

习题 6.2

(1)

解 (a) $First(Td) \cap First(Td[\check{I}]) = \{int, float\}$
不为空, 不是 LL(1) 文法

化简: 1. 去 ϵ 产生式
 $\check{A} \rightarrow \check{A}A | A \quad A \rightarrow Td | Td[\check{I}] \quad \check{I} \rightarrow i | \check{I}, i$

2. 消除左递归
 $\check{A} \rightarrow \check{A}A' \quad A' \rightarrow AA' | \epsilon \quad A \rightarrow Td | Td[\check{I}]$
 $\check{I} \rightarrow iI' \quad I' \rightarrow iI' | \epsilon \quad T \rightarrow int | float$

3. 消除回溯
 $\check{A} \rightarrow \check{A}A' \quad A' \rightarrow AA' | \epsilon \quad A \rightarrow TdT' \quad T' \rightarrow \epsilon | [\check{I}]$
 $\check{I} \rightarrow iI' \quad I' \rightarrow iI' | \epsilon \quad T \rightarrow int | float$
 $First(T) = \{int, float\} \quad Follow(T) = \{d\}$
 $First(d) = \{d\} \quad Follow(d) = \{[\check{I}]\}$
 $First(T') = \{\epsilon, [\check{I}]\} \quad Follow(T') = \{int, float, \#\}$
 $First(\check{I}) = \{i\} \quad Follow(\check{I}) = \{\check{I}\}$
 $First(I') = \{\epsilon, i\} \quad Follow(I') = \{\check{I}\}$
 $First(\check{A}) = \{int, float\} \quad Follow(\check{A}) = \{\#\}$
 $First(A) = \{int, float\} \quad Follow(A) = \{int, float, \#\}$
 $First(A') = \{int, float, \epsilon\} \quad Follow(A') = \{\#\}$

(2)

$S \rightarrow Ab$ 的候选式首符集为 $\{a, b\}$;
 $A \rightarrow aB | \epsilon$ 的候选式首符集分别为 $\{a\}, \{b, \epsilon\}, \{\epsilon\}$, 其中 $\{b, \epsilon\}$ 与 $\{\epsilon\}$ 相交, 所以这个文法不是 LL(1) 文法, 原因是有回溯, 修剪如下:
 $S \rightarrow aB | \check{C}$
 $\check{C} \rightarrow b\check{D}$
 $\check{D} \rightarrow b | \epsilon$
 上述文法中, S 的两个候选式首符集分别为 $\{a\}, \{b\}$, 不相交; \check{C} 的首符集为 $\{b\}$; \check{D} 的两个候选式的首符集分别为 $\{b\}, \{\epsilon\}$, FOLLOW 集为空, 都不相交。因此, 修剪后的文法是 LL(1) 文法。

若写为 $S \rightarrow ab|bb|b$, 也视为正确

(3)

S 的两个候选式的首符集分别为 $\{a\}$, $\{b, c\}$, 不相交;
B 的两个候选式的首符集分别为 $\{b\}$, $\{c, d\}$, 不相交;
C 的两个候选式的首符集分别为 $\{c\}$, $\{d\}$, 不相交.
因此原文法是 LL(1) 文法。

大作业 (二)

变元的 FIRST 集:

$$\text{FIRST}(P) = \{d, \text{if}, \text{while}, \text{return}, \{, \text{int}, \text{void}\}$$

$$\text{FIRST}(\check{D}) = \{\epsilon, \text{int}, \text{void}\}$$

$$\text{FIRST}(D) = \{\text{int}, \text{void}\}$$

$$\text{FIRST}(T) = \{\text{int}, \text{void}\}$$

$$\text{FIRST}(\check{A}) = \{\epsilon, d, \text{int}, \text{void}\}$$

$$\text{FIRST}(A) = \{d, \text{int}, \text{void}\}$$

$$\text{FIRST}(\check{S}) = \{d, \text{if}, \text{while}, \text{return}, \{\}$$

$$\text{FIRST}(S) = \{d, \text{if}, \text{while}, \text{return}, \{\}$$

$$\text{FIRST}(B) = \{d, i, (\}$$

$$\text{FIRST}(E) = \{d, i, (\}$$

$$\text{FIRST}(\check{R}) = \{\epsilon, d, i, (\}$$

$$\text{FIRST}(R) = \{d, i, (\}$$

变元的 FOLLOW 集:

$$\text{FOLLOW}(P) = \{\#\}$$

$$\text{FOLLOW}(\check{D}) = \{d, \text{if}, \text{while}, \text{return}, \{, \text{int}, \text{void}\}$$

$$\text{FOLLOW}(D) = \{d, \text{if}, \text{while}, \text{return}, \{, \text{int}, \text{void}\}$$

$$\text{FOLLOW}(T) = \{d\}$$

$$\text{FOLLOW}(\check{A}) = \{d, \text{int}, \text{void}, \}$$

$$\text{FOLLOW}(A) = \{d, \text{int}, \text{void}, \}$$

$$\text{FOLLOW}(\check{S}) = \{:, \}, \#\}$$

$$\text{FOLLOW}(S) = \{\text{else}, :, \}, \#\}$$

$$\text{FOLLOW}(B) = \{\wedge, \vee, \}$$

$$\text{FOLLOW}(E) = \{r, +, *, \}, \text{else}, :, \}, \#, \wedge, \vee, \}, d, i, (\}$$

$$\text{FOLLOW}(\check{R}) = \{), d, i, (\}$$

$$\text{FOLLOW}(R) = \{), d, i, (\}$$

不满足 LL(1) 文法的原因如下:

- ① $\check{D} \rightarrow \check{D}D$, $\check{A} \rightarrow \check{A}A$, $\check{S} \rightarrow \check{S};S$, $B \rightarrow B\wedge B \mid B\vee B$, $E \rightarrow E+E \mid E * E$,
 $\check{R} \rightarrow \check{R}R$ 这几个规则中存在直接左递归

- ② 同一变元的不同候选式首符集两两相交:

如 $D \rightarrow Td \mid Td[i] \mid Td(\check{A}) \mid \check{D}\check{S}$, 三个候选式的首符集相交

- ③ 可空变元的首符集和 FOLLOW 集相交:

$$\epsilon \in \text{FIRST}(\check{D}),$$

$$\text{FIRST}(\check{D}) = \{\epsilon, \text{int}, \text{void}\}$$

$$\text{FOLLOW}(\check{D}) = \{d, \text{if}, \text{while}, \text{return}, \{, \text{int}, \text{void}\}$$

$$\text{FIRST}(\check{D}) \cap \text{FOLLOW}(\check{D}) \neq \emptyset$$