CFG & CFL

$G = (V, T, P, S)$ where every production in P is of type $A \to \alpha$ (where $A \in V$ and $\alpha \in (V + T)^*$) is a Context Free Grammar (CFL)

Example: $\underline{G}$: $S \to aSa \mid bSb \mid a \mid b \mid \epsilon$

Context Free Language (CFL) :

Set of finite / infinite set of strings derived by a CFG is a CFL.

ie. $L(G) = \{ w \mid S \overset{*}{\Rightarrow} w \text{ and } w \in T^* \}$

For above example
$L(G) = \{ \epsilon, a, b, aa, bb, aaa, bab, aba, bbb, \dots \}$

Derivation $(\overset{*}{\Rightarrow})$

Consider grammar

$$S \to A B$$
$$A \to aAa \mid b$$
$$B \to bbB \mid \epsilon$$

Does string $\underline{aaabbbaaa}$ belong to language of above grammar?

Derivation Tree
Parse Tree

start symbol is root

$aaabbbaaa \notin L$

string is leaf
[Every T.b string is leaf]

Language of above grammar is $\{ a^n b a^n b^{2m} \mid n \geq 0, m \geq 0 \}$

Ex2

$$S \to aSbS \mid bSaS \mid \epsilon$$

Test for : $\underline{aabaabba}$ $\in L$