

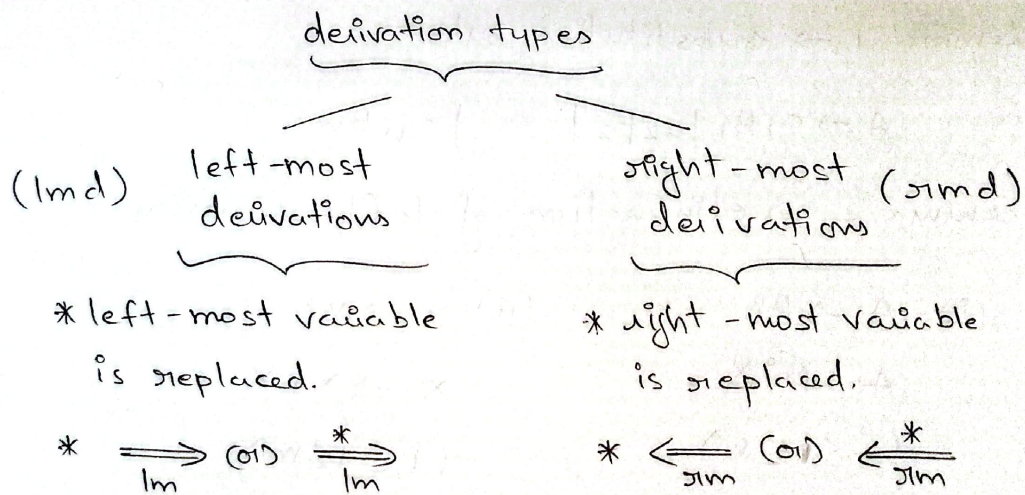
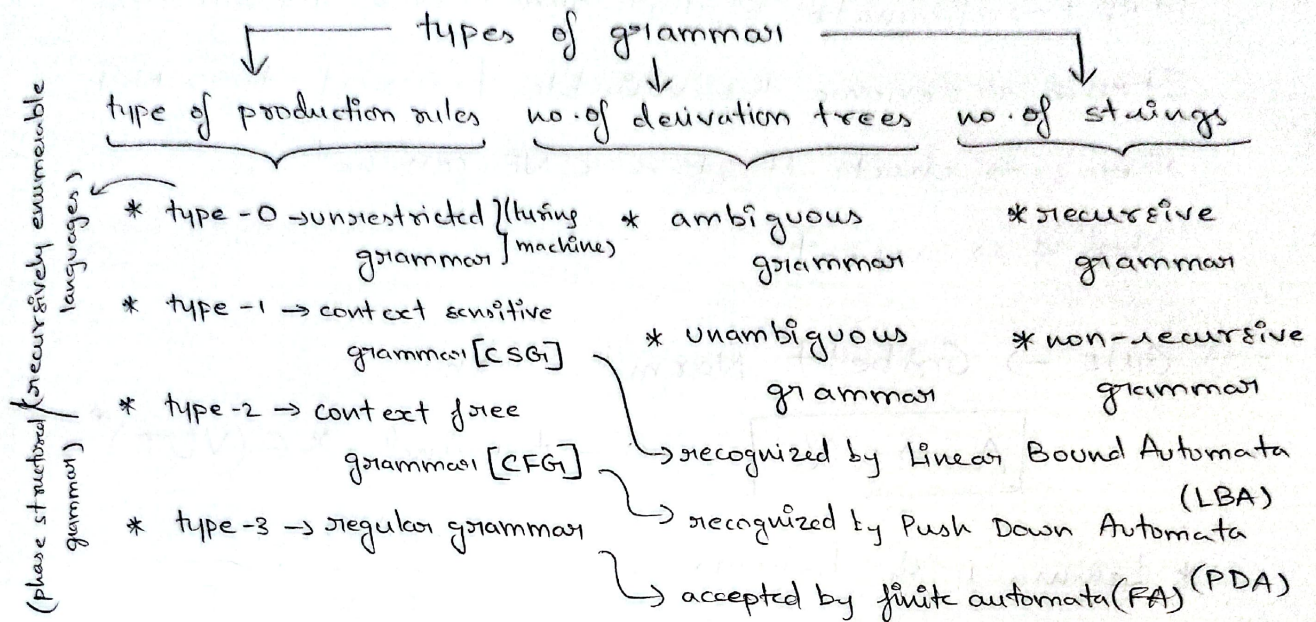
* grammar representation $\Rightarrow (V, T, P, S)$

$\rightarrow V$ - set of non-terminals (or) variable list

$\rightarrow T$ - set of terminals

$\rightarrow P$ - production rule

$\rightarrow S$ - special non-terminal (starting symbol)



* Ambiguous Grammar -

$\Rightarrow E \rightarrow E + E \mid E * E \mid id$

⊗ Simplification of CFG:

① eliminating epsilon production

② " unit "

③ " useless "

\Rightarrow CNF \rightarrow Chomsky Normal Form.

$$\boxed{\begin{array}{l} N \cdot T \rightarrow N \cdot T \times N \cdot T \\ N \cdot T \rightarrow T \end{array}}$$

(NT \rightarrow non-terminal,
T \rightarrow terminal)

Reducing CFG into CNF -

Step 1 \rightarrow eliminate ϵ , unit and useless production

Step 2 \rightarrow rename the variables / convert to 2 N.T

Step 3 \rightarrow check if it a CNF (or) not.

Step 4 \rightarrow repeat.

\Rightarrow GNF \rightarrow Greibet Normal Form.

$$\boxed{A \rightarrow a \alpha} \quad a \rightarrow \text{terminal}, \alpha \in (V \cup T)^*$$

* Lemma 1 & Lemma 2. eg: $S \rightarrow \underbrace{aA_1A_2Z_2}_A \alpha \underbrace{bA_1Z_2}_B$

① Lemma 1 \rightarrow substitution rule.

$$A \rightarrow a_1 \beta_1 | a_2 \beta_2 | \dots | a_n \beta_n$$

② Lemma 2 \rightarrow elimination of left recursion

$$(i) \quad A \rightarrow \beta_i$$

$$A \rightarrow \beta_i X$$

$$(i \leq i \leq n)$$

$$(ii) \quad X \rightarrow \alpha_i$$

$$X \rightarrow \alpha_i X$$

$$(i \leq i \leq m)$$

\Rightarrow 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 $A_i \rightarrow A_i \alpha$, apply the following

$\nearrow i < j$ - leave it as it is

$\rightarrow i > j$ - lemma 1

$\searrow i = j$ - lemma 2