

2.4.4 核心代码形式化描述及其实现

实现 LL(1)文法分析的一种有效方法是使用一张分析表和一个栈进行联合控制，而分析表的构造需要用到给定文法的 FIRST 集与 FOLLOW 集^[2]。下面依次介绍预测分析程序的总控程序、FIRST 集、FOLLOW 集与分析表的构造流程。

预测分析程序的总控程序形式化描述^[1]：

```

let  $a$  be the first symbol of  $w$ ;
let  $X$  be the top stack symbol;
while (  $X \neq \$$  ) { /* stack is not empty */
    if (  $X = a$  ) pop the stack and let  $a$  be the next symbol of  $w$ ;
    else if (  $X$  is a terminal ) error();
    else if (  $M[X, a]$  is an error entry ) error();
    else if (  $M[X, a] = X \rightarrow Y_1 Y_2 \cdots Y_k$  ) {
        output the production  $X \rightarrow Y_1 Y_2 \cdots Y_k$ ;
        pop the stack;
        push  $Y_k, Y_{k-1}, \dots, Y_1$  onto the stack, with  $Y_1$  on top;
    }
    let  $X$  be the top stack symbol;
}

```

Figure 10 LL(1)预测分析总控形式化描述

FIRST 集构造流程^[1]：

To compute $\text{FIRST}(X)$ for all grammar symbols X , apply the following rules until no more terminals or ϵ can be added to any FIRST set.

1. If X is a terminal, then $\text{FIRST}(X) = \{X\}$.
2. If X is a nonterminal and $X \rightarrow Y_1 Y_2 \cdots Y_k$ is a production for some $k \geq 1$, then place a in $\text{FIRST}(X)$ if for some i , a is in $\text{FIRST}(Y_i)$, and ϵ is in all of $\text{FIRST}(Y_1), \dots, \text{FIRST}(Y_{i-1})$; that is, $Y_1 \cdots Y_{i-1} \xRightarrow{*} \epsilon$. If ϵ is in $\text{FIRST}(Y_j)$ for all $j = 1, 2, \dots, k$, then add ϵ to $\text{FIRST}(X)$. For example, everything in $\text{FIRST}(Y_1)$ is surely in $\text{FIRST}(X)$. If Y_1 does not derive ϵ , then we add nothing more to $\text{FIRST}(X)$, but if $Y_1 \xRightarrow{*} \epsilon$, then we add $\text{FIRST}(Y_2)$, and so on.
3. If $X \rightarrow \epsilon$ is a production, then add ϵ to $\text{FIRST}(X)$.

Figure 11 FIRST 集构造流程

FOLLOW 集构造流程^[1]：