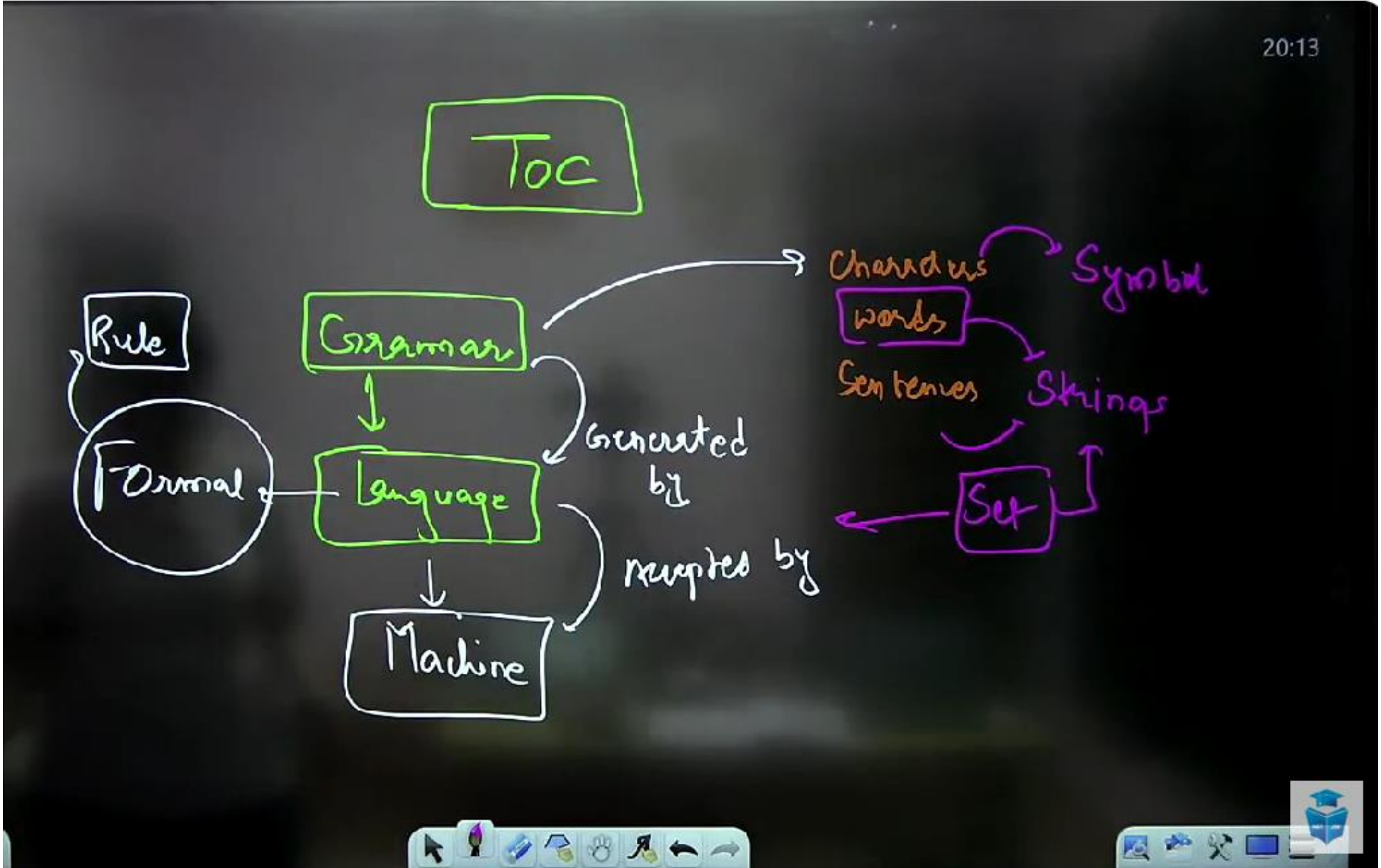
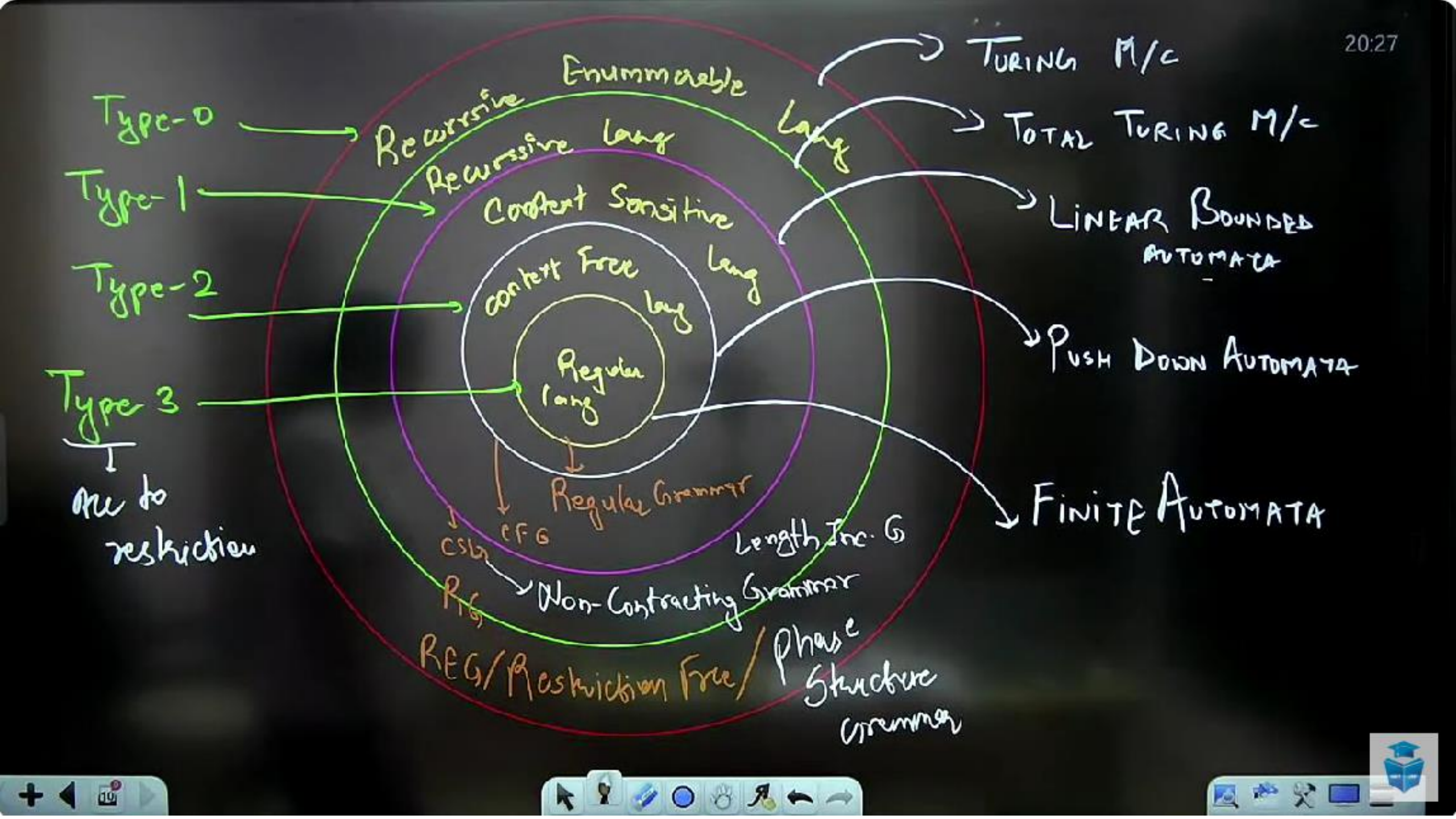

20:13
Toc
Rule
Grammars
Formal
Language
Machine
Generated by
accepted by
Characters
Symbol
words
Sentences
Strings
Set


20:27
Type-0
Type-1
Type-2
Type-3
Recursive
Enummerable
Recursive lang
Lang
Context Sensitive
context Free
lang
lang
Regular
lang
Regular Grammar
CSG
CFG
RG
Length Inc. G
Non-Contracting Grammar
REG/Restriction Free/
Phase
Structure
Grammar
Turing M/c
Total Turing M/c
Linear Bounded
Automata
Push Down Automata
Finite Automata
one to
restriction

Alphabet → $\Sigma$

Symbol (Tokens)

- $\phi$
- $\varepsilon$
- $a, b \in$ Terminals
- $A, B, S \in$ Non-Terminals

$V_n$

Strings $(\omega) \in \Sigma^*$

Language (Set of Strings)

$\alpha \rightarrow \beta$

$V_n \rightarrow V_n$

$V_n \rightarrow T$

$V_n \rightarrow TV_n \mid V_nT$

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

Set of all Possible string $\leftarrow \Sigma^*$

$\Sigma^*$ ↓ Kleen's Closure ↓ All Alphabets

$(0, 1, 2, 3, \ldots n)$

$\{\phi, \varepsilon, a, aa, ab, bb, ba, aac \ldots\}$

$\Sigma^+$ Positive closure

$\Sigma^+ = \Sigma^* - \varepsilon$

For Any Grammar 'G' $\Rightarrow$ $G(S, V_n, \Sigma, P)$

- $S$: Start Symbol
- $V_n$: Set of Non-Terminals
- $\Sigma$: Set of terminals / Symbols
- $P$: Production rule $(\alpha \to \beta)$

$$L(G) = \{ \omega \mid \omega \in \Sigma^*, S \xrightarrow{*} \omega \}$$

**Valid Production:** $\alpha \in (\Sigma + V_n)^* . V_n . (\Sigma + V_n)^*$

$\beta \in (\Sigma + V_n)^*$

$\alpha \to \beta$

- $S \to \varepsilon$ ✓
- $S \to a$ ✓
- $S \to B$ ✓
- $S \to aB$ ✓
- $B \to a$ ✓
- $B \to SS$ ✓
- $B \to BB$ ✓

Recursive Enu. G.

Type-0 : Phase structure Grammar

Unrestricted Grammar

$\alpha$
$\beta$ } $-x$ No restriction on $\alpha$ or $\beta$.

$\alpha \to \beta$ :: $\alpha \to (V_n \cup \Sigma)^* . V_n . (V_n \cup \Sigma)^*$

$\beta \to (V_n \cup \Sigma)^*$

C.S.G

## Type-1 (CSL) Non-Contracting Grammar
Length Increasing Grammar

$\alpha \to \beta$

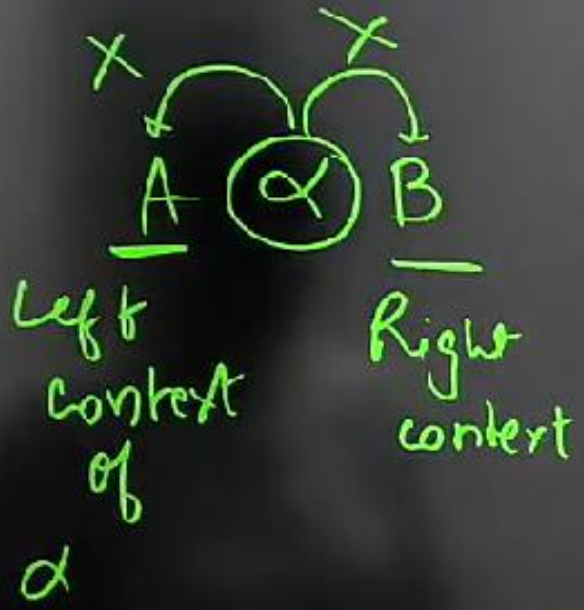
$\alpha \to (V_n \cup \Sigma)^* . V_n . (V_n \cup \Sigma)^*$

- $\beta \to (V_n \cup \Sigma)^+$ → Start symbol → $\varepsilon$ ✓
- $|\alpha| \leq |\beta|$

$\beta \in \Sigma$

$AaB \to b$

# Type-2 : Context Free Grammar




$|\alpha| = 1$


+

CSG ✓

$\alpha \rightarrow (V_n \cup \Sigma)^* \cdot V_n \cdot (\Sigma \cup V_n)^*$

# Type - 3 : Finite Grammar / Regular Grammar

Subset of

## LINER GRAMMAR

CSG
1) $|\alpha| \leq |\beta|$

CFG
2) $|\alpha| = 1$

± 3) $\alpha \rightarrow V_n$

$\beta \rightarrow \Sigma^* . V_n$

$V_n . \Sigma^*$

$V_n$

Right liner

Ex $A \rightarrow aB / Ba / a / B$

$A \rightarrow aAB$ ✗

$|A| = |B| = 1$

Left liner