

⊕ precedence over ⊗ id

⊕ right-as.

⊗ left-as.

$E \rightarrow E + T \mid T$

$T \rightarrow T * F \mid F$

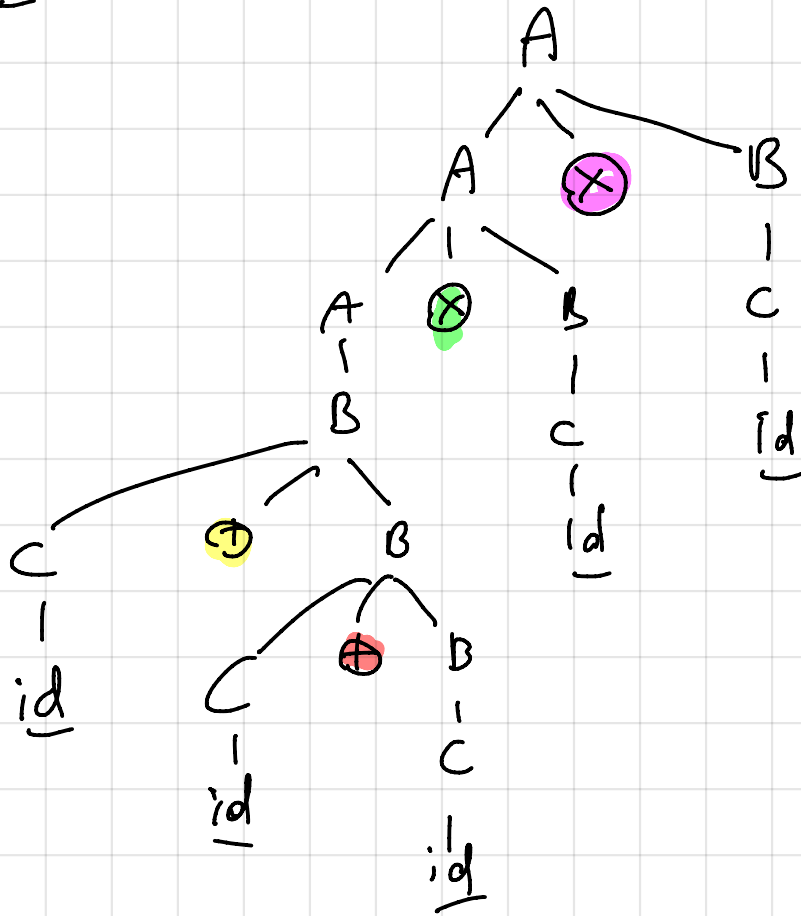
$F \rightarrow _ _$

$\rightarrow A \rightarrow A \otimes B \mid B$

$B \rightarrow C \oplus B \mid C$

$C \rightarrow \underline{id} \mid (A)$

id ⊕ id ⊕ id ⊗ id ⊗ id



A grammar for regexp on $\Sigma = \{a, b\}$

$$R \rightarrow R + A \mid A$$

$$A \rightarrow A \cdot B \mid B$$

$$B \rightarrow B^* \mid C$$

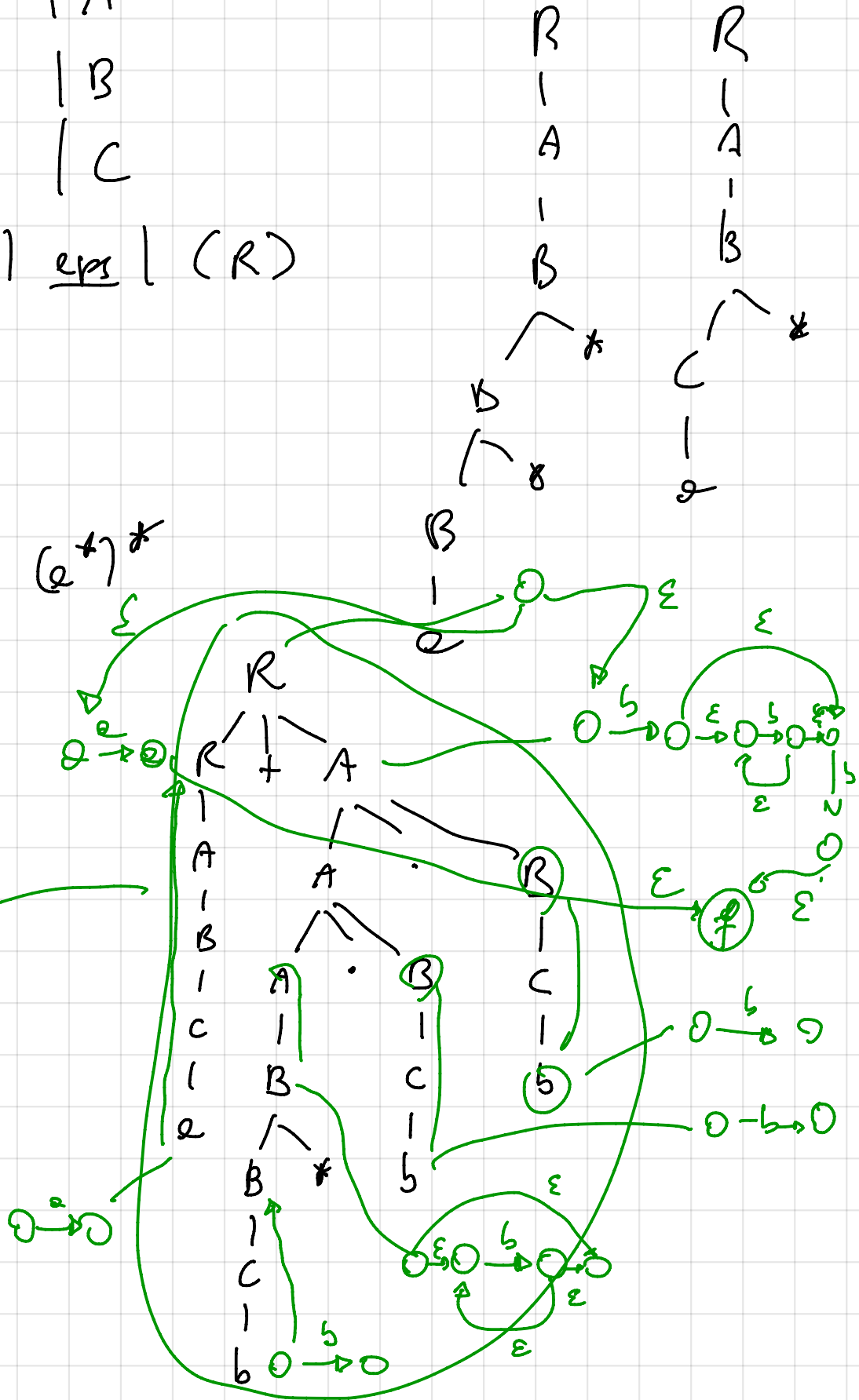
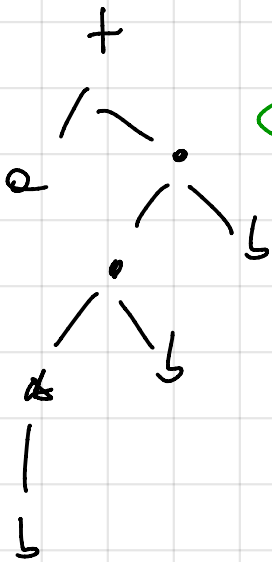
$$C \rightarrow a \mid b \mid \epsilon \mid (R)$$

C^*



$(a^+)^*$

$a + b^* | b$



$\boxed{+ -}$ $\boxed{* /}$

$E \rightarrow E + T \mid E - T \mid T$

$T \rightarrow T * F \mid F / T \mid F$

$F \rightarrow \underline{id} \mid (E)$

+ is left-associative

- is left-associative

+, - same precedence

* is left-associative.

/ is right-associative

*, / have the same precedence

$$L = \{ a^m bc \mid m > 0 \} \cup \{ b^m cb \mid m > 0 \} \cup \{ ca^m \mid m > 0 \}$$

$$S \rightarrow aA \mid bB \mid cC$$

$$A \rightarrow aA \mid bc$$

$$B \rightarrow bB \mid cb$$

$$C \rightarrow b \mid aD$$

$$D \rightarrow aD \mid \epsilon$$

$$cb \$$$

$$cae \$$$

$$\text{FIRST}(S) = \{ a, b, c \} \quad \text{FOLLOW}(S) = \{ \$ \}$$

$$\text{FIRST}(A) = \{ a, b \} \quad \text{FOLLOW}(A) = \{ \$ \}$$

$$\text{FIRST}(B) = \{ b, c \} \quad \text{FOLLOW}(B) = \{ \$ \}$$

$$\text{FIRST}(C) = \{ b, a \} \quad \text{FOLLOW}(C) = \{ \$ \}$$

$$\text{FIRST}(D) = \{ \epsilon, a \} \quad \text{FOLLOW}(D) = \{ \$ \}$$

	a	b	c	\$
S	S → aA	S → bB	S → cC	
A	A → aA	A → bc		
B		B → bB	B → cb	
C	C → aD	C → b		
D	D → aD			D → ε

MATCHED	STACK	INPUT	ACTION
	S \$	cb \$	S → cC
	cC \$	cb \$	match
c	C \$	b \$	C → b
c	b \$	b \$	match
cb	\$	\$	ACCEPT

MATCHED	STACK	INPUT	ACTION
	S \$	cae \$	S → cC
	cC \$	cae \$	match
c	C \$	ae \$	C → aD
c	aD \$	ae \$	match
ca	D \$	a \$	D → aD
ca	aD \$	a \$	match
cae	D \$	\$	D → ε
cae	\$	\$	ACCEPT

$E \rightarrow E + T \mid T$ $id \neq id$

$T \rightarrow T * F \mid F$

$F \rightarrow id \mid (E)$

$E \xRightarrow{zm} T \xRightarrow{zm} T * F \xRightarrow{zm} T * id \xRightarrow{zm} F * id \xRightarrow{zm} id * id$

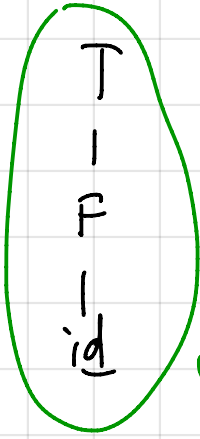
$id * id$

\Rightarrow
 $F \rightarrow id$

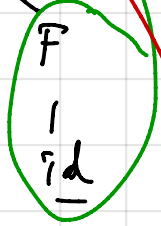
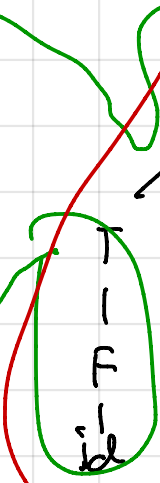
$F \Rightarrow$
 $T \rightarrow F$
 id

T
 F
 id

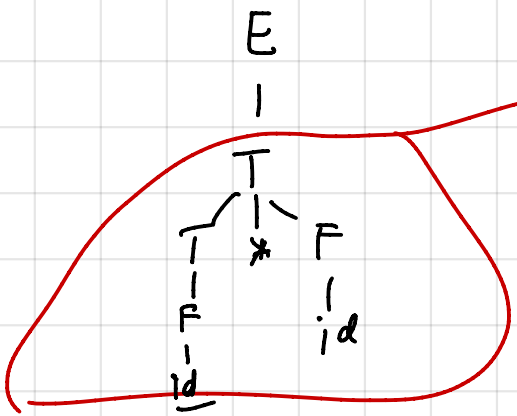
\Rightarrow
 $F \rightarrow id$



\Rightarrow
 $T \rightarrow T * F$



\Rightarrow
 $E \rightarrow T$



$$S \rightarrow OS2 \mid 01$$

00211

$$S \rightarrow 01$$

|

$$S \Rightarrow OS2 \Rightarrow 00S11 \Rightarrow 000111$$

↑
handle

00S11

$$S \rightarrow OS1$$

$$S \Rightarrow OS1 \Rightarrow 00S11$$

↑
handle ..

↑
handel

$S \rightarrow SS+ \mid SS* \mid \epsilon$ $\epsilon\epsilon\epsilon*\epsilon++\epsilon$

SHIFT-REDUCE

PARSER

STACK

INPUT

ACTION

STACK	INPUT	ACTION
handle \$	$\epsilon\epsilon\epsilon*\epsilon++\epsilon$	SHIFT
ϵ \$	$\epsilon\epsilon*\epsilon++\epsilon$	Reduce $S \rightarrow \epsilon$
S \$	$\epsilon\epsilon*\epsilon++\epsilon$	SHIFT
ϵ S \$	$\epsilon*\epsilon++\epsilon$	Reduce $S \rightarrow \epsilon$
S S \$	$\epsilon*\epsilon++\epsilon$	SHIFT
ϵ S S \$	$*\epsilon++\epsilon$	Reduce $S \rightarrow \epsilon$
S S S \$	$*\epsilon++\epsilon$	SHIFT
ϵ S S S \$	$\epsilon++\epsilon$	Reduce $S \rightarrow SS*$
S S S \$	$\epsilon++\epsilon$	SHIFT
ϵ S S S \$	$++\epsilon$	Reduce $S \rightarrow \epsilon$
S S S \$	$++\epsilon$	SHIFT
ϵ S S S \$	$+\epsilon$	Reduce $S \rightarrow SS+$
S S \$	$+\epsilon$	SHIFT
ϵ S S \$	ϵ	Reduce $S \rightarrow SS+$
S \$	ϵ	ACCEPT

$S \Rightarrow_{2m} SS+ \Rightarrow_{2m} SSS++ \Rightarrow_{2m} S\epsilon++ \Rightarrow_{2m} SSS*\epsilon++$
 $\Rightarrow_{2m} SS\epsilon*\epsilon++ \Rightarrow_{2m} S\epsilon\epsilon*\epsilon++ \Rightarrow_{2m} \epsilon\epsilon\epsilon*\epsilon++$