First

Let $G = \langle V, \Sigma, R, S \rangle$ be a CFG.

Definition

For every sentential form α of G,

$$First(\alpha) = \{a \in \Sigma \mid \alpha \stackrel{*}{\Rightarrow} a\beta\} \cup \Upsilon$$

where

$$\Upsilon = \begin{cases} \{\varepsilon\} & \text{if } \alpha \stackrel{*}{\Rightarrow} \varepsilon \\ \varnothing & \text{otherwise} \end{cases}$$

with β a sentential form of G.

Follow

Let $G = \langle V, \Sigma, R, S \rangle$ be a CFG.

Definition

For every $A \in V$,

$$\mathit{Follow}(A) = \{a \in \Sigma \mid S \overset{*}{\Rightarrow} \alpha\, A\, a\, \beta\} \cup \Xi$$

where

$$\Xi = \begin{cases} \{\$\} & \text{if } S \overset{*}{\Rightarrow} \alpha\, A \\ \varnothing & \text{otherwise} \end{cases}$$

with α and β sentential forms of G and \$ is not.

Computing *First* for Single Symbols

1: **for all** $a \in \Sigma$ **do**
2: $\quad First(a) = \{a\}$
3: **for all** $A \in V$ **do**
4: $\quad First(A) = \{\}$
5: $change =$ TRUE
6: **while** $(change)$ **do**
7: $\quad change =$ FALSE
8: $\quad$ **for all** $(A \longrightarrow B_1 \cdots B_k) \in R$ **do**
9: $\quad\quad$ **if** $\varepsilon \in First(B_1) \cap \cdots \cap B_k$ **then**
10: $\quad\quad\quad$ **if** $\varepsilon \notin First(A)$ **then**
11: $\quad\quad\quad\quad First(A) = First(A) \cup \{\varepsilon\}$
12: $\quad\quad\quad\quad change =$ TRUE
13: $\quad\quad$ **for** $i = 1$ to k **do**
14: $\quad\quad\quad$ **if** $(\varepsilon \in First(B_1) \cap \cdots \cap B_{i-1})$ **then**
15: $\quad\quad\quad\quad$ **if** $(First(B_i) - \{\varepsilon\}) \not\subseteq First(A)$ **then**
16: $\quad\quad\quad\quad\quad First(A) = First(A) \cup (First(B_i) - \{\varepsilon\})$
17: $\quad\quad\quad\quad\quad change =$ TRUE

Computing *Follow*

1: **for all** $A \in V$ **do**
2: $\quad Follow(A) = \{\}$
3: $Follow(S) = \{\$\}$
4: $change = \text{TRUE}$
5: **while** $(change)$ **do**
6: $\quad change = \text{FALSE}$
7: $\quad$ **for all** $(A \longrightarrow \alpha B\beta) \in R$ **do**
8: $\quad\quad$ **if** $(First(\beta) - \{\varepsilon\}) \not\subseteq Follow(B)$ **then**
9: $\quad\quad\quad Follow(B) = Follow(B) \cup (First(\beta) - \{\varepsilon\})$
10: $\quad\quad\quad change = \text{TRUE}$
11: $\quad\quad$ **if** $\varepsilon \in First(\beta)$ **then**
12: $\quad\quad\quad$ **if** $Follow(A) \not\subseteq Follow(B)$ **then**
13: $\quad\quad\quad\quad Follow(B) = Follow(B) \cup Follow(A)$
14: $\quad\quad\quad\quad change = \text{TRUE}$