

# CS & IT ENGINEERING

## Compiler Design

Lexical Analysis and Syntax Analysis



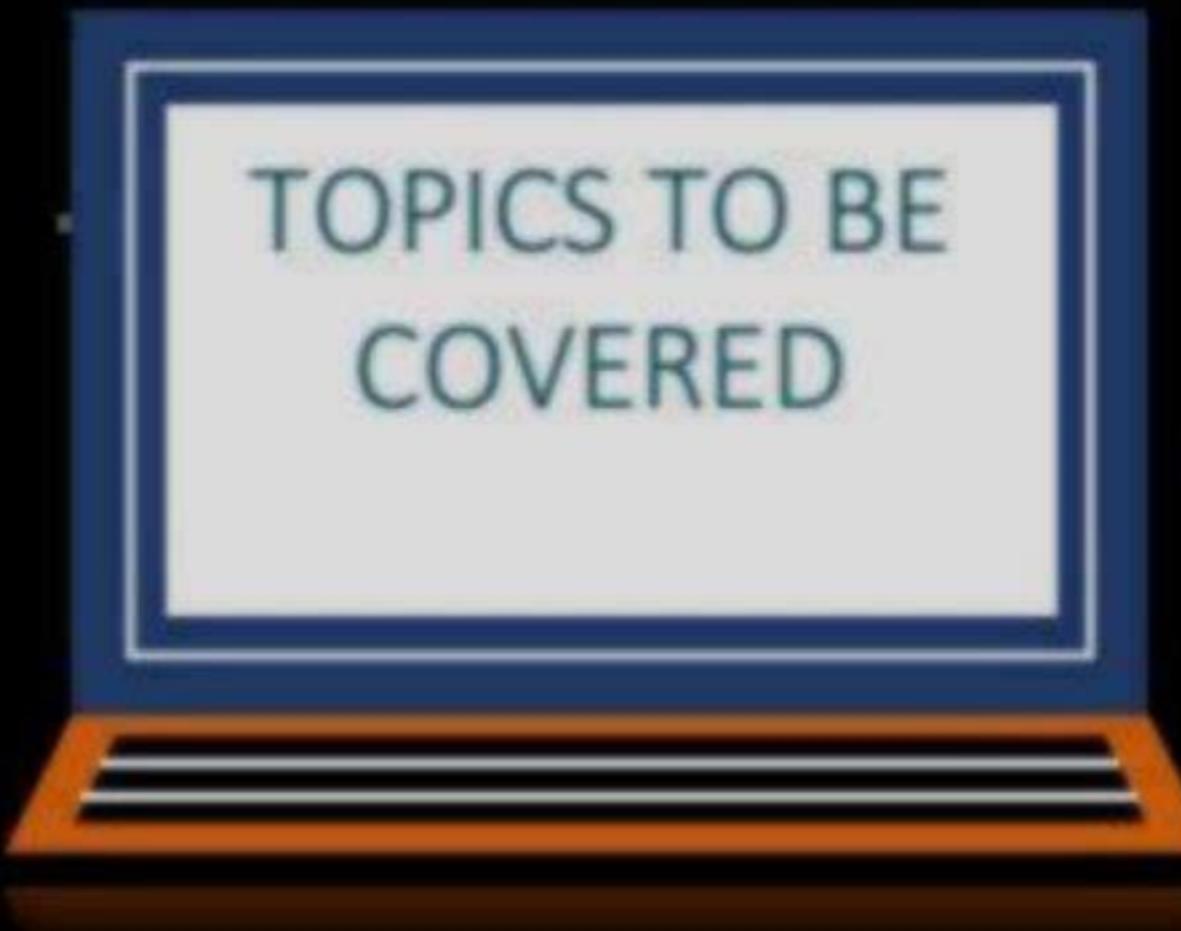
Lecture No. 11



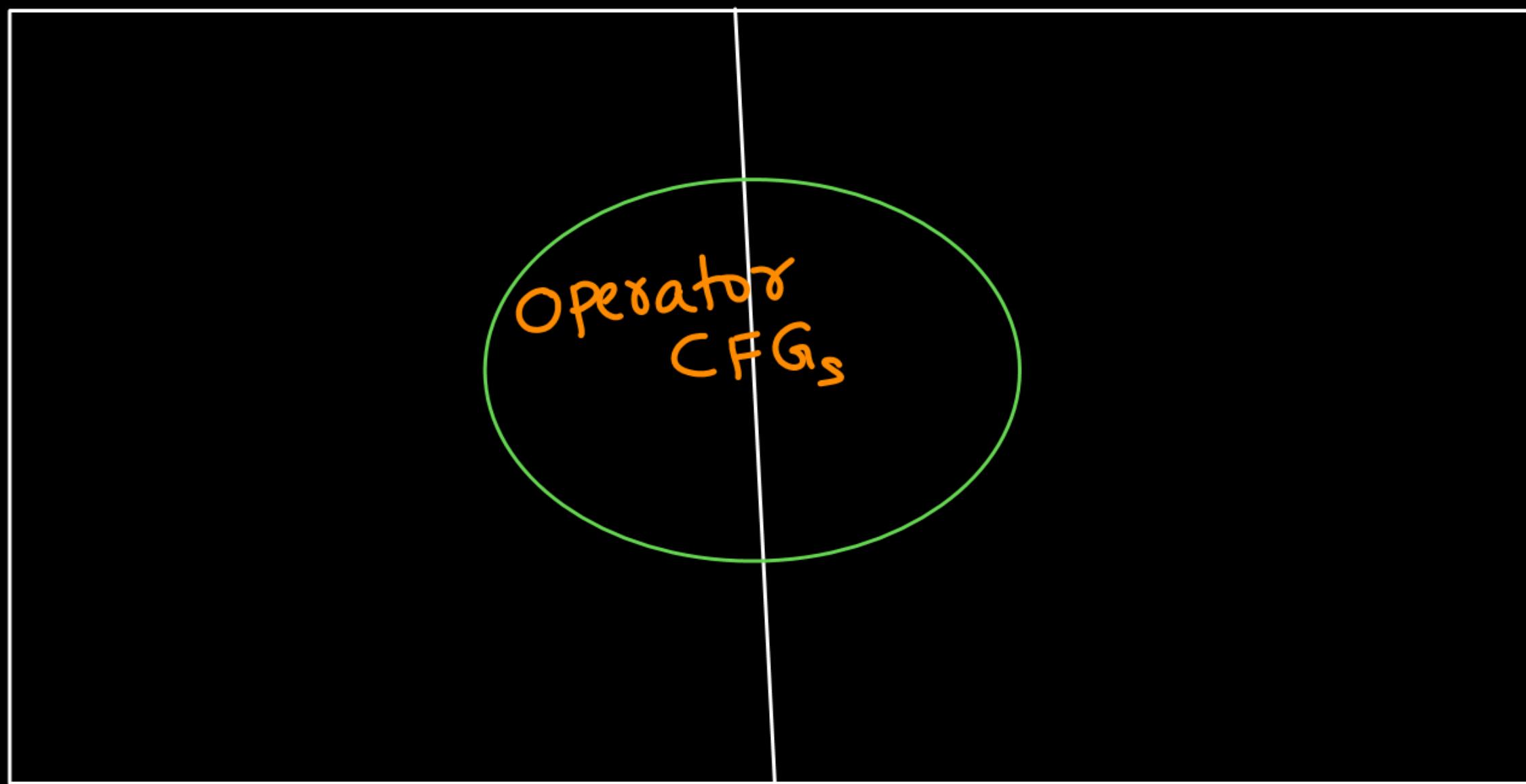
By- DEVA Sir

## operator precedence parsing

- Operator Grammar
- Operator precedence Relations
- How to Compute operator  
precedences ?



All CFGs



Unambiguous CFGs

Ambiguous CFGs

# Operator Grammat [Operator CFG]



It is CFG where

no production contain 2 consecutive nonterminals  
and  
no null production in CFG

①

$$S \rightarrow a$$

O.G.✓

②

$$\begin{array}{l} E \rightarrow E+E \\ E \rightarrow a \end{array}$$

O.G.✓

③

$$\begin{array}{l} E \rightarrow EE \\ E \rightarrow a \end{array}$$

Not O.G.

④

$$E \rightarrow E+E|\epsilon$$

not O.G.

⑤

$$E \rightarrow E+E|a|\epsilon$$

Not O.G.

# Operator precedence Relations :

1) Highest precedence  
(More)

2) Lowest precedence  
(less)

3) Equal precedence

}  $\rightarrow$  Associativity

↳ i) Left associative

ii) Right associative

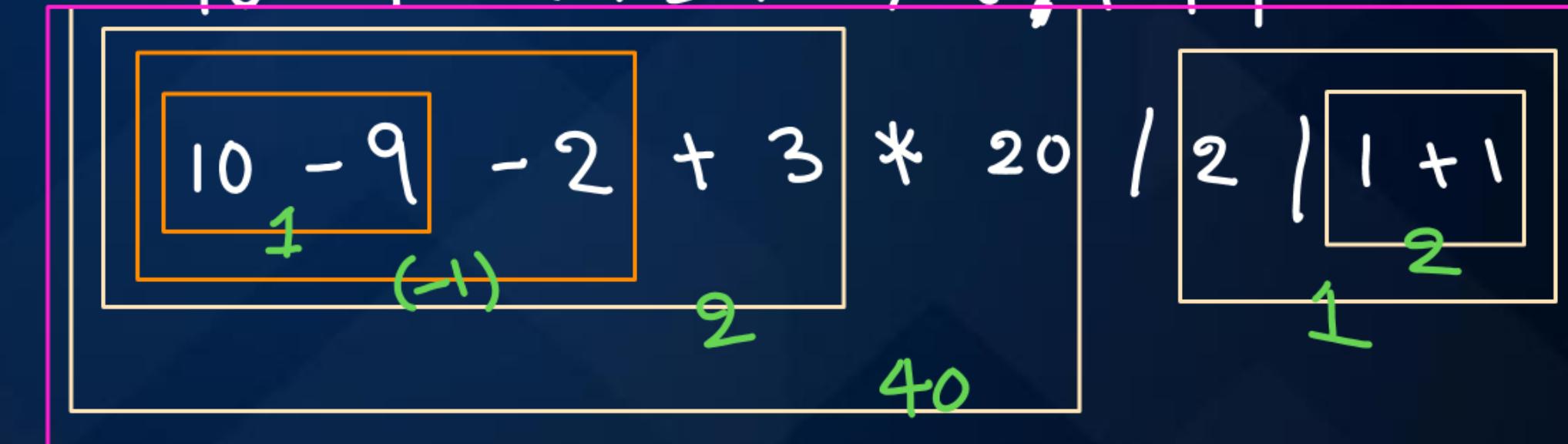
①

	Order	Associativity
-	Highest	Left to Right
+, *	"	"
/	Lowest	Right to Left

Consider this precedence table.

Find O/p for

$$10 - 9 - 2 + 3 * 20 / 2 / 1 + 1$$



$$= 40$$

- ②
- is highest , \* is lowest.
  - follows Left Associative , Remaining follows Right to left.

Find O/p for

$$3 * 2 + \underbrace{3 - 1}_{2} + \underbrace{\underbrace{4 - 2 - 1}_{1}}_{2}$$



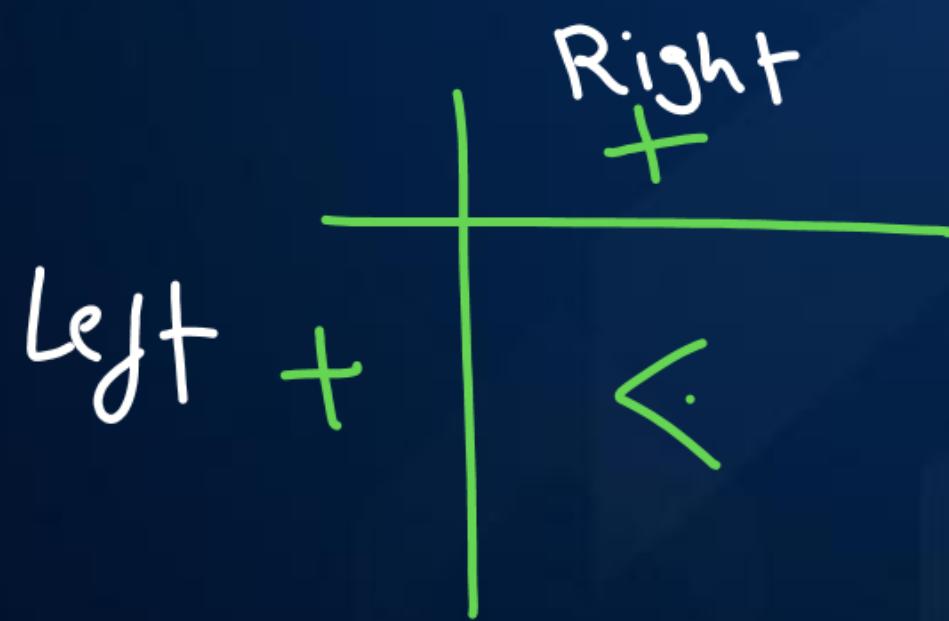
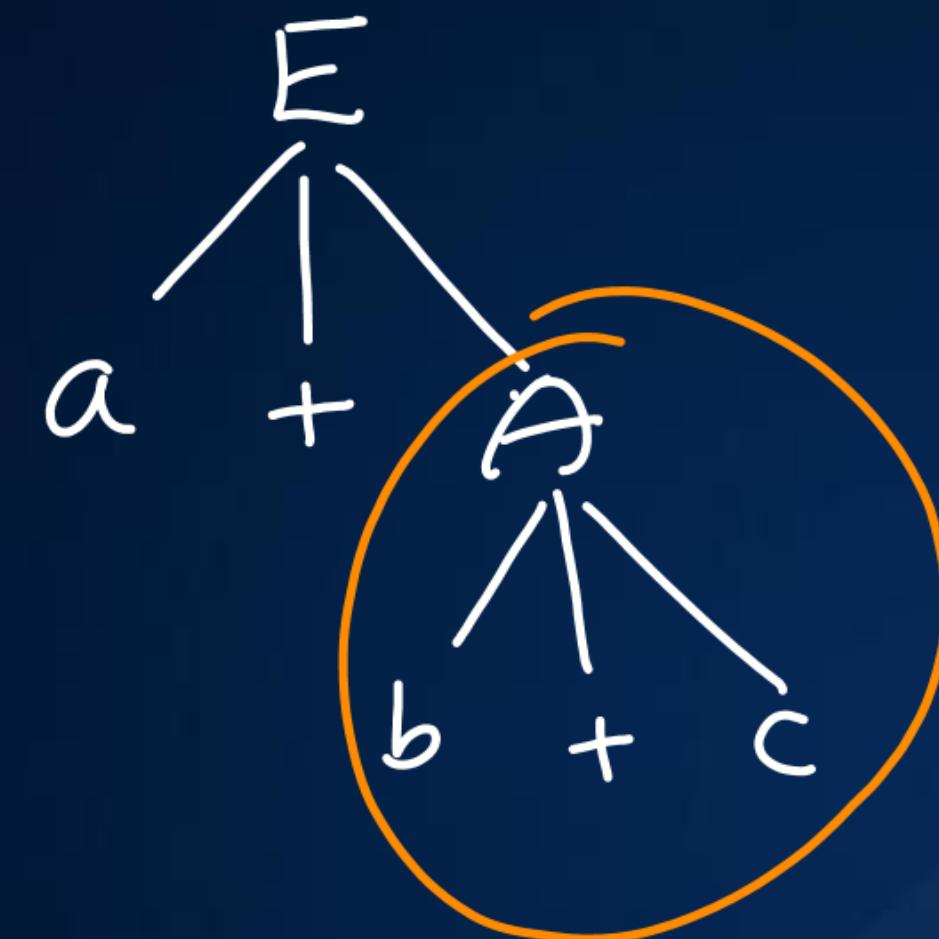
Left to Right  
Right to left  
Right to left

$$3 * 2 + 2 + 1$$

3  
5

$$= 15$$

③



$$a + \boxed{b + c}$$

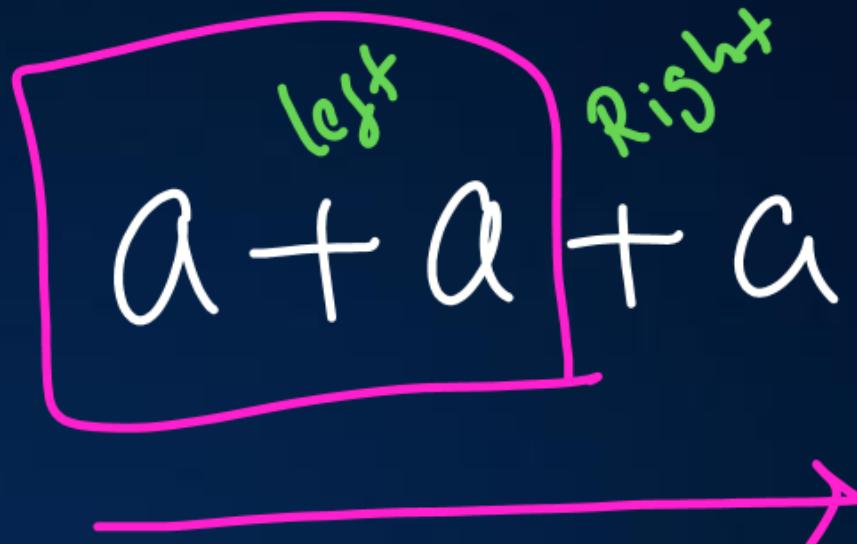
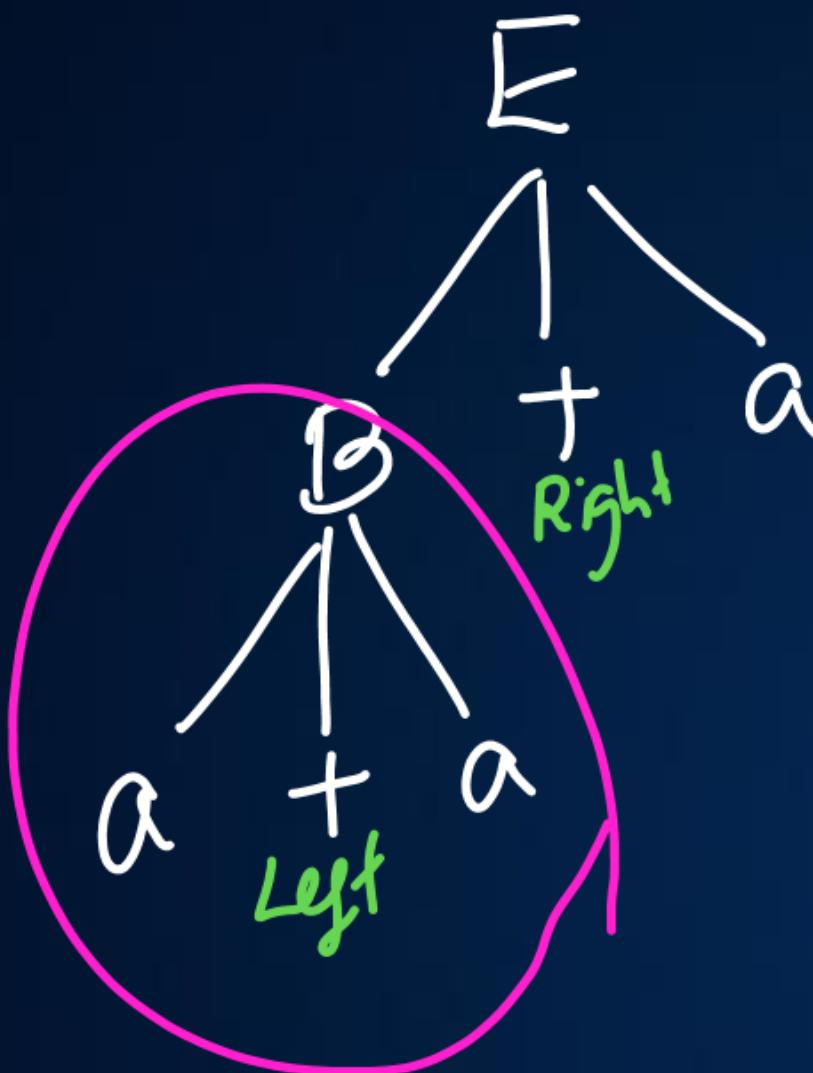
Left + has less precedence than  
Right +

+ is Right Associative

+ < +  
Left Right

P  
W

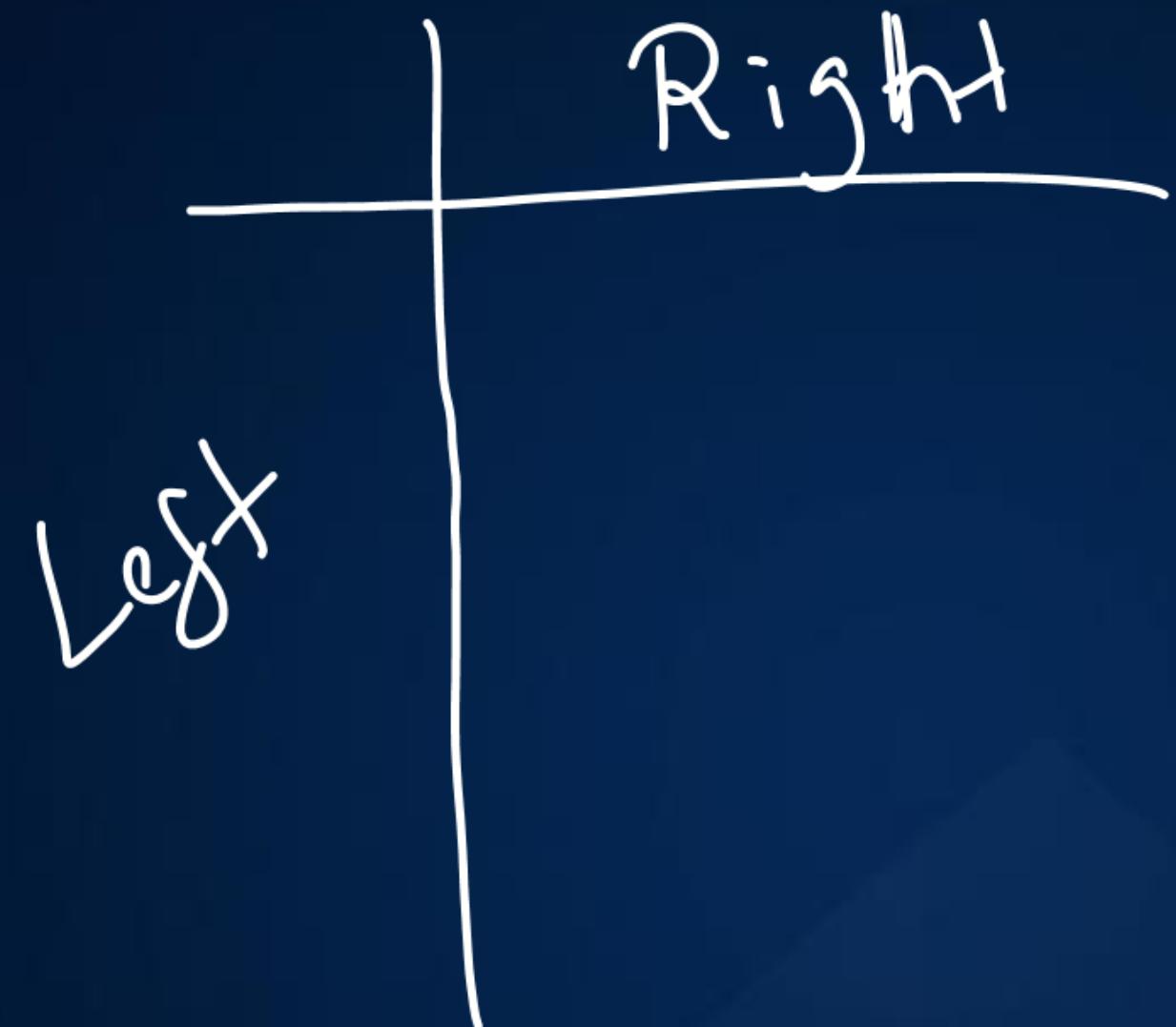
④



+ is Left ASSOCiativE

$$\begin{array}{c} + \\ \diagup \quad \diagdown \\ + \quad + \\ \diagup \quad \diagdown \\ + \quad > \end{array}$$

$$\begin{array}{c} + \\ \diagup \quad \diagdown \\ + \quad + \\ \diagup \quad \diagdown \\ + \quad > \end{array}$$



Left Right

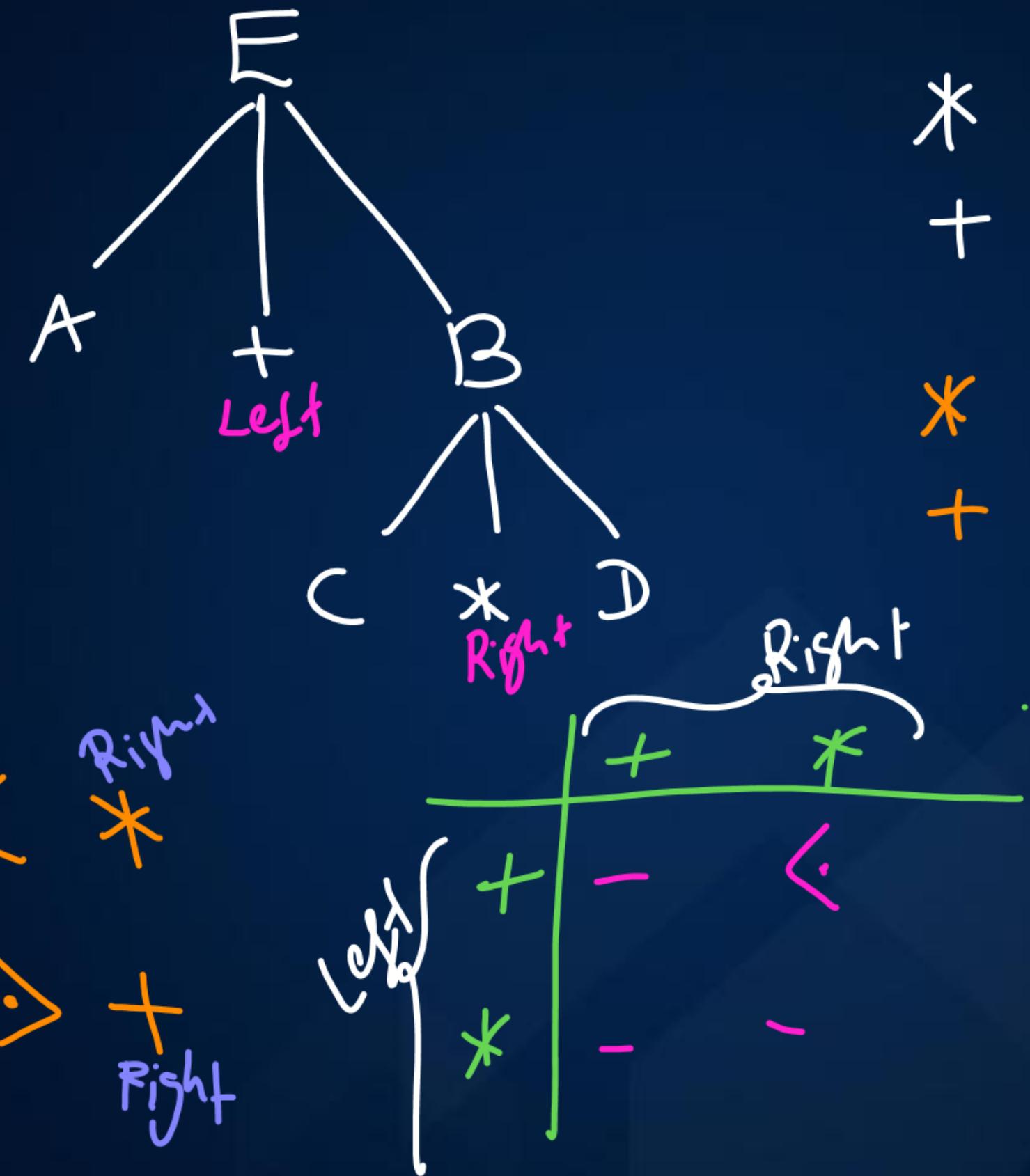
$x < y$

$x > y$

$x \doteq y$

(5)

P  
W

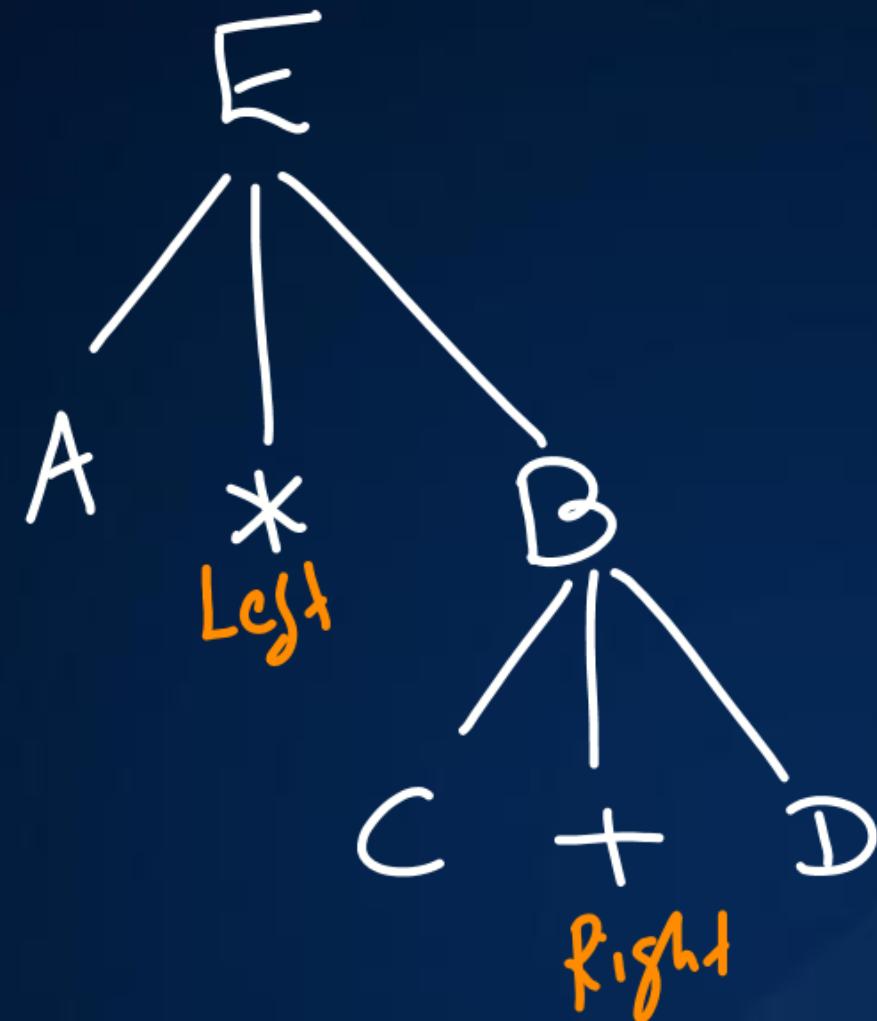


\* is highest +  
+ is lowest +

\* is highest than +  
+ is lowest than \*

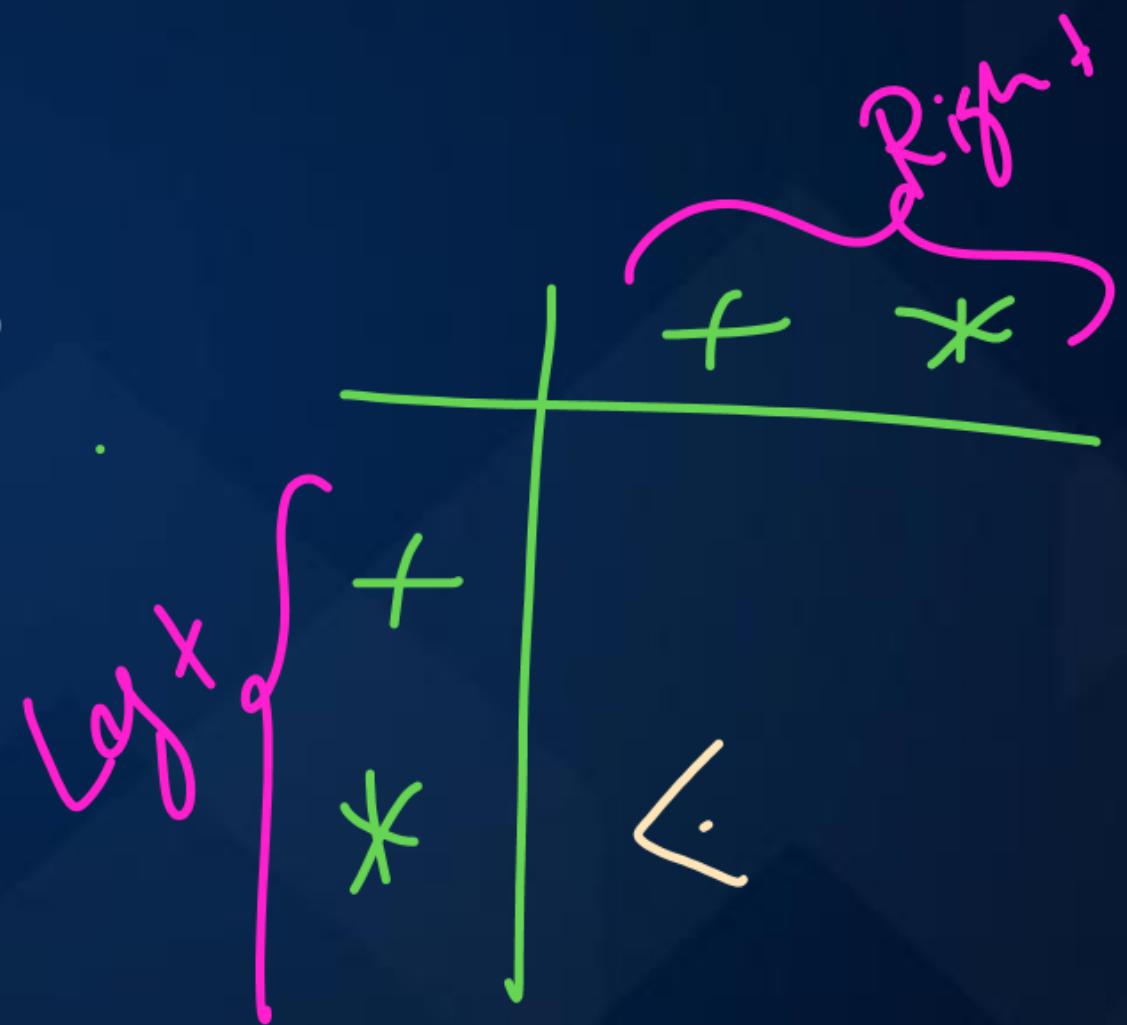
⑥

P  
W



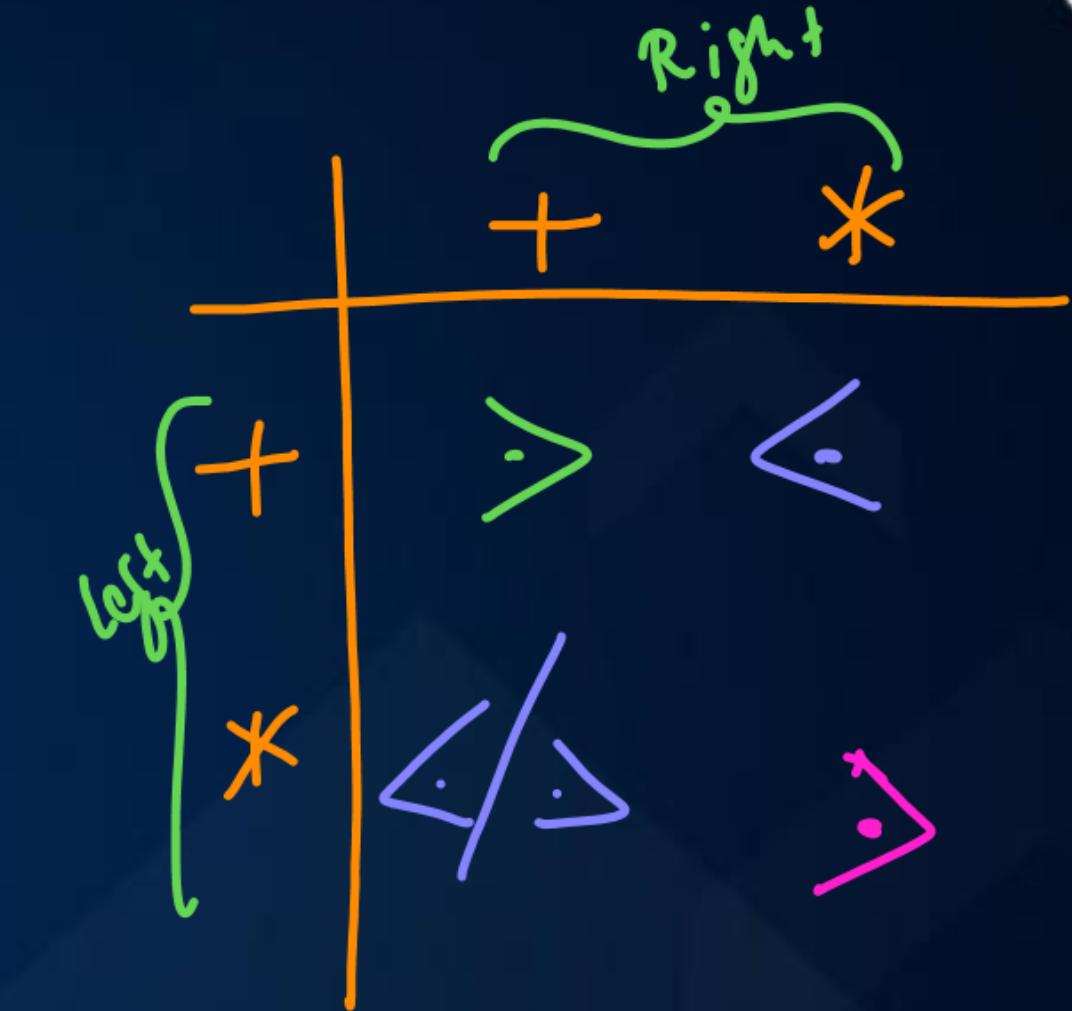
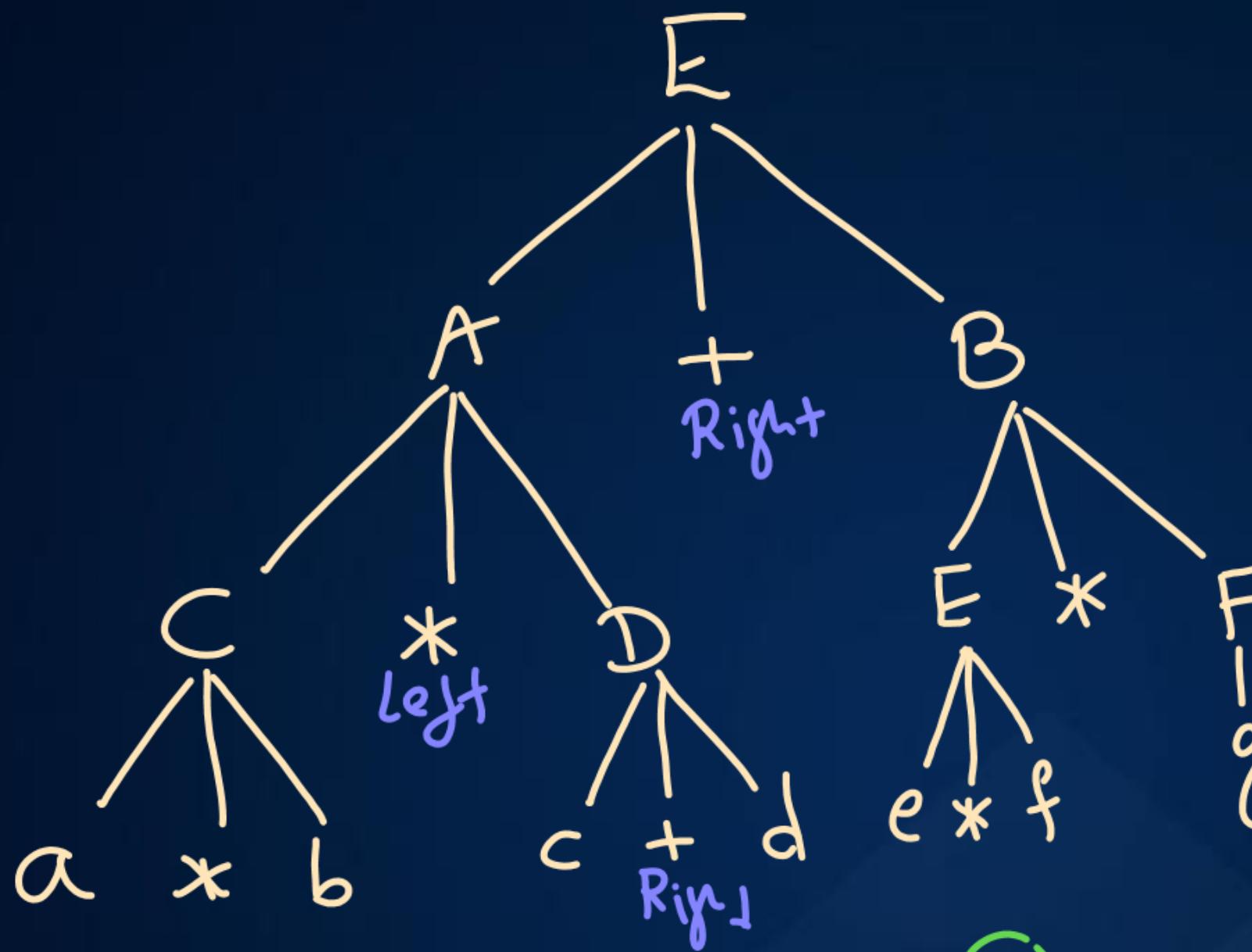
- I)  $* < +$
- II)  $+ > *$

$+$  is Highest  
 $*$  is Lowest

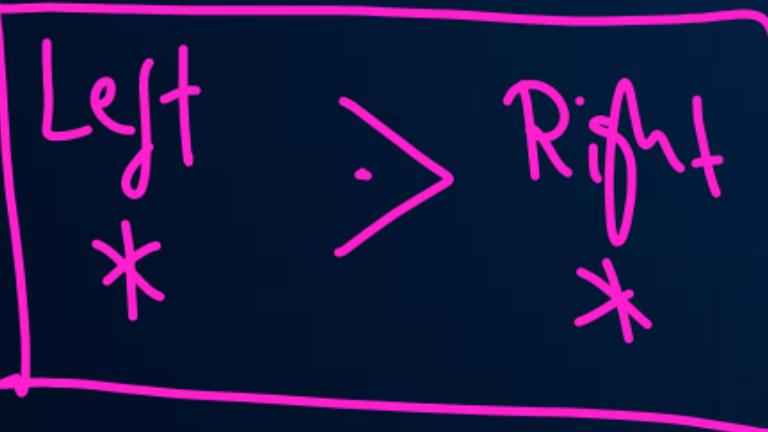


F

P  
W



I)



\* is left associative

II

+

>

+

+ is left Associative

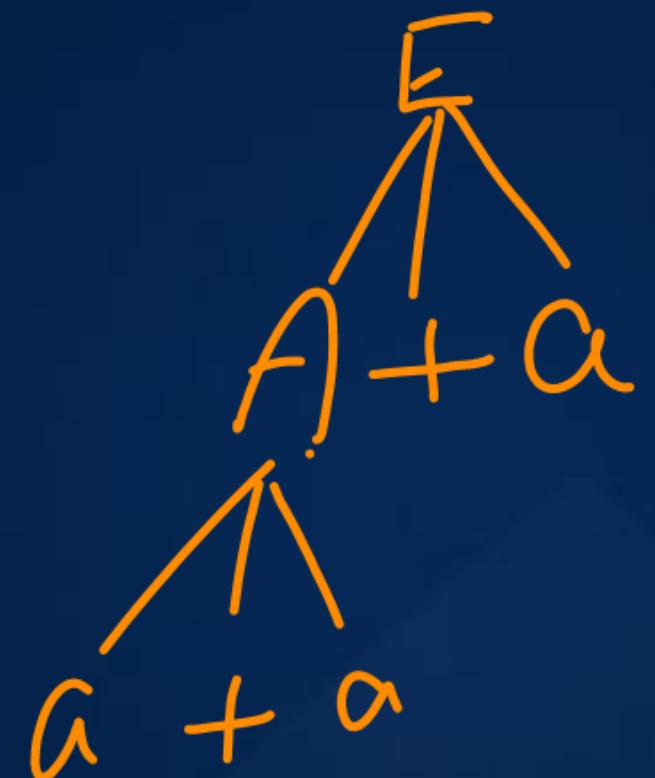
⑧

$$E \rightarrow A + a \mid a$$

P  
W

$$\boxed{a + a} + a$$

$$A \rightarrow a + a$$



+ is Left Associative

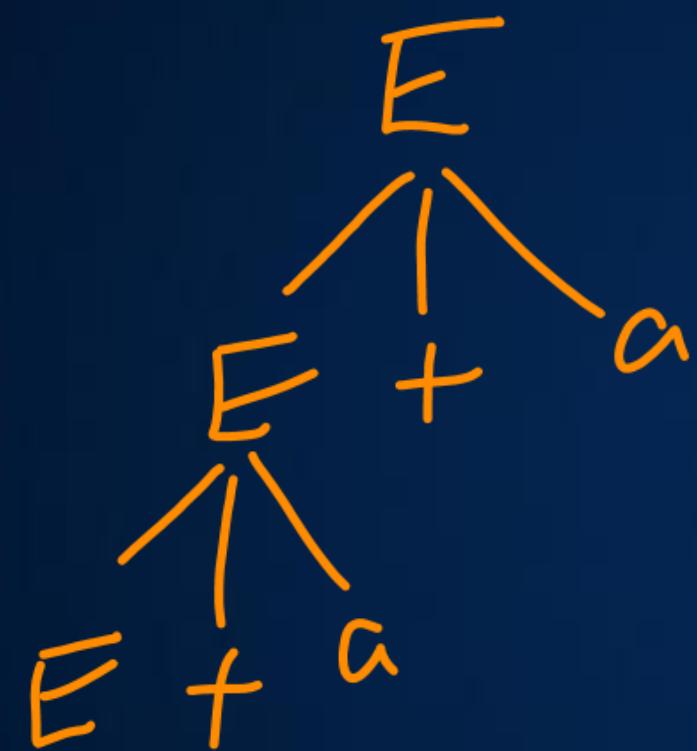
$$+ > +$$

⑨

$$E \rightarrow E + a \mid a$$

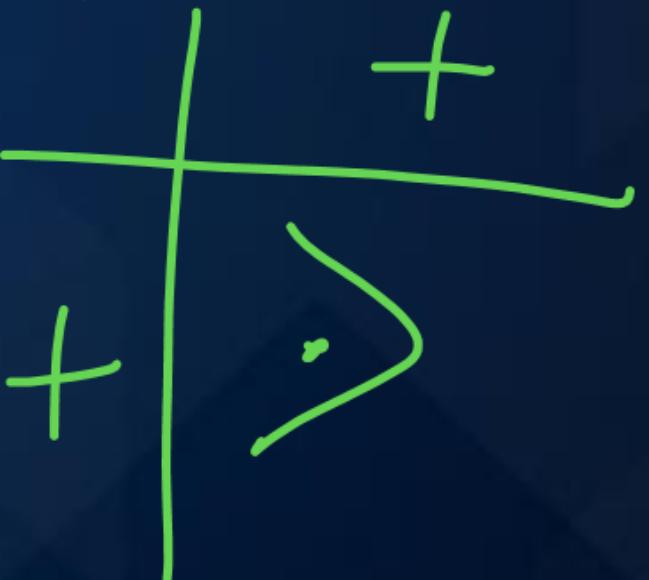
Left Rec

⇒ + is Left Associative  
because + associated  
with left Rec



$$a + a + a$$

+ is Left Associative



⑩

$$E \rightarrow a * E \mid a$$

Right Rec

\* is Right Associative

⑪

$$E \rightarrow a * A \mid a$$
$$A \rightarrow a * a$$

\* is Right Associativ

12

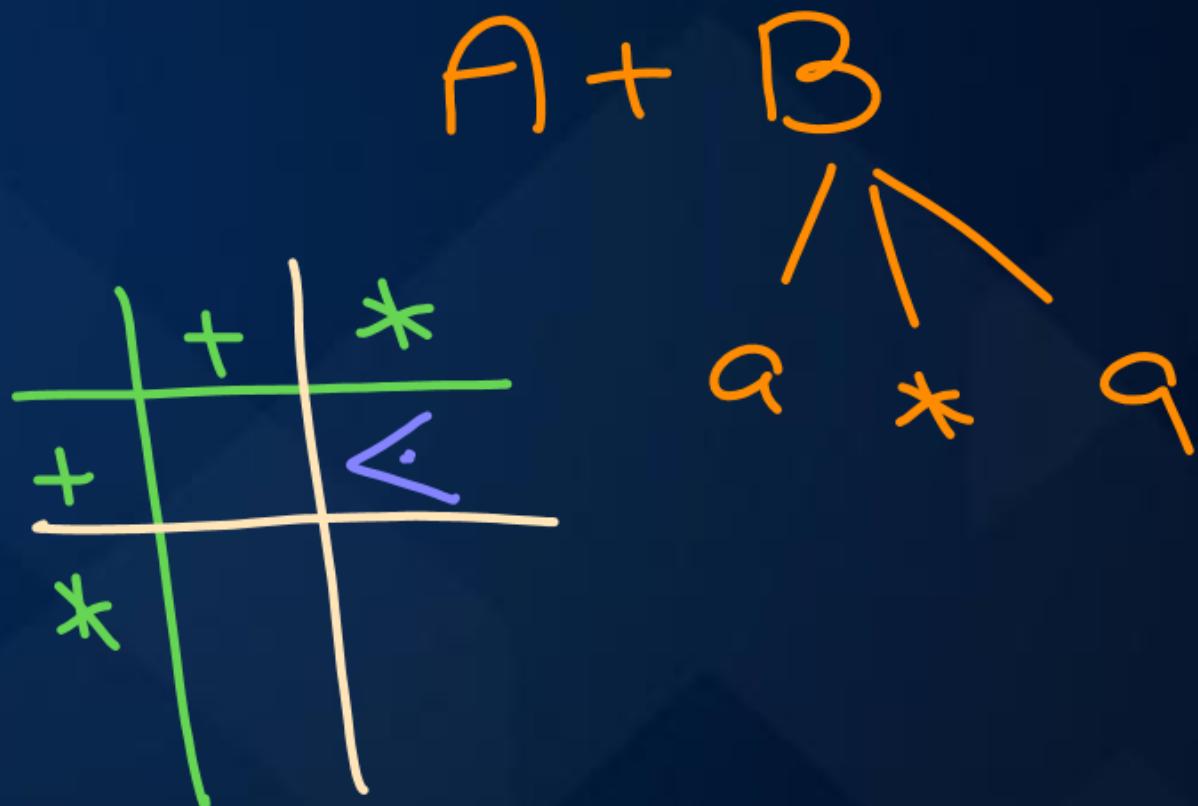
$$S \rightarrow A + B \mid a$$

$$A \rightarrow a$$

$$B \rightarrow a * a$$

\* is highest  
+ is lowest

a+a\*a



13

$$E \rightarrow E + T \mid a$$

$$T \rightarrow F * T \mid b$$

$$F \rightarrow c$$



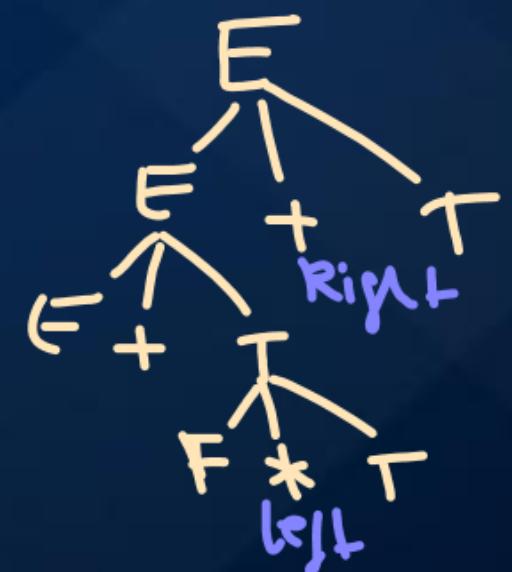
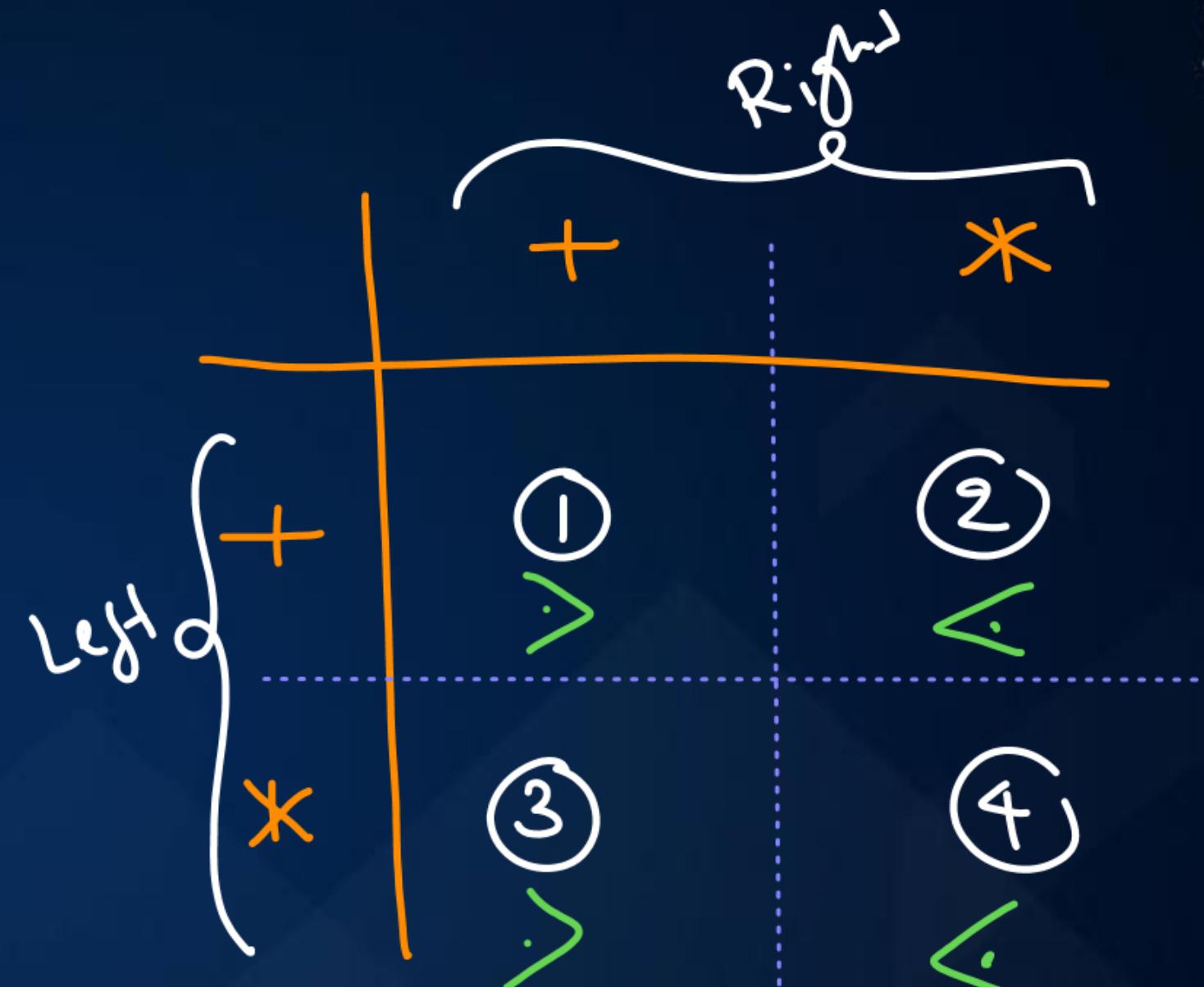
① + is Left ASSociative

② + < \*

③ \* > +

④ \* is Right ASSociative

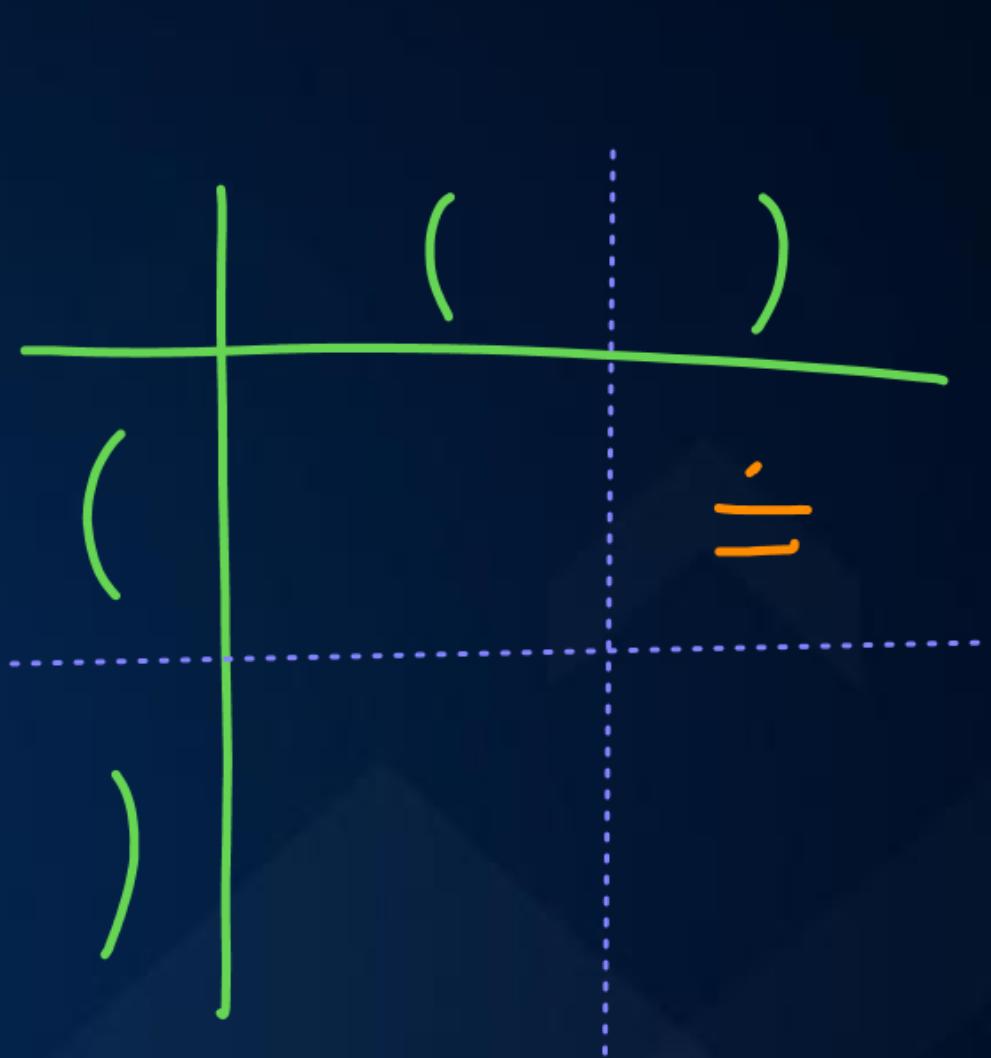
P  
W



14

$$E \rightarrow (E) | a$$

(  $\doteq$  )  
Left Right



P  
W

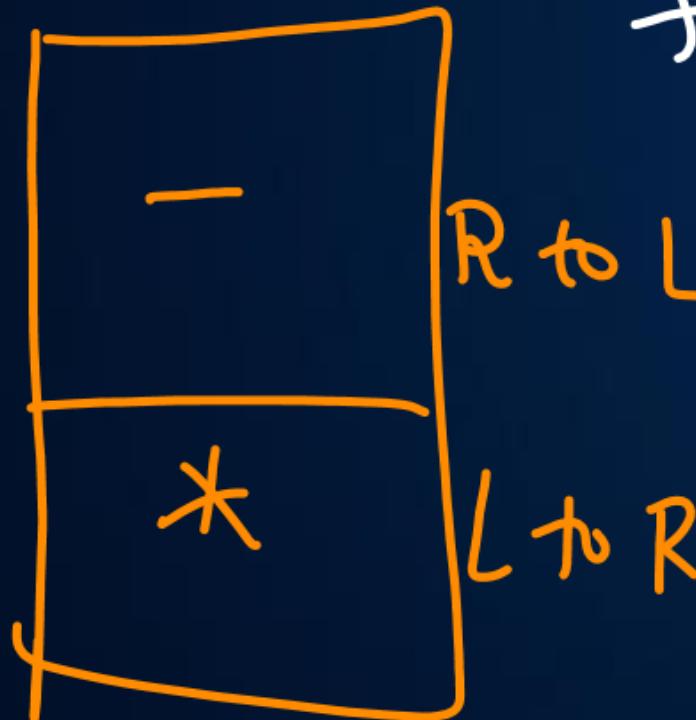
(15)

$$E \rightarrow E-E \mid E * E \mid id$$

Here OG  
is not required

If - is highest , - is Right Associative and  
 \* is left Associative then

find o/p for



$$5 - 2 - 1 * 3$$

5  
 - 2  
 - 1  
 \* 3  
 = 12

$$E \rightarrow E + E \mid E * E \mid E - E \mid E/E \mid E \% E \mid (E) \mid id$$

It will generate all arithmetic expressions

$$3 - \underbrace{1 - 2}_{-1} + \underbrace{5 - 2}_3 = x \\ =$$

- is highest
- is Right to left

$$3 - \cancel{1} \cancel{- 2} = x$$

Note: Operator precedence Relations can be computed using

- 1) Parse Tree
- 2) Operator precedence Table
- 3) Unambiguous Operator Grammar
- 4) Information provided in English statements.

↳ Operator precedence Relations ✓

Next: SDTs

H.W. : Practice all GATE PYQs  
till now.

