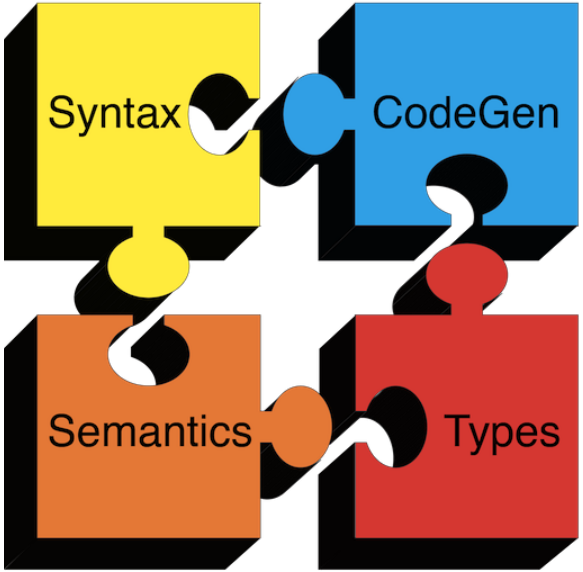

Compilers

First Sets

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First Sets

- Consider non-terminal A, production $A \to \alpha$, & token t
- $T[A,t] = \alpha$ in two cases:

- If $\alpha \to^* t\ \beta$
  - α can derive a t in the first position
  - We say that $t \in First(\alpha)$

- If $A \to \alpha$ and $\alpha \to^* \varepsilon$ and $S \to^* \beta\ A\ t\ \delta$
  - Useful if stack has A, input is t, and A cannot derive t
  - In this case only option is to get rid of A (by deriving ε)
    - Can work only if t can follow A in at least one derivation
  - We say $t \in Follow(A)$

First Sets

Definition

$$\text{First}(X) = \{\, t \mid X \rightarrow^{*} t\alpha \} \cup \{\varepsilon \mid X \rightarrow^{*} \varepsilon\}$$

Algorithm sketch:

1. $\text{First}(t) = \{\, t \,\}$
2. $\varepsilon \in \text{First}(X)$
   - if $X \rightarrow \varepsilon$
   - if $X \rightarrow A_1 \ldots A_n$ and $\varepsilon \in \text{First}(A_i)$ for $1 \leq i \leq n$
3. $\text{First}(\alpha) \subseteq \text{First}(X)$ if $X \rightarrow A_1 \ldots A_n\ \alpha$
   – and $\varepsilon \in \text{First}(A_i)$ for $1 \leq i \leq n$

First Sets

- Recall the grammar

$E \rightarrow T\ X$ $\qquad$ $X \rightarrow +\ E \mid \varepsilon$

$T \rightarrow (\ E\ ) \mid \text{int}\ Y$ $\qquad$ $Y \rightarrow *\ T \mid \varepsilon$