

BOTTOM UP PARSING- Shift Reduce parser

Shift Reduce parser attempts for the construction of parse in a similar manner as done in bottom-up parsing i.e. the parse tree is constructed from leaves(bottom) to the root(up). A more general form of the shift-reduce parser is the LR parser.

This parser requires some data structures i.e.

- An input buffer for storing the input string.
- A stack for storing and accessing the production rules.

Basic Operations –

- **Shift:** This involves moving symbols from the input buffer onto the stack.
- **Reduce:** If the handle appears on top of the stack then, its reduction by using appropriate production rule is done i.e. RHS of a production rule is popped out of a stack and LHS of a production rule is pushed onto the stack.
- **Accept:** If only the start symbol is present in the stack and the input buffer is empty then, the parsing action is called accept. When accepted action is obtained, it means successful parsing is done.
- **Error:** This is the situation in which the parser can neither perform shift action nor reduce action and not even accept action.

Example 1 – Consider the grammar

$S \rightarrow S + S$

$S \rightarrow S * S$

$S \rightarrow id$

Perform Shift Reduce parsing for input string “id + id + id”.

Stack	
\$	
\$id	
\$S	
\$S+	
\$S+id	
\$S+S	
\$S	
\$S+	
\$S+id	
\$S+S	
\$S	

Example 2 – Consider the grammar

$E \rightarrow 2E2$

$E \rightarrow 3E3$

$E \rightarrow 4$

Perform Shift Reduce parsing for input string “32423”.

Stack	Input Buffer	Parsing Action
\$	32423\$	Shift
\$3	2423\$	Shift
\$32	423\$	Shift
\$324	23\$	Reduce by $E \rightarrow 4$
\$32E	23\$	Shift
\$32E2	3\$	Reduce by $E \rightarrow 2E2$
\$3E	3\$	Shift
\$3E3	\$	Reduce by $E \rightarrow 3E3$
\$E	\$	Accept

Example 3 – Consider the grammar

$S \rightarrow (L) \mid a$

$L \rightarrow L, S \mid S$

Perform Shift Reduce parsing for input string “(a, (a, a))”.

Stack	Input Buffer	Parsing Action
\$	(a , (a , a)) \$	Shift
\$ (	a , (a , a)) \$	Shift
\$ (a	, (a , a)) \$	Reduce $S \rightarrow a$
\$ (S	, (a , a)) \$	Reduce $L \rightarrow S$
\$ (L	, (a , a)) \$	Shift
\$ (L ,	(a , a)) \$	Shift

Stack	Input Buffer	Parsing Action
\$ (L , (	a , a)) \$	Shift
\$ (L , (a	, a)) \$	Reduce $S \rightarrow a$
\$ (L , (S	, a)) \$	Reduce $L \rightarrow S$
\$ (L , (L	, a)) \$	Shift
\$ (L , (L ,	a)) \$	Shift
\$ (L , (L , a	) ) \$	Reduce $S \rightarrow a$
\$ (L , (L, S	) ) \$	Reduce $L \rightarrow L, S$
\$ (L , (L	) ) \$	Shift
\$ (L , (L )	) \$	Reduce $S \rightarrow (L)$
\$ (L, S	) \$	Reduce $L \rightarrow L, S$
\$ (L	) \$	Shift
\$ (L)	\$	Reduce $S \rightarrow (L)$
\$ S	\$	Accept