

First

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

Definition

For every sentential form α of G ,

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

where

$$\Upsilon = \begin{cases} \{\varepsilon\} & \text{if } \alpha \xRightarrow{*} \varepsilon \\ \emptyset & \text{otherwise} \end{cases}$$

with β a sentential form of G .

Follow

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

Definition

For every $A \in V$,

$$\text{Follow}(A) = \{a \in \Sigma \mid S \xRightarrow{*} \alpha A a \beta\} \cup \Xi$$

where

$$\Xi = \begin{cases} \{\$ \} & \text{if } S \xRightarrow{*} \alpha A \\ \emptyset & \text{otherwise} \end{cases}$$

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

Computing *First* for Single Symbols

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

Computing *Follow*

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