



CS & IT Engineering



Deva sir





TOPICS TO BE
COVERED

Basics of TOC

B.Tech. / B.E.



2006
↳ 210

2007 ⇒ M.Tech (ITB)
↳ 119

2009 ⇒ GATE / teaching / ^{IT}placements
↓
2022 IT ⇒ Embedded systems

≥ 5000 students personally
≥ 1 lakh " platforms

Q1) How to prepare TOC?

1st:

class Notes
and
GATE Questions

Q2) Weightage in GATE?

8M-9M

Q3) Teacher: 40-50 Hours

Student: 60 Hrs + 40 Hours = 100 Hours

Syllabus:

① Basics

^{1m-2m} ② Regular Expressions

^m ③ DFA, NFA, FA with O/P, P.L.

④ Regular Grammars

^{m-2m} ⑤ Regular and Non regular languages

^m ⑥ closure properties

^{2m-3m} ⑦ CFG, PDA, CFL, DCFLs, closure properties

^{2m-3m} ⑧ TM, decidable and undecidable problems

12-14
12 years
Schooling

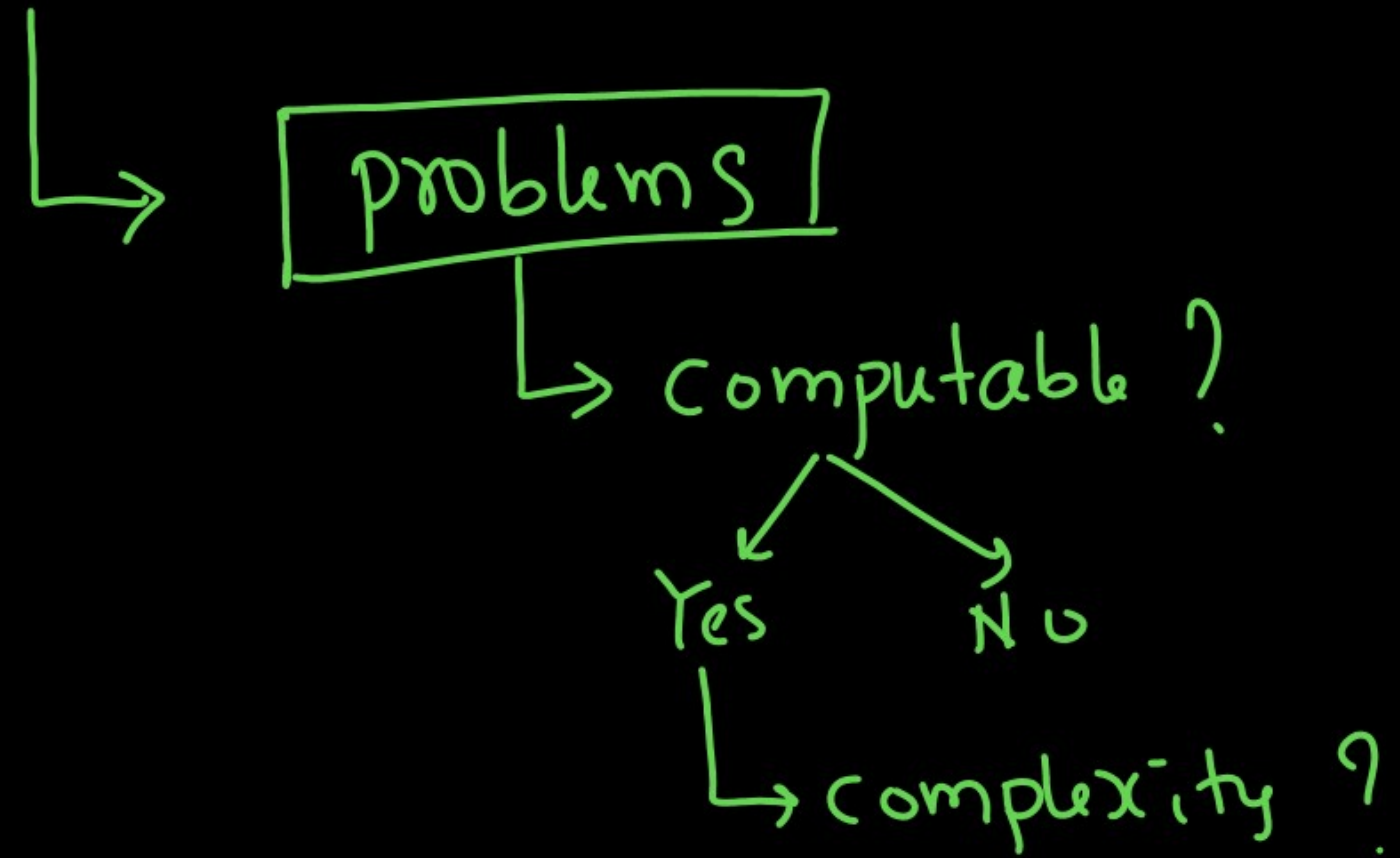
4 years
B.Tech

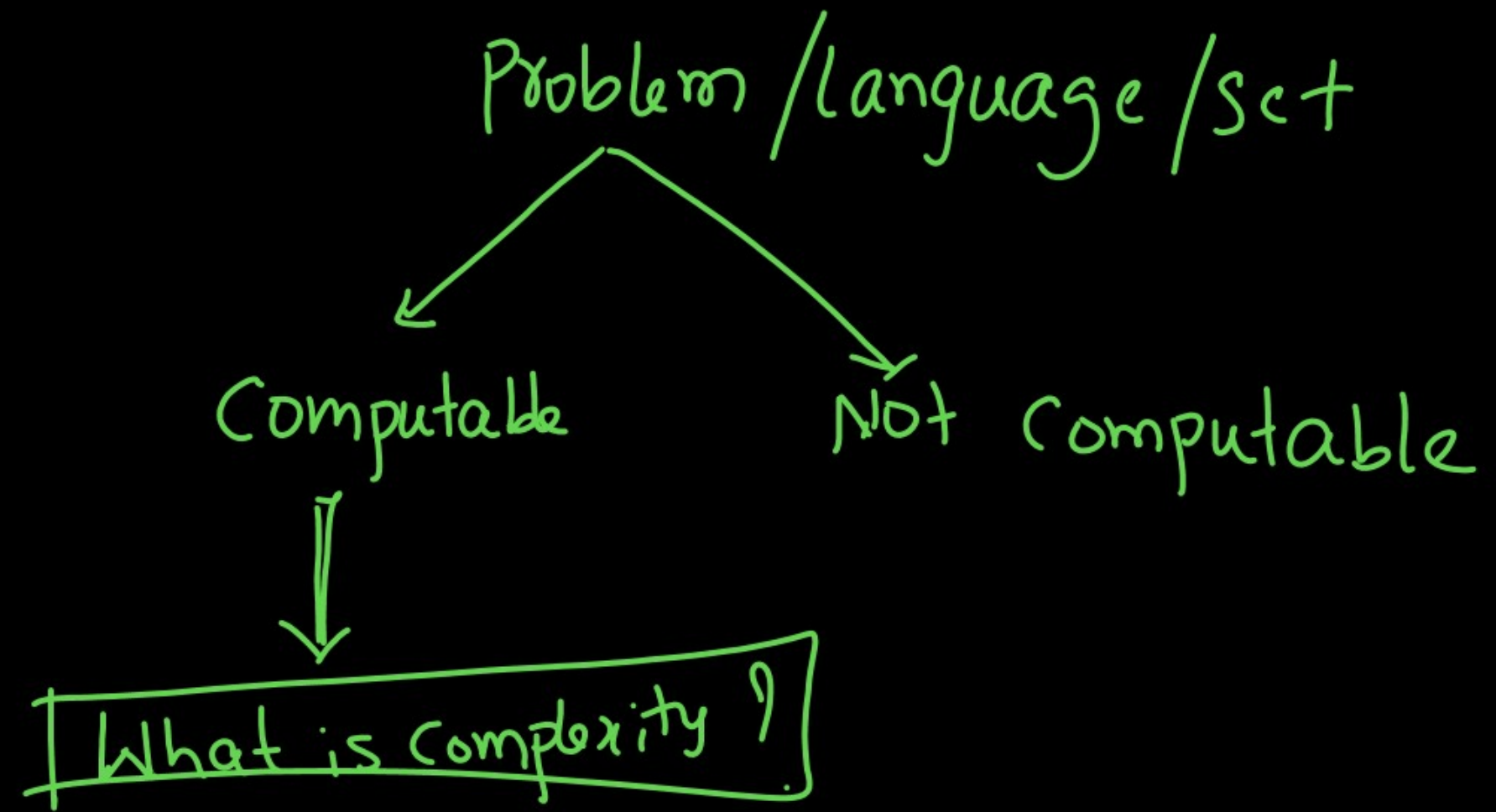
2 years
M.Tech

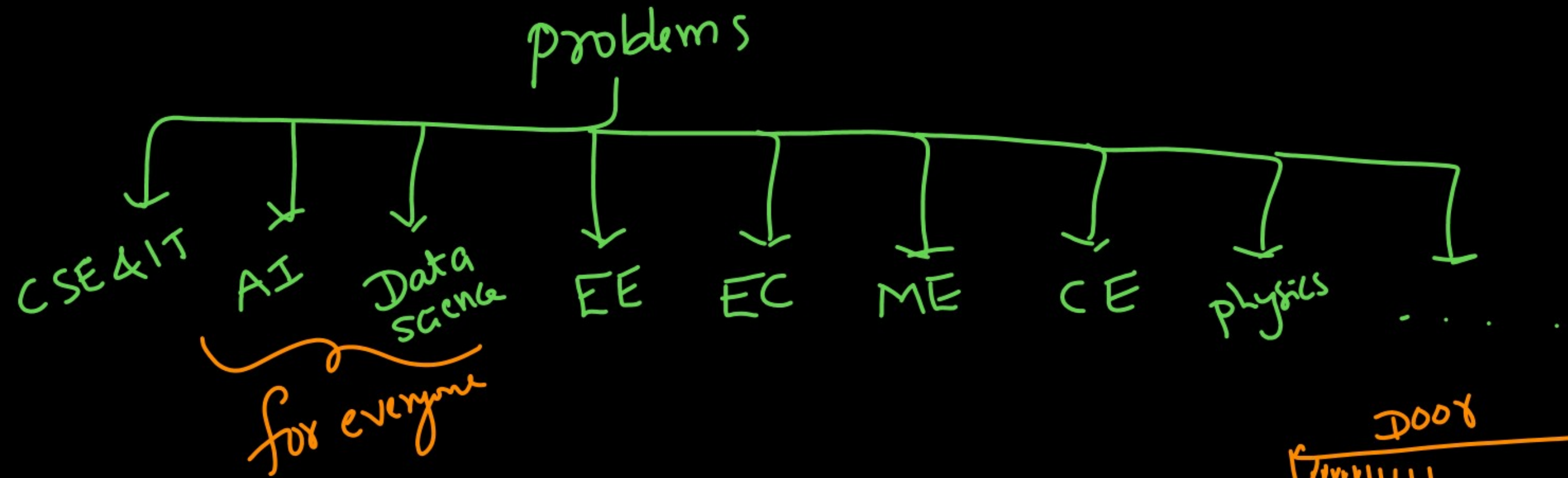
Basics of Theory of Computation

- ① What is TOC?
- ② Chomsky Hierarchy?
- ③ Basics :
 - Symbol, Alphabet
 - String
 - Language
 - Automata
 - Grammar
- ④ Relations

What is TOC?

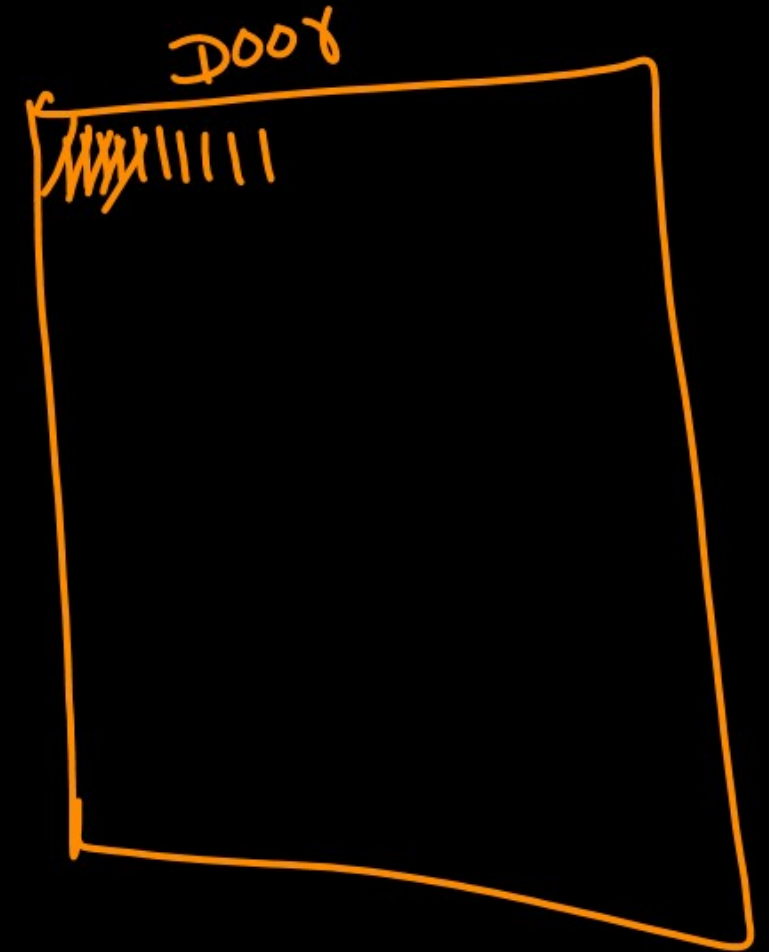


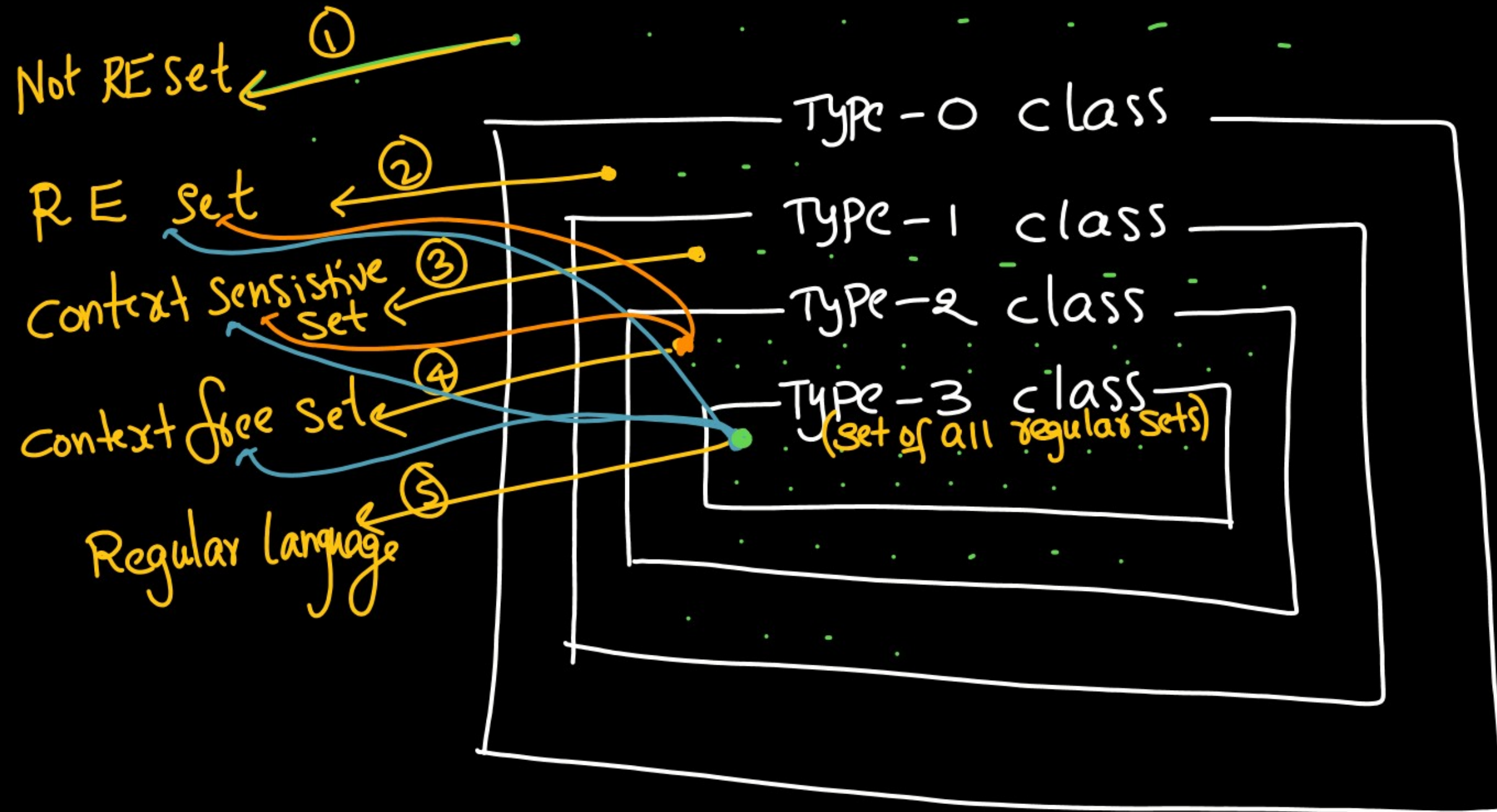


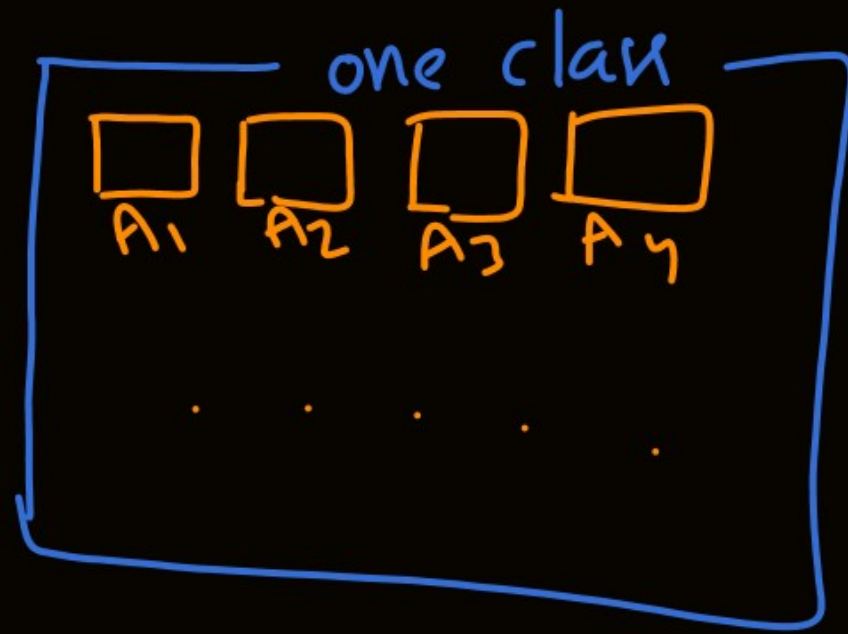


YOU: $2 + 3 \Rightarrow 5$

My Mother: $\overline{1111}$







class: set of languages
↳ Language of languages

Set

Language

→ We have 4 classes

→ Type 3 class, Type 2 class, Type 1 class, Type 0 class

Type-3 class:

→ It has all regular languages

→ Each regular language is called as Type-3 language

Regular Set \in Type-3 class

\in Type-2 class

\in Type-1 "

\in Type-0 "

Type-3 class

Reg_1

Reg_2

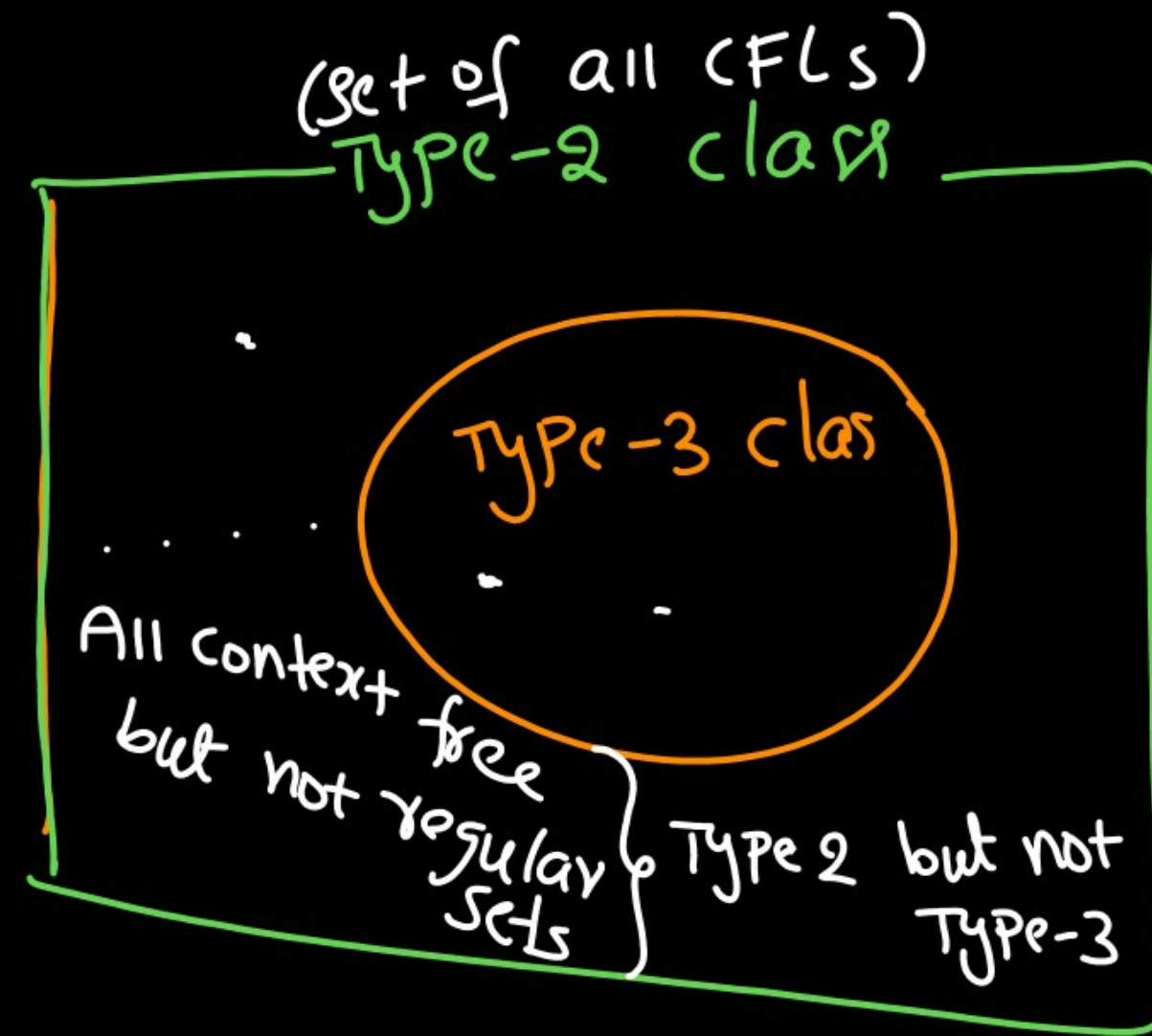
Reg_3

Reg_4

...

Not regular
languages

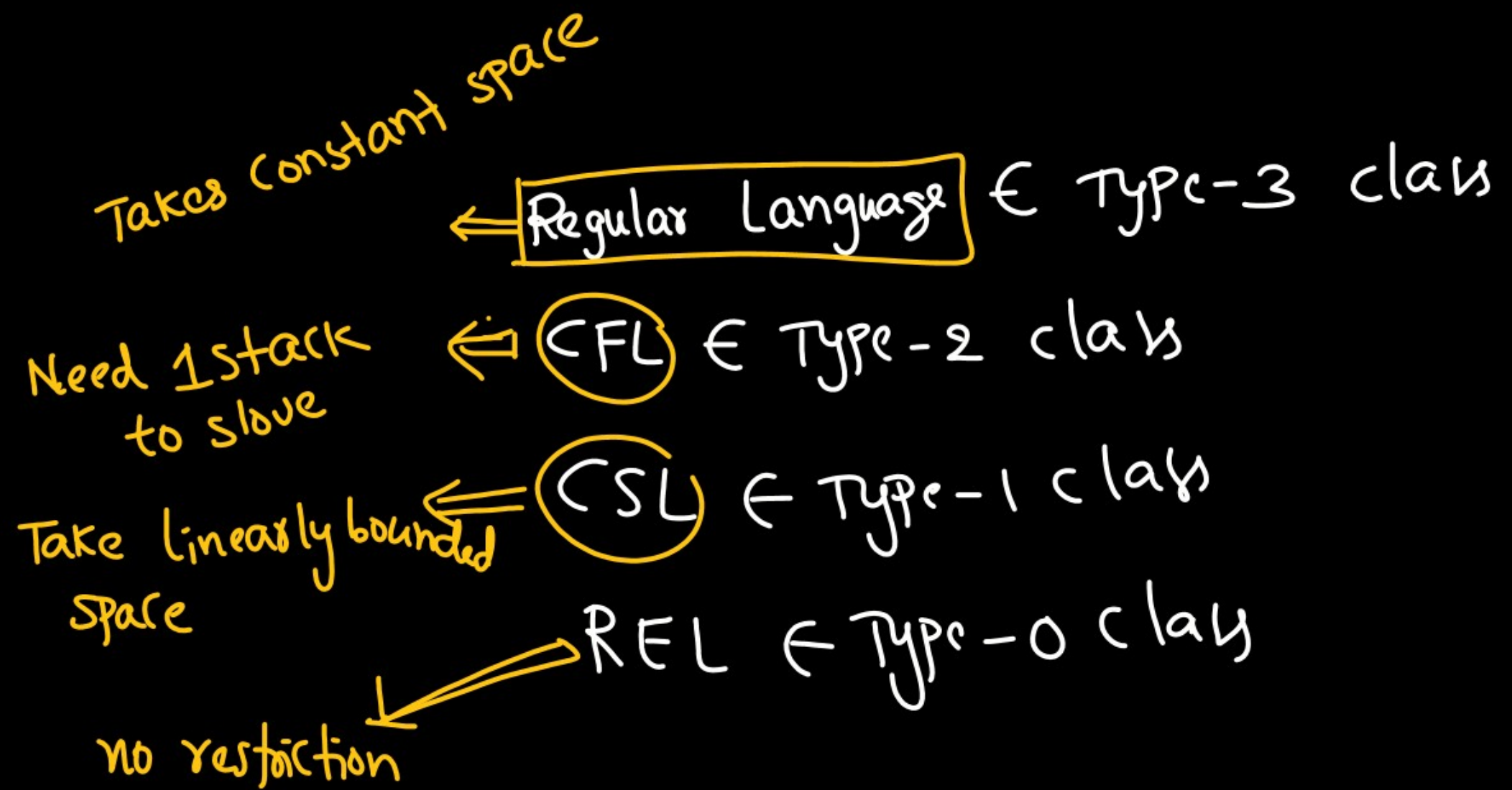
Infinite no. of regular languages



→ Every regular set is CFL

→ Type 3 class \subset Type-2 class

 → Regular set \subset CFL
 Wrong statement



problems
(sets)
(languages)

collection of sets

⇐ class language of languages

collection of strings

⇐ Language language of strings

Symbol:

→ What is a symbol?

Ans: Anything
Smallest thing
Unique

Is a symbol?

I don't know.

After knowing
Alphabet, we can
say 'a' is symbol
or not.



Alphabet (Σ)

→ It is collection of symbols (set)

$$\Sigma = \{a, b\}$$

⇒ a and b are symbols
 ⇒ c is not symbol
 ⇒ ϵ is not symbol

$$\Sigma = \{a, \epsilon, 0\}$$

⇒ a, ϵ , and 0 are symbols
 ⇒ b is not symbol
 ⇒ 1 is not symbol

- Input Alphabet (Σ)
- Output Alphabet (Δ)
- Tape Alphabet (τ)
- Stack Alphabet (Γ)
- English Alphabet
- C character set
- C++ " "
- Hindi Alphabet

$$\Sigma = \{ \boxed{\text{gate}}, \boxed{(0,1)}, \boxed{\text{false}} \}$$

$$= \{ x, y, z \}$$

How many symbols ?

$$= 3$$

Symbol

→ It is one length

$$|\boxed{\text{gate}}| = 1$$

$$|\boxed{(0,1)}| = 1$$

$$|\boxed{\text{false}}| = 1$$

$$\Sigma = \{ \{a, b, c\}, (((,))) , \{1, \{2\}\}, \varepsilon \}$$

How many symbols?

= 5

special string
empty string ϵ
zero length string

$$\Sigma_1 = \{g, a, t, e\}$$

①

$$|gate| = 4$$

one one one one

③ $|\epsilon| = 0$

$$\Sigma_2 = \{gate, \epsilon\}$$

Empty string
(zero length string)

② $|gate| = 1$
one

④ $|\epsilon| = 1$

It is symbol
don't consider as empty string

String

↳ It is a sequence of finite no. of symbols

$$\Sigma = \{a, b\}$$

Zero length string

Length of string is 0

ϵ or λ
↓
not a symbol

a

b

one length

aa

ab

ba

bb

2 length

3 length strings

aaa

aab

aba

abb

baa

bab

bba

bbb

Empty String

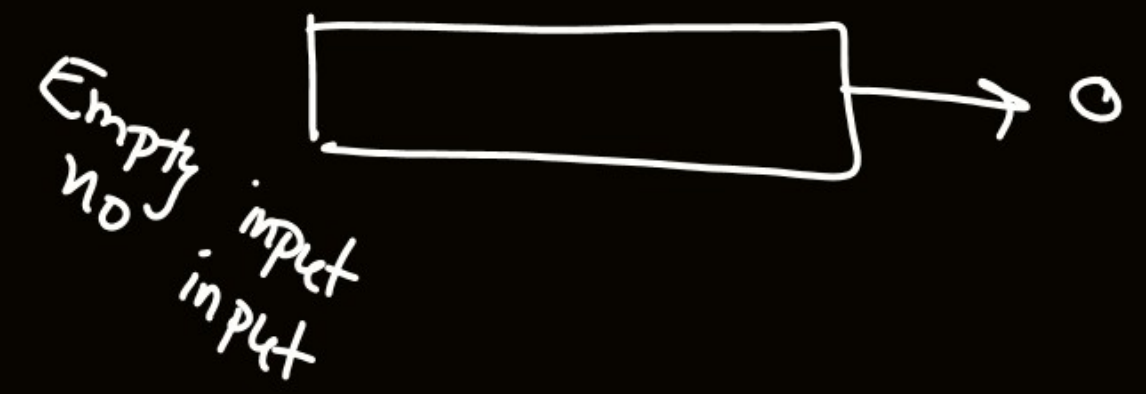
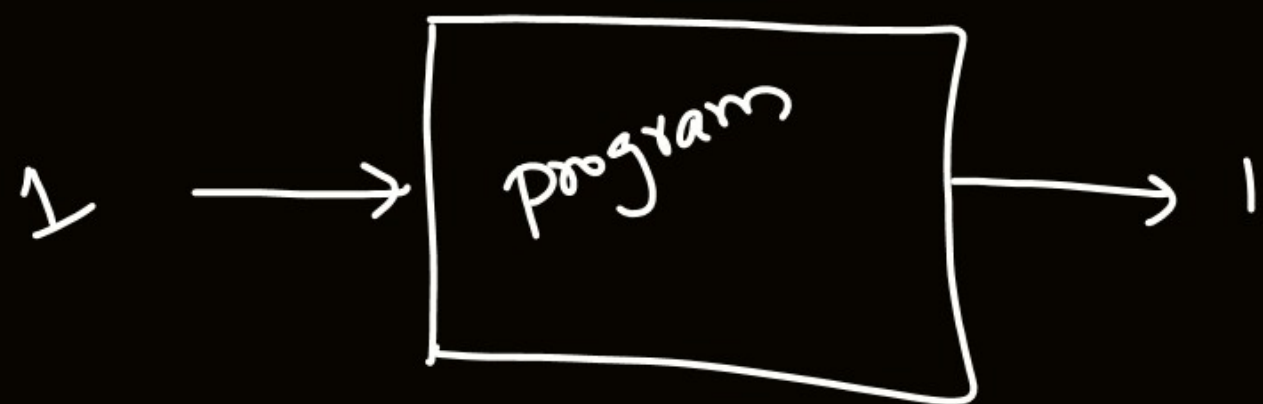
ϵ or λ

No. of symbols in sequence = 0

Empty Set

$\{ \} = \Phi$

No. of elements in set = 0



$\Sigma = \{a, b, c, d\}$

$n=4$
 $k=3$

$\begin{matrix} & 4 & & 4 \\ \rightarrow & a & a & a \\ & a & a & b \\ & a & a & c \\ & a & a & d \\ & a & b & a \\ & a & b & b \\ & a & b & c \\ & a & b & d \\ & a & c & a \\ & a & c & b \\ & a & c & c \\ & a & c & d \\ & \vdots & & \\ & d & d & d \end{matrix}$

1) How many 3 length strings?

$$= \begin{matrix} \square \\ 4 \end{matrix} \begin{matrix} \square \\ 4 \end{matrix} \begin{matrix} \square \\ 4 \end{matrix} = 4^3 = 64$$

2) How many k length strings over n symbols?

$$= |\Sigma|^k = n^k$$

H.W.



Operations on strings :

- Q1) What is prefix ? How many prefixes ?
- Q2) " " suffix ? How many suffixes ?
- Q3) " " substring ? How many substrings ?
- Q4) " " concatenation of 2 strings ?

*Thank you
Aspirants*

