**1.**

**LR(0) State Diagram:**

S0: <decl> -> .struct <tag> “{” L “}” goto[S0, struct] = S1

S1: <decl> -> struct . <tag> “{” L “}” goto[S1, <tag>] = S2

<tag> ->. ID goto[S1, ID] = S3

<tag -> .r3

S2: <decl> -> struct <tag> . “{” L “}” goto[S2, “{”] = S4

S3: <tag> -> ID . r2

S4: <decl> ->struct <tag> “{” . L “}” goto[S4, L] = S5

L -> . L <field> goto[S4, L] = S5

L -> . <field> goto[S4, <field>] = S6

<field> -> . int ID goto[S4, int] = S7

<field> -> . ID ID goto[S4, ID] = S8

S5: <decl> -> struct <tag> “{” L . “}” goto[S5, “}”] = S9

L -> L . <field> goto[S5, <field>] = S10

<field> -> . int ID goto[S5, int] = S7

<field> -> . ID ID goto[S5, ID] = S8

S6: L -> <field> . r5

S7: <field> -> int . ID goto[S7, ID] = S11

S8: <field> -> ID . ID goto[S8, ID] = S12

S12: <field> -> ID ID . r7

S11: <field> -> int ID . r6

S10: L -> L <field> . r4

S9: <decl> -> struct <tag> “{” L “}” . r1

**SLR Parsing Table:**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | struct | { | } | ID | int | $ | <tag> | L | <field> |
| 0 | s1 |  |  |  |  |  |  |  |  |
| 1 |  | r3 |  | s3 |  |  | g2 |  |  |
| 2 |  | s4 |  |  |  |  |  |  |  |
| 3 |  | r2 |  |  |  |  |  |  |  |
| 4 |  |  |  | s8 | s7 |  |  | g5 | g6 |
| 5 |  |  | s9 | s8 | s7 |  |  |  | g10 |
| 6 |  |  | r5 | r5 | r5 |  |  |  |  |
| 7 |  |  |  | s11 |  |  |  |  |  |
| 8 |  |  |  | s12 |  |  |  |  |  |
| 9 |  |  |  |  |  | r1 |  |  |  |
| 10 |  |  | r4 | r4 | r4 |  |  |  |  |
| 11 |  |  | r6 | r6 | r6 |  |  |  |  |
| 12 |  |  | r7 | r7 | r7 |  |  |  |  |

**2.**

|  |  |  |
| --- | --- | --- |
| Parsing Stack | Next Action | Remaining Input |
| 0 | g1 | 100 – 30 \* (50 + 3) \n $end |
| 0 1 | s3 |  |
| 0 1 3 | r10 | -30 \* (50 + 3) \n $end |
| 0 1 | g7 |  |
| 0 1 7 | r6 |  |
| 0 1 | g6 |  |
| 0 1 6 | r5 |  |
| 0 1 | g5 |  |
| 0 1 5 | s11 |  |
| 0 1 5 11 | s3 | 30 \* (50 + 3) \n $end |
| 0 1 5 11 3 | r10 | \* (50 + 3) \n $end |
| 0 1 5 11 | g7 |  |
| 0 1 5 11 7 | r6 |  |
| 0 1 5 11 | g16 |  |
| 0 1 5 11 16 | s12 | \*(50 + 3) \n $end |
| 0 1 5 11 16 12 | s4 | (50 + 3) \n $end |
| 0 1 5 11 16 12 4 | s3 | 50 + 3) \n $end |
| 0 1 5 11 16 12 4 3 | r10 | + 3) \n $end |
| 0 1 5 11 16 12 4 | g7 |  |
| 0 1 5 11 16 12 4 7 | r6 |  |
| 0 1 5 11 16 12 4 | g6 |  |
| 0 1 5 11 16 12 4 6 | r5 |  |
| 0 1 5 11 16 12 4 | g8 |  |
| 0 1 5 11 16 12 4 8 | s10 | + 3) \n $end |
| 0 1 5 11 16 12 4 8 10 | s3 | 3 ) \n $end |
| 0 1 5 11 16 12 4 8 10 3 | r10 | ) \n $end |
| 0 1 5 11 16 12 4 8 10 | g7 |  |
| 0 1 5 11 16 12 4 8 10 7 | r6 |  |
| 0 1 5 11 16 12 4 8 10 | g15 |  |
| 0 1 5 11 16 12 4 8 10 15 | r3 |  |
| 0 1 5 11 16 12 4 | g8 |  |
| 0 1 5 11 16 12 4 8 | s14 |  |
| 0 1 5 11 16 12 4 8 14 | r9 | \n $end |
| 0 1 5 11 16 12 | g17 |  |
| 0 1 5 11 16 12 17 | r7 |  |
| 0 1 5 11 | g16 |  |
| 0 1 5 11 16 | r4 |  |
| 0 1 | g5 |  |
| 0 1 5 | s9 |  |
| 0 1 5 9 | r1 | $end |
| 0 | g1 |  |
| 0 1 | s2 |  |
| 0 1 2 | Accept | <eof> |
|  |  |  |
|  |  |  |

**3.**

**LR(0) State Diagram:**

S0: <prog> -> . <limit> L <limit> goto[S0, <limit>] = S1

<limit> -> . lines goto[S0, lines] = S2

<limit> -> . r3

L -> . L lines stmt goto[S0, L] = S3

L -> . L ; stmt goto[S0, L] = S3

L -> . stmt goto[S0, stmt] = S4

S1: <prog> -> <limit> . L <limit> goto[S1, L] = S5

L -> . L lines stmt goto[S1, L] = S5

L -> . L ; stmt goto[S1, L] = S5

L -> . stmt goto[S1, stmt] = S4

S2: <limit> -> lines . r2

S3: L -> L . lines stmt goto[S3, lines] = S6

L -> L . ; stmt goto[S1, ;] = S7

S4: L -> stmt . r6

S5: <prog> -> <limit> L . <limit> goto[S5, <limit>] = S8

<limit> -> . lines goto[S5, lines] = S9

<limit> -> . r3

L -> L . lines stmt goto[S5, lines] = S9

L -> L . ; stmt goto[S5, ;] = S7

S9: <limits> -> lines . r2

L -> L lines . stmt goto[S9, stmt] = S10

S6: L -> L lines . stmt goto[S6, stmt] = S10

S7: L ; . stmt goto[S7, stmt] = S11

S8: <prog> -> <limit> L <limit> . r1

S10: L -> L lines stmt . r4

S11: L - > L ; stmt . r5

**SLR Parsing Table:**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | stmt | lines | ; | $ | <limit> | L |
| 0 | r3, s4 | s2 |  | r3 | g1 | g3 |
| 1 | s4 |  |  |  |  | g5 |
| 2 | r2 |  |  | r2 |  |  |
| 3 |  | s6 | s7 |  |  |  |
| 4 |  | r6 | r6 | r6 |  |  |
| 5 | r3 | s9 | s7 | r3 | g8 |  |
| 6 | s10 |  |  |  |  |  |
| 7 | s11 |  |  |  |  |  |
| 8 |  |  |  | r1 |  |  |
| 9 | r2, s10 |  |  |  |  |  |
| 10 |  | r4 | r4 | r4 |  |  |
| 11 |  | r5 | r5 | r5 |  |  |

**4.**

**LALR(1) States:**

S3: L -> L . lines stmt goto[S3, lines] = S6 {lines, $, ;}

L -> L . ; stmt goto[S3, ;] = S7 {lines, $, ;}

S5: <prog> -> <limit> L . <limit> goto[S5, <limit>] = S8 {$}

L -> L . lines stmt goto[S5, lines] = S9 {lines, $, ;}

L -> L . ; stmt goto[S5, ;] = S7 {lines, $, ;}

<limit> -> . lines goto[S5, lines] = S9 {$}

<limit> -> . r3 {$}

S2: <limit> -> lines . r2 {stmt, $}

S4: L -> stmt . r6 {lines, $, ;}

S1: <prog> -> <limit> . L <limit> goto[S1, L] = S5 {$}

L -> . L lines stmt goto[S1, L] = S5 {lines, $, ;}

L -> . L ; stmt goto[S1, L] = S5 {lines, $, ;}

L -> . stmt goto[S1, stmt] = S4 {lines. $, ;}

S0: <prog> -> . <limit> L <limit> goto[S0, <limit>] = S1 {$}

<limit> -> . lines goto[S0, lines] = S2 {stmt}

<limit> -> . r3 {stmt}

L -> . L lines stmt goto[S0, L] = S3 {lines, $, ;}

L -> . L ; stmt goto[S0, L] = S3 {lines, $, ;}

L -> . stmt goto[S0, stmt] = S4 {lines, $, ;}

S6: L -> L lines . stmt goto[S6, stmt] = S10 {lines, $, ;}

S7: L -> L ; . stmt goto[S7, stmt] = S11 {lines, $, ;}

S11: L -> L ; stmt . r5 {lines, $, ;}

S10: L -> L lines stmt . r4 {lines, $, ;}

S9: L -> L lines . stmt goto[S9, stmt] = S10 {lines, $, ;}

<limit> -> lines . r2 {$}

S8: <prog> -> <limit> L <limit> . r1 {$}

**LALR Parsing Table:**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | stmt | lines | ; | $ | <limit> | L |
| 0 | r3, s4 | s2 |  |  | g1 | g3 |
| 1 | s4 |  |  |  |  | g5 |
| 2 | r2 |  |  | r2 |  |  |
| 3 |  | s6 | s7 |  |  |  |
| 4 |  | r6 | r6 | r6 |  |  |
| 5 |  | s9 | s7 | r3 | g8 |  |
| 6 | s10 |  |  |  |  |  |
| 7 | s11 |  |  |  |  |  |
| 8 |  |  |  | r1 |  |  |
| 9 | s10 |  |  |  |  |  |
| 10 |  | r4 | r4 | r4 |  |  |
| 11 |  | r5 | r5 | r5 |  |  |