

Definedness-Tag

Let Y be the smallest set such that:

//defined symbols on the right that flow into variables on the left

- $\left\{ (\alpha, R, \tau) \mid \alpha = l \rightarrow r \in \mathfrak{R}, \tau \in \text{pos}(r), \tau = \pi.v, r|_{\tau} \in D, \right.$
 $\left. \beta = s \rightarrow t \in \mathfrak{R}, \exists \text{MGU for } l|_{\pi} \text{ and } s, \omega \in \text{pos}(s), s|_{\omega} \in V, v \nparallel \omega \right\} \subseteq Y$

//data flows in (separate) rules

- $\left\{ (\beta, L, \omega) \mid \alpha = l \rightarrow r \in \mathfrak{R}, \tau \in \text{pos}(r), \tau = \pi.v, \right.$
 $\left. \beta = s \rightarrow t \in \mathfrak{R}, \exists \text{MGU for } l|_{\pi} \text{ and } s, \omega \in \text{pos}(s), s|_{\omega} \in V, v \nparallel \omega \right\} \subseteq Y, \text{ if } (\alpha, R, \tau) \in Y$

//data flows in same rules

- $\left\{ (\alpha, R, \tau) \mid \alpha = l \rightarrow r \in \mathfrak{R}, \pi \in \text{pos}(l), \tau \in \text{pos}(r), l|_{\pi} = r|_{\tau} \in V \right\} \subseteq Y, \text{ if } (\alpha, L, \pi) \in Y$

Final result

$$F := X \cap Y$$