

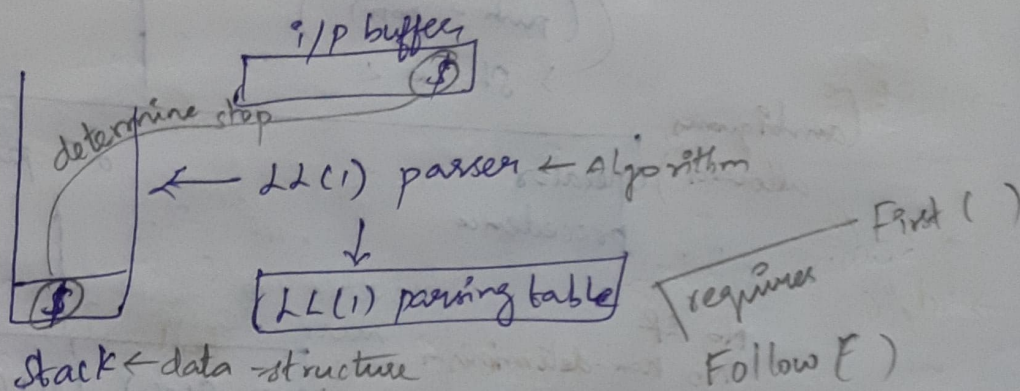
LL(1) parser:-

L → Left to right parsing

L → Left most derivation

1 → no. of look-aheads

→ how many no. of symbols we look when we make decision



Examples of First & Follow:-

Remember:-

* Follow never has ϵ in it

* Follow of start (symbol) is always $\$$ and then check for the NT in RHS of that grammar, if there include in its follow also with start NT

* If nothing follows, either $\$$ or follow of the LHS succeeds

eg: $A \rightarrow BC \Rightarrow A \text{ code} \Rightarrow BC \text{ code}$

1)	First ()	follow ()
$S \rightarrow \underline{ABCDE}$	$\{a, b, c\}$	$\{\$ \}$ only $\$$ as S doesn't occur in RHS anywhere
$A \rightarrow a/\epsilon$	$\{a, \epsilon\}$	$\{b, c\}$ → first of B & first of C
$B \rightarrow b/\epsilon$	$\{b, \epsilon\}$	$\{c\}$
$C \rightarrow c$	$\{c\}$	$\{d, e, \$ \}$ → as $DE \rightarrow \epsilon$, it has follow of S as follow () to include $\$$ as C present in RHS of S
$D \rightarrow d/\epsilon$	$\{d, \epsilon\}$	$\{e, \$ \}$
$E \rightarrow e/\epsilon$	$\{e, \epsilon\}$	$\{\$ \}$

2) $S \rightarrow$
 $B \rightarrow$
 $C \rightarrow$

3) $E \rightarrow$
 $E' \rightarrow$
 $T \rightarrow$
 $T' \rightarrow$
 $F \rightarrow$

4) $S \rightarrow$
 $A \rightarrow$
 $B \rightarrow$
 $C \rightarrow$

5) $S \rightarrow$
 $A \rightarrow$
 $B \rightarrow$

6) $S \rightarrow$
 $B \rightarrow$
 $C \rightarrow$
 $D \rightarrow$
 $E \rightarrow$
 $F \rightarrow$

of symbols we
make
ion

First ()

()

and then
grammar, if
start NT

follow of the
de

le

occurs in RHS
anywhere
first of C

it has follow of
to include
RHS of S

2) $S \rightarrow Bb/\epsilon d$
 $B \rightarrow aB/\epsilon$
 $C \rightarrow CC/\epsilon$

First ()
 $\{a, b, c, d\}$
 $\{a, \epsilon\}$
 $\{c, \epsilon\}$

Follow ()
 $\{\$ \}$
 $\{b\}$
 $\{d\}$

3) $E \rightarrow TE$
 $E' \rightarrow +TE'/\epsilon$
 $T \rightarrow FT$
 $T' \rightarrow *FT/\epsilon$
 $F \rightarrow id/(C)$

First ()
 $\{id, (\}$
 $\{+, \epsilon\}$
 $\{id, (\}$
 $\{*, \epsilon\}$
 $\{id, (\}$

Follow ()
 $\{\$,)\}$
 $\{\$,)\}$
 $\{+, \$,)\}$
 $\{+, \$,)\}$
 $\{*, +, \$,)\}$

4) $S \rightarrow ACB/CbB/Ba$
 $A \rightarrow da/(BC)$
 $B \rightarrow g/\epsilon$
 $C \rightarrow h/\epsilon$

First ()
 $\{d, g, h, \epsilon, b, a\}$
 $\{d, g, h, \epsilon\}$
 $\{g, \epsilon\}$
 $\{h, \epsilon\}$

Follow ()
 $\{\$ \}$
 $\{h, g, \$ \}$
 $\{a, \$, g, h\}$
 $\{g, \$, b, h\}$

5) $S \rightarrow aABb$
 $A \rightarrow c/\epsilon$
 $B \rightarrow d/\epsilon$

First ()
 $\{a\}$
 $\{c, \epsilon\}$
 $\{d, \epsilon\}$

Follow ()
 $\{\$ \}$
 $\{d, b\}$
 $\{b\}$
Follow ()

6) $S \rightarrow aBDh$
 $B \rightarrow CC$
 $C \rightarrow bC/\epsilon$
 $D \rightarrow EF$
 $E \rightarrow g/\epsilon$
 $F \rightarrow f/\epsilon$

First ()
 $\{a\}$
 $\{c\}$
 $\{b, \epsilon\}$
 $\{g, f, \epsilon\}$
 $\{g, \epsilon\}$
 $\{f, \epsilon\}$

$\{\$ \}$
 $\{g, f, h\}$
 $\{g, f, h\}$
 $\{h\}$
 $\{f, h\}$
 $\{h\}$

$$S \rightarrow AaAb / BbBa$$

$$A \rightarrow \epsilon$$

$$B \rightarrow \epsilon$$

	a	b	\$
S	$S \rightarrow AaAb$	$S \rightarrow BbBa$	
A	$A \rightarrow \epsilon$	$A \rightarrow \epsilon$	
B	$B \rightarrow \epsilon$	$B \rightarrow \epsilon$	

In every cell, he
get only one production,
Therefore this grammar is
LL(1)

1)

$$S \rightarrow$$

$$\Rightarrow A \rightarrow \alpha_1 / \alpha_2 / \alpha_3 / \dots / \alpha_n$$

if $\alpha_1, \alpha_2, \alpha_3$ are mutually exclusive then, it
contributes LL(1) grammar

If they have same terms, they will be placed
under single cell which make that as non-deterministic

$$\Rightarrow A \rightarrow \alpha / \epsilon$$

$F(\alpha)$ Follow(A)

intersects

then it is not LL(1)

$$1) S \rightarrow asbs / bsas / \epsilon$$

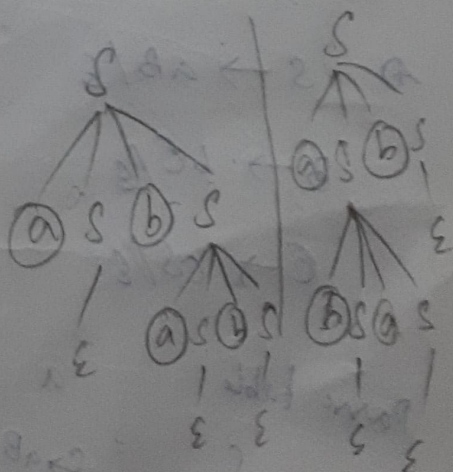
$$\text{first}(S) \Rightarrow \{a, b, \epsilon\}$$

$$\text{follow}(S) \Rightarrow \{a, b, \$\}$$

Parse table

	a	b	\$
S	$S \rightarrow asbs$ $S \rightarrow \epsilon$	$S \rightarrow bsas$ $S \rightarrow \epsilon$	$S \rightarrow \epsilon$

multiple entries not LL(1)



Ambiguous

2) $S \rightarrow aABb$
 $A \rightarrow c/\epsilon$
 $B \rightarrow d/\epsilon$

First ()
 $\{a\}$
 $\{c, \epsilon\}$
 $\{d, \epsilon\}$

Follow ()
 $\{\$ \}$
 $\{d, b\}$
 $\{b\}$

Parse table :-

	a	b	c	d	\$
S	$S \rightarrow aABb$				
A	$S \rightarrow$	$A \rightarrow \epsilon$	$A \rightarrow c$	$A \rightarrow \epsilon$	
B		$B \rightarrow \epsilon$		$B \rightarrow d$	

LL(1) grammars

3) $S \rightarrow A/a$
 $A \rightarrow a$
 must check leads to multiple entries

Parse table

	a	\$
S	$S \rightarrow A$ $S \rightarrow a$	
A	$A \rightarrow a$	

First ()

$\{a\}$
 $\{a\}$

Follow ()

$\{\$ \}$

$\{\$ \}$

Not LL(1) grammar

Ambiguous grammar

4) $S \rightarrow aB/\epsilon$

$B \rightarrow bC/\epsilon$

$C \rightarrow cS/\epsilon$

First ()

$\{a\}$

$\{b\}$

$\{c, \epsilon\}$

Follow ()

$\{\$ \}$

$\{\$ \}$

$\{\$ \}$

Parse table

	a	b	c	\$
S	$S \rightarrow aB$			$S \rightarrow \epsilon$
B		$B \rightarrow bC$		$B \rightarrow \epsilon$
C			$C \rightarrow cS$	$C \rightarrow \epsilon$

LL(1) grammar