

LR(K) GRAMMARS

- A grammar G is said to be **LR(k)** if, given any right-most derivation of a string in G , and any of its derivation steps $uAv \Rightarrow uxv$ where v is a string of terminals, the production $A \rightarrow x$ can be inferred by scanning ux and at most the first k symbols of v .
- LR(k) grammars are **unambiguous** and **can be left-recursive**
- Every LL(k) grammar is LR(k)
- LR(k) grammars can be parsed using shift-reduce parsers: table driven bottom-up parsers which can be automatically generated from LR(k) grammars.

SHIFT-REDUCE PARSING

- Bottom-up or shift-reduce parsers consist of
 - An input stream of tokens which will be read from left to right
 - A symbol stack
 - A state stack
 - A parsing table used to decide what kind of operation should be performed depending on what is on the stacks
- Shift-reduce parsers loop until the following two conditions are satisfied:
 - There are no more tokens to read
 - There is only one element on each stack: S on the symbol stack.
- At each step of the loop they do one of the following:
 - Shift: $S\langle\text{state}\rangle$
 - read a token and push it on the symbol stack
 - push state on state stack
 - Reduce: $R\langle\text{production}\rangle$
 - pop the N top elements off each stack (where N is the number of terminals and non-terminals on the RHS of production)
 - insert production LHS in input stream
 - build parse tree

EXAMPLE

Grammar

- (1) S → real IDLIST
- (2) IDLIST → IDLIST, ID
- (3) IDLIST → ID
- (4) ID → a | b | c | d

State	S	IDLIST	ID	real	,	a b c d	\$
1	HALT			S2			
2		S5	S4			S3	
3					R4		R4
4					R3		R3
5					S6		R1
6			S7			S3	
7					R2		R2

State Stack	Input	Symbol Stack	Operation
1	real a, b, c \$		S2
1 2	a, b, c \$	real	S3
1 2 3	, b, c \$	real a	R4
1 2	ID, b, c \$	real	S4
1 2 4	, b, c \$	real ID	R3
1 2	IDLIST, b, c \$	real	S5
1 2 5	, b, c \$	real IDLIST	S6
1 2 5 6	b, c \$	real IDLIST ,	S3
1 2 5 6 3	, c \$	real IDLIST , b	R4
1 2 5 6	ID , c \$	real IDLIST ,	S7
1 2 5 6 7	, c \$	real IDLIST , ID	R2
1 2	IDLIST, c \$	real	S5
1 2 5	, c \$	real IDLIST	S6
1 2 5 6	c \$	real IDLIST ,	S3
1 2 5 6 3	\$	real IDLIST , c	R4
1 2 5 6	ID \$	real IDLIST ,	S7
1 2 5 6 7	\$	real IDLIST , ID	R2
1 2	IDLIST \$	real	S5
1 2 5	\$	real IDLIST	R1
1	S \$		HALT