(U2)

* grammar representation ⇒ (V, T, P, S)

→ V - set of non-terminals (or) variable list

→ T - set of terminals

→ P - production rule

→ S - special non-terminal (starting symbol)

types of grammar

- type of production rules
  - * type-0 → unrestricted grammar (turing machine) — recursively enumerable languages
  - * type-1 → context sensitive grammar [CSG] — recognized by Linear Bound Automata (LBA)
  - * type-2 → context free grammar [CFG] — recognized by Push Down Automata (PDA)
  - * type-3 → regular grammar — accepted by finite automata (FA)
- no. of derivation trees
  - * ambiguous grammar
  - * unambiguous grammar
- no. of strings
  - * recursive grammar
  - * non-recursive grammar

(phase structured grammar)

derivation types

(lmd) left-most derivations

* left-most variable is replaced.

* $\Rightarrow_{lm}$ (or) $\overset{*}{\Rightarrow}_{lm}$

right-most derivations (rmd)

* right-most variable is replaced.

* $\Leftarrow_{rm}$ (or) $\overset{*}{\Leftarrow}_{rm}$

* Ambiguous Grammar -

⇒ E → E+E | E*E | id

Simplification of CFG:

① eliminating epsilon production

② " unit "

③ " useless "

⟹ CNF → Chomsky Normal Form

N.T → N.T × N.T
N.T → T

(NT → non-terminal, T → terminal)

Reducing CFG into CNF -

Step 1 → eliminate ∈, unit and useless production

Step 2 → rename the variables / convert to 2 N.T

Step 3 → check if it a CNF (or) not.

Step 4 → repeat.

⟹ GNF → Greibett Normal Form.

$A \to a\alpha$ a → terminal, $\alpha \in (V \cup T)^*$

* Lemma 1 & Lemma 2. eg: $S \to aA_1A_2Z_2 \mid bA_1Z_2$ (A, α, β)

① Lemma 1 → substitution rule.

$$A \to a_1\beta_1 \mid a_2\beta_2 \mid \cdots \mid a_n\beta_n$$

② Lemma 2 → elimination of left recursion

(i) $A \to \beta i$

$A \to \beta i X$

$(i \le 1 \le n)$

(ii) $X \to \alpha i$

$X \to \alpha i X$

$(i \le 1 \le m)$

⟹ Conversion to GNF -

① check if it is CNF (or) not.

② if yes, move to ③, else convert to CNF

③ rename the variables

④ $A_i \to A_j\alpha$, apply the following → $i < j$ - leave it as it is
→ $i > j$ - lemma 1
→ $i = j$ - lemma-2