Simplified Rules:

01 program ::= expr '\n'

02 expr ::= NUMBER

03 | ( expr )

04 | expr OP expr

05 | - expr

FIRST(program) = { NUMBER ( - }

FIRST(expr) = { NUMBER ( - }

FOLLOW(program) = { }

FOLLOW(expr) = { ) \n OP }

Bottom-up, table-driven, shift-reduce LR(1) parse of (1+2)\*3

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Step | Parse Stack | LA Symbol | Unscanned Input | Action |
| 0 | $0 | ( | 1+2)\*3 \n $ | shift 3 |
| 1 | $0 (3 | 1 | +2)\*3 \n $ | shift 7 |
| 2 | $0 (3 NUMBER17 | + | 2)\*3 \n $ | reduce 02 | expr ::= NUMBER |
| 3 | $0 (3 expr11 | + | 2)\*3 \n $ | shift 16 |
| 4 | $0 (3 expr11 OP+16 | 2 | )\*3 \n $ | shift 7 |
| 5 | $0 (3 expr11 OP+16 NUMBER27 | ) | \*3 \n $ | reduce 02 | expr ::= NUMBER |
| 6 | $0 (3 expr11 OP+16 expr13 | ) | \*3 \n $ | reduce 04 | expr::= expr OP expr |
| 7 | $0 (3 expr11 | ) | \*3 \n $ | shift 18 |
| 8 | $0 (3 expr11 )18 | \* | 3 \n $ | reduce 03 | expr ::= ( expr ) |
| 9 | $0 expr1 | \* | 3 \n $ | shift 15 |
| 10 | $0 expr1 OP\*15 | 3 | \n $ | shift 6 |
| 11 | $0 expr1 OP\*15 NUMBER36 | \n | $ | reduce 02 | expr ::= NUMBER |
| 12 | $0 expr1 OP\*15 expr2 | \n | $ | reduce 04 | expr::= expr OP expr |
| 13 | $0 expr1 | \n | $ | shift 14 |
| 14 | $0 expr1 \n14 | $ |  | reduce 01 | program ::= expr '\n' |
|  | $0 program5 | $ |  | ACCEPT |

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| State |  | Production | ACTION | | | | | | | LHS GOTO | | |
|  | NUMBER | ( | ) | - | OP | \n | $ | program | | expr |
| 0 | ~~0~~ | S0 -> • program  program -> • expr \n  expr -> • NUMBER  expr -> • ( expr )  expr -> • expr OP expr  expr -> • - expr | shift 6 | shift 3 |  | shift 8 |  |  |  | 5 | | 1 |
| 1 | ~~1~~ | expr -> expr • OP expr  expr -> expr • \n |  |  |  |  | shift 15 | shift 14 |  |  | |  |
| 2 | ~~13~~ | expr -> expr • OP expr  expr -> expr • \n |  |  |  |  | reduce 04? | reduce 04 |  |  | |  |
| 3 | ~~4~~ | expr -> ( • expr )  expr -> • NUMBER  expr -> • ( expr )  expr -> • expr OP expr  expr -> • - expr | shift 7 | shift 4 |  | shift 9 |  |  |  |  | | 11 |
| 4 | ~~9~~ | expr -> ( • expr )  expr -> • NUMBER  expr -> • ( expr )  expr -> • expr OP expr  expr -> • - expr | shift 7 | shift 4 |  | shift 9 |  |  |  |  | | 12 |
| 5 | ~~2~~ | S0 -> program • |  |  |  |  |  |  | ACCEPT |  | |  |
| 6 | ~~3~~ | expr -> NUMBER • |  |  |  |  | reduce 02 | reduce 02 |  |  | |  |
| 7 | ~~8~~ | expr -> NUMBER • |  |  | reduce 02 |  | reduce 02 |  |  |  | |  |
| 8 | ~~5~~ | expr -> - • expr  expr -> • NUMBER  expr -> • ( expr )  expr -> • expr OP expr | shift 6 | shift 3 |  | shift 8 |  |  |  |  | | 10 |
| 9 | ~~10~~ | expr -> - • expr  expr -> • NUMBER  expr -> • ( expr )  expr -> • expr OP expr | shift 7 | shift 4 |  | shift 9 |  |  |  |  | | 17 |
| 10 | ~~6~~ | expr -> - expr • |  |  |  | reduce 05? |  | reduce 05 |  |  | |  |
| 11 | ~~7~~ | expr -> ( expr • )  expr -> expr • OP expr |  |  | shift 18 |  | shift 16 |  |  |  | |  |
| 12 | ~~15~~ | expr -> ( expr • )  expr -> expr • OP expr |  |  | shift 19 |  | shift 16 |  |  |  | |  |
| 13 | ~~18~~ | expr -> expr • OP expr  expr -> expr OP expr • |  |  | reduce 04 |  | reduce 04? |  |  |  | |  |
| 14 | ~~11~~ | program -> expr \n • |  |  |  |  |  |  | reduce 01 |  | |  |
| 15 | ~~12~~ | expr -> expr OP • expr  expr -> • NUMBER  expr -> • ( expr )  expr -> • expr OP expr  expr -> • - expr | shift 6 | shift 3 |  | shift 8 |  |  |  |  | | 2 |
| 16 | ~~17~~ | expr -> expr OP • expr  expr -> • NUMBER  expr -> • ( expr )  expr -> • expr OP expr  expr -> • - expr | shift 7 | shift 4 |  | shift 9 |  |  |  |  | | 13 |
| 17 | ~~14~~ | expr -> - expr • |  |  | reduce 05 |  | reduce 05? |  |  |  | |  |
| 18 | ~~16~~ | expr -> ( expr ) • |  |  |  |  | reduce 03 | reduce 03 |  |  | |  |
| 19 | ~~19~~ | expr -> ( expr ) • |  |  | reduce 03 |  | reduce 03 |  |  |  | |  |
| State |  | Production | ACTION | | | | |  | | | GOTO | |
|  | NUMBER | ( | ) | - | OP | \n | $ | program | | expr |