1.

(1)

S🡪a||(T)

T🡪ST’

T’🡪, ST’|

(2)

是LL(1)。预测分析表：

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | a | ∧ | ( | ) | , | # |
| S | S🡪a | S🡪∧ | S🡪(T) |  |  |  |
| T | T🡪ST’ | T🡪ST’ | T🡪ST’ |  |  |  |
| T’ |  |  |  | T’🡪 | T’🡪,ST’ |  |

2.

(1)

FIRST(E)={(, a, b, ∧}

FIRST(E’)={+, }

FIRST(T)={(, a, b, ∧}

FIRST(T’)={(, a, b, ∧, }

FIRST(F)={(, a, b, ∧}

FIRST(F’)={\*, }

FIRST(P)={(, a, b, ∧}

FOLLOW(E)={), #}

FOLLOW(E’)={), #}

FOLLOW(T)={+, ), #}

FOLLOW(T’)={+, ), #}

FOLLOW(F)={(, a, b, ∧, +, ), #}

FOLLOW(F’)={(, a, b, ∧, +, ), #}

FOLLOW(P)={\*, (, a, b, ∧, +, ), #}

(2)

For E’🡪+E|, FIRST(+E)∩FIRST()∩FOLLOW(E’)={+}∩{}=;

For T’🡪T|, FIRST(T)∩FIRST()∩FOLLOW(T’)={(,a,b,∧}∩{}=;

For F’🡪\*F’|, FIRST(\*F’)∩FIRST()∩FOLLOW(F’)={\*}∩{}=;

For P🡪(E)|a|b|∧, FIRST((E))∩FIRST(a)∩FIRST(b)∩FIRST(∧)∩FOLLOW(P’)={(}∩{a}∩{b}∩{}=

综上，该文法是LL(1)的。

(3)

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | + | \* | ( | ) | a | b | ∧ | # |
| E |  |  | E🡪TE’ |  | E🡪TE’ | E🡪TE’ | E🡪TE’ |  |
| E’ | E’🡪+E |  |  | E’🡪 |  |  |  | E’🡪 |
| T |  |  | T🡪FT’ |  | T🡪FT’ | T🡪FT’ | T🡪FT’ |  |
| T’ | T’🡪 |  | T’🡪T | T’🡪 | T’🡪T | T’🡪T | T’🡪T | T’🡪 |
| F |  |  | F🡪PF’ |  | F🡪PF’ | F🡪PF’ | F🡪PF’ |  |
| F’ | F’🡪 | F’🡪\*F | F’🡪 | F’🡪 | F’🡪 | F’🡪 | F’🡪 | F’🡪 |
| P |  |  | P🡪(E) |  | P🡪a | P🡪b | P🡪∧ |  |

3.

(1)

FIRST(S)={a,b,}

FIRST(A)={a,}

FIRST(B)={b,}

FOLLOW(S)={#}

FOLLOW(A)={b,#}

FOLLOW(B)={}

For A🡪a|, FIRST(a)∩FIRST()∩FOLLOW(A)=;

For B🡪b|, FIRST(b)∩FIRST()∩FOLLOW(B)=

综上，该文法是LL(1)的。

(2)

FIRST(S)={a,b}

FIRST(A)={a,b,}

FIRST(B)={b,}

FOLLOW(S)={#}

FOLLOW(A)={b,#}

FOLLOW(B)={b,#}

For A🡪a|B|, FIRST(a)∩FIRST(B)∩FIRST()∩FOLLOW(A)={b}

综上，该文法不是LL(1)的。

(3)

FIRST(S)={a,b}

FIRST(A)={a,}

FIRST(B)={b,}

FOLLOW(S)={#}

FOLLOW(A)={a,b,#}

FOLLOW(B)={a,b,#}

For A🡪a|, FIRST(a)∩FIRST()∩FOLLOW(A)={a}

综上，该文法不是LL(1)的.

(4)

FIRST(S)={a,b,c,d}

FIRST(B)={b,c,d}

FIRST(C)={c,d}

FOLLOW(S)={e,#}

FOLLOW(B)={e,#}

FOLLOW(C)={e,#}

For S🡪aSe|B, FIRST(aSe)∩FIRST(B)∩FOLLOW(S)=;

For B🡪bBe|C, FIRST(bBe)∩FIRST(C)∩FOLLOW(B)=;

For C🡪cCe|d, FIRST(cCe)∩FIRST(d)∩FOLLOW(C)=;

综上，该文法是LL(1)的。

4.

FIRST(Expr)={-, ( , id}

FIRST(ExprTail)={-,}

FIRST(Var)={id}

FIRST(VarTail)={(, }

FOLLOW(Expr)={), #}

FOLLOW(ExprTail)={), #}

FOLLOW(Var)={-, ), #}

FOLLOW(VarTail)={-, ), #}

分析表：

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | - | ( | ) | id | # |
| Expr | Expr🡪-Expr | Expr🡪(Expr) |  | Expr🡪Var ExprTail |  |
| ExprTail | ExprTail🡪-Expr |  | ExprTail🡪 |  | ExprTail🡪 |
| Var |  |  |  | Var🡪id VarTail |  |
| VarTail | VarTail🡪 | VarTail🡪(Expr) | VarTail🡪 |  | VarTail🡪 |

(2)

分析过程：

|  |  |  |  |
| --- | --- | --- | --- |
| 步骤 | 符号栈 | 输入串 | 所用产生式 |
| 0 | #Expr | Id--id((id))# |  |
| 1 | # ExprTail Var | Id--id((id))# | Expr🡪Var ExprTail |
| 2 | # ExprTail VarTail id | Id--id((id))# | Var🡪id VarTail |
| 3 | # ExprTail VarTail | --id((id))# |  |
| 4 | # ExprTail | --id((id))# | VarTail🡪 |
| 5 | #Expr- | --id((id))# | ExprTail🡪-Expr |
| 6 | #Expr | -id((id))# |  |
| 7 | #Expr- | -id((id))# | Expr🡪-Expr |
| 8 | #Expr | id((id))# |  |
| 9 | # ExprTail Var | id((id))# | Expr🡪Var ExprTail |
| 10 | # ExprTail VarTail id | id((id))# | Var🡪id VarTail |
| 11 | # ExprTail VarTail | ((id))# |  |
| 12 | # ExprTail )Expr( | ((id))# | VarTail🡪(Expr) |
| 13 | # ExprTail )Expr | (id))# |  |
| 14 | # ExprTail ))Expr( | (id))# | Expr🡪(Expr) |
| 15 | # ExprTail ))Expr | id))# |  |
| 16 | # ExprTail )) ExprTail Var | id))# | Expr🡪Var ExprTail |
| 17 | # ExprTail )) ExprTail VarTail id | id))# | Var🡪id VarTail |
| 18 | # ExprTail )) ExprTail VarTail | ))# |  |
| 19 | # ExprTail )) ExprTail | ))# | VarTail🡪 |
| 20 | # ExprTail )) | ))# | ExprTail🡪 |
| 21 | # ExprTail ) | )# |  |
| 22 | # ExprTail | # |  |
| 23 | # | # | ExprTail🡪 |

5.

先消除左递归：

消除间接左递归：

排序：Declist Decl IdList Type ScalarType Bound Sign ScalarTypeList

Declist🡪Declist; Decl|Decl

Decl🡪IdList: Type

IdList🡪IdList, id|id

Type🡪ScalarType|array (ScalarTypeList) of Type

ScalarType🡪id|Bound..Bound

Bound🡪Sign intLiteral|id

Sign🡪+|-|

ScalarTypeList🡪 ScalarTypeList, ScalarType| id

|+ intLiteral..Bound|- intLiteral..Bound|intLiteral..Bound|id..Bound

消除直接左递归：

Declist🡪 Decl Declist’

Declist’🡪; Decl Declist’|

Decl🡪IdList: Type

IdList🡪 id IdList’

IdList’🡪 , id IdList’|

Type🡪ScalarType|array (ScalarTypeList) of Type

ScalarType🡪id|Bound..Bound

Bound🡪Sign intLiteral|id

Sign🡪+|-|

ScalarTypeList🡪 id ScalarTypeList’ |+ intLiteral..Bound ScalarTypeList’|- intLiteral..Bound ScalarTypeList’|intLiteral..Bound ScalarTypeList’|id..Bound ScalarTypeList’

ScalarTypeList’🡪, ScalarType ScalarTypeList’|

消除回溯：

Declist🡪 Decl Declist’

Declist’🡪; Decl Declist’|

Decl🡪IdList: Type

IdList🡪 id IdList’

IdList’🡪 , id IdList’|

Type🡪ScalarType|array (ScalarTypeList) of Type

ScalarType🡪id|Bound..Bound

Bound🡪Sign intLiteral|id

Sign🡪+|-|

ScalarTypeList🡪id A|+intLiteral..BoundScalarTypeList’|

-intLiteral..BoundScalarTypeList’|intLiteral..Bound ScalarTypeList’

A🡪 ScalarTypeList’|..Bound ScalarTypeList’

ScalarTypeList’🡪, ScalarType ScalarTypeList’|

综上，LL(1)的语法即为所求。