Closure Properties of CFL - II

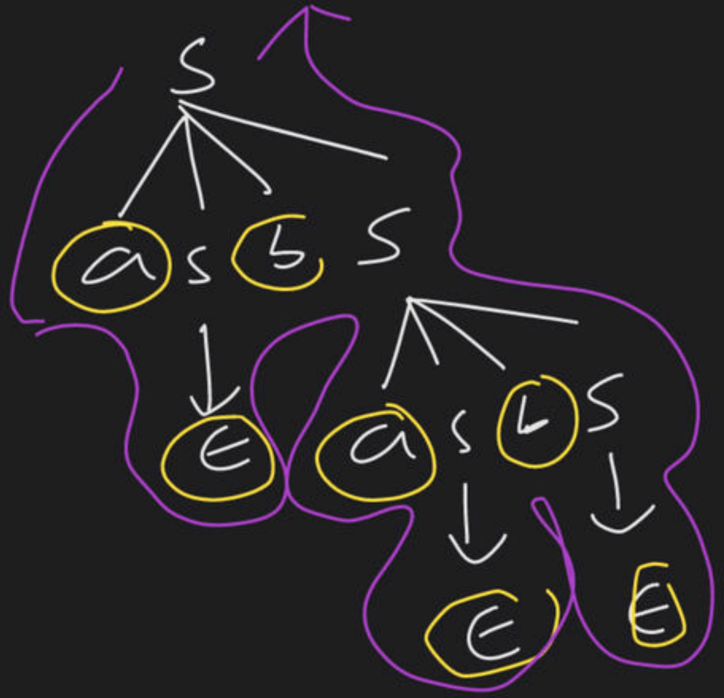
Complete Course on Theory of Computation

Subbarao Lingamgunta • Lesson 33 • Mar 21, 2022

ex

S → asbs | bsas | ϵ

i/p: abab



Note

⇓

To check given grammar is ambiguous or not undecidable

S → as/a

⇓

⟹ a, aa, aaa, aaaa, ...

abab

S → as/sa/a

G ⟹ Ambiguous ⟹

atleast 1-string to check membership

S → asa/a/ϵ

1-Language contain $\Rightarrow$ Multiple grammar

1-Grammar generate $\Rightarrow$ 1-Language.

According to chomsky-Types of Grammar

Type-0 (U.R.G)

$\Downarrow$

REL

$$(V+T)^{+} \longrightarrow (V+T)^{*}$$

Type-1 (CSG)

$\Updownarrow$

CSL

$$(V+T)^{+} \longrightarrow (V+T)^{+}$$

$$\alpha \qquad \beta$$

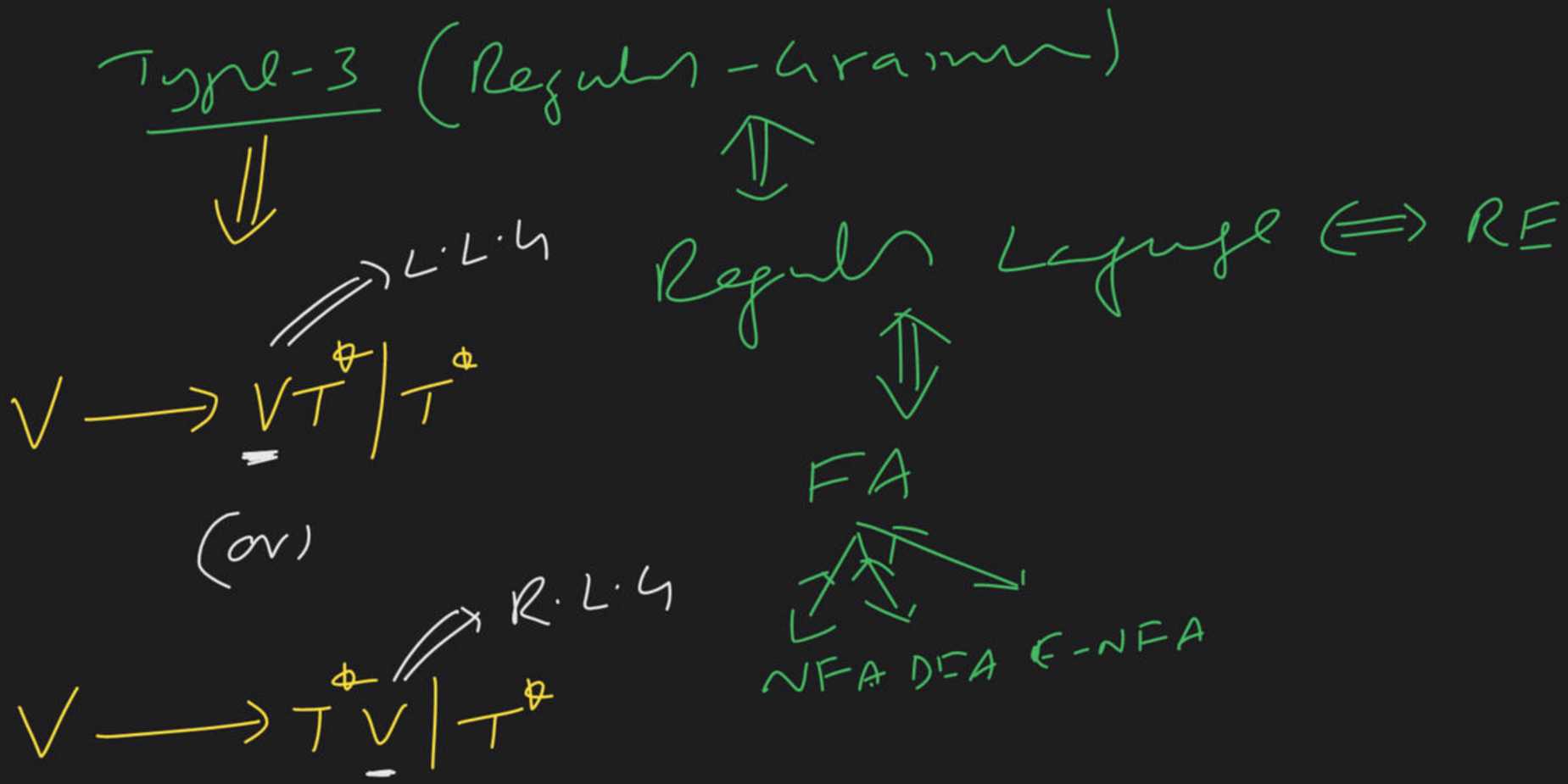
$$|\alpha| \leq |\beta|$$

Type-2 (CFG)

$\Updownarrow$

CFL

$$V \longrightarrow (V+T)^{*}$$


Type-3 (Regular Grammar)
Regular Language ⟺ RE
FA
NFA DFA ε-NFA
L.L.G
V → VT* | T*
(or)
R.L.G
V → T*V | T*

Find Type means

=

Highest type-number

ex

$S \to ABd$

$AB \to cD$

$aD \to e$

Left

$S.V \Longrightarrow T_3\ T_2$

m

T_0

$|\alpha| \leq |\beta|$

(1)

ex

$S \to ABd$

$B \to DEF$

$E \to cd$

Type

Left

$S.V$ $\quad$ m

T_2

(2)

ex

$S \rightarrow aS \mid b$ (R.L.4)

Type = 3

Left = S.V

$I_2, I_3 \Rightarrow I_3$

ex

$S \rightarrow abcd \mid cde$

Type = 4

Left = S.V

$I_0, I_1, I_2, I_3 \Rightarrow I_3$

$S \rightarrow Sa \mid b \Rightarrow L \cdot L \cdot G$

$A \rightarrow bA \mid b \Rightarrow R \cdot L \cdot G$

$S \rightarrow Sa \mid b$

$A \rightarrow a$

$L \cdot L \cdot G$

$\Downarrow$

Regular $\subset T_3$

Type 0

$\Downarrow$

Left

$\Downarrow$

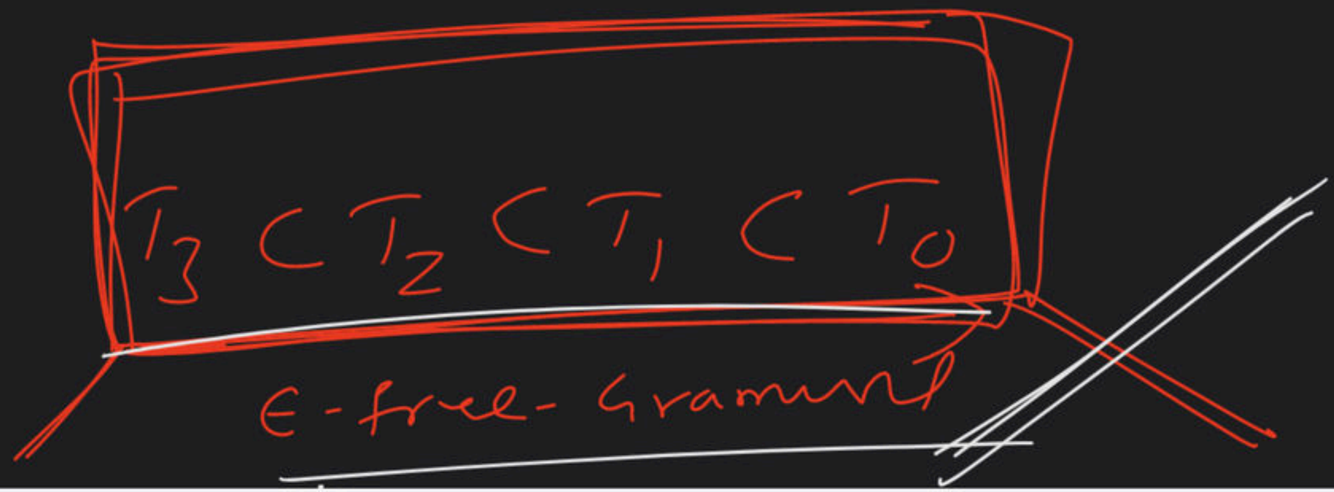
S

$\Downarrow$

S.V

$\Downarrow$

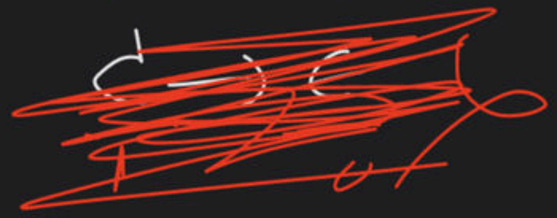
$T_2, \cancel{T_1}, \cancel{T_0} \Rightarrow T_2$



S → ABC

A → bc

B → de



T2

Type

Left

Si

T2, T3 ⇒ T2 ⇒ T0, T1

T2

T1

T2 T1

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Context Free Grammar (CFG)

Write CFG $L = \{ a^m b^n \mid m, n \geq 1 \}$

$\Rightarrow$ ab, aaaab, abbbb, aaabbb

CFL

$S \rightarrow A.B$

$A \rightarrow aA \mid a \Rightarrow a^m \mid m \geq 1$

$B \rightarrow bB \mid b \Rightarrow b^n \mid n \geq 1$

$a^m b^n \mid m, n \geq 1$

CFG

$S \rightarrow aS \mid aB$

$B \rightarrow b \mid bB$

b

bbbbB

aB

aaaaaaaaaa