Original Grammer in BNF Form\

|  |  |  |
| --- | --- | --- |
| State New Name | State | BNF Grammer |
| P | <prog> | 🡪 **program** <identifier>; **var** <dec-list> **begin** <stat-list> **end.** |
| I | <identifier> | 🡪 <letter> <IB> |
| IB | <IB> | 🡪 <letter> <IB> |
| IB | <IB> | 🡪 <digit> <IB> |
| IB | <IB> | 🡪 λ |
| DL | <dec-list> | 🡪 <dec> : <type> ; |
| DC | <dec> | 🡪 <identifier>, <dec> |
| DC | <dec> | 🡪 < identifier > |
| TP | <type> | 🡪 **integer** |
| SL | <stat-list> | 🡪 <stat> |
| SL | <stat-list> | 🡪 <stat> <stat-list> |
| ST | <stat> | 🡪 <write> |
| ST | <stat> | 🡪 <assign> |
| W | <write> | 🡪 **write** (<str> < identifier > ); |
| SR | <str> | 🡪”value=” |
| SR | <str> | 🡪 λ |
| A | <assign> | 🡪 < identifier > = <expr>; |
| E | <expr> | 🡪 <expr> + <term> |
| E | <expr> | 🡪 <expr> - <term> |
| E | <expr> | 🡪 <term> |
| T | <term> | 🡪 <term> \* <factor> |
| T | <term> | 🡪 <term> / <factor> |
| T | <term> | 🡪 <factor> |
| F | <factor> | 🡪 < identifier > |
| F | <factor> | 🡪 <number> |
| F | <factor> | 🡪 <expr> |
| N | <number> | 🡪 <sign> <digit> <NB> |
| NB | <NB> | 🡪 <digit> <NB> |
| NB | <NB> | 🡪 λ |
| S | <sign> | 🡪 + |
| S | <sign> | 🡪 - |
| S | <sign> | 🡪 λ |
| D | <digit> | 🡪 0 |
| D | <digit> | 🡪 1 |
| D | <digit> | 🡪 2 |
| D | <digit> | 🡪 3 |
| D | <digit> | 🡪 4 |
| D | <digit> | 🡪 5 |
| D | <digit> | 🡪 6 |
| D | <digit> | 🡪 7 |
| D | <digit> | 🡪 8 |
| D | <digit> | 🡪 9 |
| L | <letter> | 🡪 a |
| L | <letter> | 🡪 b |
| L | <letter> | 🡪 c |
| L | <letter> | 🡪 d |
| L | <letter> | 🡪 w |
| L | <letter> | 🡪 f |

Table is reconstructed before removing left-recursion

|  |  |
| --- | --- |
| State | BNF Grammer |
| P | 🡪 **program** I ; **var** DL **begin** SL **end.** |
| I | 🡪 L IB |
| IB | 🡪 L IB |
| IB | 🡪 D IB |
| IB | 🡪 λ |
| DL | 🡪 DC : TP ; |
| DC | 🡪 I, DC |
| DC | 🡪 I |
| TP | 🡪 **integer** |
| SL | 🡪 ST |
| SL | 🡪 ST SL |
| ST | 🡪 W |
| ST | 🡪 A |
| W | 🡪 **write** (SR I ); |
| SR | 🡪”value=” |
| SR | 🡪 λ |
| A | 🡪 I = E; |
| E | 🡪 E + T |
| E | 🡪 E – T |
| E | 🡪 T |
| T | 🡪 T \* F |
| T | 🡪 T / F |
| T | 🡪 F |
| F | 🡪 I |
| F | 🡪 N |
| F | 🡪 E |
| N | 🡪 S D NB |
| NB | 🡪 D NB |
| NB | 🡪 λ |
| S | 🡪 + |
| S | 🡪 - |
| S | 🡪 λ |
| D | 🡪 0 |
| D | 🡪 1 |
| D | 🡪 2 |
| D | 🡪 3 |
| D | 🡪 4 |
| D | 🡪 5 |
| D | 🡪 6 |
| D | 🡪 7 |
| D | 🡪 8 |
| D | 🡪 9 |
| L | 🡪 a |
| L | 🡪 b |
| L | 🡪 c |
| L | 🡪 d |
| L | 🡪 w |
| L | 🡪 f |

Removing Left-Recursion

|  |  |
| --- | --- |
| State | BNF Grammer |
| P | 🡪 **program** I PB |
| PB | 🡪 ; PC |
| PC | 🡪 **var** DL PD |
| PD | 🡪 **begin** SL PE |
| PE | 🡪 **end.** |
| I | 🡪 L IB |
| IB | 🡪 L IB |
| IB | 🡪 D IB |
| IB | 🡪 λ |
| DL | 🡪 DC DLB |
| DLB | 🡪 : TP DLC |
| DLC | 🡪 ; |
| DC | 🡪 I, DCB |
| DCB | 🡪 , DCC |
| DCB | 🡪 λ |
| TP | 🡪 **integer** |
| SL | 🡪 ST SLB |
| SLB | 🡪 SL |
| SLB | 🡪 λ |
| ST | 🡪 W |
| ST | 🡪 A |
| W | 🡪 **write** WB |
| WB | 🡪 ( WC |
| WC | 🡪 SR WD |
| WD | 🡪 I WE |
| WE | 🡪 ) WF |
| WF | 🡪 ; |
| SR | 🡪”value=” |
| SR | 🡪 λ |
| A | 🡪 I AB |
| AB | 🡪 = E AC |
| AC | 🡪 ; |
| E | 🡪 T EB |
| EB | 🡪 + T EB |
| EB | 🡪 – T EB |
| EB | 🡪 λ |
| T | 🡪 F TB |
| TB | 🡪 \* F TB |
| TB | 🡪 / F TB |
| TB | 🡪 λ |
| F | 🡪 ( E ) |
| F | 🡪 I |
| F | 🡪 N |
| N | 🡪 S D NB |
| NB | 🡪 D NB |
| NB | 🡪 λ |
| S | 🡪 + |
| S | 🡪 - |
| S | 🡪 λ |
| D | 🡪 0 |
| D | 🡪 1 |
| D | 🡪 2 |
| D | 🡪 3 |
| D | 🡪 4 |
| D | 🡪 5 |
| D | 🡪 6 |
| D | 🡪 7 |
| D | 🡪 8 |
| D | 🡪 9 |
| L | 🡪 a |
| L | 🡪 b |
| L | 🡪 c |
| L | 🡪 d |
| L | 🡪 w |
| L | 🡪 f |

The First and Follow Table

|  |  |
| --- | --- |
| State | FIRST |
| P | 🡪 **program** |
| PB | 🡪 ; |
| PC | 🡪 **var** |
| PD | 🡪 **begin** |
| PE | 🡪 **end.** |
| I | 🡪 a b c d w f |
| IB | 🡪 a b c d w f 0 1 2 3 4 5 6 7 8 9 λ |
| DL | 🡪 a b c d w f |
| DLB | 🡪 : |
| DLC | 🡪 ; |
| DC | 🡪 a b c d w f |
| DCB | 🡪 , λ |
| TP | 🡪 **integer** |
| SL | 🡪 **write**  a b c d w f |
| SLB | 🡪 write a b c d w f λ |
| ST | 🡪 write a b c d w f |
| W | 🡪 **write** |
| WB | 🡪 ( |
| WC | 🡪 “values=” λ |
| WD | 🡪 I |
| WE | 🡪 ) |
| WF | 🡪 ; |
| SR | 🡪”value=” |
| SR | 🡪 λ |
| A | 🡪 a b c d w f |
| AB | 🡪 = |
| AC | 🡪 ; |
| E | 🡪 ( a b c d w f + - 0 1 2 3 4 5 6 7 8 9 |
| EB | 🡪 + - λ |
| T | 🡪 ( a b c d w f + - 0 1 2 3 4 5 6 7 8 9 |
| TB | 🡪 \* / λ |
| F | 🡪 ( a b c d w f + - 0 1 2 3 4 5 6 7 8 9 |
| N | 🡪 + - 0 1 2 3 4 5 6 7 8 9 |
| NB | 🡪 0 1 2 3 4 5 6 7 8 9 λ |
| S | 🡪 + - λ |
| D | 🡪 0 1 2 3 4 5 6 7 8 9 |
| L | 🡪 a b c d w f |

FOLLOW Table

|  |  |
| --- | --- |
| State | FOLLOW |
| P | 🡪 **$** |
| PB | 🡪 **$** |
| PC | 🡪 **$** |
| PD | 🡪 **$** |
| PE | 🡪 **$** |
| I | 🡪 ; , ) = : \* / + - |
| IB | 🡪 ; , ) = : \* / + - |
| DL | 🡪 begin |
| DLB | 🡪 begin |
| DLC | 🡪 begin |
| DC | 🡪 : |
| DCB | 🡪 : |
| TP | 🡪 ; |
| SL | 🡪 **end.** |
| SLB | 🡪 **end.** |
| ST | 🡪 **write**  a b c d w f **end.** |
| W | 🡪 **write**  a b c d w f **end.** |
| WB | 🡪 **write**  a b c d w f **end.** |
| WC | 🡪 **write**  a b c d w f **end.** |
| WD | 🡪 **write**  a b c d w f **end.** |
| WE | 🡪 **write**  a b c d w f **end.** |
| WF | 🡪 **write**  a b c d w f **end.** |
| SR | 🡪 **write**  a b c d w f **end.** |
| SR | 🡪 **write**  a b c d w f **end.** |
| A | 🡪 **write**  a b c d w f **end.** |
| AB | 🡪 **write**  a b c d w f **end.** |
| AC | 🡪 **write**  a b c d w f **end.** |
| E | 🡪 ; ) |
| EB | 🡪 ; ) |
| T | 🡪 + - ; ) |
| TB | 🡪 + - ; ) |
| F | 🡪 \* / + - ; ) |
| N | 🡪 \* / + - ; ) |
| NB | 🡪 \* / + - ; ) |
| S | 🡪 0 1 2 3 4 5 6 7 8 9 |
| D | 🡪 a b c d w f 0 1 2 3 4 5 6 7 8 9 ; , ) = : \* / + - |
| L | 🡪 a b c d w f 0 1 2 3 4 5 6 7 8 9 ; , ) = : \* / + - |

Setting up the Predictive Parsing Table chart

|  |  |
| --- | --- |
| State | BNF Grammer |
| P | 🡪 **program** I PB | FIRST | **program** |
| PB | 🡪 ; PC | FIRST | ; |
| PC | 🡪 **var** DL PD | FIRST | **var** |
| PD | 🡪 **begin** SL PE | FIRST | **begin** |
| PE | 🡪 **end.** | FIRST | **end.** |
| I | 🡪 L IB | FIRST (L) | a b c d w f |
| IB | 🡪 L IB | FIRST (L) | a b c d w f |
| IB | 🡪 D IB | FIRST (D) | 0 1 2 3 4 5 6 7 8 9 |
| IB | 🡪 λ | FOLLOW (IB) | ; , ) = : \* / + - |
| DL | 🡪 DC DLB | FIRST (DC) | a b c d w f |
| DLB | 🡪 : TP DLC | FIRST | : |
| DLC | 🡪 ; | FIRST | ; |
| DC | 🡪 I, DCB | FIRST (I) | a b c d w f |
| DCB | 🡪 , DC | FIRST | , |
| DCB | 🡪 λ | FOLLOW (DCB) | : |
| TP | 🡪 **integer** | FIRST | **integer** |
| SL | 🡪 ST SLB | FIRST (ST) | **write** a b c d w f |
| SLB | 🡪 SL | FIRST (SL) | **write** a b c d w f |
| SLB | 🡪 λ | FOLLOW (SLB) | **end.** |
| ST | 🡪 W | FIRST (W) | **write** |
| ST | 🡪 A | FIRST (A) | a b c d w f |
| W | 🡪 **write** WB | FIRST | **write** |
| WB | 🡪 ( WC | FIRST | ( |
| WC | 🡪 SR WD | FIRST (SR) | **“value=”** |
| WD | 🡪 I WE | FIRST (I) | a b c d w f |
| WE | 🡪 ) WF | FIRST | ) |
| WF | 🡪 ; | FIRST | ; |
| SR | 🡪”value=” | FIRST | **“value=”** |
| SR | 🡪 λ | FOLLOW (SR) | **end.** |
| A | 🡪 I AB | FIRST (I) | a b c d w f |
| AB | 🡪 = E AC | FIRST | = |
| AC | 🡪 ; | FIRST | ; |
| E | 🡪 T EB | FIRST (T) | ( a b c d w f + - 0 1 2 3 4 5 6 7 8 9 |
| EB | 🡪 + T EB | FIRST | + |
| EB | 🡪 – T EB | FIRST | - |
| EB | 🡪 λ | FOLLOW (EB) | ; ) |
| T | 🡪 F TB | FIRST (F) | ( a b c d w f + - 0 1 2 3 4 5 6 7 8 9 |
| TB | 🡪 \* F TB | FIRST | \* |
| TB | 🡪 / F TB | FIRST | / |
| TB | 🡪 λ | FOLLOW (TB) | + - ; ) |
| F | 🡪 ( E ) | FIRST | ( |
| F | 🡪 I | FIRST (I) | a b c d w f |
| F | 🡪 N | FIRST (N) | + - 0 1 2 3 4 5 6 7 8 9 |
| N | 🡪 S D NB | FIRST (S D) | + - 0 1 2 3 4 5 6 7 8 9 |
| NB | 🡪 D NB | FIRST (D) | 0 1 2 3 4 5 6 7 8 9 |
| NB | 🡪 λ | FOLLOW (NB) | \* / + - ; ) |
| S | 🡪 + | FIRST | + |
| S | 🡪 - | FIRST | - |
| S | 🡪 λ | FOLLOW (S) | 0 1 2 3 4 5 6 7 8 9 |
| D | 🡪 0 | FIRST | 0 |
| D | 🡪 1 | FIRST | 1 |
| D | 🡪 2 | FIRST | 2 |
| D | 🡪 3 | FIRST | 3 |
| D | 🡪 4 | FIRST | 4 |
| D | 🡪 5 | FIRST | 5 |
| D | 🡪 6 | FIRST | 6 |
| D | 🡪 7 | FIRST | 7 |
| D | 🡪 8 | FIRST | 8 |
| D | 🡪 9 | FIRST | 9 |
| L | 🡪 a | FIRST | a |
| L | 🡪 b | FIRST | b |
| L | 🡪 c | FIRST | c |
| L | 🡪 d | FIRST | d |
| L | 🡪 w | FIRST | w |
| L | 🡪 f | FIRST | f |