Compilers

Follow Sets

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- Definition:

  $$Follow(X) = \{\ \underline{t}\ |\ S \rightarrow^* \beta\ \underline{X}\ \underline{t}\ \delta\ \}$$

  $$S \rightarrow \underline{X\ \underline{t}} \rightarrow \underline{AB\underline{t}} \rightarrow$$
  $$\underline{A\underline{t}}$$

  $$X \rightarrow AB \xrightarrow{\$} \underline{A\underline{t}\beta}$$

- Intuition
  - If $\underline{X} \rightarrow \underline{A}\,\underline{B}$ then $\underline{First(B)} \subseteq \underline{Follow(A)}$ and

    $$\underline{Follow(X)} \subseteq Follow(B)$$

    - if $\underline{B \rightarrow^*}\ \varepsilon$ then $\underline{Follow(X)} \subseteq \underline{Follow(A)}$

  - If S is the start symbol then $\underline{\$} \in Follow(\underline{S})$

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Algorithm sketch:

1. $\$ \in Follow(S)$

2. $First(\beta) - \{\varepsilon\} \subseteq Follow(X)$

   – For each production $A \rightarrow \alpha \, X \, \beta$

3. $Follow(A) \subseteq Follow(X)$

   – For each production $A \rightarrow \alpha \, X \, \beta$ where

   $\varepsilon \in First(\beta)$

$$E \rightarrow TX \rightarrow \underline{T} \pm E$$

- Recall the grammar

$$E \rightarrow \underline{T} \, \underline{X} \qquad\qquad X \rightarrow \pm \underline{E} \mid \varepsilon$$
$$T \rightarrow \underline{(E)} \mid \underline{int} \, \underline{Y} \qquad Y \rightarrow \underline{*T} \mid \varepsilon$$

$$Follow(\underline{X}) = Follow(\underline{E})$$
$$Follow(E) = Follow(\underline{X})$$
$$Follow(E) \subseteq Follow(T)$$
$$Follow(Y) = Follow(T)$$
$$Follow(T) = Follow(Y)$$

$$Follow(E) = \{ \, \mathbin{\$},) \, \}$$
$$Follow(X) = \{ \, \mathbin{\$},) \, \}$$
$$Follow(T) = \{ +, \mathbin{\$},) \, \}$$
$$Follow(Y) = \{ +, \mathbin{\$},) \, \}$$
$$Follow('(') = \{ \, (, int \, \}$$
$$Follow(')') = \{ +, \mathbin{\$},) \, \}$$
$$Follow('\pm') = \{ \, (, int \, \}$$
$$Follow('*') = \{ \, (, int \, \}$$
$$Follow(int) = \{ *, +, \mathbin{\$},) \, \}$$