Context free grammar → A grammar $G = (V_N, T, S, P)$ is said to be CFG if all the production are of form

$A \to \alpha$

where $\alpha \in (V_N \cup T)^*$

Every regular grammar is CFG or family of of RG is proper subset of CFG

Ex.

$S \to aSa \mid bSb \mid \Lambda$

$S \to aSa \to aaSaa \to aabSbaa$
$\to aabbaa$

or

$S \to bSb \to baSab \to baab$

from above derivation we can say that

$L(G) = ww^R : w \in (a, b)^*$

$S \to abB$
$A \to aaBb \mid \Lambda$
$B \to bbAa$

$S \to abB$
$\to abbbAa$
$\to abbbaaBba$
$\to abbbaabbAaba$
$\to abbbaabbaba$

$L(G) \to ab(bbaa)^n bba(ba)^n$

Generating CFG for any given CFL

1. $L = a^n b^n \quad n \geq 0$

$S \to aSb \mid \Lambda$

2. $L = a^n b^m \quad n \geq m \quad , n \geq 0$

$S \to aSb \mid A$

$A \to aA \mid a$

3. $L = a^n b^m \quad n \leq m \quad n \geq 0, m \geq 0$

$S \to aSb \mid B$

$B \to Bb \mid b$

4. $S \to a^n b^m c^n \quad n \geq 0, \quad m \geq 0$

$S \to aSc \mid A$

$A \to bA \mid \Lambda$

5. $S \to a^n b^n c^m d^m \quad n > 0 \quad m \geq 0$

$S \to AB$

$A \to aAb \mid ab$

$B \to cBd \mid \Lambda$

Scanned with CamScanner

6. $L = a^n b^m c^m d^n \quad n \geq 0 \; m \geq 0$

$S \to aSd \mid A$

$A \to bAc \mid \Lambda$

7. $L = a^n b^m c^k \quad n \geq 0 \; m \geq 0 \quad n = m$ or $m = k$

So $L = \underbrace{a^n b^n c^k}_{L_1} \cup \underbrace{a^n b^m c^m}_{L_2}$

generate seperate grammar for L_1 and L_2 by start symbol as S_1 and S_2

$S_1 \to AC$ $\qquad$ $S_2 \to BD$

$A \to aAb \mid \Lambda$ $\qquad$ $B \to aB \mid \Lambda$

$C \to cC \mid \Lambda$ $\qquad$ $D \to bDc \mid \Lambda$

Now combine both as

$S \to S_1 \mid S_2$

8. $L = wcw^R$ where $w, w^R \in (a, b)^*$

Here the string are palindrome having same symbol as first and last and last end in c

or grammar is

$S \to aSa \mid bSb \mid c$

9. $L = ww^R$

$S \rightarrow aSa \mid bSb \mid \Lambda$

10. L = Equal number of a and b

→ to check for equality for each a there should exist corresponding b and vice versa so Grammar is

$S \rightarrow aSb \mid bSa \mid \Lambda$

but we are not able to genrate string abba by this so add $S \rightarrow SS$ therefore final grammar for same

$S \rightarrow aSb \mid bSa \mid SS \mid \Lambda$

or

$S \rightarrow aSbS \mid bSaS \mid \Lambda$

11. $L = ww^x$ where $w^x \neq w^R$

$S \rightarrow aSa \mid bSb \mid A$

$A \rightarrow aAb \mid bAa \mid aA \mid bA \mid a \mid b$

genrate reverse then inbalance same.