

## Script generated by TTT

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## Lookahead Sets

### Definition: First<sub>1</sub>-Sets

For a set  $L \subseteq T^*$  we define:

$$\text{First}_1(L) = \{\epsilon \mid \epsilon \in L\} \cup \{u \in T \mid \exists v \in T^* : uv \in L\}$$

Example:  $S \rightarrow \epsilon \mid aSb$

$\text{First}_1(S)$
$\epsilon$
$ab$
$aa bb$
$aaa bbb$
...

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## Lookahead Sets

### Arithmetics:

$\text{First}_1(\_)$  is distributive with union and concatenation:

$$\begin{aligned} \text{First}_1(\emptyset) &= \emptyset \\ \text{First}_1(L_1 \cup L_2) &= \text{First}_1(L_1) \cup \text{First}_1(L_2) \\ \text{First}_1(L_1 \cdot L_2) &= \text{First}_1(\text{First}_1(L_1) \cdot \text{First}_1(L_2)) \\ &:= \text{First}_1(L_1) \odot_1 \text{First}_1(L_2) \end{aligned}$$

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### Definition: 1-concatenation

Let  $L_1, L_2 \subseteq T \cup \{\epsilon\}$  with  $L_1 \neq \emptyset \neq L_2$ . Then:

$$L_1 \odot_1 L_2 = \begin{cases} L_1 & \text{if } \epsilon \notin L_1 \\ (L_1 \setminus \{\epsilon\}) \cup L_2 & \text{otherwise} \end{cases}$$

If all rules of  $G$  are productive, then all sets  $\text{First}_1(A)$  are non-empty.

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## Lookahead Sets

For  $\alpha \in (N \cup T)^*$  we are interested in the set:

$$\text{First}_1(\alpha) = \text{First}_1(\{w \in T^* \mid \alpha \rightarrow^* w\})$$

**Idea:** Treat  $\epsilon$  separately:  $\text{First}_1(A) = F_\epsilon(A) \cup \{\epsilon \mid A \rightarrow^* \epsilon\}$

- Let  $\text{empty}(X) = \text{true}$  iff  $X \rightarrow^* \epsilon$ .
- $F_\epsilon(X_1 \dots X_m) = \bigcup_{i=1}^j F_\epsilon(X_i)$  if  $\bigwedge_{i=1}^{j-1} \text{empty}(X_i) \wedge \neg \text{empty}(X_j)$

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$\text{First}_1(\_)$  is **distributive** with union and concatenation:

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