

## First and Follow

### Rules For Calculating First Function-

#### Rule-01:

For a production rule  $X \rightarrow \epsilon$ ,

$$\text{First}(X) = \{ \epsilon \}$$

#### Rule-02:

For any terminal symbol 'a',

$$\text{First}(a) = \{ a \}$$

#### Rule-03:

For a production rule  $X \rightarrow Y_1 Y_2 Y_3$ ,

#### Calculating First(X)

- If  $\epsilon \notin \text{First}(Y_1)$ , then  $\text{First}(X) = \text{First}(Y_1)$
- If  $\epsilon \in \text{First}(Y_1)$ , then  $\text{First}(X) = \{ \text{First}(Y_1) - \epsilon \} \cup \text{First}(Y_2 Y_3)$

#### Calculating First( $Y_2 Y_3$ )

If  $\epsilon \notin \text{First}(Y_2)$ , then  $\text{First}(Y_2 Y_3) = \text{First}(Y_2)$

- If  $\epsilon \in \text{First}(Y_2)$ , then  $\text{First}(Y_2 Y_3) = \{ \text{First}(Y_2) - \epsilon \} \cup \text{First}(Y_3)$

Similarly, we can make expansion for any production rule  $X \rightarrow Y_1 Y_2 Y_3 \dots Y_n$ .

	<b>First</b>
$S \rightarrow ABCD$	$\{b, c\}$
$A \rightarrow b \mid \epsilon$	$\{b, \epsilon\}$
$B \rightarrow c$	$\{c\}$
$C \rightarrow d$	$\{d\}$
$D \rightarrow e$	$\{e\}$

## Follow Function-

$\text{Follow}(\alpha)$  is a set of terminal symbols that appear immediately to the right of  $\alpha$ .

## Rules For Calculating Follow Function-

### Rule-01:

For the start symbol  $S$ , place  $\$$  in  $\text{Follow}(S)$ .

### Rule-02:

For any production rule  $A \rightarrow \alpha B$ ,

$$\text{Follow}(B) = \text{Follow}(A)$$

### Rule-03:

For any production rule  $A \rightarrow \alpha B \beta$ ,

- If  $\epsilon \notin \text{First}(\beta)$ , then  $\text{Follow}(B) = \text{First}(\beta)$
- If  $\epsilon \in \text{First}(\beta)$ , then  $\text{Follow}(B) = \{ \text{First}(\beta) - \epsilon \} \cup \text{Follow}(A)$

	<b>Follow</b>
$S \rightarrow ABCD$	$\{ \$ \}$
$\underline{A \rightarrow b} \mid \epsilon$	$\{ c \}$
$\underline{B \rightarrow c}$	$\{ d \}$
$\underline{C \rightarrow d}$	$\{ e \}$
$\underline{D \rightarrow e}$	$\{ \$ \}$

**Example:-**

	<b>First</b>	<b>Follow</b>
$S \rightarrow ABCD$	$\{b, c\}$	$\{\$ \}$
$A \rightarrow b \mid \epsilon$	$\{b, \epsilon\}$	$\{c\}$
$B \rightarrow c$	$\{c\}$	$\{d\}$
$C \rightarrow d$	$\{d\}$	$\{e\}$
$D \rightarrow e$	$\{e\}$	$\{\$ \}$
$S \rightarrow ABCDE$	$\{a, b, c\}$	$\{\$ \}$
$A \rightarrow a \mid \epsilon$	$\{a, \epsilon\}$	$\{b, c\}$
$B \rightarrow b \mid \epsilon$	$\{b, \epsilon\}$	$\{c\}$
$C \rightarrow c$	$\{c\}$	$\{d, e, \$ \}$
$D \rightarrow d \mid \epsilon$	$\{d, \epsilon\}$	$\{e, \$ \}$
$E \rightarrow e \mid \epsilon$	$\{e, \epsilon\}$	$\{\$ \}$
$S \rightarrow Bb \mid Cd$	$\{a, b, c, d\}$	$\{\$ \}$
$B \rightarrow aB \mid \epsilon$	$\{a, \epsilon\}$	$\{b\}$
$C \rightarrow cC \mid \epsilon$	$\{c, \epsilon\}$	$\{d\}$
$E \rightarrow TE'$	$\{id, (\}$	$\{\$, )\}$
$E' \rightarrow +TE' \mid \epsilon$	$\{+, \epsilon\}$	$\{\$, )\}$
$T \rightarrow FT'$	$\{id, (\}$	$\{+, \$, )\}$
$T' \rightarrow *FT' \mid \epsilon$	$\{*, \epsilon\}$	$\{+, \$, )\}$
$F \rightarrow id \mid (E)$	$\{id, (\}$	$\{*, +, \$, )\}$
$S \rightarrow ACB \mid CbB \mid Ba$	$\{d, g, h, b, a, \epsilon\}$	$\{\$ \}$
$A \rightarrow da \mid BC$	$\{d, g, h, \epsilon\}$	$\{h, g, \$ \}$
$B \rightarrow g \mid \epsilon$	$\{g, \epsilon\}$	$\{\$, a, h, g\}$
$C \rightarrow h \mid \epsilon$	$\{h, \epsilon\}$	$\{g, b, h, \$ \}$
$S \rightarrow aABb$	$\{a\}$	$\{\$ \}$
$A \rightarrow c \mid \epsilon$	$\{c, \epsilon\}$	$\{d, b\}$
$B \rightarrow d \mid \epsilon$	$\{d, \epsilon\}$	$\{b\}$
$S \rightarrow aBDh$	$\{a\}$	$\{\$ \}$
$B \rightarrow cC$	$\{c\}$	$\{g, f, h\}$
$C \rightarrow bC \mid \epsilon$	$\{b, \epsilon\}$	$\{g, f, h\}$
$D \rightarrow EF$	$\{g, f, \epsilon\}$	$\{h\}$
$E \rightarrow g \mid \epsilon$	$\{g, \epsilon\}$	$\{f, h\}$
$F \rightarrow f \mid \epsilon$	$\{f, \epsilon\}$	$\{h\}$

