

This is an alternative approach to defining the first and follow sets. A nonterminal  $A$  is *nullable* if  $A \Rightarrow^* \epsilon$ .

1.  $\text{First}(a) = \{a\}$  for all terminals  $a$ .
2. Let  $X \rightarrow Y_1 Y_2 \dots Y_k$  be a production
  - (a) If all  $Y_i$  are nullable, then so is  $X$ .
  - (b) For each  $i = 1 \dots k$ ,
    - i. If  $Y_1, \dots, Y_{i-1}$  are nullable, then  $\text{First}(X) = \text{First}(X) \cup \text{First}(Y_i)$ .
    - ii. If  $Y_{i+1} \dots Y_k$  are nullable, then  $\text{Follow}(Y_i) = \text{Follow}(Y_i) \cup \text{Follow}(X)$
    - iii. For each  $j$  from  $i+1$  to  $k$ , if  $Y_{i+1}, \dots, Y_{j-1}$  are nullable, then  $\text{Follow}(Y_i) = \text{Follow}(Y_i) \cup \text{First}(Y_j)$ .

In this notation, a grammar is LL(1) as long as for each nonterminal  $X$  each pair of productions  $X \rightarrow \alpha_1, X \rightarrow \alpha_2$  satisfies

$$\text{First}(\alpha_1) \cap \text{First}(\alpha_2) = \emptyset.$$