Top-Down Parsing

We assume $w$ and $w'$ denote sequences of terminal symbols. We assume $k : w$ denotes the first $k$ symbols in $w$ if number of symbols in $w$ greater or equal $k$. Otherwise, $k : w$ denotes $w$.

For $A \rightarrow \alpha$:

$$\text{Follow}(A) = \{ w' \mid S \Rightarrow^*_{L} wA\beta \Rightarrow^*_{L} w\alpha\beta \Rightarrow^*_{L} ww' \}$$

For any $\alpha$:

$$\text{First}(A) = \{ w \mid \alpha \Rightarrow^*_L w \}$$

$$\text{First}_k(A) = \{ k : w \mid w \in \text{First}(A) \}$$

$G$ is SLL($k$) iff for $A \rightarrow \alpha \mid \beta$ ($\alpha \neq \beta$)

$$\text{First}_k(\alpha\text{Follow}(A)) \cap \text{First}_k(\beta\text{Follow}(A)) = \emptyset.$$  

$G$ is LL($k$) iff if $S \Rightarrow^*_L uA\gamma \Rightarrow^*_L u\alpha\gamma \Rightarrow^*_L uw$,  

$S \Rightarrow^*_L uA\gamma \Rightarrow^*_L u\beta\gamma \Rightarrow^*_L uw'$ and $k : w = k : w'$ then $\alpha = \beta$.  

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Observations:

- SLL(1) iff LL(1).
- SLL(k) implies LL(k).
- SLL(k) implies grammar is unambiguous.
- In case of a LL(k) grammar the expansion of the leftmost non-terminal symbol is always uniquely determined by
  - the consumed part of the input and
  - by the next k symbols of the remaining input.